Total No. of Questions : 8] **SEAT No. :**

P2155 **[Total No. of Pages : 3**

[4721] - 1001
M.A./M.Sc. (Semester - I)
MATHEMATICS
MT - 501 : Real Analysis
(2013 Pattern) (Credit System)

)Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Explain the construction of cantor set, hence show that it's measure is zero. **[5]**

b) Show that complement of a measurable set is measurable. **[3]**

c) Prove that $f(x) = \begin{cases} x^2 \sin\left(\frac{1}{x}\right) & 0 < x \le 1 \\ 0 & x = 0 \end{cases}$ is of bounded variation. **[2]**

$$\int(\phi + \psi) = \int \phi + \int \psi.$$

Q2) a) State and prove Egorov theorem. **[5]**

b) If f and g are measurable functions, then prove that $f + g$ and f^2 are measurable. **[3]**

c) Give an example of two measurable sets A and B such thats A + B is not measurable. **[2]**

Q3) a) State and prove Monotone convergence theorem. **[5]**

b) Define a simple function. If ϕ and are simple functions then prove that

[3]

c) Define Dini numbers. Find Dini number for the function F(x) = |x| at origin. **[2]**

P.T.O.

Q4) a) If $\{f_n\}$ is a sequence of measurable functions such that *and* $|f_n(x)| \leq g(x)$, where g is integrable, then prove that . **[4]**

b) Prove that a real valued function F on $[a,b]$ is of bounded variation if and only if F is the difference of two increasing bounded functions. **[4]**

c) If f be a measurable finite valued function on [0,1] and suppose that $|f(x) - f(y)|$ is integrable on [0,1] × [0,1] then show that f is integrable on [0,1]. **[2]**

Q5) a) IF be a finite collection of open balls in R^d, then prove that, there exists a disjoint sub - collection Bi_1, Bi_2, ... Bi_K of B such that, **[5]**

b) Define locally integrable function. Prove that $e^{|x|}$ is locally integrable, but not integrable on R. **[3]**

c) If $f \geq 0$ and f is integrable and f then prove that $M\left(\bigcup_{j=1}^{k} Q_j\right) \leq \sum_{j=1}^{k} M\left(Bi_j\right)$ **[2]**

Q6) a) State and prove Fatou's lemma. **[4]**

b) If and $E_2 \subseteq R^{d_2}$ then prove that, $M_*(E_1 \times E_2) \leq M_*(E_1).\ M_*(E_2)$, where $M_*(E_k) \neq 0$, for K = 1,2. **[4]**

c) Find the measures of the following sets. **[2]**

i) A = {2, 4, 6, 8, 10}

ii) B = [–1, 2]

Q7) a) If E is measurable subset of R^d with M (E) < , then prove that for

a finite union of closed cubes such that $M(E \Delta F) \leq \in$. **[5]**

b) If F and G are absolutely continuous function on $[a,b]$ then show that the function FG is absolutely continuous on $[a,b]$. **[5]**

Q8) a) If then prove that $M_*(E) = \inf M_*(O)$, where the infimum is taken over all open sets O containing E. **[5]**

b) If F is absolutely continuous on $[a,b]$ and $F'(x) = 0$ a.e. x, then prove that F is a constant function. **[5]**

$$E \subseteq R^d,$$

Total No. of Questions : 8] **SEAT No. :**

P2156 **[Total No. of Pages : 3**

[4721] - 1002
M.A./M.Sc. (Semester - I)
MATHEMATICS
MT - 502 : Advanced Calculus
(2013 Pattern) (Credit System)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Define directional derivative of a scalar field. Show that the existence of all directional derivative at a point need not imply continuity of a function. **[5]**

b) If $f : \mathrm{R}^3 \to \mathrm{R}$ is defined by $f(\bar{x}) = \|\bar{x}\|^4$. Find all points (x, y, z) for which $f'((1,2,3),(x,y,z)) = 0.$ **[3]**

c) State the Implicit Function theorem. **[2]**

Q2) a) If a vector field $\bar{f} : \mathrm{R}^n \to \mathrm{R}^m$ is differentiable at $\bar{a}$ with total derivative $\bar{T}_a$ then **[4]**

i) Prove that the directional derivative $\bar{f}'(\bar{a};\bar{y})$ exists for every $\bar{a}$ in R^n and $\bar{T}_{\bar{a}}(\bar{y}) = \bar{f}'(\bar{a};\bar{y})$

ii) If $\bar{f} = (f_1, ..., f_m)$ and $\bar{y} = (y_1, ..., y_n)$ then express

$\bar{T}_{\bar{a}}(\bar{y}) = \sum_{k=1}^{m} \nabla f_k(\bar{a}).\bar{y}\,\bar{e}_k$ also express $\bar{T}_{\bar{a}}$ $(\bar{y})$ has matrix product of Jacobian matrix of $\bar{f}$ at $\bar{a}$ and $\bar{y}$ as $n \times 1$ matrix.

b) Evaluate the directional derivative of $f(x,y,z) = 3x - 5y + 2x$ at (2,2,1) in the direction of the outward normal to the sphere $x^2 + y^2 + z^2 = 9.$ **[4]**

c) State the chain rule for derivatives of vector field. **[2]**

P.T.O.

Q3) a) Define Line Integral. Let $\bar{\alpha}$ and $\bar{\beta}$ be equivalent piecewise smooth path and let $\bar{f}$ be a vector field defined and bounded on graph C of $\bar{\alpha}$ and $\bar{\beta}$. Prove that $\int_c \bar{f}.d\bar{\alpha} = \int_c \bar{f}.d\bar{\beta}$ if $\bar{\alpha}$ and $\bar{\beta}$ trace out C in the same direction. **[4]**

b) A particle of mass *m* moves along a curve under the action of a force field $\bar{f}$. If the speed of the particle at time t is V(*t*), its kinetic energy is defined to be $\frac{1}{2}mv^2(t)$. Prove that the change in kinetic energy in any time interval is equal to the work done by $\bar{f}$ during this time interval. **[3]**

c) Show that the line integral of a continuous gradient is zero around every piecewise smooth closed path in subset S of R^n. **[3]**

Q4) a) Let $\bar{f}$ be a vector field that is continuous on an open connected set S in R^n and assume that the Line integral of $\bar{f}$ is independent of the path in S. Let $\bar{a}$ be a fixed point of S and define a scalar field on S by the equation $\phi(\bar{x}) = \int_{\bar{a}}^{\bar{x}} \bar{f}.d\bar{\alpha}$ where $\bar{\alpha}$ is any piecewise smooth path in S joining $\bar{a}$ to $\bar{x}$. Show that gradient of ϕ exists and is equal to $\bar{f}$. **[5]**

b) Let $S = \{(x,y) \in R^2 / (x,y) \neq (0,0)\}$ and let $\bar{f}$ be the vector field defined on S by the equation $f(x,y) = \frac{-y}{x^2+y^2}\bar{i} + \frac{x\bar{j}}{x^2+y^2}$. Show that $D_1 f_2 = D_2 f_1$ everywhere on S. Is $\bar{f}$ a gradient on S? Justify. **[3]**

c) Calculate the line integral of the vector field **[2]**

$\bar{f}(x,y,z) = (y^2 - z^2)\bar{i} + 2yz\bar{j} - x^2\bar{k}$ along the path described by

$\bar{\alpha}(t) = t\bar{i} + t^2\bar{j} + t^3\bar{k} \quad 0 \leq t \leq 1.$

Q5) a) Prove that every function f which is bounded on a rectangle Q has a lower integral $\underline{I}(f)$ and upper integral $\overline{I}(f)$. When is f integrable? **[4]**

b) Evaluate $\iiint_S dxdydz$ where S is a solid sphere of radius a and center at origin by transforming to spherical co-ordinates. **[4]**

c) State Green's Theorem for a plane region bounded by a smooth Jordan curve. **[2]**

Q6) a) Define Fundamental vector product. Find the Fundamental vector product for the surface $\bar{r}(x,y) = x\bar{i} + y\bar{j} + f(x,y)\bar{k}$. What are the singular point of this surface? **[4]**

b) A parametric surface S is described by the vector equation

$\bar{r}(u,v) = u\cos v\bar{i} + u\sin v\bar{j} + u^2\bar{k}$ where $0 \le u \le 4$ and $0 \le v \le 2\pi$. Compute the Fundamental vector product in terms of u and v. Prove that the area of S is $\pi\left(65\sqrt{65} - 1\right)/6$. **[4]**

c) State the formula for the change of variables in double integral. **[2]**

Q7) a) State Stoke's Theorem and explain all terms. **[5]**

b) By using polar - co - ordinates evaluate $\int_0^{2a}\left[\int_0^{\sqrt{2ax-x^2}}(x^2+y^2)dy\right]dx$. **[5]**

Q8) a) State Gauss Divergence Theorem and explain all terms. **[5]**

b) Let $\bar{F}(x,y,z) = P(x,y,z)\bar{i} + Q(x,y,z)\bar{j} + R(x,y,z)\bar{k}$ be a vector field. Compute the curl and divergence of curl $\bar{F}$ assuming that all the mixed partial derivatives are continuous. **[5]**

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Total No. of Questions : 8] **SEAT No. :**

P2157 **[Total No. of Pages : 3**

[4721] - 1003
M.A./M.Sc. (Semester - I)
MATHEMATICS
MT - 503 : Group Theory
(2013 Pattern) (Credit System)

)Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Without using Lagrange's theorem, Prove that a group of order 6 cannot have a subgroup of order 4. **[4]**

b) Define the centralizer of an element a in a group G. *If* $G = GL(2, R)$ and $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \in G$ then find C(A) in G. **[3]**

c) In a finite group, show that the number of nonidentity elements that satisfy the equation $x^5 = e$ is a multiple of 4. **[3]**

Q2) a) If d is a positive divisor of n, then prove that the number of elements of order d in a cyclic group of order n is $\phi(d)$. **[4]**

b) Show that the group of positive rational numbers under multiplication is not cyclic **[4]**

c) Prove that if a is the only element of order 2 in a group G, then a lies in the centre of the group. **[2]**

Q3) a) Prove that every permutation of a finite set can be written as a cycle or as a product of disjoint cycles. **[4]**

b) If β is a 10-cycle then for which integers i between 2 and 10 is β^i also a 10-cycle? justify. **[3]**

P.T.O.

c) How many elements of order 5 are there in A_6? Justify. **[3]**

Q4) a) Prove that every group is isomorphic to a group of permutation. **[5]**

b) Show that Q, the group of rational numbers under addition, has no proper subgroup of finite index **[5]**

Q5) a) If G and H are finite cyclic groups and if $G \oplus H$ is cyclic then prove that |G| and |H| are relatively prime **[4]**

b) Prove that D_4 cannot be expressed as an internal direct product of two proper subgroups **[3]**

c) Show by example that in a factor group G/H it can happen that aH=bH but $|a| \neq |b|$ **[3]**

Q6) a) If ϕ is a homomorphism from a group G to a group $\bar{G}$ and H is a sub group of G then prove that $|\phi(H)|$ divides $|H|$. **[4]**

b) Determine all homomorphisms from Z_4 to itself **[3]**

c) If H and K are distinct sub groups of G of index 2 then show that $\frac{G}{H \cap K}$ is not cyclic **[3]**

Q7) a) If $|G| = p^n$, where P is a prime and n is a positive integer then prove that Z(G) has more than one element **[4]**

b) How many abelian groups are there of order 7^2? List them. **[3]**

c) Find the class equation of S_3 and hence find all normal subgroups of S_3 **[3]**

Q8) a) If G is a group of order pq, where p and q are primes with p < q and P does not divide q–1 then prove that G is cyclic group. **[5]**

b) Determine all groups of order 99 **[5]**

Total No. of Questions : 8] **SEAT No. :**

P2158 **[Total No. of Pages : 4**

[4721]-1004
M.A/M.Sc. (Semester - I)
MT - 504 : NUMERICAL ANALYSIS
(2013 Pattern) (Credit System)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***
3) ***Use of nonprogrammable scientific calculator is allowed.***

Q1) a) Let *f* be a twice continuously differentiable function on the interval [*a*, *b*] with $p \in (a,b)$ and $f(p) = 0$. Further, suppose that $f'(p) \neq 0$. Then show that there exists a $\delta > 0$ such that for $p_0 \in I = [p-\delta, p+\delta]$, the sequence $\{p_n\}$ generated by Newton's method converges to *p*. **[5]**

b) For each of the following sequence determine rate of convergence. Find which sequence converges to 1 faster **[3]**

$$\lim_{x\to 0} \frac{\sin x^2}{x^2} \text{ and } \lim_{x\to 0} \frac{(\sin x)^2}{x^2}$$

c) Perform the secant method to determine p_3, the third approximation to the location of the root, for the equation $x^3 + 2x^2 - 3x - 1 = 0$. Take $p_0 = 1, p_1 = 2$. **[2]**

Q2) a) The function $f(x) = 27x^4 + 162x^3 - 180x^2 + 62x - 7$ has a zero at $x = \frac{1}{3}$. Perform ten iterations of Newton's method, on this function, starting with $p_0 = 0$. What is the appearent order of convergence of the sequence of approximations? What is the multiplicity of zero at $x = \frac{1}{3}$? **[5]**

b) The sequence listed below was obtained from fixed point iteration applied to the function $g(x) = \sqrt{\frac{10}{2+x}}$ which has a unique fixed point, apply Aitken's Δ^2 method to this sequence.

P.T.O.

n	p (n)
1	2.236067977
2	1.536450382
3	1.681574897
4	1.648098560
5	1.655643081
6	1.653933739
7	1.654320556

[3]

c) Given $x = \sqrt{a}$ is a fixed point of the function $g(x) = \dfrac{x^3 + 3xa}{3x^2 + a}$. Determine the order of convergence and the asymptotic error constant of the sequence $p_n = g(p_{n-1})$ towards $x = \sqrt{a}$. **[2]**

Q3) a) Solve the following system of linear equations using Gaussian elimination with partial pivoting **[5]**

$$x_1 - 3x_2 + 7x_3 = 2$$
$$2x_1 + 4x_2 - 3x_3 = -1$$
$$-3x_1 + 7x_2 + 2x_3 = 3$$

b) Explain the QR algorithm for finding eigenvalues of symmetric tridigonal matrix. **[3]**

c) Compute the condition number K_∞ for the matrix **[2]**

$$\mathrm{A} = \begin{bmatrix} 2.01 & 1.99 \\ 1.99 & 2.01 \end{bmatrix}$$

Q4) a) Show that the matrix $\mathrm{A} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 2 \\ -1 & 0 & 2 \end{bmatrix}$ has no LU decomposition.

Rearrange the rows of A so that the resulting matrix does have an LU decomposition. **[5]**

b) For the coefficient matrix $A = \begin{bmatrix} 3 & -1 & 1 \\ 2 & -6 & 3 \\ -9 & 7 & -20 \end{bmatrix}$ and the right hand side vector $b = \begin{bmatrix} 4 \\ -13 \\ 7 \end{bmatrix}$, write out the components of the Jacobi method iteration equation. Then, starting with the initial vector $X^{(0)} = 0$, perform two iterations of the Jacobi method. **[3]**

c) Verify that the pair $L = \begin{bmatrix} 1 & 0 \\ 3 & 1 \end{bmatrix}, U = \begin{bmatrix} 1 & 2 \\ 0 & -2 \end{bmatrix}$ forms an LU decomposition of A and then use this decomposition to solve the system $AX = \begin{bmatrix} 4 & 6 \end{bmatrix}^T$. **[2]**

Q5) a) Using scaled partial pivoting during factor step find matrices L, U and P such that LU = PA. **[5]**

Where $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ -1 & 1 & 2 & 3 \\ 1 & -1 & 1 & 2 \\ -1 & 1 & -1 & 5 \end{bmatrix}$

b) Approximate the smallest eigenvalue and its associated eigenvector for the matrix **[3]**

$$A = \begin{bmatrix} 5 & -2 & 2 \\ 4 & -3 & 4 \\ 3 & -6 & 7 \end{bmatrix}$$

Use a convergence tolerance of 5×10^{-5}.

c) For the following system of linear equations, write out the vector valued function F associated with the system and compute the Jacobian F **[2]**

$$1 + x_2 - e^{-x_1} = 0$$
$$x_1^3 - x_2 = 0$$

Q6) a) Derive the forward difference approximation for the second derivative

$$f''(x_0) \approx \frac{f(x_0) - 2f(x_0 + h) + f(x_0 + 2h)}{h^2}$$

What is the error term associated with this formula? Numerically verify the order of approximations using $f(x) = e^x$ and $x_0 = 0$. **[5]**

b) Approximate the value of the integral $\int_0^1 \frac{1}{1+x^2} dx$ using the trapezoidal rule. Verify that the theoretical error bound holds. **[2]**

c) Determine the values for the coefficients A_0, A_1 and A_2 so that the quadrature formula

$$I(f) = \int_{-1}^{1} f(x)dx = A_0 f\left(\frac{-1}{3}\right) + A, f\left(\frac{1}{3}\right) + A_2 f(1)$$

has degree of precision atleast 2. **[3]**

Q7) a) Verify that the composite midpoint rule has rate of convergence O (h^2) by approximating the value of $\int_0^1 \sqrt{1+x^3}\, dx$. **[5]**

b) Apply Euler's method to approximate solution of the initial value problem.

$$\frac{dx}{dt} = 1 + \frac{x}{t}, \qquad 1 \le t \le 3, \qquad x(1) = 1$$

using 4 steps. Find the corresponding error in each step. **[5]**

Q8) a) Find solution of the initial value problem

$$\frac{dx}{dt} = \frac{t}{x}, \qquad 0 \le t \le 5, \; x(0) = 1$$

using fourth order Runge Kutta method with a step size $h = 1$. **[5]**

b) Define : **[5]**

i) Rate of convergence.
ii) Householder matrix.
iii) The degree of precision.
iv) Triangular matrix.
v) Orthogonal matrix.

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Total No. of Questions : 8] SEAT No. :

P2159 [Total No. of Pages : 3

[4721] - 1005
M.A./M.Sc. (Semester - I)
MATHEMATICS
MT - 505 : Ordinary Differential Equations
(2013 Pattern) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) If $y_1(x)$ and $y_2(x)$ are any two solutions of equation $y'' + p(x)y' + Q(x)y = 0$ on [a,b], then prove that their wronskian $w = w(y_1, y_2)$ is either identically zero or never zero on [a,b]. **[5]**

b) Verify that $y_1 = x^2$ is one solution of $x^2y'' + xy' - 4y = 0$, and then find the other solution y_2. **[3]**

c) Verify that $y_l = 1$ and $y_2 = \log x$ are linearly independent solutions of differential equation $y'' + (y')^2 = 0$ on any interval to the right of origin. **[2]**

Q2) a) Discuss the method of undetermined coefficients to find the solution of second order differential equation with constant coefficients. **[5]**

b) Find a particular solution of differential equation $y'' = y' - 6y = e^{-x}$ by variation of parameter method. **[3]**

c) Replace the differential equation $x''(t) + 4tx'(t) + t^2X = 0$ by an equivalent system of first order equations. **[2]**

Q3) a) State and prove Sturm seperation theorem. **[5]**

b) Show that the zeros of the functions asinx + bcosx and csinx + dcosx are distict and occurs alternately if ad–bc $\neq 0$. **[3]**

c) Classify the singular points on the x-axis of

$x^3(x-1)y'' - 2(x-1)y' + 3xy = 0.$ **[2]**

P.T.O.

Q4) a) Use the method of Frobenius series to solve the differential equation $2xy'' + y' - y = 0$ about regular singular point 0. **[5]**

b) Let $u(x)$ be any non-trivial solution of $u'' + q(x)u = 0$ where $q(x) > 0$ for all $x > 0$. If $\int_1^\infty q(x)dx = \infty$, then prove that $u(x)$ has infinitely many zeros on positive x-axis. **[3]**

c) Find power series solution of differential equation $y' = 2xy$. **[2]**

Q5) a) Solve the system **[5]**

$$\frac{dx}{dt} = x + y$$

$$\frac{dy}{dt} = 4x - 2y.$$

b) Determine the nature of point $x = \infty$ for the equation **[3]**

$$x^2y'' + xy' + (x^2 - 4)y = 0.$$

c) Find the indicial equation and its roots for the differential equation **[2]**

$$2x^2y'' + x(2x+1)y' - y = 0.$$

Q6) a) For the following system $\frac{dx}{dt} = x$ **[5]**

$$\frac{dy}{dt} = -x + 2y.$$

i) Find the critical points.

ii) Find the differential equation of path.

iii) Solve the equation to find the path.

b) Prove that the function $E(x, y) = ax^2 + bxy + cy^2$ is of positive definite if and only if $a > 0$ and $b^2 - 4ac < 0$. **[3]**

c) Find the general solution of a system **[2]**

$$\frac{dx}{dt} = y$$
$$\frac{dy}{dt} = x.$$

Q7) a) If m_1 and m_2 are roots of the auxiliary equation of the system **[5]**

$$\frac{dx}{dt} = a_1 x + b_1 y$$
$$\frac{dy}{dt} = a_2 x + b_2 y.$$

which are real, distict and of same sign, then prove that the critical point (0,0) is a node.

b) Find the general solution near $x = 0$ of the hypergeometric equation **[5]**

$x(1-x)y'' + [c-(a+b+1)x]y' - aby = 0.$ where a,b and c are constants.

Q8) a) Show that the function $f(x, y) = xy^2$ satisfies Lipschitz condition on any rectangle $a \le x \le b$ and $c \le y \le d$; but it does not satisfy a Lipschitz condition on any strip $a \le x \le b$ and $-\infty < y < \infty$. **[5]**

b) Solve the following initial value problem **[5]**

$$\frac{dy}{dx} = z \quad , \quad y(0) = 1$$
$$\frac{dz}{dx} = -y, \quad z(0) = 0.$$

Total No. of Questions : 8]

SEAT No. :

P2134

[Total No. of Pages : 2

[4721]-11

M.A./M.Sc. (Semester - I)

MATHEMATICS

MT-501: Real Analysis - I

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Define a normed linear space and give examples of two different norms on R^n. **[6]**

b) Let M be a set of all ordered n-tuples of 0's and 1's for $x, y \in$ M defined $d(x,y)$ = number of places in which x and y differ. Is d a metric on M? Verify. **[5]**

c) Show that $e[a, b]$ is an inner product space with respect to an inner product defined by, for $f, g \in e[a, b]$ $< f, g > = \int_a^b f(x)\, g(x)\, dx$. **[5]**

Q2) a) State and prove Cauchy Schwaz's inequality. **[6]**

b) Show that $e[0, 1]$ is infinite dimensional. **[8]**

c) State Arzela–Ascoli theorem. **[2]**

Q3) a) In a metric space, show that finite intersection of open sets is open,whether we can replace word "finite" by "arbitrary"? Justify. **[6]**

b) What are open sets in a discrete metric space? Is Q open in R? Verify. **[5]**

c) Consider R with Euclidean metric. Give an open cover of (–10, 10) which doesn't have finite subcover. **[5]**

P.T.O.

Q4) a) With usual notations prove that l^1 is complete. **[6]**

b) Find interior of $A = \left\{ \frac{1}{n} / n \in N \right\}$ and QCR **[4]**

c) Is Canter set compact? Explain. **[6]**

Q5) a) Define a measurable function and show that, following statements are equivalent. **[8]**

i) $\{x|f(x)>a\}$ is measurable for $\forall a \in R$

ii) $\{x \mid f(x) \geq a\}$ is measurable for $\forall a \in R$

iii) $\{x \mid f(x) < a\}$ is measurable for $\forall a \in R$

iv) $\{x \mid f(x) \leq a\}$ is measurable for $\forall a \in R$

b) Let $L(R^n)$ denote the collection of all functions that are integrable with respect to Lebesgue measure M. If M denotes the Lebesgue measurable set and E$\underline{C}$M then show that **[4]**

$$\int_E (f+g)dm = \int_E fdm + \int_E gdm \text{ for } f, g \in L(R^n)$$

c) Is sequence of Riemann integrable functions converges to a Riemann integrable function? Verify. **[4]**

Q6) a) State and prove Fatou's lemma. **[8]**

b) State and prove Holder's inequality. **[6]**

c) With usual notations prove that $L^p(\mu)$ is a linear space. **[2]**

Q7) a) State and prove Bessel's equality. **[6]**

b) Find classical Fourier series of a function $f(x) = x^2$. **[5]**

c) What is Gram-Smidt process? Apply it to functions 1, x, x^2, ------. **[5]**

Q8) a) State and prove Baire category theorem. **[8]**

b) State and prove Bessel's inequality. **[8]**

Total No. of Questions : 8]

SEAT No. :

P2135

[Total No. of Pages : 2

[4721]-12

M.A./M.Sc. (Semester - I)

MATHEMATICS

MT-502: Advanced Calculus

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Use of calculator is not allowed.***
3) ***Figures to the right indicate full marks.***

Q1) a) Show that composition of continuous functions is always continuous. **[5]**

b) State and prove mean value theorem for derivatives of scalar field. **[8]**

c) Show with example that mixed partial derivatives may or may not be equal. **[3]**

Q2) a) Comment: Existance of directional derivative implies continuity of the function. **[6]**

b) State and prove sufficient condition of differentiability. **[10]**

Q3) a) Find the directional derivative of Scalar field $f(x, y) = x^2 - 3xy$ along the parobola $y = x^2 - x + 2$ at the point (2, 4). **[5]**

b) State and prove matrix form of chain rule. **[6]**

c) Calculate the work done by constant force with help of line integrals. **[5]**

Q4) a) State and prove second fundamental theorem for line integrals. **[8]**

b) Determine whether or not the vector field $f(x, y) = 3x^2yi + x^2y^2j$ is a gradient on any subset of R^2. **[4]**

c) Evaluate $\iint_Q xy(x+y)dxdy$ where Q = [0, 1] × [0, 1]. **[4]**

P.T.O.

Q5) a) Show that graph of continuous real valued function defined on closed interval has content zero. **[5]**

b) Compute volume of the solid enclosed by the ellipsoid $\frac{x^2}{9}+\frac{y^2}{16}+\frac{z^2}{25}=1$. **[5]**

c) Transform the integral to polar coordinates and compute its value **[6]**

$$\int_0^a \left[\int_0^x \sqrt{x^2+y^2}\, dy \right] dx.$$

Q6) a) State and prove Green's Theorem for plane regions bounded by piecewise smooth Jordan curves. **[8]**

b) Write a note on parametric representation of a cone and fundamental vector product. **[8]**

Q7) a) State and prove Strokes theorem. **[8]**

b) Calculate divergence and curl of a curl. **[8]**

Q8) a) State and prove Divergence theorem for solid bounded by orientable closed surface. **[10]**

b) State and prove necessary conditions for a vector field to be gradient. **[6]**

Total No. of Questions : 8]

SEAT No. :

P2136

[Total No. of Pages : 3

[4721]-13

M.A./M.Sc. (Semester - I)

MATHEMATICS

MT-503: Linear Algebra

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***All questions carry equal marks.***
3) ***Figures to the right indicate full marks.***

Q1) a) Prove that a linearly independent subset of a finite dimensional vector space can be extended to form a basis of the vector space. **[6]**

b) Find the basis and dimension of the following subspaces of the vector space V of $n \times n$ matrices over R : **[5]**

i) the set of all symmetric matrices.

ii) the set of all skew symmetric matrices.

c) Prove that if A is an $n \times n$ nilpotent matrix over R, then $A^n = 0$. **[5]**

Q2) a) If V and V^1 are two vector spaces over the same field K and B is a finite basis of V. If $f : B \to V^1$ is an arbitrary mapping then prove that there exists a unique $T \in L(V, V^1)$ such that $T|B = f$. **[6]**

b) Let V be a 2n-dimensional vector space and let W_1 and W_2 be $(n+1)$ dimensional subspaces of V. Prove that $\dim(W_1 \cap W_2) \geq 2$. **[5]**

c) Let V be a vector space over R and let $V = W \oplus X$. Let R be a linear operator on V defined by **[5]**

$R(W + X) = W - X$ for $W \in W$, $X \in X$

Prove that

i) $R^2 = I$

ii) R is diagonalizable

P.T.O.

Q3) a) If W is any subspace of a finite dimensional vector space V over the field K then

Prove that, $\dim V = \dim W + \dim W^0$,

where W^0 is the annihilator of W. **[6]**

b) Show that $B = \{[2\ \ 1\ \ 1]^t, [3\ \ 4\ \ 1]^t, [2\ \ 2\ \ 1]^t\}$ is a basis of R^3 over R. Find a basis of R^3 dual to B. **[6]**

c) Find non-zero subspaces W_1, W_2 and W_3 of R^3 such that $R^3 = W_1 + W_2 + W_3$, $W_i \cap W_j = \{0\}$ for $i \neq j$ but $R^3 \neq W_1 \oplus W_2 \oplus W_3$. **[4]**

Q4) a) Let T be a linear operator on a vector space of dimension *n*. Define an eigen value and an eigenvector of T. Prove that eigenvalues of T may not exists. Find all eigenvalues and eigenvectors of identify operator. **[6]**

b) Prove that similar matrices have the same characteristic polynomial but the converse is not true. **[5]**

c) State the Cayley Hamilton theorem. Using this theorem, find all possible minimal polynomials if the characteristic polynomial is $X^2(X-1)^3(X+1)$. **[5]**

Q5) a) Let T be a linear operator on n-dimensional vector space V over K. Prove that the characteristic polynomial of T splits over K if and only if T is triangulable. **[6]**

b) Let T be a linear operator on a finite dimensional vector space V. Prove that if T is diagonalizable, then $V = \ker T \oplus \text{im}T$. **[5]**

c) Find the minimal and characteristic polynomials of the following two matrices:

$$\begin{bmatrix} 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$ **[5]**

Q6) a) Let T be a triangulable linear operator on a finite dimensional vector space V over K. Prove that if T is nilpotent, then V has a Jordan basis. **[6]**

b) Define the rational canonical form of a linear operator. Give all possible rational canonical forms if the characteristic polynomial is $(X^2 + 1)(X-1)^3$. **[5]**

c) Write all possible Jordan canonical forms if the characteristic polynomial is $(X - 2)^3 (X - 3)^2$. **[5]**

Q7) a) Prove that multiplication of two n×n upper triangular matrices over R is an upper triangular matrix. Also, prove that the inverse of an upper triangular matrix over R is an upper triangular matrix. **[8]**

b) Let V be an inner product space over R. Prove that **[8]**

i) $\|u+v\|^2 + \|u-v\|^2 = 2\|u\|^2 + 2\|v\|^2 \ \forall u, v \in V$

ii) $\|u+v\|^2 - \|u-v\|^2 = 4\langle u, v \rangle \ \forall u, v \in V$

Q8) a) Let T be a self adjoint operator on a finite dimensional inner product space V. Prove that T is positive definite if and only if all eigenvalues of T are positive. Hence deduce that if T is a positive definite operator then so is T^{-1}. **[8]**

b) Prove that the eigenvalues of a self adjoint operator are real. Also prove that a normal operator with all real eigenvalues is self adjoint. **[8]**

Total No. of Questions : 8]

SEAT No. :

P2137

[Total No. of Pages : 2

[4721]-14

M.A./M.Sc. (Semester - I)

MATHEMATICS

MT-504: Number Theory

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *Attempt any five questions.*
2) *Figures to the right indicate full marks.*

Q1) a) Let p be the prime. Show that $x^2 \equiv -1 (\text{mod } p)$ has a solutions if and only if $p = 2$ or $p \equiv 1 \text{ (mod 4)}$. **[6]**

b) What are the last two digits of 3^{541}? **[5]**

c) Find all primes p such that $x^2 \equiv 5 (\text{mod } p)$ has a solution. **[5]**

Q2) a) State and prove Gauss lemma. **[6]**

b) Prove that $\prod_{d/n} d = {}_n{}^{d(n)/2}$. **[5]**

c) Prove that $\sqrt{3}-1$ and $\sqrt{3}+1$ are associates in $Q(\sqrt{3})$. **[5]**

Q3) a) If p and q are district odd primes, then prove that

$$\left(\frac{p}{q}\right)\left(\frac{q}{p}\right) = (-1)^{\left\{\left(\frac{p-1}{2}\right)\times\left(\frac{q-1}{2}\right)\right\}}.$$ **[6]**

b) Find all solutions of the congruence $20x \equiv 4 \text{ (mod 30)}$. **[5]**

c) Solve the set of congruences
$x \equiv 1 (\text{mod } 4),\ x \equiv 0 (\text{mod } 3),\ x \equiv 5 (\text{mod } 7)$. **[5]**

P.T.O.

Q4) a) Let p denote a prime. Prove that the largest exponent e such that

$$p^e \mid n! \text{ is } e = \sum_{i=1}^{\infty} \left[\frac{n}{p^i} \right].$$ **[6]**

b) Prove that $1 + i$ is prime in $Z[i]$. **[5]**

c) Find all integers x and y such that $10x - 7y = 17$. **[5]**

Q5) a) If x and y are any real numbers, prove that **[6]**

i) $[x]+[y] \le [x+y] \le [x]+[y]+1$ and

ii) $$[x]+[-x] = \begin{cases} 0, & \text{if } x \text{ is an integer} \\ -1, & \text{otherwise} \end{cases}$$

b) Evaluate $\sum_{j=1}^{\infty} \mu(j!)$. **[5]**

c) Find the minimal polynomial of $1+\sqrt{2}+\sqrt{3}$ over Q. Is this number an algebraic integer? Justify. **[5]**

Q6) a) Prove that the product of two primitive polynomials is primitive. **[6]**

b) If α is any algebraic number, then prove that there is a rational integer b such that $b\alpha$ is an algebraic integer. **[5]**

c) Prove that 3 is a prime in Q(i), but not a prime in $Q(\sqrt{\sigma})$ **[5]**

Q7) a) Prove that every Euclidean quadratic field has the unique factorization property. **[8]**

b) Prove that the reciprocal of a unit is a unit. Also prove that the units of an algebraic number field form a multiplicative group. **[6]**

c) If $(n, 7) = 1$, then prove that $n^6 - 1$ is divisible by 7. **[2]**

Q8) a) Let $f(n)$ be a multiplicative function and let $F(n) = \sum_{d \mid n} f(d)$. Then prove that $F(n)$ is multiplicative. **[6]**

b) Explain Pollard ρ method to locate proper divisor of an integer. **[5]**

c) If p is an odd prime, then prove that $\sum_{j=1}^{p-1} \left(\frac{j}{p} \right) = 0$, where $\left(\frac{j}{p} \right)$ is Legendre symbol. **[5]**

Total No. of Questions : 8]

SEAT No. :

P2138

[Total No. of Pages : 3

[4721]-15

M.A./M.Sc. (Semester - I)

MATHEMATICS

MT-505: Ordinary Differential Equations

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) If $y_1(x)$ and $y_2(x)$ are any two solutions of equation. $y^{11} + P(x)y^1 + Q(x)y = 0$ on $[a, b]$, then prove that their Wronskian $W = W(y_1, y_2)$ is either identically zero or never zero on $[a, b]$. **[6]**

b) Change the independent variable x by $x = e^z$ and solve the equation $x^2y^{11} + 3xy^1 + 10y = 0$. **[5]**

c) Verify that $y_1 = e^x$ is one solution of $xy^{11} - (2x + 1)y^1 + (x + 1)y = 0$ and find another solution y_2 and general solution. **[5]**

Q2) a) Discuss the method of variation parameters to find the solution of second order differential equation with constant coefficients. **[8]**

b) Find the general solution of $y^{11} - y^1 - 2y = 4x^2$ by using method of undetermined coefficients. **[8]**

Q3) a) State and prove sturm seperation theorem. **[8]**

b) Verify that origin is regular singular point and calculate two independent Frobenius series solution for the equation $4xy^{11} + 2y^1 + y = 0$. **[8]**

P.T.O.

Q4) a) Let $u(x)$ be any non-trivial solution of $u^{11} + q(x)u = 0$ where $q(x) > 0$ for all $x > 0$. If $\int_1^{\infty} q(x)dx = \infty,$ then prove that $u(x)$ has infinitely many zeros on the positive X-axis. **[8]**

b) Find the normal form of equation $x^2y^{11} + xy^1 + \left(x^2 - \frac{1}{4}y\right) = 0.$ **[4]**

c) Find the particular solution of the initial value problem $y^{11} + 4y^1 + 5y = 0$ with $y(0) = 1$ and $y^1(0) = 0$. **[4]**

Q5) a) Find the indicial equation and its roots of the differential equation $2xy^{11} + x(2x + 1)y^1 - y = 0$. **[4]**

b) Determine the nature of the point $x = \infty$ for the equation $x^2y^{11} + xy^1 + (x^2 - 4)y = 0$. **[4]**

c) Find the general solution of $y^{11} + xy^1 + y = 0$ in terms of power series x. **[8]**

Q6) a) Find the general solution of the system. **[8]**

$$\frac{dx}{dt} = x + y$$

$$\frac{dy}{dt} = 4x - 2y.$$

b) Find the general solution near $x = 0$ of the hypergeometric equation.
$x(1 - x)y^{11} + [c - (a + b + 1)x]y^1 - aby = 0$
where a, b and c are constants. **[8]**

Q7) a) Prove that the function $E(x, y) = ax^2 + bxy + cy^2$ is of positive definite if and only if $a > 0$ and $b^2 - 4ac < 0$. **[5]**

b) Find critical points of $\frac{d^2x}{dt^2} + \frac{dx}{dt} - (x^3 + x^2 - 2x) = 0.$ **[5]**

c) Solve the following initial value problem. **[6]**

$$\frac{dy}{dx} = z, y(0) = 1$$

$$\frac{dz}{dx} = -y, z(0) = 0.$$

Q8) a) If m_1 and m_2 are roots of the equation of the system

$$\frac{dx}{dt} = a_1x + b_1y$$

$$\frac{dy}{dt} = a_2x + b_2y$$

which are real, distinct and of same sign, then prove that the critical point (0, 0)is a node. **[8]**

b) Find the exact solution of initial value problem $\frac{dy}{dx} = y^2, y(0) = 1;$ starting with $y_0(x) = 1$. Apply Picard's method to calculate $y_1(x)$, $y_2(x)$, $y_3(x)$ and compare it with the exact solution. **[8]**

Total No. of Questions : 8]

SEAT No. :

P2160

[Total No. of Pages : 3

[4721] - 2001

M.A./M.Sc. (Semester - II)

MATHEMATICS

MT - 601 : Complex Analysis

(2013 Pattern) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt ANY FIVE questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) If f is holomorphic at z_0, then show that $\frac{\partial f}{\partial z}(z_0)=0$ and $f'(z_0)=\frac{\partial f}{\partial z}(z_0)=2\frac{\partial u}{\partial x}(z_0)$. Also, if we write F $(x, y) = f(z)$, then show that F is differentiable in the sense of real variable, and det $J_F(x_0,y_0)=|f'(z_0)|^2$. **[4]**

b) If f is continuous function over the curve γ, then show that

$$\left|\int_\gamma f(z)\,dz\right| \le \sup_{z\in\gamma}|f(z)|.\ \text{length}\,(\gamma).$$ **[3]**

c) Suppose γ is any circle centred at the origin with positive orientation. Evaluate $\int_\gamma z^n dz$ for all integers n. **[3]**

Q2) a) Show that the power series $f(z)=\sum_{n=0}^{\infty} a_n z^n$ defines a holomorphic function in its disc of convergence. **[5]**

b) If a continuous function f has a primitive F in Ω, and γ is a curve in Ω that begins at w_1 and ends at w_2, then show that

$$\int_\gamma f(z)\,dz = F(w_2)-F(w_1)\ .$$ **[3]**

P.T.O.

c) Let z, w be two complex numbers such that $\bar{z}\,w \neq 1$. Prove that

$$\left|\frac{w-z}{1-\bar{w}z}\right| < 1 \text{ if } |z| < 1 \text{ and } |w| < 1. \qquad \textbf{[2]}$$

Q3) a) Show that a holomorphic function in an open disc has a primitive in that disc. **[4]**

b) If f is holomorphic in an open set Ω, then prove that f has infinitely many complex derivatives in Ω. **[3]**

c) Prove or disprove the following statement. Every continuous function on the closed unit disc is approximated by polynomials in the variable z. **[3]**

Q4) a) Suppose f is a holomorphic function in a region Ω that vanishes on a sequence of distinct points with a limit point in Ω. Then show that f is identically 0. **[4]**

b) If $\{f_n\}_{n=1}^{\infty}$ is a sequence of holomorphic functions that converges uniformly to a function f in every compact subset of Ω, then show that the sequence of derivatives $\{f_n'\}_{n=1}^{\infty}$ converges uniformly to f' in Ω. **[4]**

c) Let Ω be an open subset of C and let TCΩ be a triangle whose interior is also contained in Ω. Suppose that f is holomorphic in Ω except possibly at a point W inside T. Prove that if f is bounded near W, then

$$\int_{T} f(z)\,dz = 0. \qquad \textbf{[2]}$$

Q5) a) Suppose f is holomorphic in the punctured disc $D_r(z_0) - \{z_0\}$ and has an essential singularity at z_0. Then show that the image of $D_r(z_0) - \{z_0\}$ under f is dense in the complex plane. **[4]**

b) Suppose that f is holomorphic in an open set Ω except possibly at a point z_0 in Ω. If f is bounded on $\Omega - \{z_0\}$, then prove that z_0 is a removable singularity. **[4]**

c) Show that if the real part of an entire function f is bounded, then f is constant. **[2]**

Q6) a) State and prove Rouche's theorem. **[4]**

b) Suppose that f is holomorphic in a connected open set Ω, has a zero at a point $z_0 \in \Omega$, and does not vanish identically in Ω. Then show that there exists a neighbour hood $U \subset \Omega$ of z_0, a non-vanishing holomorphic function g on U, and a unique positive integer n such that

$f(z) = (z - z_0)^n g(z)$ for all $z \in U$. **[3]**

c) Prove that if f is an entire function and statisfies $\sup_{|z|=R} |f(z)| \leq AR^K + B$ for all R > 0, and for some integer $k \geq 0$ and some constants A, B > 0, then f is a polynomial of degree $\leq k$. **[3]**

Q7) a) Prove that the mero morphic functions in the extended complex plane are the rational functions. **[5]**

b) Show that $\int_{-\infty}^{\infty} \frac{\cos x}{x^2 + a^2} dx = \frac{\pi e^{-a}}{a}$, for $a > 0$. **[5]**

Q8) a) If f^+ and f^- are holomorphic functions in Ω^+ and Ω^- respectively, that extend continuously to I and $f^+(x) = f^-(x)$ for all $x \in I$, then prove that the function f defined on Ω by

$$f(z) = \begin{cases} f^+(z) \text{ if } z \in \Omega^+ \\ f^+(z) = f^-(z) \text{if } z \in I \\ f^-(z) \text{ if } z \in \Omega^- \end{cases}$$

is holomorphic on Ω. Here I denotes the interior of that part of the boundary of Ω^+ and Ω^- that lies on the real axis. **[5]**

b) Suppose K is a compact subset of C. If K^C is connected and $z_0 \notin K$, then show that the function $\frac{1}{z - z_0}$ can be approximated uniformly on K by polynomials. **[5]**

Total No. of Questions : 8] **SEAT No. :**

P2161 **[Total No. of Pages : 3**

[4721] - 2002
M.A./M.Sc. (Semester - II)
MATHEMATICS
MT - 602 : General Topology
(2013 Pattern) (Credit System)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Show that the topologies R_l and R_k are strictly finer than the standard topology on R, but they are not comparable with one another. **[5]**

b) If $\{T_\alpha\}$ is a collection of topologies on X, are $\cap T_\alpha$ and $\cup T_\alpha$ are topologies on X? Justify. **[3]**

c) Consider the discrete topology T on $X=\{a,b,c,d,e\}$ Find a subbase for T which does not contain any singleton sets. **[2]**

Q2) a) Let X and Y be two topological spaces and $A \subset X$, $B \subset Y$. Prove that product topology on A × B is the same as the subspace topology of A × B as subspace of XXY. **[5]**

b) Find closure of $K=\left\{\frac{1}{n} \middle| n \in N\right\}$ with usual topology on R and with finite complement topology on R. **[3]**

c) With usual notations prove or disprove **[2]**

i) $(A \cap B)^o = A^o \cap B^o$

ii) $(A \cup B)^o = A^o \cup B^o$

P.T.O.

Q3) a) State and prove pasting lemma. **[5]**

b) Define boundary of a set A in a topological space(X,T) **[3]**

If $X = \{a,b,c\}, T = \{\phi, X, \{a\}, \{b,c\}\}$

$A = \{b\}$, then find Bd (A)

c) Let $A = \{s,r,t\}$, $p : R \to A$ defined by, **[2]**

$$p(x) = s \text{ if } x > 0$$
$$= r \text{ if } x < 0$$
$$= t \text{ if } x = 0$$

what is the quotient topology generated by p on A.

Q4) a) Prove that the finite product of connected spaces is connected. **[5]**

b) State whether following spaces are connected. Also find their components, if any **[3]**

i) $A = \{(x,y,z) \in R^3 / xyz = 0\}$

ii) $B = \{(x,y,z) \in R^3 / xyz = 1\}$

iii) $C = \{(x,y,z) \in R^3 / |x| + |y| + |z| \notin Q\}$

c) Let A be subset of a topological space (X,T) and A is path connected is $\bar{A}$ necessarily path connected? **[2]**

Q5) a) State and prove the tube lemma. **[5]**

b) Is the finite complement topological space compact? Justify. **[3]**

c) Give an example of a locally campact space which is not compact. **[2]**

Q6) a) Define first and second countable spaces. Establish relation between them. **[5]**

b) Show that regularity is a hereditory topological property. **[3]**

c) Which of the following spaces are normal? **[2]**

i) A subspace of completely normal space.

ii) Product of two completely normal spaces.

iii) Lower limit topological space.

iv) A regular space with countable basis.

Q7) a) Prove that second countable space is Lindelöf. Is converse true? Justify. **[5]**

b) Define T_1 and T_2 spaces. Establish relation between them. **[3]**

c) Prove that product of regular spaces is regular. **[2]**

Q8) a) State and prove Tychonoff theorem. **[8]**

b) State Urysohn's lemma. **[2]**

Total No. of Questions : 8] SEAT No. :

P2162 [Total No. of Pages : 3

[4721] - 2003
M.A./M.Sc. (Semester - II)
MATHEMATICS
MT - 603 : Ring Theory
(2013 Pattern) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) If R is a ring with unity such that the set of non-units in R form an additive subgroup of (R,+), then prove that the characterstic of R is either 0 or a power of a prime **[4]**

b) If R is a ring with unity 1 and if x is a nilpotent element in the ring R, then show that $1+x$ is a unit in R. Can you replace "Nilpotent" by "Zero divisor"? justify. **[4]**

c) If K is odd integer then show that in the ring $Z_{2k}, \bar{k}$ is a idempotent element. **[2]**

Q2) a) Define a maximal ideal in a ring R. Show that the ring of rationals with usual addition and usual multiplication has a maximal ideal but the ring of rationals with usual addition and trivial multiplication $(i.e., ab = 0 \forall a, b \in Q)$ has no maximal ideal. **[5]**

b) Show that the intersection of two prime ideals is a prime ideal if and only if one of them is contained in the other. **[3]**

c) Prove or disprove

Every maximal ideal is a prime ideal. **[2]**

Q3) a) Prove that a ring R is an integral domain if and only if $R \neq (0)$, R has no non trivial nilpotent elements and (0) is a prime ideal in R. **[4]**

P.T.O.

b) Prove or disprove

The ideal (0) is a maximal ideal in Q [i] **[3]**

c) Prove or disprove

The ideal (0) is a maximal ideal in Z [i] **[3]**

Q4) a) If $f : R \to S$ and $g : S \to R$ are homomorphisms of rings then prove that kerf $\subseteq$ ker (gof) what happens if gof is monomorphism. Also prove that Im (gof) $\subseteq$ g (Imf) what happens if gof is epimorphism **[4]**

b) If R and S are both commutative rings and if $f : R \to S$ is a ring homomorphism then prove that inverse image of a prime ideal in S in a prime ideal in R. Can you replace "prime ideal" by "maximal ideal"? justify **[4]**

c) State chinese Remainder theorem for a commutative ring R with 1. **[2]**

Q5) a) Prove that a ring R is PID if and only if there is no distinction between prime elements and irreducible elements in R **[4]**

b) Show that neither Z[x] nor R [x,y] is a PID (even if R is a field). **[4]**

c) Prove or disprove

Quotient of a local ring is local **[2]**

Q6) a) Define unique factorization domain. show that the ring R = Z $\left[i\sqrt{3} \right]$ is a factorization domain but not a PID. **[4]**

b) Show that the ring R=Z$\left[\sqrt{2} \right]$ has infinite units **[3]**

c) Show that in the ring Z [i], the elements 3 + 4i and 4 – 3i are associates of each other **[3]**

Q7) a) For a commutative integral domain R with unity, prove that R [x] is PID if and only if R [x] is E.D. **[5]**

b) Find the units and nilpotent elements in the ring Z_{12} **[2]**

c) Find the units in the ring $Z_{12}[x]$ **[3]**

Q8) a) If an R– module M is generated by n elements then prove that M can be realised as a quotient of R^n **[5]**

b) Prove that a submodule of a finitely generated module over a PID is finitely generated **[5]**

Total No. of Questions : 8] **SEAT No. :**

P2163 **[Total No. of Pages : 4**

[4721] - 2004
M.A./M.Sc. (Semester - II)
MATHEMATICS
MT - 604 : Linear Algebra
(2013 Pattern) (Credit System)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Answer any Five questions.***
2) ***Figures to the right indicate full marks.***
3) ***Use of non-programmable, scientific calculator is allowed.***

Q1) a) Let V be the vector space of all mappings from R to R and V_1, V_2 be the subsets of V of even and odd functions respectively that is **[5]**

$$V_1 = \{f \in V / f(-x) = f(x)\}$$
$$V_2 = \{f \in V / f(-x) = -f(x)\}$$

then show that V is a direct sum of the subspaces V_1 and V_2

b) Find a basis of the subspace of R^4 generated by the vectors **[3]**

$$V_1 = (1,1,2,0);\ V_2 = (2,1,0,2);\ V_3 = (1,2,3,4);\ V_4 = (0,4,5,2).$$

c) Find a basis of the vector space C over R. **[2]**

Q2) a) Let U,V be vector spaces over F and let $f : \cup \to v$ be a linear mapping then show that: **[5]**

i) Ker (f) is a subspace of U.

ii) The range of f is a subspace of V.

iii) F is one-one if and only if ker $(f) = (0)$

P.T.O.

b) Let $f:\mathrm{R}^3 \to \mathrm{R}^3$ be defined by $f(x_1,x_2,x_3)=(x_1,x_1+x_2,\ x_1+x_2+x_3)$ then show that f is a linear mapping. Also, find ker (f). **[3]**

c) Let $\mathrm{V}=\mathrm{R}^3$ and $\mathrm{W}=\{(x,y,z)\in v / x^2-y^2=0\}$ be subset of V. Determine whether W is a subspace of V. **[2]**

Q3) a) If V and U are vector spaces over F and $f:\mathrm{V}\to\mathrm{U}$ is a linear mapping from V onto U, with kernel K then show that $\mathrm{U}\cong \mathrm{V}/\mathrm{K}.$ Further prove that there is a one-to-one correspondence between the set of subspaces of V containing K and set of subspaces of U. **[5]**

b) Let $f:\mathrm{R}^3\to\mathrm{R}^3$ be a linear mapping defined by f $(a,o,a+b)$. Find the matrices A and B respectively of the linear mapping *f* with respect to the standard basis (e_1,e_2,e_3) and the basis (e_1^1,e_2^1,e_3^1) where $e_1^1=(1,1,1);\ e_2^1=(0,1,1);\ e_3^1=(1,1,0).$ **[3]**

c) Let $f:\mathrm{R}^3\to\mathrm{R}^3$ be mapping defined by **[2]**

$f(x_1,x_2,x_3)=(x_1,x_2-x_1,2+x_3).$ Determine whether *f* is linear mapping.

Q4) a) Let U,V be finite dimensional vector spaces over F and Let $\phi:V\to U$ be a linear mapping. Then Prove that, rank (ϕ) + nullity (ϕ) = dim(v)**[5]**

b) If matrix $\mathrm{A}=\begin{bmatrix}1&1&2\\-1&2&1\\0&1&3\end{bmatrix}$ then Find a matrix P such that **[3]**

$$\mathrm{P}^{-1}\mathrm{AP}=\begin{bmatrix}1&0&0\\0&2&0\\0&0&3\end{bmatrix}$$

c) Define : **[2]**

i) Diagonalizable matrix

ii) Jordan block

Q5) a) Reduce the following matrix into triangular form. **[5]**

$$A = \begin{bmatrix} 1 & -2 & 0 \\ 1 & -1 & 2 \\ 0 & 1 & 1 \end{bmatrix}$$

b) Find the Jordan canonical form of the matrix, $A = \begin{bmatrix} 0 & 4 & 2 \\ -3 & 8 & 3 \\ 4 & -8 & -2 \end{bmatrix}$. **[3]**

c) Determine whether the given set of vectors are orthogonal. **[2]**

$$S = \{(1,0,-1), (0,3,-6,), (0,2,-4)\}$$

Q6) a) Let B be a symmetric bilinear form on a finite dimensional vector space V over F. If $(e_1, e_2, ..., e_n)$ is any orthogonal basis of V, then Prove that, the number of ei's such that B $(ei, ei) = 0$ is equal to the dimension of $V^{\perp}$. **[5]**

b) If B is symmetric bilinear form on a vector space V over a field F and let char (F) $\neq 2$ then prove that there exist an orthogonal basis of V relative to B. **[3]**

c) If the matrix $A = \begin{bmatrix} 4 & 2 & -2 \\ 2 & 1 & 4 \\ -2 & 4 & -2 \end{bmatrix}$ then find quadratic form of the matrix A. **[2]**

Q7) a) If V is vector space of the set of nxn matrices over R. Define **[5]**

$\langle A,B\rangle$ = trace of AB, $A,B \in V$ then show that $\langle,\rangle$ is a nondegenerate symmetric bilinear form on V.

b) If T is a self - adjoint operator on a finite-dimensional euclidean vector space E. Then prove that there is an orthonormal basis of E consisting of eigenvector of T. **[5]**

Q8) a) Prove that, If H be a hermitian form on V then linear mapping T of V into itself is H-unitary if and only if $H(Tx,Tx) = H(x,x), \forall x \in V$. **[5]**

b) State and prove Sylvester's theorem **[5]**

Total No. of Questions : 8] SEAT No. :

P2164 [Total No. of Pages : 3

[4721] - 2005
M.A./M.Sc. (Semester - II)
MATHEMATICS
MT - 605 : Partial Differential Equations
(2013 Pattern) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Eliminate the parameters a and b from the equation

$z^2(1+a^3) = 8(x+ay+b)^2$ **[4]**

b) Find the general integral of $x(y-z)\mathrm{P} + \mathrm{y}(\mathrm{z}-x)q = z(x-y)$ **[4]**

c) State the condition for the equations $f(x,y,z,p,q) = 0$ and

$g(x,y,z,p,q) = 0$ to be compatible on the domain D. **[2]**

Q2) a) Verify that the equation is integrable and find it's solution.

$yz(y+z)dn + nz(n+z)dy + xy(x+y)dz = 0$ **[4]**

b) Explain the method of solving following first order partial differential equation. **[4]**

i) $f(p,q) = 0$

ii) $z = p_x + qy + g(p,q)$

c) Find the complete integral of : $p^2 + q^2 = x + y$ **[2]**

Q3) a) If $h_1 = 0$ and $h_2 = 0$ are compatible with $f = 0$ then prove that h_1 and h_2 satisfy : $\dfrac{\partial(f,h)}{\partial(x,u_x)} + \dfrac{\partial(f,h)}{\partial(y,u_y)} + \dfrac{\partial(f,h)}{\partial(z,u_z)} = 0$ **[4]**

P.T.O.

b) Find the complete integral of : $(1+yz)d_x + z(z-x)d_y - (1+xy)dz = 0$ **[4]**

c) Solve : $x_z d_n + y_z d_y + x_y d_z = 0$ **[2]**

Q4) a) Find the complete integral of first order partial differential equation : $z^2(p^2z^2 + q^2) = 1,$ by charpitis method. **[4]**

b) Solve by Jacobis method : $x\mathrm{U}_x + y\mathrm{U}_y = \mathrm{U}z^2$ **[4]**

c) Derive the analytic expression for the monge cone at (x_0, y_0, z_0). **[2]**

Q5) a) Find the integral surface through initial data curve $C : no = -1,\ yo = s$ $z_0 = \sqrt{5}$ of the equation $(x+2)P + 2yq = 2z$ **[4]**

b) Reduce the equation : $y^2\mathrm{U}_{xx} - 2xy\mathrm{U}_{xy} + x^2\mathrm{U}_{yy} = \frac{y^2}{x}\mathrm{U}_x + \frac{x^2}{y}\mathrm{U}_y$ in to canonical form and solve it. **[4]**

c) Find two initial strip for the equation: $Z = \frac{1}{2}(p^2 + q^2) + (p-x)(q-y)$ which passes through x-axis. **[2]**

Q6) a) Using the method of sepration of variables, solve the following wave equation :

$y_{tt} - c^2 y_{xx} = 0, \quad 0 < x < c \quad t < 0$

$y(x,0) = f(x), \quad 0 \le x \le e$

$y_t(x,0) = g(x), \quad 0 \le x \le e$

$y(0,t) = y(e,t), \quad t > 0$ **[4]**

b) State and prove kelvin's Inversion theorem. **[4]**

c) Is the surface : $x^2 + y^2 + z^2 = cx^{2/3}$ is equipoential? If yes, find the poential function. **[2]**

Q7) a) If $u(x, y)$ is harmonic in bounded domain D and continous in $\bar{D} = D \cup B$. Then prove that U attains it's maximum on the boundary B of D. **[5]**

b) Using Duhamel's principle find the solution of non-homogenous Heat equation: **[5]**

$$ut + KU_{xx} = F(x,t), \qquad -\infty < x < \infty, \quad t > 0$$

$$u(x,0) = 0, \qquad -\infty < x < \infty$$

Q8) a) State Dirichletis problem for rectangle and find it's solution. **[5]**

b) Prove that, for the equation: **[5]**

$LU = u_{xy} + \frac{1}{4}U = 0$ the Riemann function is:

$$V(x, y, \alpha, \beta) = J_o\left(\sqrt{(x-\alpha)(y-\beta)}\right)$$

where Jo:denote Bessel's function of the first kind of order zero.

Total No. of Questions : 8]

SEAT No. :

P2139

[Total No. of Pages : 2

[4721]-21

M.A./M.Sc. (Semester - II)

MATHEMATICS

MT-601: General Topology

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *Attempt any five questions.*
2) *Figures to the right indicate full marks.*

Q1) a) Let X be a set; let τ_c be the collection of all subsets U of X such that X\U is either countable or all of X. Then prove that τ_c is a topology on X. **[6]**

b) Let X be a set; let B be a basis for a topology τ on X. Then prove that τ equals the collection of all unions of elements of B. **[4]**

c) Show that the topologies of R_l and R_k are not comparable. **[6]**

Q2) a) If B is a basis for the topology of X and C is a basis for the topology of Y, then prove that the collection D = {B×C|B∈ B and C∈ C} is a basis for the topology of X×Y. **[6]**

b) Show that the projection map $\pi_1 : X \times Y \to X$ maps open sets of X×Y onto open sets of X. **[5]**

c) Let X be a topological space. Then prove the following : **[5]**

i) ϕ and X are closed.

ii) Arbitrary intersections of closed sets are closed.

Q3) a) Let Y be a subspace of a topological space X; let A be a subset of Y; let $\overline{A}$ denote the closure of A in X. Then prove that the closure of A in Y equals $\overline{A} \cap Y$. **[6]**

P.T.O.

b) Prove that a subset of a topological space is closed if and only if it contains all its limit points. **[6]**

c) Prove that every finite point set in a Hausdorff space is closed. **[4]**

Q4) a) Show that if U is open in X and A is closed in X, then U – Ais open in X and A – U is closed in X. **[6]**

b) Let A and B denote subsets of a topological space X. Prove the following:

i) If $A \subset B$, then $\overline{A} \subset \overline{B}$.

ii) $\overline{A \cup B} = \overline{A} \cup \overline{B}$. **[6]**

c) Let X and Y be topological spaces. If $f : X \to Y$ is a continuous function, then prove that for every subset A of X, $f(\overline{A}) \subset \overline{f(A)}$. **[4]**

Q5) a) State and prove the pasting lemma. **[6]**

b) Suppose that $f : X \to Y$ is continuous. If x is a limit point of the subset A of X, is it necessarily true that $f(x)$ is a limit point of $f(A)$? Justify. **[4]**

c) If each space X_α is a Hausdorff space, then prove that $\prod X_\infty$ is a Hausdorff space in the both box and product topologies. **[6]**

Q6) a) Prove that the image of a connected space under a continuous map is connected. **[6]**

b) Prove that a space X is locally connected if and only if for every open set U of X, each component of U is open in X. **[6]**

c) Prove that every closed subspace of a compact space is compact. **[4]**

Q7) a) Prove that compactness implies limit point compactness, but not conversely. **[6]**

b) Prove that a subspace of a first-countable space is first-countable and a countable product of first-countable spaces is first-countable. **[6]**

c) State Tietze extension theorem. **[4]**

Q8) a) Prove that a subspace of a regular space is regular. **[5]**

b) Prove that every compact Hausdorff space is normal. **[7]**

c) State : **[4]**

i) Urysohn lemma.

ii) Tychonoff theorem.

Total No. of Questions : 8]

SEAT No. :

P2140

[Total No. of Pages : 2

[4721]-22

M.A./M.Sc. (Semester - II)

MATHEMATICS

MT-602: Differential Geometry

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Show that gradient of a function at a point is orthogonal to all the vectors tangent at that point. **[4]**

b) Show that graph of a function f is n-surface in R^{n+1} where function f is defined on open subset U of R^n..... **[4]**

c) State and prove Lagranges multiplier theorem. **[8]**

Q2) a) Find the integral curve passing through $p = (a, b)$ for the vector field $\overline{X}(p) = (1,1)$. **[4]**

b) Let S be a connected n-surface in R^{n+1}. Show that on S, there exists exactly two smooth unit normal vector fields N_1 and N_2. **[6]**

c) Find all possible Geodisics of cylinder $x_1^2 + x_2^2 = 1$ in R^3. **[6]**

Q3) a) Let S be a compact connected oriented n-surface in R^{n+1} exhibited as a level set $f^{-1}(c)$ of a smooth function $f : R^{n+1} \to R$ with $\nabla f(p) \neq 0$ for all $p \in S$. Then show that Gauss map maps S onto the unit sphere S^n. **[10]**

b) Show that the speed of Geodisic is constant. **[6]**

P.T.O.

Q4) a) What is Levi-Civita parallelism? State at least 2 properties of Levi-Civita parallelism. **[6]**

b) Find parallel transport for the great semicircle on the sphere with radius 1 in R^3. **[6]**

c) Show that parallel transport is one onto linear map. **[4]**

Q5) a) Show that Weingarten map is self adjoint. **[6]**

b) With all usual notations show that

$\nabla v\left(\bar{X}.\bar{Y}\right)=\left(\nabla v\bar{X}\right).\bar{Y}(P)+\bar{X}(P).\left(\nabla v\bar{Y}\right)$. **[6]**

c) Find global parametrization of plane curve defined by $\frac{x_1^2}{a^2}+\frac{x_2^2}{b^2}=1, a \neq 0,$

$b \neq 0$. **[4]**

Q6) a) Show that oriented connected plane curve always has a global parametrization. **[6]**

b) Find the length of 1 form η on $R^2-\{0\}$ defined by

$\eta=-\frac{x_2}{x_1^2+x_2^2}dx_1+\frac{x_1}{x_1^2+x_2^2}dx_2$ on the curve C which denotes the ellipse

$\frac{x_1^2}{a^2}+\frac{x_2^2}{b^2}=1$ oriented by inward normal. **[6]**

c) Define local parametrization and Global parametrization of a curve. **[4]**

Q7) a) Show that on each compact oriented n-surface S in R^{n+1} there exists a point p such that the second fundamental form at p is definite. **[8]**

b) For a compact connected oriented n-surface in R^{n+1}, show that Gauss-Kronecker curvature $K(p)$ is non zero iff second fundamental form is definite for all points on the surface. **[8]**

Q8) a) State and prove inverse function theorem for n-surfaces. **[8]**

b) Show that the tangent space to $SL_2(R)$ at $P=\begin{pmatrix}1 & 0\\ 0 & 1\end{pmatrix}$ can be identified with the set of all 2×2 matrices of trace zero. **[8]**

Total No. of Questions : 8]

SEAT No. :

P2141

[Total No. of Pages : 2

[4721]-23

M.A./M.Sc. (Semester - II)

MATHEMATICS

MT-603: Groups and Rings

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) For any integer $n > 2$, show that there are at least two elements in U(n), the group of units modulo n that satisfy $x^2 = 1$. **[5]**

b) Define normal subgroup. Give an example of a group which is non abelian but has a proper normal subgroup. Justify the answer. **[5]**

c) Let G be a group with the following property: If a, b and c belong to G and $ab = ca$, then $b = c$. Prove that G is abelian. Also prove that the subgroup of a cyclic group is cyclic. **[6]**

Q2) a) Prove that any cyclic group is isomorphic to either Z_n for some $n \in N$ or Z. **[5]**

b) Give an example of an infinite group with every element of finite order. Justify the answer. **[5]**

c) Find a cyclic subgroup of order 4 in U(40). Can U(n) be cyclic for some $n > 5$? Justify. **[6]**

Q3) a) Prove that every permutation of a finite set can be written as a cycle or a product of disjoint cycles. **[5]**

b) Show that a mapping $a \to \log_{10} a$ is an isomorphism from R^+ under multiplication to R under addition. **[5]**

c) Find Aut(Z_{10}), the group of automorphisms of Z_{10}. **[6]**

P.T.O.

Q4) a) Find the inverse and the order of each of the following permutations in S_{10} **[5]**

i) (1 2 4 6) (3 5 7)

ii) (1 2 9 4) (3 10) (7 8 5)

b) Let p be a prime. Prove the group of order p^2 is abelian. **[5]**

c) Let G be a finite cyclic group of order n. Prove that for each divisor k of n, G has exactly one subgroup of order k. Also list all the elements of order 8 in $Z_{8000000}$. **[6]**

Q5) a) Prove that the group of rotations of a cube is isomorphic to S_4. **[5]**

b) Suppose that G is an abelian group with an odd number of elements. Show that the product of all of the elements of G is the identity. **[5]**

c) Suppose that s and t are relatively prime positive integers. Then prove that $U(st)$ is isomorphic to the external direct product of U(s) and U(t). **[6]**

Q6) a) Let G be a group and H a normal subgroup of G. The prove that set $G/H = \{aH | a \in G\}$ is a group under operation $(aH)(bH) = abH$. **[5]**

b) Determine all the homomorphism from Z_{12} to Z_{30}. **[5]**

c) Find all the non isomorphic abelian groups of order 1176. **[6]**

Q7) a) Prove that the only group of order 255 is Z_{255}. **[5]**

b) Prove that a group of order 105 has a subgroup of order 35. **[5]**

c) If $|G| = 2p$, where p is an odd prime. Then prove that G is isomorphic to Z_{2p} or D_p. **[6]**

Q8) a) Prove that the group of order 56 is not simple. **[5]**

b) Define homomorphism and kernel of a homomorphism. Prove that every normal subgroup of a group G is the kernel of a homomorphism of G. **[5]**

c) Prove that the factor group of an abelian group is abelian. Is the converse true? Justify. **[6]**

Total No. of Questions : 8]

SEAT No. :

P2142

[Total No. of Pages : 3

[4721]-24

M.A./M.Sc. (Semester - II)

MATHEMATICS

MT-604: Complex Analysis

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) For a given power series $\sum_{n=0}^{\infty} a_n Z^n$ define the number R, $0 \le R < \infty$ by

$$\frac{1}{R} = \limsup |a_n|^{1/n}$$ **[6]**

Prove that

i) $|Z| < R$ then the series converges absolutely.

ii) $0 < r < R$ then the series converges uniformly on $\{Z : |Z| \le r\}$.

b) Under stereographic projection for each of the points Z = 0, Z = 1 + *i* give corresponding points of the unit sphere S in R^3. **[6]**

c) Define an analytic function. If $f : G \to \mathbb{C}$ is differentiable at a point '*a*' in G then prove that *f* is continuous at '*a*'. **[4]**

Q2) a) Let *f* and *g* be analytic on G and Ω respectively and suppose $f(G) \subset \Omega$. Prove that *gof* is analytic on G and $(gof)'(z) = g'(f(z))\, f'(z) \; \forall z \in G$. **[8]**

b) Define Möbius transformation. Prove that every Möbius transformation maps circle of $\mathbb{C}_\infty$ on to circles of $\mathbb{C}_\infty$. **[5]**

c) Find the radius of convergence of $\sum_{n=0}^{\infty} \frac{n^3}{n!} Z^n$. **[3]**

P.T.O.

Q3) a) Let $f: G \to \mathbb{C}$ be analytic and suppose $\bar{B}(a,r) \subset G (r > 0)$.

If $\gamma(t) = a + re^{it}\ 0 \le t \le 2\pi$ then prove that $f(z) = \frac{1}{2\pi i}\int_r \frac{f(w)}{w-z}dw$ for $|z-a| < r$. **[6]**

b) Find the fixed point of a dilation, a translation and the inversion on $\mathbb{C}_\infty$. **[5]**

c) Let $\gamma(t) = e^{it}\ 0 \le t \le 2\pi$. Find $\int_\gamma z^n dz$. **[5]**

Q4) a) State and prove Fundamental Theorem of Algebra. **[6]**

b) Let f be analytic in the disk B(a, R) and suppose that γ is a closed rectifiable curve in B(a, R). Prove that $\int_\gamma f = 0$. **[5]**

c) Evaluate $\int_r \frac{dz}{z^2+1}$ where $\gamma(t) = 2e^{it}\ 0 \le t \le 2\pi$. **[5]**

Q5) a) Let f be analytic in B(a, R) then prove that $f(z) = \sum_{n=0}^{\infty} a_n (z-a)^n$ for $|z-a| < R$ where $a_n = \frac{1}{n!} f^{(n)}(a)$ and this series has a radius of convergence $\ge R$. **[6]**

b) Let G be a connected open set and let $f: G \to \mathbb{C}$ be an analytic fuction. If the set $\{z \in G \mid f(z) = 0\}$ has a limit point in G then prove that there exists a point 'a' in G such that $f^{(n)}(a) = 0$ for each $n \ge 0$. **[6]**

c) Let f be analytic on D = B(0, 1) and suppose $|f(z)| \le 1$ for $|z| < 1$ show $|f'(0)| \le 1$. **[4]**

Q6) a) Let G be an open subset of the plane $f: G \to \mathbb{C}$ ın analytic function. If γ is a closed rectifiable curve in G s.t $\eta(\gamma, \omega) = 0$ for all ω in$\mathbb{C}$ – G then prove that for a in G–{ γ }

$$\eta(\gamma, \omega) f(a) = \frac{1}{2\pi i_\gamma}\int \frac{f(Z)}{z-a}dz.$$ **[8]**

b) If G is simply connected and $f : G \to \mathbb{C}$ is analytic then prove that f has a primitive in G. **[6]**

c) Evaluate $\int_c \frac{(5z-2)}{z-1} dz$ where C is the circle $|z| = 2$ described in anticlockwise direction. **[2]**

Q7) a) If f has an isolated singularity at 'a' then prove that the point $z = a$ is a removable singularity *iff* $\lim_{z \to a} (z-a) f(z) = 0$. **[8]**

b) State and prove Casorati-Weierstrass Theorem. **[6]**

c) State Residue Theorem. **[2]**

Q8) a) Let G be a region in $\mathbb{C}$ and f an analytic function on G. Suppose there is a constant M such that $\limsup_{z \to a} |f(z)| \leq M$ for all a in $\partial_\infty G$ prove that $|f(z)| \leq M$ for all z in G. **[6]**

b) Show that $\int_0^\infty \frac{\sin x}{x} dx = \frac{\pi}{2}$ **[5]**

c) Does there exist an analytic function $f : D \to D$ with $f\left(\frac{1}{2}\right) = \frac{3}{4}$ and $f'\left(\frac{1}{2}\right) = \frac{2}{3}$? **[5]**

Total No. of Questions : 8]

SEAT No. :

P2143

[Total No. of Pages : 3

[4721]-25

M.A./M.Sc. (Semester - II)

MATHEMATICS

MT-605: Partial Differential Equations

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Find the general integral of the equation $yzp + xzq = xy$ **[3]**

b) Obtain the partial differential equation by eliminating arbitrary function F from the equation $z = xy + \mathrm{F}(x^2 + y^2)$. **[6]**

c) Find the complete integral of $z^2(p^2z^2 + q^2) = 1$ by Charpits method. **[7]**

Q2) a) Prove that the pfaffian differential equation $\overline{\mathrm{X}}.d\bar{r} = \mathrm{P}(x, y, z)dx + \mathrm{Q}(x, y, z)dy + \mathrm{R}(x, y, z)dz = 0$ is integrable if and only if $\overline{\mathrm{X}}.\mathrm{curl}\,\overline{\mathrm{X}} = 0$ **[8]**

b) Find the integral surface of the equation $x^3p + y(3x^2 + y)q = z(2x^2 + y)$ which passes through the curve $\mathrm{C}: x_0 = 1, y_0 = s, z_0 = s(1 + s)$ **[8]**

Q3) a) Prove that a necessary and sufficient condition for the integrability of $dz = \phi(x, y, z)dx + 4(x, y, z)dy$ is

$$[f, g] = \frac{\partial(f, g)}{\partial(x, p)} + p\frac{\partial(f, g)}{\partial(z, p)} + \frac{\partial(f, g)}{\partial(y, q)} + q\frac{\partial(f, g)}{\partial(z, q)} = 0$$ **[8]**

b) Find the complete integral of $u_x^3 + u_y^2 + u_z = 1$ by using Jacobi's method. **[8]**

P.T.O.

Q4) a) Prove that the solution of Neumann problem is unique up to the addition of a constant. **[4]**

b) Find the solution of $Z = \frac{1}{2}(p^2 + q^2) + (p - x)(q - y)$ which passes through the X-axis. **[7]**

c) Reduce the following equation to canonical form

$u_{xx} + 2u_{xy} + 4u_{yy} + 2u_x + 3u_y = 0$ **[5]**

Q5) a) Show that the solution of following problem if it exists then it is unique. **[8]**

$u_{tt} - c^2 u_{xx} = \mathrm{F}(x,t), 0 < x < a$

$u(x,0) = f(x), \theta \le x \le a$

$u_t(x,0) = \mathrm{g}(x), 0 \le x \le a$

$u(0,t) = u(a,t) = 0,\ t \ge 0$

b) State and prove Harnack's theorem. **[8]**

Q6) a) If $u(x, y)$ is a harmonic function in a bounded domain D and continuous in $\bar{\mathrm{D}} = \mathrm{D} \cup \mathrm{B},$ then prove that u attain it's maximum on the boundary B of D. **[6]**

b) State Dirichiet problem for rectangle and find its solution. **[8]**

c) Classify the equation into hyperbolic, parabolic or elliptic *type.*

$u_{xx} + 2u_{zy} + \cos x.u_z = e^{y^2} u + \cosh z$ **[2]**

Q7) a) Using the variable separable method solve $u_t = ku_{xx}$; $0 < x < a, t > 0$ which satisfies condition $u(0, t) = u(a, t) = 0$, $t > 0$ and $u(x, 0) = x(a - x)$; $0 \le x \le a$. **[8]**

b) Find a solution of the partial differential equation $u_{xx} = x + y$. **[3]**

c) Prove that for the equation $u_{xx} + \frac{1}{4}u = 0;$ the Riemann function is

$\mathrm{V}(u, y, \alpha, \beta) = \mathrm{J}_0\left(\sqrt{(x - \alpha)(y - \beta)}\right),$ where J_0 denotes the Bessel's function of the first kind of order zero. **[5]**

Q8) a) Using Duhamel's principle find the solution of non-homogeneous equation

$$u_{tt} - c^2 u_{xx} = f(x,t); -\infty < x < \infty, t > 0$$ **[8]**

$$u(x,0) - u_t(x,0) = 0; -\infty < x < \infty$$

b) State and prove Kelvin's inversion theorem. **[8]**

Total No. of Questions : 5] **SEAT No. :**

P2144 **[Total No. of Pages : 2**

[4721] - 26
M.A./M.Sc. (Semester - II)
MATHEMATICS
MT - 606 : Object Oriented Programming Using C++
(2008 Pattern)

Time : 2 Hours] ***[Maximum Marks : 50***

Instructions to the candidates:

1) ***Question one is compulsory.***
2) ***Attempt any three questions from Q.2, Q.3, Q.4 and Q.5.***
3) ***Figures to the right indicate full marks.***

Q1) Attempt any Ten of the following : **[20]**

a) What is data encapsulation?

b) Give example of union in C++.

c) Write short note on 'delete operator' in C++.

d) What is use of scope resolution operator?

e) Write a program for 'boolean data type'.

f) Write the syntax of friend functions.

g) Explain the term "message passing".

h) Write a program in C++ to find square of a number.

i) What is operator overloading?

j) Write one difference between break and continue.

k) Define static number.

l) Identify the error in the following program

```
# include <iostream.h>
void main ( )
{
int num [ ] = {1, 2, 3, 4, 5, 6};
num [1] == [1] num? Cout << C "success"
          : Cout << "Error";
}
```

P.T.O.

Q2) a) Write a note on applications of object oriented programming. **[5]**

b) Write a C ++ program to start given array of integers in ascending order. **[5]**

Q3) a) Define structure and write methods of declaring variable. **[5]**

b) State the difference between if else statement and switch statement. **[5]**

Q4) a) Write a C++ program to find maximum of two numbers. **[5]**

b) Write a note on identifiers and constants. **[5]**

Q5) a) Explain the term inline function. **[5]**

b) Write a note on local classes. **[5]**

♦♦♦♦

Total No. of Questions : 8] **SEAT No. :**

P2165 **[Total No. of Pages : 3**

[4721] - 3001
M.A./M.Sc. (Semester - III)
MATHEMATICS
MT - 701 : Combinatorics
(2013 Pattern) (Credit System)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Find a recurrence relation for a_n, the number of n-digit ternary sequences without any occurrence of the subsequence "012". **[5]**

b) How many 8-digit sequences are there involving exactly six different digits? **[3]**

c) Find two different chessboards (not row or column rearrangements of one another) that have the same rook polynomial. Also, write the rook polynomial. **[2]**

Q2) a) Find ordinary generating function whose coefficient a_r equals r(r–1) (r–2) (r–3). Hence, evaluate the sum. $4 \times 3 \times 2 \times 1 + 5 \times 4 \times 3 \times 2 + ...+$ n (n–1) (n–2) (n–3). **[5]**

b) How many nonnegative integer solutions are there to the equation $2x_1 + 2x_2 + x_3 + x_4 = 12$? **[3]**

c) Solve the recurrence relation. $a_n = 2a_{n/2} + 2,$ with $n \geq 4$ and $a_2 = 1.$ **[2]**

Q3) a) Prove by combinatorial argument that **[4]**

$$\binom{n}{o}^2 + \binom{n}{1}^2 + \binom{n}{2}^2 + ... + \binom{n}{n}^2 = \binom{2n}{n}$$

P.T.O.

b) Suppose a school with 120 students offers Yoga and Karate. If the number of students taking Yoga alone is twice the number taking Karate (possibly, Karate and Yoga), if 25 more students study neither skill than study both skills, and if 75 students take at least one skill, then how many students study Yoga? **[4]**

c) Find a generating function for a_k, the number of k-combinations of n types of objects with an even number of the first type, an odd number of the second type and any amount of the other types. **[2]**

Q4) a) How many arrangements are there of MURMUR with no pair of consecutive letters the same? **[5]**

b) If three distinct dice are rolled, what is the probability that the highest value is twice the smallest value? **[3]**

c) A basketball team has 5 players, 3 in forward positions and 2 in guard positions. How many ways are there to pick a team if there are 6 forwards, 4 guards and 2 people who can play forward or guard? **[2]**

Q5) a) If 10 steaks and 15 lobsters are distributed among four people, how many ways are there to give each person at most 5 steaks and at most 5 lobsters? **[5]**

b) How many 6-letter sequences are there with at least 3 vowels (A,E,I,O,U)? No repetitions are allowed. **[3]**

c) Find a generating function for a_r, the number of ways n distinct dice can show a sum of r. Which coefficient do we want? **[2]**

Q6) a) How many r-digit ternary sequences are there in which : **[5]**

i) No digit occurs exactly twice?

ii) 0 and 1 each appear a positive even number of times?

b) Solve the recurrence relation, $a_n^2 = 2a_{n-1}^2 + 1$; with $a_o - 1$ **[3]**

c) Find a recurrence relation for the number of ways to distribute n distinct objects into five boxes. What is the initial condition? **[2]**

Q7) a) Using generating function, solve the recurrence relation **[5]**

$$a_n = 2a_{n-1} + 2^n \text{ ; with } a_o = 1$$

b) How many permutations of the 26 letters are there that contain none of the sequences MATH, RUNS, FROM, or JOE? **[5]**

Q8) a) Seven dwarfs $D_1, D_2, D_3, D_4, D_5, D_6, D_7$ each must be assigned to one of the seven jobs in a mine, $J_1, J_2, J_3, J_4, J_5, J_6, J_7$. If D_1 cannot do jobs J_1 or J_3; if D_2 cannot do J_1 or J_5; If D_4 cannot do J_3 or J_6; if D_5 cannot do J_2 or J_7; if D_7 cannot do J_4; and if D_3 and D_6 can do all jobs. How many ways are there to assign the dwarfs to different Jobs? **[5]**

b) How many 10 letter words are there in which each of the letters e,n,r,s occur : **[5]**

i) At most once?

ii) At least once?

Total No. of Questions : 8] **SEAT No. :**

P2166 **[Total No. of Pages : 3**

[4721] - 3002
M.A./M.Sc. (Semester - III)
MATHEMATICS
MT - 702 : Field Theory
(2013 Pattern) (Credit System)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) If F is a field and p $(x) \in F[x]$ is an irreducible polynomial then prove there exist a field K containing an isomorphic copy of F in which p (x) has a root. **[4]**

b) Show that p $(x) = x^2 + 1$ is an irreducible polynomial over the field Z_3. Find an extension field E of Z_3 in which p (x) has a root. Also find the cardinality of E. **[4]**

c) Prove or disprove $Q(\sqrt{3})$ and $Q(\sqrt{-3})$ are field isomorphic. **[2]**

Q2) a) If α is a rational root of a monic polynomial in Z $[x]$ then prove that α is on integer **[4]**

b) In the field $E = Q(\sqrt[3]{2})$, express the element $\frac{3}{1+\sqrt[3]{2}-\sqrt[3]{4}}$ as a polynomial in $\sqrt[3]{2}$ **[4]**

c) If the field E is an extension of a field F of prime degree then show that for every $a \in E, F(a) = F$ or $F(a) = E$. **[2]**

Q3) a) If L is a finite extension of the field K and K is a finite extension of the field F then prove that L is a finite extension of the field F and **[5]**

[L : F] = [L : K] [K : F]

P.T.O.

b) Prove that $\left[Q\left(\sqrt{2},\sqrt{3}\right):Q\right]=4$ also find the basis of $Q\left(\sqrt{2},\sqrt{3}\right)$ over Q. **[3]**

c) Find the minimal polynomial of $\sqrt{-3}+\sqrt{2}$ over Q. **[2]**

Q4) a) If K_1 and K_2 are two finite extensions of a field F contained in the field K, then Prove that $[K_1K_2 : F] \leq [K_1 : F]\ [K_2 : F]$. **[4]**

b) If $K_1 = Q\left(\sqrt{2}\right)$ and $K_2 = Q\left(\sqrt[3]{2}\right)$ then find the composite field of K_1 and K_2. Also find the degree of this composile field. **[4]**

c) Show that doubling the cube is impossible. **[2]**

Q5) a) Prove that for any field F, if $f(x) \in F\ [x]$ then there exist an extension K of F which is a splitting field for $f(x)$ **[5]**

b) If $\overline{F}$ is algebraic closure of F then prove that $\overline{F}$ is algebraically closed. **[3]**

c) Prove that an algebraic extension of a perfect field is separable. **[2]**

Q6) a) Prove that every irreducible polynomial over a finite field F is separable. **[4]**

b) Define n^{th} cycliotomic polynomial $\phi_n(x)$. Find cyclitomic polynomial $\varphi_n(x)$ for n = 1,2,3,4 **[4]**

c) Show that $Q\left(\sqrt[4]{2}\right)$ is not a normal extension of Q. **[2]**

Q7) a) With usual notation, show that $G = Gal\left(Q\left(\sqrt{2},\sqrt{3}\right)/Q\right)$ is isomorphic to Klein four group $Z_2 \oplus Z_2$. **[5]**

b) Construct a field with nine elements. **[3]**

c) Show that all sub fields of $Q\left(\sqrt{2},\sqrt{3}\right)$ are Galois extensions of Q. **[2]**

Q8) a) Define **[4]**

i) Cyclic extension

ii) Radical extension

Show that the polynomial $f(x) = x^2 + ax + b$ is solvable by radical.

b) Find α such that $Q(\alpha) = Q\left(\sqrt{2}, \sqrt{3}\right)$ **[3]**

c) Find the splitting field of $x^5 - 1 \in Q[x]$ is it a normal extension of Q? **[3]**

Total No. of Questions : 8] **SEAT No. :**

P2167 **[Total No. of Pages : 3**

[4721] - 3003
M.A./M.Sc. (Semester - III)
MATHEMATICS
MT - 703 : Functional Analysis
(2013 Pattern) (Credit System)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) For an operator A on a Hilbert space H, if A=A* and <Ah,h> = 0 for all $h \in H$, then prove that A = 0. **[5]**

b) Let H be a separable Hilbert space with basis $\{e_n\}$. If A is an operator defined by $Ae_n = \frac{1}{n} e_n$, then show that A is compact operator. **[3]**

c) State Hahn – Banach Theorem. **[2]**

Q2) a) Let H be a Hilbert space and M be a closed subspace of H. Prove that $(M^{\perp})^{\perp} = M$. **[4]**

b) Show that the Fourier transform is a linear isometry from $L_C^2[0, 2\pi]$ onto $l^2(Z)$. **[4]**

c) Give an example of an orthonormal basis of $L^2[-\pi, \pi]$. **[2]**

Q3) a) If A is a normal operator and λ, μ are distinct eigen values of A, then prove that $\ker (A - \lambda) \perp \ker (A - \mu)$. **[4]**

b) State open mapping theorem. **[2]**

c) Give an example of a (non-identity) Unitary operator on an infinite dimensional Hilbert space. **[4]**

P.T.O.

Q4) a) If $A \in B(H)$, prove that $\|A\| = \|A^*\| = \|A^* A\|^{1/2}$ **[4]**

b) If $\{x_n\}$ is a sequence in Banach space X such that $\sum_{n=1}^{\infty} \|xn\| < \infty$, then prove that the series $\sum_{n=1}^{\infty} x_n$ converges in X. **[4]**

c) Give an example of a Banach space which is not a Hilbert space. **[2]**

Q5) a) Let X be a normed space and f be a linear functional on X. If ker f is closed, prove that f is continuous. **[4]**

b) Give an example of a convex set in a Hilbert space. **[2]**

c) If T is compact then prove that there exists a sequence $\{T_n\}$ of operators of finite rank such that $\|T - T_n\| \to 0$. **[4]**

Q6) a) State and prove the principle of uniform Boundedness. **[5]**

b) Prove that the identity operator on an infinite dimensional Hilbert space is not a compact operator. **[3]**

c) Define a reflexive space and give an example. **[2]**

Q7) a) State and prove Riesz Representation Theorem for a Hilbert space. **[5]**

b) Let $\phi : \{-\pi, \pi] \to C$ be defined by $\phi(t) = e^{it}$ and

$M_\phi : L^2[-\pi, \pi] \to L^2[-\pi, \pi]$ be the operator defined by $M_\phi(f) = \phi f$.

Find M_ϕ^* and $\|M_\phi\|$. **[5]**

Q8) a) State and prove closed Graph Theorem. **[5]**

b) Prove that $L_1^* = L^\infty$. **[5]**

Total No. of Questions : 8]

SEAT No. :

P2145

[Total No. of Pages : 2

[4721] - 31
M.A./M.Sc. (Semester - III)
MATHEMATICS
MT - 701 : Functional Analysis
(2008 Pattern)

Time : 3 Hours] *[Maximum Marks : 80*

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Let X be a normed space over C. Let $0 \neq a \in X$. Show that there is some functional f on X such that $f(a) = \|a\|$ and $\|f\| = 1$. **[6]**

b) Let H be a 2 - dimensional Hilbert space. Let the operator T on H be defined by $Te_1 = e_2$ and $Te_2 = -e_1$. Find the spectrum of T. **[2]**

c) State and prove Hahn - Banach Theorem. **[8]**

Q2) a) Let H be a Hilbert space and f be a functional on H. Prove that there exists a unique vector $y \in H$ such that $f(x) = \langle x, y \rangle$ for every $x \in H$. **[8]**

b) Show that the operator T on a finite dimensional Hilbert space H is normal if and only if its adjoint T* is a polynomial in T. **[6]**

c) Find $M^{\perp}$ if $M = \{(x, y) : x - y = 0\} \subset R^2$. **[2]**

Q3) a) If T is an operator on a Hilbert space H, then prove that T is normal if and only if its real and imaginary parts commute. **[6]**

b) i) Let X and Y be normed spaces. If X is finite dimensional, then show that every linear transformation from X to Y is continuous. **[4]**

ii) Give an example of a discontinuous linear transformation. **[4]**

c) A linear operator $T : l^2 \to l^2$ is defined by $T(x_1, x_2, x_3, ...) = \left(x_1, \frac{x^2}{2}, ..., \frac{x_n}{n}, ...\right)$. Find T*. **[2]**

P.T.O.

Q4) a) If P and Q are projections on closed linear subspaces M and N of a Hilbert space H, then prove that $M \perp N$ if and only if PQ = 0 if and only if QP = 0. **[6]**

b) If T is any operator on a Hilbert space H and if α, β are scalars such that $|\alpha| = |\beta|$, then show that $(\alpha T + \beta T^*)$ is normal. **[4]**

c) If T is an operator on a Hilbert space H for which $<T_x, x> = 0$ for all $x \in H$, then prove that T = 0. **[6]**

Q5) a) State and prove the uniform boundedness principle. **[8]**

b) Let T be an operator on H. If T is non - singular, then show that $\lambda \in \sigma(T)$ if and only if $\lambda^{-1} \in \sigma(T^{-1})$. **[4]**

c) Let $\{A_n\}$ be a sequence in B(H) and $A \in B(H)$ such that $\|A_n - A\| \to 0$ as $n \to \infty$. If each A_n is self - adjoint, then show that A is self - adjoint. **[4]**

Q6) a) Let Y be a closed subspace of a normed linear space X. Show that a sequence $\{x_n + Y\}$ converges to X + Y if and only if there is a sequence $\{y_n\}$ in Y such that $\{x_n + y_n\}$ converges to x in X. **[8]**

b) Give an example of an operator which is an isometry but not unitary. Justify your answer. **[4]**

c) Show that the unitary operators on a Hilbert space H form a group under composition. **[4]**

Q7) a) State and prove the open mapping theorem. **[8]**

b) Let $X = C'([0, 1])$ and $Y = C([0, 1])$ both with sup norm. Let $F : X \to Y$ be defined as $f(g) = g'$. Show that F is linear, closed but not continuous. Explain why the closed graph theorem is not applicable? **[8]**

Q8) a) Let T be a normal operator on H with spectrum $\{\lambda_1, \lambda_2, ...,\lambda_m\}$. Show that T is self - adjoint if and only if each λ_i is real. **[4]**

b) Show that every positive operator on a finite dimensional Hilbert space has a unique positive square root. **[4]**

c) Prove that every finite dimensional subspace of a normed linear space X is closed. Give an example of a subspace which is not closed. **[8]**

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Total No. of Questions : 8]

SEAT No. :

P2146

[Total No. of Pages : 2

[4721] - 32
M.A./M.Sc. (Semester - III)
MATHEMATICS
MT - 702 : Ring Theory
(2008 Pattern)

Time : 3 Hours] *[Maximum Marks : 80*

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Define an integral domain and show that any finite integral domain is a field. **[6]**

b) Define nilpotent element of a commutative ring R.

Prove that if x is nilpotent element of a commutative ring R then either x is zero or a zero divisor. Also prove that $1 + x$ is a unit in R. **[6]**

c) Give an example (with justification) of an infinite Boolean ring. **[4]**

Q2) a) If A is a subring and B is an ideal of a ring R then prove that **[6]**

$$\frac{A + B}{B} \cong \frac{A}{A \cap B}$$

b) If I and J are two ideals of a ring R then prove that $IJ \subseteq I \cap J$. **[4]**

c) If I = 6Z, J = 10Z then find I + J, IJ and $I \cap J$. **[6]**

Q3) a) If R is a commutative ring with unity then prove that an ideal M is a maximal ideal of R if and only if the quotient R/M is a field. **[8]**

b) Prove or disprove

i) The ideal I = (x) is prime ideal of Z[x] **[2]**

ii) The ideal J = $(2, x)$ is maximal ideal of Z[x] but not a principal ideal of Z[x]. **[6]**

P.T.O.

Q4) a) Prove that every ideal in a Euclidean domain is principal. **[8]**

b) Use above result (a) to show that the ring $Z\left[\sqrt{-5}\right]$ is not a Euclidean domain. **[6]**

c) State chinese Remainder theorem. **[2]**

Q5) a) Prove that every non zero ideal in a principal ideal domain is a maximal ideal. **[6]**

b) Prove that a quotient of a PID by a prime ideal is again a PID. **[4]**

c) Prove that the intersection of two prime ideals is again a prime ideal if and only if one of them is contained in the other. **[6]**

Q6) a) Prove that in a UFD a non - zero element is a prime if and only if it is irreducible. **[8]**

b) Show that **[6]**

i) $2i$ is irreducible but not prime in the ring $Z[2i]$.

ii) The elements 2 and $2i$ not associates of each other in $Z[2i]$.

c) Prove that the cardinality of the quotient ring $\frac{Z[i]}{(1+i)}$ is two **[2]**

Q7) a) If R is UFD and F is its field of fraction and if $p(x)$ is monic irreducible polynomial in $R[x]$ then prove that $p[x]$ is irreducible in $F[x]$ **[6]**

b) What is the field of fraction of the ring

$R = Z[2i]=\{a+2bi \mid a,b \in z\}$

Use the result in (a) to prove that $Z[2i]$ is not a UFD. **[6]**

c) Describe the ring structure of the ring $\frac{Z[x]}{(x^2)}$. **[4]**

Q8) a) If I is a proper ideal in the integral domain R and if $p(x)$ is a nonconstant monic polynomial in $R[x]$.

Prove that if the image of $p(x)$ in $\frac{R}{I}[x]$ cannot be factored in $\frac{R}{I}[x]$ into two polynomials of smaller degree, then $p(x)$ is irreducible in $R[x]$. **[8]**

b) Show that the polynomial $f(x)=x^n+1$ is irreducible over Q but reducible over R. **[4]**

c) Prove or disprove The polynomial x^2+xy+1 is irreducible in $Z[x,y]$. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P2147

[Total No. of Pages : 2

[4721] - 33
M.A./M.Sc. (Semester - III)
MATHEMATICS
MT - 703 : Mechanics
(2008 Pattern)

Time : 3 Hours] *[Maximum Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Explain the following terms. **[6]**

i) Scleronomic and Rheonomic constraints.

ii) Hamiltonian principle for conservative system.

iii) D' Alembert's principle

b) A particle is constrained to move on the surface of a cylinder of fixed radius. Find the Lagrange's equation of motion. **[6]**

c) Find the force generated by the potential $\phi(x, y, z) = -x^2y - 2z + 9$. **[4]**

Q2) a) A particle of mass m moves in a plane under the action of a conservative force f with components $F_X = -K^2(2x + y)$, $F_Y = -K^2(x + 2y)$, K is a constant. Find the total energy of the motion, the Lagrangian, and the equations of motion of the particle. **[8]**

b) If the Lagrangian does not contain time t expliciey, then prove that total energy of the conservative system is conserved. **[8]**

Q3) a) Find the Hamillon's canonical equations for a one - dimensional harmonic oscillator for which the kinetic energy is $\frac{1}{2}mx^2$ and the potential energy is $\frac{1}{2}Kx^2$. **[4]**

b) Show that the generalized momentum corresponding to a cyclic co - ordinate is conserved. **[4]**

c) Find Hamilton's equations of motion from the Hamilton's principle. **[8]**

P.T.O.

Q4) a) Show that the Hamilton's principle $\delta\int_{t_0}^{t} L dt = 0$ also holds for the non - conservative system. **[7]**

b) Show that the geodesic $\theta = \theta(r)$ in polar co - ordinates is a straight line. **[7]**

c) Explain the principle of least action. **[2]**

Q5) a) A particle slides down a curve in the vertical plane under gravity. Find the curve such that it reaches the lowest point in shortest time **[8]**

b) Explain the Hamilton's principle. **[2]**

c) Find the extremal of the functional $I = \int_1^2 \left(\frac{x^3}{y'^2} \right) dx$, subject to the conditions that y(1) = 0, y(2) = 3. **[6]**

Q6) a) Show that the Euler - Lagrange's equation of the functional $I(y(x)) = \int_{x_1}^{x_2} f(x, y, y')dx$ has the first integral $f - y'\frac{\partial f}{\partial y'}$ = constant, if the integrand does not depend on x. **[6]**

b) Prove that the extremal of the isoperimetric problem $I = \int_1^4 y'^2 dx$ subject to the condition $\int_1^4 y dx = 36$ and y(1) = 3, y(4) = 24 is a parabola. **[6]**

c) Explain non - conservative and rheonomic system. **[4]**

Q7) a) Prove the kepler's second law of plane tary motion. **[4]**

b) Explain the Differential equation of the orbit. **[6]**

c) Describe the motion of the rigid body. **[6]**

Q8) a) Explain the eulerian angles. **[2]**

b) Show that the transformation $p = \frac{1}{Q}.q = PQ^2$ is canonical and find the generating function. **[4]**

c) If u < v are any two constants of motion of any given holonomic dynamical system, then prove that their poisson bracket [u, v] is also constant of motion. **[5]**

d) Prove that poisson brackets are invariant under canonical transformation. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P2148

[Total No. of Pages : 3

[4721] - 34
M.A./M.Sc. (Semester - III)
MATHEMATICS
MT - 704 : Measures and Integration
(2008 Pattern)

Time : 3 Hours] *[Maximum Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***
3) ***All symbols have their usual meanings.***

Q1) a) Define following terms with suitable example. **[6]**

i) Outer Measure

ii) Signed measure

iii) Hausdorff Measure

b) Let $\{E_i\}$ be a sequence of measurable sets. If $E_1 \subseteq E_2 \subseteq .....$, then show that $\mu(\lim E_i) = \lim \mu(E_i)$ **[6]**

c) Show that there exists an uncountable set of zero measure. **[4]**

Q2) a) If f and g are integrable functions and E is a measurable set the show that **[6]**

i) $\int_E (c_1 f + c_2 g) = c_1 \int_E f + c_2 \int_E g$

ii) If $|h| \leq |f|$ and h is a measurable then h is integrable.

iii) If $f \geq g$ a.e. then $\int f \geq \int g$.

b) Suppose that to each α in a dense set D of real numbers there is assigned a set $B_\alpha \in B$ such that $B_\alpha \subset B_\beta$ for $\alpha < \beta$. Then show that there exist a unique measurable extended real valued function f on X such that $f \leq \alpha$ on B_α and $f \geq \alpha$ on $X \sim B_\alpha$ **[6]**

c) Show that if f is a non - negative measurable function, then $f = 0$ a.e. If and only if $\int f\, dx = 0$. **[4]**

P.T.O.

Q3) a) Let (X, *B*) be a measurable space, $<\mu_n>$ a sequence of measures that converge set wise to a measure μ and $<f_n>$ a sequence of nonnegative measurable functions that converge pointwise to the function *f* then show that **[6]**

$$\int f \, d\mu \leq \underline{\lim} \int f_n d\mu_n$$

b) Let $<f_n>$ be a sequence of measurable functions that converge to a function *f* except at the points of set E of measure zero. Then prove that *f* is a measurable function if μ is complete. **[6]**

c) Show that the function $x^{-1}\sin x$ is Riemann integrable on $(-\infty, \infty)$ but its Lebesgue integral does not exist. **[4]**

Q4) a) Let *v* be a signed measure on the measurable space (*X*, *B*) then prove that there is a positive set A and a negative set B such that $X = A \bigcup B$ and $A \bigcap B = \phi$. **[6]**

b) Let *v* be a signed measure on (X, *B*) and $E \in B$ with *v*(E) >0. Then show that there exist A, a set positive with respect to *v*, such that $A \subset E$ and $v(A) > 0$. **[6]**

c) Let $f, g \in L^p(\mu)$ and *a, b* be constants then show that $af + bF \in L^p(\mu)$. **[4]**

Q5) a) Let (X, B, μ) be a σ - finite measure space, and let υ be a measure defined on *B* which is absolutely continuous with respect to μ. Then prove that there is a nonnegative measurable function *f* such that for each set *E* in *B* we have $\upsilon E = \int_E f d\mu$. **[8]**

b) Show that the following conditions on the signed measure μ and *v* on (X, B) are equivalent. **[8]**

i) $v << \mu$

ii) $|v| << |\mu|$

iii) $v^+ << \mu$

iv) $v^- << \mu$

Q6) a) Let *F* be a bounded linear functional on $L^p(\mu)$ with $1 \leq p \leq \infty$ and μ a σ - finite measure. Then show that there is a unique element *g* in L^q where $1/p + 1/q = 1$, such that $F(f) = \int fg d\mu$ with $||F|| = ||g||_q$. **[6]**

b) Show that the class B of μ^* - measurable sets is a σ - algebra. **[6]**

c) Let μ be a measure on an algebra G, μ^* the outer measure induced by μ, and E any set. Show that for $\varepsilon > 0$, there is a set $A \in G$ with $E \subset A$ and $\mu^*(A) \leq \mu^*(E) + \varepsilon$. **[4]**

Q7) a) Define product measure. Let E (subset of X × Y) a set in $B_{\sigma\delta}$ and x be a point of X. Then show that E_x (x cross section E) is a measurable subset of Y. **[8]**

b) Let (X, B, μ) be a finite measure space and g an integrable function such that for some constant M, $|\int g\phi\, d\mu| \leq M \|\phi\|_p$ for all simple functions ϕ then show that $g \in L^q$. **[8]**

Q8) a) Let μ be a finite measure defined on σ - algebra which contains all the Baire sets of a locally compact space X. If μ is inner regular then show that it is regular. **[6]**

b) Let μ be a measure on an algebra G and μ^* the outer measure induced by μ. Then prove that the restriction $\bar{\mu}$ of μ^* to the μ^*- measurable sets is an extension of μ to σ - algebra containing G. **[6]**

c) Let μ^* be a topologically regular outer measure on X then prove that each Borel set is μ^* - measurable. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P2149

[Total No. of Pages : 2

[4721] - 35
M.A./M.Sc. (Semester - III)
MATHEMATICS
MT - 705 : Graph Theory - I
(2008 Pattern)

Time : 3 Hours] *[Maximum Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Prove that the complete graph K_n can be expressed as the union of k bipartite graphs if and only if $n \leq 2^k$. **[8]**

b) In each class below, determine the smallest n such that there exist nonisomorphic n - vertex graphs having the same list of vertex degrees. **[8]**

i) all graphs

ii) loopless graphs

iii) simple graphs

Q2) a) Prove that the Petersen graph has girth 5. **[4]**

b) Let e be an edge appearing an odd number of times in a closed walk W. Prove that W contains the edges of a cycle through e. **[4]**

c) Prove that a graph G is Eulerian if it has at most one non - trivial component and its vertices all have even degree. **[8]**

Q3) a) Let x and y be adjacent vertices in a graph G. For all $z \in V(G)$, prove that $|d_G(x,z) - d_G(y,z)| \leq 1$. **[2]**

b) Prove that the nonnegative integers $d_1, \ldots\ldots, d_n$ are the vertex degrees of some graph if and only if Σd_i is even. **[6]**

c) Prove that every loopless graph G has a bipartite subgraph with at least $e(G)/2$ edges. **[8]**

P.T.O.

Q4) a) Show that K_4 decomposes into three copies of P_3 **[2]**

b) Let T be a tree with average degree *a*. Determine *n*(T) in terms of *a*. **[4]**

c) Prove that repeatedly applying the Augmenting Path Algorithm to a bipartite graph produces a matching and a vertex cover of equal size. **[10]**

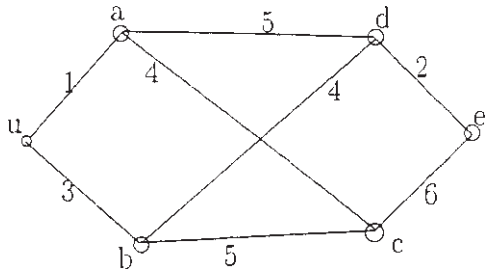
Q5) a) Prove that deleting a vertex of maximum degree cannot increase the average degree, but deleting a vertex of minimum degree can reduce the average degree. **[5]**

b) Prove that $K_{2,3}$ is not contained in any hypercube Q_k. **[5]**

c) Prove that for an *n* - vertex graph G (with $n \geq 1$), G has $n - 1$ edges and no cycles if and only if G has no loops and has, for each $u, \upsilon \in V(G)$, exactly one u, υ - path. **[6]**

Q6) a) Let T(G) denote the number of spanning trees of a graph G. Prove that if $e \in E(G)$ is not a loop, then T(G) = T(G – *e*) + T(*G*.e). **[8]**

b) Using Dijkstras algorithm find the shortest distance from *u* to every other vertex in the following graph. **[4]**



c) Prove that every component of the symmetric difference of two matchings is a path or an even cycle. **[4]**

Q7) a) Prove that if G is a bipartite graph, then the maximum size of a matching in G equals the minimum size of a vertex cover of G. **[8]**

b) Prove that two blocks in a graph share at most one vertex. **[6]**

c) Prove that if T is a tree with *n* vertices and independence number *k*, then the maximum size of matching $\alpha'(T)$ is $n - k$. **[2]**

Q8) a) Prove that the connectivity of the hypercube Q_k is *k*. **[4]**

b) Prove that a graph is 2 - connected if and only if it has an ear decomposition. **[6]**

c) Prove that a graph *G* is 2^k colorable if and only if *G* is the union of *k* bipartite graphs. **[6]**

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Total No. of Questions : 8] **SEAT No. :**

P2168 **[Total No. of Pages : 3**

[4721] - 4001
M.A./M.Sc. (Semester - IV)
MATHEMATICS
MT - 801 : Number Theory
(2013 Pattern) (Credit System)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Let p denote a prime. Then prove that $x^2 \equiv -1 \pmod{p}$ has solution if and only if $p = 2$ or $p \equiv 1 \pmod{4}$. **[5]**

b) Prove that $\frac{1}{5}n^5 + \frac{1}{3}n^3 + \frac{7}{15}n$ is an integer for every integer n. **[3]**

c) Solve the congruence $x^3 + 2x - 3 \equiv 0 \pmod{5}$. **[2]**

Q2) a) If (a,m) = 1, then prove that $a^{\phi(m)} \equiv 1 \pmod{m}$. **[5]**

b) Show that $61 ! + 1 \equiv 0 \equiv 63 ! + 1 \pmod{71}$. **[3]**

c) For what real number x is it true that **[2]**

i) $\left[x + \frac{1}{2}\right] + \left[x - \frac{1}{2}\right] = 2x$?

ii) $[x + 3] = 3 + [x]$?

Q3) a) Let p denote a prime. Then prove that the largest exponent e such that $p^e | n!$ is $e = \sum_{i=1}^{\infty} \left[\frac{n}{p^i}\right]$. **[5]**

P.T.O.

b) For every integer n, prove that $\sum_{d|n} \phi(d) = n.$ **[3]**

c) Find the smallest integer x such that $\phi(x) = 6$. **[2]**

Q4) a) If p and q are distict odd primes, then prove that $\left(\frac{p}{q}\right)\left(\frac{q}{p}\right) = (-1)^{\left\{\frac{p-1}{2}\right\}\left\{\frac{q-1}{2}\right\}}$ **[4]**

b) Find all integers that give the remainders 1,2,3 when divided by 3,4,5 respectively. **[4]**

c) Find a positive integer n such that $\mu(n) + \mu(n+1) + \mu(n+2) = 3.$ **[2]**

Q5) a) If Q is odd and Q > 0, then prove that $\left(\frac{2}{Q}\right) = (-1)^{\frac{(Q^2-1)}{8}}.$ **[4]**

b) Prove that $\pi_{d/n} d = n^{d(n)/2}.$ **[4]**

c) Write a single congruence that is equivalent to the pair of congruences $x \equiv 1 \pmod 4$, $x \equiv 2 \pmod 3$. **[2]**

Q6) a) State and prove Wilson's theorem. **[5]**

b) If an irreducible polynomial P(x) divides a product f (x) g (x), then prove that P (x) divides at least one of the polynomials f(x) and g (x) **[3]**

c) Prove that if α is algebraic of degree n, then $-\alpha$ and α^{-1} are also algebraic of degree n. **[2]**

Q7) a) i) If α and β are algebraic numbers, then prove that $\alpha+\beta$ is also algebraic number.

ii) If α and β are algebraic integers, then prove that $\alpha+\beta$ is also algebraic integer.

[5]

b) i) Prove that the norm of product equals the product of norms. $N(\alpha\beta) = N(\alpha)N(\beta)$.

ii) Prove that $N(\alpha) = 0$ if and only if $\alpha = 0$.

iii) If γ is an integer in $Q(\sqrt{m})$, then prove that $N(\gamma) = \pm 1$ if and only if γ is a unit.

[5]

Q8) a) Prove that every Euclidean quadratic field has the unique factorisation property. **[5]**

b) Find all solutions of $101x + 37y = 3819$. **[5]**

Total No. of Questions : 8] **SEAT No. :**

P2169 **[Total No. of Pages : 3**

[4721] - 4002
M.A./M.Sc. (Semester - IV)
MATHEMATICS
MT - 802 : Differential Geometry
(2013 Pattern) (Credit System)

)Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any Five questions of the following.***
2) ***Figures to the right indicate full marks.***

Q1) a) Let S be an n-surface in R^{n+1}, let $\propto : I \to S$ be a parametrized curve in s, let to $\in$ I, and let $v \in S \propto (to)$. Then prove that there exists Qunique vector field V, tangent to S along $\propto$, which is parallel and has $V(t_o) = V$. **[4]**

b) Find the integral curve through the point p=(1,0) of the vector field $X(p) = (p, X(p))$, where $X(x_1, x_2) = (-x_2, x_1)$. **[3]**

c) Show that the speed of geodesic is censtant. **[3]**

Q2) a) Prove that the Weingarten map L_p is self-adjoint. **[5]**

b) Let $f : \cup \to R$ be a smooth function, where $\cup$ is an open subset of R^{n+1}, and let $\propto : I \to \cup$ be an integral curve of ∇f. Show that $\frac{d}{dt}(fo \propto)(t) = \|\nabla f(\propto (t))\|^2$ for all $t \in I$. **[3]**

c) Sketch the level sets $f^{-1}(c)$ for $n = 0, 1$ of the function $f(x_1, x_2, ...x_{n+1}) = x_{n+1}$, $c = -1, 0, 1$. **[2]**

Q3) a) Let S denote the cylinder $x_1^2 + x_2^2 = r^2$ of radius r in R^3. Show that $\propto$ is a geodesic of S it and only if $\propto$ is of the form $\propto (t) = (r\cos(at+b), r\sin(at+b), (t+d)$ for some real numbers a,b,c and d. **[4]**

P.T.O.

b) Let $\propto(t)=(x(t),y(t))(t\in I)$ be a local parametrization of the oriented plane curve C. With usual notation, show that $Ko\propto=\frac{x^1y^{11}-y^1x^{11}}{\left(x^{1^2}+y^{1^2}\right)^{3/2}}$. **[4]**

c) Define the Gauss map and the spherical image of the oriented n-surface. **[2]**

Q4) a) Prove that on each compact oriented n-surface S in R^{n+1} there exists a point P such that the second fundamental form at P is definite. **[5]**

b) Let C be a connected oriented plane curve and $\beta:I\to C$ be a unit speed global parametrization of C. Prove that β is either one to one or periodic. **[3]**

c) If an n-surface S contains a line segment L, then show that L is a geodesic of S. **[2]**

Q5) a) Let S be an n-surface in R^{n+1} oriented by the unit normal vector field N. Let $P\in S$ and V$\in$ Sp. prove that for every parametrized curve $\propto: I\to S$, with $\dot{\propto}(t_o)$ = V for some $t_o\in I$, $\ddot{\propto}(t_o)$, N(P) = $\mathrm{L_p}(v).V$ **[4]**

b) For each pair of orthogonal unit vectors $\{e_1, e_2,\}$ in R^3 and each $a\in$ R, show that the great circle, $\propto(t)$ = (cosat) e_1+(sinat) e_2 is a geodesic in 2-sphere. **[3]**

c) Let SC R^{n+1} be a connected n-surface in R^{n+1}. Prove that there exist on S exactly two smooth unit normal vector fields N_1 and N_2, and $N_2(p)=-N_1(p)$ for all $P\in S$. **[3]**

Q6) a) Let S be an n-surface in R^{n+1} S = $f^{-1}(c)$ where $f:\cup\to\mathrm{R}$ is such that $\nabla f(q)\neq 0$ for all $q\in S$. Suppose $g:\cup\to\mathrm{R}$ is a smooth function and $P\in S$ is an extreme point of g on S for all $q\in S$. Prove that there exists a real number λ such that $\nabla g(p)=\lambda\nabla f(p)$. **[5]**

b) Show that the 1-farm η on $R^2 - \{0\}$ defined by

$$\eta = -\frac{x_2}{x_1^2 + x_2^2} dx_1 + \frac{x_1}{x_1^2 + x_2^2} dx_2 \text{ is not exact} \quad \textbf{[5]}$$

Q7) a) Let S be a 2 - surface in R^3 and let $\propto : I \to S$ be a geodesic in S with $\dot{\propto} \neq 0$. Then prove that a vector field X tangent to S along $\propto$ is parallel along $\propto$ if and only if both $\|X\|$ and the angle between X and $\dot{\propto}$ are constant along $\propto$. **[4]**

b) Let $a = (a_1, a_2, ..., a_{n+1}) \in R^{n+1}, a \neq 0$. Show that the spherical image of an n-surface S is contained in the n-plane $a_1 x_1 + a_2 x_2 + ... + a_n x_n = 0$ if and only if for every $p \in S$ there is an open interval I about O such that $p + ta \in S$ for all $t \in I$. **[4]**

c) Sketch the following vector field on R^2. **[2]**

i) X(P) = P for all $P \in R^2$.

ii) X($x_1 x_2$) = ($-x_2$, x_1).

Q8) a) State and prove Inverse Function Thearem for n-surface. **[5]**

b) Let S be the ellipsoid $\frac{x_1^2}{a^2} + \frac{x_2^2}{b^2} + \frac{x_3^2}{c^2} = 1$, a,b,c all non-zero, which is oriented by the outward normal. Show that the Gaussian curvature of S is $K(P) = \dfrac{1}{a^2 b^2 c^2 \left(\dfrac{x_1^2}{a^4} + \dfrac{x_2^2}{b^4} + \dfrac{x_3^2}{c^4} \right)^2}$ **[5]**

Total No. of Questions : 8] **SEAT No. :**

P2170 **[Total No. of Pages : 4**

[4721] - 4003
M.A./M.Sc. (Semester - IV)
MATHEMATICS
MT - 803 : Fourier Series and Boundary Value Problems
(2013 Pattern) (Credit System)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Suppose $f \in C_p(0,\pi)$. Show that the Fourier cosine series coefficients a_n tend to zero as n tends to infinity. **[4]**

b) Find the Fourier cosine series on the interval $0 < x < \pi$ that corresponds to the function f defined by $f(x) = x^2 \ (0 < x < \pi)$. **[3]**

c) Find the Fourier sine series for the function

$$f(x) = x(\pi^2 - x^2) \ \ (0 < x < 1)$$ **[3]**

Q2) a) Let f denote a function such that **[4]**

i) f is continuous on the interval $-\pi \le x \le \pi$.

ii) $f(-\pi) = f(\pi)$

iii) its derivative F1 is piecewise continuous on the interval $-\pi < x < \pi$.
Prove that the Fourier series

$$\frac{a_0}{2} + \sum_{n=1}^{\infty}(a_n \cos nx + b_n \sin nx)$$ for f, with coefficients

$$a_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\cos nx\,dx, \ b_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\sin nx\,dx$$ converges absolutely and uniformly to $f(x)$ on the interval $-\pi \le x \le \pi$.

P.T.O.

b) Find the fourier series for the function $f(x)=\begin{cases}\frac{-\pi}{2} \text{ when} -\pi<x<0\\ \pi/2 \text{ when } 0<x<\pi\end{cases}$

Also show that this Fourier series converges to $f(x)$ on the interval $-\pi \le x \le \pi$. **[4]**

c) Show that the function defined by the equations

$f(x)=\begin{cases}x\sin\left(\frac{1}{x}\right) & when\, x \neq 0\\ 0 & when x=0\end{cases}$ is continuous at $x = 0$ but that neither $f_R'(0)$ nor $f_L'(0)$ exists. **[2]**

Q3) a) Solve the following linear boundary value problem.

$u_t(x,t)=ku_{xx}(x,t)\ \ (0<x<c, t>0)$

$u_x(0,t)=0,\ u_x(c,t)=0\ (t>0)$

$u(x,0)=f(x).$ **[5]**

b) Solve the following boundary value problem

$u_t(x,t)=ku_{xx}(x,t)+q(t)\ (0<x<\pi, t>0)\ \ u(0,t)=0,\ u(\pi,t)=0,$ and

$u(x,0)=f(x).$ **[5]**

Q4) a) Solve the following boundary value problem

$\rho^2 u_{\rho\rho}(\rho,\phi)+\rho u_{\rho}(\rho,\phi)+u_{\phi\phi}(\rho,\phi)=0 \quad (0<\rho<a, 0<\phi<\pi)$ satisfying homogeneous conditions $u_{\phi}(\rho,0)=0,\quad u_{\phi}(\rho,\pi)=0 \quad (0<\rho<a)$ nonhomogeneous condition $u(a,\phi)=f(\phi)\ \ (0<\phi<\pi).$ **[4]**

b) Derive the eigenvalues and eigenfunctions of the sturm-Liouville problem

$X^{11}(x)+\lambda X(x)=0, X(0)=0, X(c)=0.$ **[4]**

c) Verify that each of the functions $u_0 = y.$ and u_n = sinhny cosnx (n = 1,2,3,.....) satisfies Laplace equation

$u_{xx}(x,y)+u_{yy}(x,y)=0\ \ (0<x<\pi, 0<y<2)$

and three boundary conditions

$u_x(0,y)=u_x(\pi,y)=0,\ u(x,0)=0.$ **[2]**

Q5) a) Let C_n(n = 1,2,3.....) be the Fourier constants for a function f in $C_p(a,b)$ with respect to an orthonormal set $\{\phi_n(x)\}_{n=1}^{\infty}$ in that space.

Then prove that all possible linear combinations of the functions

$\phi_1(x), \phi_2(x), ...\phi_n(x),$ the combination

$C_1\phi_1(x) + C_2\phi_2(x) + ... + C_N\phi_N(x)$ is the best approximation in the mean to $f(x)$ on the fundamental interval $a < x < b.$ **[4]**

b) Prove that a necessary and sufficient condition for an orthonormal set $\{\phi_n(x)\}_{n=1}^{\infty}$ to be complete is that for each function f in the space considered, Parseval's equation $\sum_{n=1}^{\infty} C_n^2 = \| f \|^2$

where C_n are the fourier constants $C_n = (f, \phi_n),$ be satisfied. **[4]**

c) Show that the function $\psi_1(x) = 1$ and $\psi_2(x) = x$ are orthogonal on the interval $-1 < x < 1$ and determine constants A and B such that the function $\psi_3(x) = 1 + Ax + Bx^2$ is orthogonal to both ψ_1 and ψ_2 on the interval. **[2]**

Q6) a) If λ_m and λ_n are distict eigenvalue of the Sturm-Liouville problem $[r(x)X'(x)]' + [q(x) + \lambda P(x)]X(x) = 0 \quad (a < x < b)$ under the condition $a_1X(a) + a_2X'(a) = 0, \quad b_1X(b) + b_2X'(b) = 0,$ then prove that corresponding eigen functions $X_m(x)$ and $X_n(x)$ are orthogonal with respect to weight function $p(x)$ on the interval $a < x < b.$ **[4]**

b) Solve the following boundary value problem

$u_{xx}(x,y) + u_{yy}(x,y) = 0 \quad (0 < x < \pi, y > 0)$

$u_x(0,y) = 0, \; u(\pi,y) = 0 \quad (y > 0)$

$-Ku_y(x,0) = f(x) \quad (0 < x < \pi)$

where K is positive constant. **[4]**

c) Find eigenvalues of normalized eigen function $X'' + \lambda X = 0, \; X(0) = 0,$ $X(1) = 0.$ **[2]**

Q7) a) For the singular Sturm-Liouville problem consisting of the differential equation $x\frac{d^2X}{dx^2}+\frac{dX}{dx}+\lambda xX=0 \ \ (0<x<c)$ Prove that **[5]**

i) the eigenvalues are $\lambda_j=\alpha_j^2$ and corresponding eigen functions are $X_j=J_0(\alpha_j x)$ when $X(c)=0 \ \ (j=1,2,3,.....)$.

ii) the eigenvalues are $\lambda_j=\alpha_j^2$ and corresponding eigen functions are $X_j=J_0(\alpha_j x)$, where $\alpha_j\,(j=1,2,3.....)$ are positive roots of equation $hJ_0(\alpha c)+(\alpha c)J_0^1(\alpha c)=0.$

b) Solve the following boundary value problem. **[5]**

$$u_t=k\left(u_{\rho\rho}+\frac{1}{\rho}u_\rho\right) \ \ (0<\rho<c,\ t>0)$$

$$u_\rho(c,t)=0 \qquad (t>0)$$
$$u(\rho,o)=f(\rho),$$

Q8) a) Prove that the eigenvalues and corresponding eigenfunctions of the singular sturm - Liouville problem $\left[(1-x^2)X'(x)\right]'+\lambda X(x)=0 \ \ (-1<x<1)$ are $\lambda_n=n(n+1),$ and $X_n(x)=P_n(x) \ \ (n=0,1,2,.....)$ where $P_n(x)$ are Legendre polynomials. Also prove that the set $\{P_n(x)\}_{n=0}^{\infty}$ is orthogonal on the interval $-1<x<1$ with weight function unity. **[4]**

b) Solve the Legendre's equation

$$(1-x^2)y''-2xy'+\lambda y=0\,.$$ **[3]**

c) Expand the function $f(x)=1 \ \ (0<x<1)$ in a series of Legendre polynomial of odd degree. **[3]**

Total No. of Questions : 8] **SEAT No. :**

P2150 **[Total No. of Pages : 2**

[4721] - 41
M.A./M.Sc. (Semester - IV)
MATHEMATICS
MT - 801 : Field Theory
(2008 Pattern)

Time : 3 Hours] ***[Maximum Marks : 80***

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) If $f(x) = a_0 + a_1x + ... + a_{n-1}x^{n-1} + x^n \in z[x]$ is a monic polynomial and if $f(x)$ has a root $a \in Q$ then prove that $a \in Z$ and a divides a_0. **[6]**

b) Show that $x^3 - x - 1 \in Q[x]$ is irreducible over Q. **[6]**

c) If F is a field then state any four basic properties of F[x]. **[4]**

Q2) a) If $f(x) \in F[x]$ is a non - zero nonconstant polynomial over the field F then prove that there exist an extension field E of F in which $f(x)$ has a root. **[8]**

b) Show that the polynomial $x^2 + x + 1 \in Z_2[x]$ is irreducible over the field Z_2. If U is a root of this polynomial in some extension K of Z_2 then show that the subfield $Z_2[4]$ of K has 4 elements. Write the addition and multiplication table for the elements in Z_2[u]. **[8]**

Q3) a) If the field E is a finite extension of the field F then prove that E is an algebraic extension of F. Is the converse true? Justify. **[8]**

b) Prove that $\sqrt{2}$ and $\sqrt{3}$ are algebraic over the field Q. Find the degree of $Q\left(\sqrt{2}, \sqrt{3}\right)$ over Q. **[6]**

c) Find the minimal Polynomial of $\sqrt{2} + 5$ over Q. **[2]**

P.T.O.

Q4) a) If K is algebraically closed field then prove that every irreducible polynomial in K[n] is of degree 1. **[6]**

b) If K is a splitting field of $f(x) \in F[x]$ over the field F then prove that K is an algebraic extension of F. **[6]**

c) Find the splitting field of $x^3 + x^2 + 1 \in Z_2[x]$. **[4]**

Q5) a) Define the normal of a field F. Show that every finite extension of a finite field is normal. **[6]**

b) If F is a finite field then show that number of elements of F is P^n for some prime P and for some positive integer *n*. **[6]**

c) Construct a field with 8 elements. **[4]**

Q6) a) Define

i) A separable polynomial over a field F. **[8]**

ii) Perfect field F.

Prove that every extension of Q (field of rational numbers) is separable.

b) If E is finite separable normal extension of the field F then prove that F is the fixed field of G(E/F) **[8]**

Q7) a) If E is a finite extension of a field F then with usual notation prove that

$|G(E/F)| \leq [E : F]$. **[8]**

b) Prove that $G(Q(\alpha)/Q)$, where $\alpha^5 = 1$ $\alpha \neq 1$ is isomorphic to the cyclic group of order 4. **[8]**

Q8) a) Define

i) Radical extension of a field F. **[6]**

ii) Polynomial soluable by radical. Show that it an irreducible polynomial $P(x) \in F[x]$ over a field F has a root in a radical extension of F then $P(x)$ is solvable by radical over F.

b) Show that it is impossible to construct square equal in area to the area of a circle of radius 1 **[6]**

c) Show that the field of complex numbers C is a normal extension of field or real numbers R. What about R over the field of rationals Q. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P2151

[Total No. of Pages : 3

[4721] - 42
M.A./M.Sc. (Semester - IV)
MATHEMATICS
MT - 802 : Combinatorics
(2008 Pattern)

Time : 3 Hours] *[Maximum Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) What fraction of all arrangements of INSTRUCTOR have two consecutive vowels? **[6]**

b) What is the probability of randomly choosing a permutation of the 10 digits 0, 1, 2, ...9 in which : **[6]**

i) An odd digit is in the first position and 1, 2, 3, 4 or 5 is in the last position.

ii) 5 is not in the first position and 9 is not in the last position.

c) Find all derangements of 1, 2, 3, 4, 5 with the help of associated chessboard of darkened squares. **[4]**

Q2) a) Prove by combinatorial argument that C(r, r) + C(r + 1, r) + C(r + 2, r) +.....+ C(n, r) = C(n + 1, r + 1). Hence evaluate the sum

$1 \times 2 \times 3 + 2 \times 3 \times 4 + ...+ (n - 2)(n - 1)n$. **[6]**

b) How many arrangements of MISSISSIPPI are there with no pair of consecutive S's? **[6]**

c) Among 40 toy robots, 28 have a broken wheel or are rusted but not both, 6 are not defective, and the number with a broken wheel equals the number with rust. Find how many robots are rusted. **[4]**

Q3) a) Find ordinary generating function whose coefficient a_r equals $3r + 7$. Hence evaluate the sum $7 + 10 + 13 + ... + (3n + 7)$ **[6]**

b) How many ways are there to split 6 copies of one book, 7 copies of a second book, and 11 copies of a third book between two teachers, If

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each teacher gets 12 books and each teacher gets at least 2 copies of each book? **[6]**

c) How many integer solutions are there to $x_1 + x_2 + x_3 + x_4 + x_5 = 28$ with **[4]**

i) $x_i > 0$.

ii) $x_i \geq i$ (i = 1, 2, 3, 4, 5)

Q4) a) How many n - digit numbers are there with at least one of the digits 1 or 2 or 3 absent? **[6]**

b) Use generating functions to find the number of ways to select 10 balls from a large pile of red, white and blue balls if the selection has at most two red balls. **[6]**

c) Show that any subset of eight distinct integers between 1 and 14 contains a pair of integers K, *l* such that K divides *l*. **[4]**

Q5) a) How many r digit ternary sequences are there with an even number of O's and even number of 1's? **[6]**

b) Using inclusion - exclusion principle, find the number of arrangements of a, a, a, b, b, b, c, c, c without three consecutive letters the same? **[6]**

c) Solve the recurrence relation **[4]**

$a_n = 2a_{\frac{n}{2}} + 5,\ n \geq 4$ with $a_2 = 1$

Q6) a) Solve the recurrence relation using Generating functions $a_n = a_{n-1} + n(n-1), a_0 = 1$ **[6]**

b) How many ways are there to deal a 6 - card hand that contains at least one jack, at least one 8, and at least one 2? **[6]**

c) How many 10 - letter words are there in which each of the letters e, n, r, s occur at least once? **[4]**

Q7) a) Find a recurrence relation for the ways to distribute n identical balls into k distinct boxes with between two and four balls in each box. Repeat the problem with balls of three colours. **[6]**

b) Solve the recurrence relation **[6]**

$a_n = a_{n-1} + 3(n-1)$; $a_0 = 1$.

c) How many arrangements of six O's, five 1's, and four 2's are there in which the first O precedes the first 1, which precedes the first 2? **[4]**

Q8) a) Find recurrence relation for the number of n - digit ternary sequences with an even number of O's and an even number of 1's ? **[8]**

b) How many ways are there to assign six different city cars C_1, C_2, C_3, C_4, C_5, C_6 to six officers O_1, O_2, O_3, O_4, O_5, O_6 if O_1 will not drive cars C_1 and C_4; if O_2 will not drive cars C_1 or C_5; if O_3 will drive all cars; if O_4 will not drive C_1 or C_5; if O_5 will not drive C_4; and if O_6 will not drive car C_6? **[8]**

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Total No. of Questions : 8]

SEAT No. :

P2152

[Total No. of Pages : 2

[4721] - 43
M.A./M.Sc. (Semester - IV)
MATHEMATICS
MT - 803 : Differentiable Manifolds
(2008 Pattern)

Time : 3 Hours] *[Maximum Marks : 80*

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Define K - dimensional volume of a parametrized manifold of dimension K in R^n and prove that it is invariant under reparametrization. **[7]**

b) Show that $g(x, y) = 2(x_1y_3 - y_1x_3) - 5(x_2y_4 - y_2x_4)$ is an alternating 2 - tensor on R^4. Further, express g as a combination of elementary tensors. **[6]**

c) Give an example of a 1 - manifold in R^2, covered by a single coordinate patch. **[3]**

Q2) a) Define differential of a O - form and prove that for a C^∞ scalar function *f*,

$$df = (D_1 f)dx_1 + (D_2 f)dx_2 + \ldots\ldots\ldots + (D_n f)dx_n$$ **[6]**

b) Show that the n - ball $B^n(a)$ is an n - manifold in R^n. Find the boundary of $B^n(a)$. **[6]**

c) If G is a symmetric tensor, show that (with usual notation) AG = 0. Is the converse true? Justify. **[4]**

Q3) a) Define the differential operator d and for any k - form w, show that d(dw) = 0 **[8]**

b) Let $W = xydx + 3dy - yzdz$ and $\eta = xdx - yz^2dy + 2xdz$. Find $W \wedge N$. **[4]**

c) Find centroid of the parametrized curve $\alpha(t) = (2\cos t, 2\sin t)$, $0 < t < \pi$. **[4]**

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Q4) a) With usual notation, prove that $\alpha^*(dw) = d(\alpha^*, w)$ **[7]**

b) Find a basis for the tangent space to the unit sphere at $\left(0, \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$. **[5]**

c) Define exact form and give an example. **[4]**

Q5) a) Let M be an orientable k - manifold with non - empty boundary. Prove that ∂M is orientable. **[7]**

b) Let $A = R^2 - \{0\}$. If $W = \frac{xdx + ydy}{x^2 + y^2}$, then show that W is a closed form in A. **[4]**

c) State Stokes's theorem. **[5]**

Q6) a) What is the dimension of $A^k(V)$, the space of alternating k - tensors on an n - dimensional vector space Y? Justify. **[7]**

b) Let $W = xydx + yzdy + xzdz$. Find dW. **[4]**

c) Let $\alpha(t) = \sin 2t(|\cos t| \sin t)$, $0 < t < \pi$ and M be the image set of α. Is α a coordinate patch for M? Justify. **[5]**

Q7) a) If w and η are k and *l* forms respectively, then prove that $d(w \wedge \eta) = dw \wedge \eta + (-1)^k w \wedge d\eta$ **[8]**

b) State Green's theorem for compact 2 - manifolds in R^2. **[4]**

c) If $f(x, y, z) = 2x_1y_2z_2 - x_1y_3z_1$ and $g(x, y) = x_2y_1 - 5x_3y_1$ be tensors on R^4. Find $f \otimes g$. **[4]**

Q8) a) Let $\alpha : (0, 1)^3 \to R^4$ be given by $\alpha(s, t, u) = (s, u, t, (2u - t)^2)$. Let Y be the image set of α. Evaluate $\int_Y x_1 dx_1 \wedge dx_3 \wedge dx_4 + 2x_2x_3 dx_1 \wedge dx_2 \wedge dx_3$. **[8]**

b) If $T : V \to W$ is a linear transformation, and if f and g are alternating tensors on W, then prove that $T^*(f \wedge g) = T^* f \wedge T^* g$. **[8]**

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Total No. of Questions : 8]

SEAT No. :

P2153

[Total No. of Pages : 2

[4721] - 44
M.A./M.Sc. (Semester - IV)
MATHEMATICS
MT - 804 : Algebric Topology
(2008 Pattern)

Time : 3 Hours] *[Maximum Marks : 80*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) When are two maps $f_1, f_2 : X \to Y$ said to be homotopic? That is $f_1 \cong f_2$? **[4]**

b) If $f_1, f_2 : X \to Y$, and $g_1, g_2 : Y \to Z$, and $f_1 \cong f_2$ and $g_1 \cong g_2$, Prove that $g_1 f_1 \cong g_2 f_2$. **[6]**

c) Prove that the identity map Id : $R^n \to R^n$ Id(x) = x, is homotopic to the constant map C : $R^n \to R^n$. c(x) = 0 **[6]**

Q2) a) When do two spaces X and Y said to have the same homotopy type? **[4]**

b) Prove that the relation of being of the same homotopy type is an equivalence relation. **[6]**

c) If X and Y are homeomorphic, prove that they have the same homotopy type, Is the converse true? **[6]**

Q3) a) Prove that S' is not a retract of B^2. **[6]**

b) Prove that $\Pi_1(R^n, 0)$ is a singleton group. **[6]**

c) Calculate $\Pi_1(S' \times R, ((1,0),0))$. **[4]**

Q4) a) If f is any closed path at x_0, and g is the constant path at x_0, prove that f * g is equivalent to f. **[6]**

b) Define the fundamental group $\Pi_1(X, x_0)$. What is the identity element? **[4]**

c) Prove that $\Pi_1(X \times Y, (x_0, y_0)) \cong \Pi_1(X, x_0) \times \Pi_1(Y, y_0)$ **[6]**

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Q5) a) Define a covering space. **[4]**

b) Prove that $P : R \to S'$, $P(t) = e^{2\pi it}$ is a covering map. **[6]**

c) Prove that every covering map is open. **[6]**

Q6) a) When does a map $P : E \to B$ have the homotopy lifting property? **[6]**

b) Let $P : \tilde{X} \to X$ be a covering map and $f_1, f_2 : Y \to \tilde{X}$ be two liftings of $f : Y \to X$. If Y is connected, and there exists $y_0 \in Y$, with $f_1(y_0) = f_2(y_0)$, prove that $f_1 = f_2$, **[10]**

Q7) a) When is a set S of P + 1 points is R^n said to be geometrically independent? **[6]**

b) Give an example of four points S in R^3 that are geometrically independent. For this example, find **[10]**

i) $\Pi(s)$, the corresponding 3 dimensional hyperplane and

ii) the open geometric 3 simplex corresponding to S.

Q8) a) When does a space X have the fixed point property? **[4]**

b) Prove that X = [0, 1] has the fixed point property. **[6]**

c) If $f : X \to Y$ is a homeomorphism, and X has the fixed point property, prove that Y has the fixed point property. **[6]**

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Total No. of Questions : 8] **SEAT No. :**

P2154 **[Total No. of Pages : 2**

[4721] - 45
M.A./M.Sc. (Semester - IV)
MATHEMATICS
MT - 805 : LATTICE Theory
(2008 Pattern)

)Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any Five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Let $\mathbb{N}_0$ be the set of all non-negative integers. Define $m \leq n$ if there exists $k \in \mathbb{N}_0$ such that $n = km$. Prove that $\mathbb{N}_0$ is a lattice under this relation. **[6]**

b) Prove that the set $Con(L)$ of all congruence relations on a lattice L forms a lattice. **[5]**

c) Define the concept of lattice homomorphism. Prove that every homomorphism is an isotone map. Is the converse true? Justify your answer. **[5]**

Q2) a) Prove that a lattice L is distributive if and only if for any two ideals I, J of $L, I \vee J = \{i \vee j \mid i \in I, j \in J\}$. **[6]**

b) Let L be a pseudocomplemented lattice. Assume that $S(L) = \{a^* \mid a \in L\}$ is a bounded lattice. Prove that $S(L)$ is distributive. **[5]**

c) Show that the following inequalities hold in any lattice **[5]**

i) $(x \wedge y) \vee (x \wedge z) \leq x \wedge (y \vee z)$;

ii) $(x \wedge y) \vee (x \wedge z) \leq x \wedge (y \vee (x \wedge z))$.

Q3) a) Prove that in a distributive lattice L, the element $a \neq 0$ is join-irreducible if and only if $L - [a)$ is a prime ideal. **[6]**

b) Prove that every prime ideal of a Boolean lattice is maximal. **[5]**

c) Prove that every modular lattice satisfies the upper and the lower covering conditions. **[5]**

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Q4) a) Let P be a prime ideal of a lattice L. Prove that P is a meet-irreducible element of the ideal lattice $Id(L)$ but not conversely. **[6]**

b) Let L be a pseudocomplemented lattice. Show that $a^{\perp} = \{x \in L \mid x \wedge a = 0\}$ is an ideal of L. **[5]**

c) Prove that a maximal ideal of a distributive lattice is prime but not conversely. **[5]**

Q5) a) Prove that a lattice is modular if and only if it does not contain a sublattice isomorphic to N_5. **[8]**

b) Prove that for a pseudocomplemented lattice L, the set $S(L) = \{a^* \mid a \in L\}$ is a lattice. **[4]**

c) Let I and J be ideals of a distributive lattice L. If $I \wedge J$ and $I \vee J$ are principal ideals then prove that I and J are also principal ideals. **[4]**

Q6) a) Prove that every finite distributive lattice is isomorphic to ring of sets. **[8]**

b) Let L be a distributive lattice with 0. Prove that $Id(L)$, the ideal lattice of L is pseudocomplemented. **[4]**

c) Prove that $Id(L)$, the set of all ideals of a lattice L, is a lattice. Is $Id(L)$ a complete lattice? Justify your answer. **[4]**

Q7) a) State and prove Stone's Theorem for distributive lattices. **[8]**

b) State and prove Nachbin theorem. **[8]**

Q8) a) State and prove Jordan-Hölder Theorem for semimodular lattices. **[7]**

b) State and prove Fixed-Point Theorem for complete lattices. **[5]**

c) Prove that in a distributive lattice, the ideal generated by a dual atom is prime. **[4]**

Total No. of Questions : 8]

SEAT No. :

P3035

[Total No. of Pages :3

[4722] - 1001
M.Sc. (Physics)
PHY UT 501: CLASSICAL MECHANICS
(2014 Pattern Credit system) (4-Credits) (Semester - I)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answer any five questions out of eight questions.***
2) ***Neat labelled diagram must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of calculator is allowed.***

Q1) a) Find the horizontal component of the coriolis force acting on a body of mass 1.5kg moving with a horizontal velocity 100m/sec at 30ºN latitude on earth. **[4]**

b) Show that the transformation **[3]**

$Q = 1/p$ and $P = qp^2$ is canonical

c) Obtain the Lagrangian and equation of motion for a simple Pendulum. **[3]**

Q2) a) Write the coriolis force for. **[4]**

i) River flow on the surface of the earth

ii) Formation of Cyclones

b) Write the type of constraints for **[3]**

i) Gas filled hollow sphere

ii) Pendulum with variable length

c) Using Poisson's Bracket, prove that **[3]**

$[L_x, p_y] = p_z$

P.T.O.

Q3) a) A bead of mass 'm' slides on a smooth uniform circular wire of radius 'r' which is rotating with a constant angular velocity 'w' about a fixed vertical diameter. set up the Lagrangian and find the equation of motion of the bead. **[4]**

b) Using Variational principle, show that the shortest distance between two point in a plane is a straight line. **[3]**

c) Define: **[3]**

i) Configuration space

ii) Phase space

iii) State space

Q4) a) Describe the Hamiltonian and Hamilton's equation for an ideal spring mass arrangement. **[4]**

b) The eccentricity of the earth's orbit is 0.0167. Calculate the ratio of maximum and minimum speed of the earth in its orbit. **[3]**

c) If $[\phi,\psi]$ be the poisson bracket, then prove that

$$\frac{\partial}{\partial t}[\phi,\psi]=\left[\frac{\partial\phi}{\partial t},\psi\right]+\left[\phi,\frac{\partial\psi}{\partial t}\right].$$ **[3]**

Q5) a) Show that the transformation defined by $q=\sqrt{2p}\cdot\sin\phi$ and $p=\sqrt{2p}\cdot\cos\phi$ is a canonical. **[4]**

b) Explain **[3]**

i) Geosynchronous orbit

ii) Geostationary orbit

c) State and prove Virial theorem. **[3]**

Q6) a) Show that the transformation **[4]**

$Q = \left(e^{-2q} - p^2\right)^{1/2}$ and $P = \cos^{-1}\left(p \cdot e^{q}\right)$ is a canonical.

b) Calculate the reduced mass of HCl. Given AMV for hydrogen and clorine are 1 & 35.5 respectively. **[3]**

c) Show that, A function whose Poisson bractet with Hamiltonian vanishes is a contant of motion. **[3]**

Q7) a) Derive equation of motion for a particle moving under central force. What is the form of the equation, when the particle is moving under an attractive inverse square law force $\left(F = -\frac{k}{r^2}\right)$. **[5]**

b) Find the equation to the curve passing through two fixed points such that the area of the surface obtained by revolving the curve about y-axis is minimum. **[5]**

Q8) a) Show that, invariance of Lagranges equation under Galilean transformation. **[5]**

b) Describe the Hamiltonian and Hamilton's equation of motion for charged particle in an electromagnetic field. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P3036

[Total No. of Pages :3

[4722] - 1002
M.Sc.
PHYSICS
PHY UT - 502 : Electronics
(4-Credit Based - 2014 Pattern) (Semester - I)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Solve any FIVE questions out of the EIGHT questions.***
2) ***Neat diagram must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of calculator is allowed.***

Q1) a) Explain how the timer IC 555 can be operated as an Astable multivibrator, using timing diagrams. **[4]**

b) Explain using neat circuit diagram and waveforms, the application of timer IC 555 as Monostable multivibrator. **[3]**

c) Give the internal block diagram of a 3pin voltage regulator and explain its working. **[3]**

Q2) a) Give circuit diagram of R-2R ladder type converter. Discuss the advantages and disadvantages of R-2R type converter. **[4]**

b) What is foldback current limit? Draw the circuit diagram of foldback power supply using IC 723. Explain its operation. **[3]**

c) Place on the truth table and map the function. **[3]**

$$R = \overline{A}\,\overline{B}\,\overline{C}\,D + A\,\overline{B}\,C\,\overline{D} + \overline{A}\,\overline{B}\,C\,\overline{D}$$

Q3) a) A counter type A/D converter uses 6-bit binary counter and 1MHz clock. Calculate the time required for the conversion of an analogue input voltage for which the binary number is 001101. **[4]**

b) Give the circuit diagram for Triangular wave generator using OPAMPs and explain its operation. **[3]**

P.T.O.

c) What output voltage would be produced by a D/A converter whose output range is 0 to 10V and whose input number is **[3]**

i) 100 (for a 2 bit DAC)

ii) 0111 (for a 4 bit DAC)

iii) 10011100 (for 8 bit DAC)

Q4) a) Why does an analogue to digital converter require some minimum conversion time. Discuss the working of a successive approximation type ADC and explain how the speed of conversion is maximum in this case. **[4]**

b) What is up and down counter? Explain the working of a 3-bit down counter with the help of a time diagram. **[3]**

c) State the various laws of Boolean Algebra. Explain what do you mean by Associative and distributive law. Is NAND operation a associative or not? Alternately, if $X = (\overline{AB})C$ and $Y = A(\overline{BC})$, is X = Y. **[3]**

Q5) a) Explain with a neat diagram the working of a BCD counter. **[4]**

b) What is the use of PRE or CLR lead of a FF in a counter circuit? **[3]**

c) Give only circuits for MOD-2, MOD-6 and MOD-8 operation using IC 7490. **[3]**

Q6) a) Draw a neat circuit diagram of a complete voltage regulated power supply using discrete components. Explain the role of each block. **[4]**

b) What is the function of A/D converter? Where it can be used? **[3]**

c) What are different applications of counters. **[3]**

Q7) a) Design Astable multivibrator using IC 741 for the following specifications.

$V_{CC} = \pm 15V$, $V_o = 12V$, and $f_o = 5KHz$.

Also give its output waveforms. **[5]**

b) Calculate output frequency f_o, lock in range Δf_L, capture frequency range Δf_c of IC 565 PLL, if $R_T = 100K\Omega$, $C_T = 0.1\,\mu F$ and C= 10 PF. **[5]**

Q8) a) Design a series voltage regulator using discrete components for the following specifications. **[5]**

$V_{in} = 20V$, $V_o = 10V$ and $I_L = 1A$.

b) Design voltage controlled oscillator (VCO) using IC 566 for the following specifications.

$V_{CC} = 12V$, $V_o = 10V$, $f_o = 100KHz$ **[5]**

Total No. of Questions : 8]

SEAT No. :

P3037

[Total No. of Pages : 3

[4722] - 1003
M.Sc.
PHYSICS
PHY UT-503: Mathematical Methods in Physics
(2014: 4 Credit Based System Pattern) (Semester - I)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt ANY FIVE questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table and calculator is allowed.***

Q1) a) Define Vector space and subspace. **[4]**

b) Find Laplace transform of $\cos(\omega t)$. **[3]**

c) Obtain the Associated Legendre function $P_2^3(x)$. **[3]**

Q2) a) State and prove the Parseval's identity for Fourier series. **[4]**

b) Determine whether or not the following vectors in R^3 are linearly dependent: **[3]**

{(2, –3, 7), (0,0,0), (3,–1, –4)}.

c) Prove that: $H_n'(x) = 2n\, H_{n-1}(x)$. **[3]**

Q3) a) Verify that $\langle u, v \rangle = x_1y_1 - x_1y_2 - x_2y_1 + 3x_2y_2$, where $u = (x_1, x_2)$ and $v = (y_1, y_2)$ is an inner product in R^2. **[4]**

b) For what value of k is (1,k,5) a linear combination of $u = (1, -3,2)$ and $v = (2, -1, 1)$. **[3]**

c) What is half way Fourier sine and half way Fourier cosine series? **[3]**

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Q4) a) Diagonalize the following matrix: $A = \begin{pmatrix} 1 & 4 \\ 2 & 3 \end{pmatrix}$. **[4]**

b) Let $V = R^3$. Show that W is a subspace of V, where

$W = \{(a,b,0) / a,b \in R\}$. **[3]**

c) Prove that: $J_{n+1}(x) = \frac{2n}{x} J_n(x) - J_{n-1}(x)$. **[3]**

Q5) a) Using the generating function for Legendre polynomials determine $P_0(x)$, $P_1(x)$ and $P_2(x)$. **[4]**

b) Prove that the Inverse Laplace transform operator L^{-1} is linear. **[3]**

c) Write the vector $V = (1, -2, 5)$ as a linear combination of the vectors

$e_1 = (1,1,1)$, $e_2 = (1,2,3)$ and $e_3 = (2, -1, 1)$. **[3]**

Q6) a) Expand $f(x) = x^2, 0 < x < 2\pi$ in a Fourier series if the period is 2π. **[4]**

b) Determine the Laguerre polynomials $L_0(x)$ and $L_1(x)$ using Rodrigue's formula. **[3]**

c) Discuss whether or not R^2 is a subspace of R^3. **[3]**

Q7) a) Let $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ and let T be the linear operator on R^2 defined by $T(V) = AV$ (where V is written as a column vector). Find the matrix of T in each of the following bases: **[5]**

i) $\{e_1 = (1,0), e_2 = (0,1)\}$, i.e. usual basis;

ii) $\{f_1 = (1,3), f_2 = (2,5)\}$.

b) State and Prove the orthogonality property of Legendre polynomials. **[5]**

Q8) a) Using the Fourier integral theorem, show that $\int_0^\infty \frac{\cos \alpha x}{\alpha^2 + 1} d\alpha = \frac{\pi}{2} e^{-x}$, $x \geq 0$.

Hint: Use the integration

$$\int_0^\infty e^{-u} \cos \alpha u \, d\alpha = \frac{1}{\alpha^2 + 1}.$$ **[5]**

b) Consider the following basis of Euclidean space R^3:

$\{v_1 = (1,1,1), v_2 = (0,1,1), v_3 = (0,0,1)\}$

Using the Gram-Schmidt orthogonalization process, transform $\{v_i\}$ into an orthonormal basis $\{u_i\}$. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P3038

[Total No. of Pages : 2

[4722] - 1004
M.Sc.
PHYSICS
PHYUT - 504 :Atoms and Molecules
(2013 - Pattern - 4 Credits) (Semester - I)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Solve any five questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table and electronic pocket calculator is allowed.***

Given:

Rest mass of electron	=	$9.901 \times 10^{-31} kg$
Charge on electron	=	1.6021×10^{-19} Coulomb
Plank's constant	=	6.626×10^{-34} Js
Boltzman constant	=	$1.38054 \times 10^{-23} Jk^{-1}$
Avogadro's number	=	9.27×10^{-24} amp.m^2
1 eV	=	$1.6021 \times 10^{-19} J$

Q1) a) Explain Normal Zeeman effect. Hence derive the necessary formula for shift in wavelength d λ. **[4]**

b) List the four quantum numbers, their allowed values and functions of each. **[3]**

c) The band origin of a transition in C_2 is observed at 19,378 cm^{-1} while the rotational fine structure indicates that the rotational constants in excited and ground states are respectively B' = 1.7527 cm^{-1} & B'' = 1.6326 cm^{-1}. Estimate the position of the band head. **[3]**

Q2) a) Derive the expression for geometrical structure factor for a bcc structure. **[4]**

b) What are the different types of coupling schemes. Explain any one in details. **[3]**

c) When Hg vapour in a discharge tube is exposed to a magnetic field 5Wb/m^2, the line of wavelength $\lambda = 4226.75 A^{\circ}$ exhibits normal Zeeman splitting. Calculate wavelength of three components of normal Zeeman pattern. **[3]**

P.T.O.

Q3) a) What does the term resonance means in NMR? Obtain the resonance condition for NMR? **[4]**

b) State and explain Frank-Condon Principle. **[3]**

c) Determine Lande of factor for $^3D_{5/2}$ state. **[3]**

Q4) a) Explain Debye model of lattice heat capacity. **[4]**

b) Write note on vibration coarse structure. **[3]**

c) The ground state of chlorine is $^2P_{3/2}$. Find magnetic moment of chlorine. **[3]**

Q5) a) Discuss the vibrational modes of 1-D monoatomic lattice of identical atoms. Hence derive the dispersion relation. **[4]**

b) Explain the experimental arrangement to study the Zeeman effect. **[3]**

c) The vibrational structure of the absorption spectrum of O_2 becomes a continuum at 56876 cm^{-1}. If the upper electronic state dissociates into one ground state atom and one excited state atom with excitation energy 15875cm^{-1}. Estimate the dissociation energy of the ground state of O_2 in cm^{-1}. **[3]**

Q6) a) Draw block diagram of X-band ESR spectrometer and state its basic requirements. **[4]**

b) What is Normal and Umklapp process. **[3]**

c) On the basis of Laue diffraction theory obtain the condition for diffraction maxima. **[3]**

Q7) a) Explain band origin and band head in relation to rotational fine structure of electronic vibrational spectra. **[5]**

b) Derive the dispersion relation for a linear diatomic lattice and explain origin of optical mode and acoustic mode. **[5]**

Q8) a) Define atomic scattering factor and show that its maximum value is equal to the atomic number Z of the atom. **[5]**

b) Explain Paschen Back effect for 2s-2p transition. **[5]**

Total No. of Questions : 8]

SEAT No. :

P3039

[Total No. of Pages :3

[4722] - 1005
M.Sc.
PHYSICS
PHY- UT 505: Experimental Techniques in Physics - I
(CBS 2013 Pattern 4-Credits) (Semester - I)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions out of eight questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables and pocket calculators is allowed.***

Q1) a) Explain auto and cross signal processing. **[4]**

b) Differentiate the term: viscous flow and molecular flow. **[3]**

c) Write two different principles to reduce the pressure. **[3]**

Q2) a) From the kinetic theory of genes, prove Charle's law. **[4]**

b) Draw neat diagrams explaining the operation of rotary pump. **[3]**

c) A refrigeration system using Freon exhibits refrigerant loss of 1gm of Freon per year at 25ºC. How large is the leak gas flow Q_L? **[3]**

(Given: Gas constant R = 83.14 mbar. lit/mol.K, M_{Freon} = 121 g/mole).

Q3) a) Write the pressure ranges of the following vacuum pumps in Torr: **[4]**

i) Rotary

ii) Diffusion

iii) Sputter ion

iv) Molecular drag

b) Write the advantages of thermocouple gauge. **[3]**

P.T.O.

c) Name and represent graphically the following type of signals **[3]**

i) the output signal from the thermostat on a refrigerator

ii) the electrical signal to spark plug in a car engine

iii) a pure musical tone

Q4) a) Fill the following table **[4]**

Pressure range (Torr)	Guage used
1. $1\text{-}10^{-3}$	
2. $10^{-2}\text{-}10^{-5}$	
3. $10^{-3}\text{-}10^{-7}$	
4. $10^{-3}\text{-}10^{-10}$	

b) Describe the various types of errors in brief. **[3]**

c) The diffusion pump has intake port diameter 5cm and its speed in 60lit/sec. It is connected to a chamber by a tube having a speed 56.5 lit/sec. Calculate an effective pump speed. **[3]**

Q5) a) Determine the average value for the function $y(t) = 30 + 2\sin 6\pi t$ over the time period 0 to 0.1s. **[4]**

b) Define the terms: throuput, impedance of a vacuum line and conductance of a vacuum line. **[3]**

c) Write the principle of sputter ion pump. **[3]**

Q6) a) What is throttling process? Prove that entropy remains constant in a throttling process. **[4]**

b) With the help of neat diagram describe the construction of molecular drag pump. **[3]**

c) Calculate pump down time to reduce the pressure 380 Torr to 10^{-2} Torr if volume of chamber is 20 lit and pump speed is 40 lit/min. **[3]**

Q7) a) With the help of neat diagram explain the construction of optical tweezers. **[5]**

b) Derive an expression for pump down time. **[5]**

Q8) a) With the help of schematic describe the construction and working of diffusion pump. **[5]**

b) With the help of neat diagram write the construction and working of Bayard-Alpert gauge. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P3027

[Total No. of Pages :2

[4722] - 101
M.Sc. (Physics)
PHY UT 501: CLASSICAL MECHANICS
(2013 Pattern) (Semester - I) (Credit system) (5-Credits)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions out of eight questions.***
2) ***Draw neat diagram wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables and electronic calculator is allowed.***

Q1) a) Show that invariance of Lagrange's equations under Galilean transformation. **[4]**

b) The eccentricity of the earth's orbit is 0.0167. Calculate the ratio of maximum and minimum speeds of the earth in its orbit. **[3]**

c) Prove the distributive law [F, G+K] = [F,G] + [F,K] for Poisson's bracket. **[3]**

Q2) a) Show that the shortest distance between two points in a plane is a straight line. **[4]**

b) What are generalised coordinates? Write generalised coordinates for Fly wheel. **[3]**

c) Show that the function $F = -\sum \phi p$ generates the identify transformation. **[3]**

Q3) a) Obtain equation of motion for Focault's pendulum. **[4]**

b) Prove the identify $[F_1 + F_2, G] = [F_1,G] + [F_2,G]$. **[3]**

c) Show that if a given coordinate is cyclic in Lagrangian, it will also be cyclic in Hamiltonian. **[3]**

P.T.O.

Q4) a) State Liouville's theorem for first and second part. **[4]**

b) State Hamilton's variational principle. Deduce the modified Hamilton's principle. **[3]**

c) Show that transformation defined by $q = \sqrt{2p}\sin\phi$, $p = \sqrt{2p}\cos\phi$ is canonical by using Poisson's bracket. **[3]**

Q5) a) Show that Poisson bracket of two constant of motion is a constant of motion. **[4]**

b) Set up Hamiltonian and obtain equation of motion for simple harmonic oscillator. **[3]**

c) Using Poisson Bracket, prove that $[L_x, L_y] = L_z$. **[3]**

Q6) a) A particle of mass m is attracted towards a given point by a force of the form k/r^2, where k is a constant. Write down the expression for the Hamiltonian of the system and derive Hamilton's equation of motion. **[4]**

b) Write the type of constraint for **[3]**

i) Simple pendulum with rigid support

ii) Deformable bodies

c) Obtain the Lagrangian and equation of motion for Atwood's machine. **[3]**

Q7) a) Find the central force under the action of which a particle will follow an orbit described by $r = a(1+\cos\theta)$. **[5]**

b) Discuss the effect of coriolis force on **[5]**

i) Flow of river

ii) Cyclones

Q8) a) Using Variational principle, explain Brachistochrone problem. **[5]**

b) Obtain the equation of motion of a particle in space by Lagrangian method in cartesian coordinates. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P3028

[Total No. of Pages :3

[4722] - 102
M.Sc.
PHYSICS
PHY UT - 502 : Electronics
(5-Credit Based System) (2013 Pattern) (Semester - I)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Solve any FIVE questions out of the following EIGHT questions.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicates full marks.***
4) ***Use of calculator is allowed.***

Q1) a) Explain how the timer IC 555 can be operated as an Astable multivibrator using timing diagrams. **[4]**

b) Give circuit diagram for R-2R ladder type converter. Discuss the advantages and disadvantages of R-2R type converter. **[3]**

c) What is foldback current limit? Draw the circuit diagram of foldback power supply using IC 723. Explain its operation. **[3]**

Q2) a) Draw a neat circuit diagram of IC 555 Monostable multivibrator and explain its operation with waveforms. **[4]**

b) Place on the truth table and map the function. **[3]**

$$R = \overline{A}\,\overline{B}\,\overline{C}\,D + A\,\overline{B}\,C\,\overline{D} + A\,\overline{B}\,\overline{C}\,\overline{D}$$

c) Explain with the internal block diagram of a 3-pin fixed voltage regulator. **[3]**

Q3) a) Give the circuit diagram of square wave generator using an OPAMPs and explain its operation. **[4]**

b) A dual slope converter uses a five bit counter and a clock generator of frequency 100KHz. Calculate the time required for the A/D conversion for analogue input producing a binary output of 01000. **[3]**

P.T.O.

c) What output voltage would be produced by a D/A converter whose output range is 0 to 10V and whose input number is **[3]**

i) 100 (for a 3-bit D/A converter)

ii) 0111 (for a 4-bit DAC) and

iii) 10011100 (for 8 bit DAC)

Q4) a) Draw a circuit diagram of foldback current limiting power supply using IC 723 and explain its working. **[4]**

b) What are applications of up and down counter? Explain the working of a 3-bit down counter with the help of a time diagram. **[3]**

c) State the various laws of Boolean Algebra. Explain what do you mean by Associative and distributive law. Is NAND operation a associative or not?

Alternately, if $X = (\overline{AB})C$ and $Y = A(\overline{BC})$, is $X = Y$ or $X = \overline{Y}$. **[3]**

Q5) a) Explain with a neat diagram the working of a 4-bit decade counter. **[4]**

b) What is the use of a PRE or CLR lead of a FF in a counter circuit? Where it can be used? **[3]**

c) Give only circuits for MOD-2, MOD-6 and MOD-7 operation. **[3]**

Q6) a) Draw a neat circuit diagram of voltage regulated power supply using discrete components. Explain the role of each block. Why do you need pre-regulator circuit. **[4]**

b) What is the function of A/D converter and D/A converter? Where it can be used. **[3]**

c) What are different applications of counters? Specify the fields of applications. **[3]**

Q7) a) Design Monostable multivibrator using IC 741. Use the following specifications.

$V_{CC} = \pm 15V$, $V_o = 12V$, $T = 1\,\mu s$.

Also give it output waveforms. **[5]**

b) Calculate output frequency f_0, lock range Δf_L and capture frequency range Δf_c of IC 565 PLL, if $R_T = 100K\,\Omega$, $C_T = 0.1\,\mu F$ and C = 10 pF. **[5]**

Q8) a) Design a series voltage regulator using discrete components for the following specifications. **[5]**

$V_{in} = 25V$, $V_o = 10V$ and $I_L = 1A$.

b) Design voltage controlled oscillator (VCO) using IC 566 for the following specifications

$V_{CC} = 10V$, $V_o = 10V$, $f_o = 200KHz$ **[5]**

Total No. of Questions : 8]

SEAT No. :

P3029

[Total No. of Pages : 3

[4722] - 103
M.Sc. (Physics)
PHY UT-503: MATHEMATICAL METHODS IN PHYSICS
(2013 Pattern) (5 Credit Based System) (Semester - I)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt ANY FIVE questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables and calculator is allowed.***

Q1) a) State any prove Cauchy's integral formula. **[4]**

b) If $f(z) = \overline{z}$. Show that *f*(*z*) is not an analytic function of *z*. **[3]**

c) Draw the region representing $|z| < 1$ in *z*-plane. **[3]**

Q2) a) Show that {(1,1,1), (1,1,0), (1,0,0)} is an independent basis of R^3 and determine the coordinates of *v* = (4,3,–2) w.r.t. this basis. **[4]**

b) Define subspace W of a vector space V. **[3]**

c) Let $V \equiv R^3$ show that W is a subspace of V where

W = {(*a*, *b*, *c*): *a* + *b*+ *c* = 0}. **[3]**

Q3) a) Define: **[4]**

i) adjoint of an operator

ii) self adjoint operator.

Consider a self-adjoint operator opering on eigenvector *v* such that $Tv = \lambda v$. Show that the eigenvalue λ is real.

P.T.O.

b) Define **[3]**

i) Inner product space

ii) $\|v\|$ if v is a vector in Inner product space.

c) Find whether the following set of vectors are dependent or independent in R^2. **[3]**

i) {(1,1), (2,5)}

ii) {(1,0), (2,3), (7,5)}.

Q4) a) State and prove Parseval's identity. **[4]**

b) Write the Dirichlet conditions that the function $f(x)$ should satisfy in order to expand in terms of Fourier series. **[3]**

c) Show that $\mathcal{L}\{F(at)\} = \frac{1}{a} f\left(\frac{s}{a}\right)$. **[3]**

Q5) a) Write the generating function for Hermite polynomial and prove the recurrence relations **[4]**

$$H_{n+1}(x) = 2x\, H_n(x) - 2n\, H_{n-1}(x)$$

$$H_n'(x) = 2n\, H_{n-1}(x)$$

b) Find Fourier series expansion for the function

$f(x) = x^2 \quad -\pi < x < \pi$. **[3]**

c) The Rodrigue's formula for Laquerre functions is

$L_n(x) = \frac{e^x}{n!}\frac{d^n}{dx^n}\left(x^n e^{-x}\right)$ for integral n generate $L_0(x), L_1(x), L_2(x)$. **[3]**

Q6) a) Prove the orthogonality integral $\int_{-1}^{1} p_n(x)\ p_m(x)dx = 0$ for $n \neq m$. **[4]**

b) If T^+ is an adjoint of operator T. Show that $(T_1T_2)^+ = T_2^+\ T_1^+$. **[3]**

c) Find the Laplace transform of $\mathcal{L}\{e^{-4t} \cdot \cosh 2t\}$ **[3]**

Q7) a) Let W be the subspace of R^4 generated by {(1, –2, 5,–3), (2,3,1,–4) and (3,8,–3,–5)}. Find the basis and dimensions of W. Expand basis of W to be the basis of R^4. **[5]**

b) Find the eigenvalues and the orthonormal eigenvectors of the matrix

$$\begin{pmatrix} 1 & 2 & 0 \\ 2 & 1 & -6 \\ 2 & -2 & 3 \end{pmatrix}.$$ **[5]**

Q8) a) State and prove Taylor Theorem. **[5]**

b) The generating function for Bessel's f^n. is $e^{x/2\left(t-\frac{1}{t}\right)} = \sum_n J_n(x)\, t^n$.

Prove the two recurrence relations using this generating function. Hence prove $\frac{d}{dx}\left[x^n J_n(x)\right] = x^n J_{n-1}(x)$. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P3030

[Total No. of Pages : 2

[4722] - 104
M.Sc.
PHYSICS
PHYUT - 504 :Atoms Molecules and Lasers
(2013 Pattern - 5 Credits) (Semester - I)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Solve any five questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table and electronic pocket calculator is allowed.***

Given:

Rest mass of electron	=	$9.901 \times 10^{-31} kg$
Charge on electron	=	1.6021×10^{-19} Coulomb
Plank's constant	=	6.626×10^{-34} Js
Boltzman constant	=	$1.38054 \times 10^{-23} Jk^{-1}$
Avogadro's number	=	9.27×10^{-24} amp.m^2
1 eV	=	$1.6021 \times 10^{-19} J$

Q1) a) What is NMR? Draw block diagram of NMR and explain its working. **[4]**

b) State Pauli's exclusion principle. What is Hund's Rule? **[3]**

c) Calculate ratio of spontaneous emission to stimulated emission if wavelength of radiation is 550nm at 2000K. **[3]**

Q2) a) Discuss the construction and working of CO_2 laser. **[4]**

b) Explain the information derived from vibrational analysis of electronic vibrational spectra. **[3]**

c) What is Lande of factor? Calculate of factor for $^3D_3$ State. **[3]**

Q3) a) Calculate Zeeman shift observed in normal Zeeman effect when a spectral line of wavelength 600 A° is subjected to magnetic field 0.4 wb/m^2. **[4]**

b) What is holography? How it differce from photography. **[3]**

c) Write short note on vibrational coarse structure. **[3]**

P.T.O.

Q4) a) State and explain Frank-Condon principle. **[4]**

b) Define gyromagnetic ratio. State the relation connecting $\bar{\mu}_5$ and $\bar{S}$ of an electron. **[3]**

c) What is nuclear g_N factor for 19_F nucleus which has a magnetic moment of 2.6273 μ_N. Nuclear spin quantum number $I = 1/2$. **[3]**

Q5) a) What are industrial applications of Laser. **[4]**

b) State the atomic quantum numbers, their allowed values and functions. **[3]**

c) A gas laser is generating a beam of 3mW power. Calculate the number of photons emitted by the laser (λ = 670 nm) **[3]**

Q6) a) What is ESR? What are basic requirements of ESR spectrometer? Draw its block diagram. **[4]**

b) Show that the threshold condition for lasing is **[3]**

$$\gamma_{th} = \alpha_s + \frac{1}{2L} \ln \frac{1}{r_1 r_2}$$

c) Find the possible number of terms for 'pd' electron configuration using L-S coupling scheme. **[3]**

Q7) a) Discuss rotational fine structure of electronic vibrational transitions. **[5]**

b) Differentiate between spatial and temporal coherence. **[5]**

Q8) a) What is Zeeman effect? Explain Normal Zeeman effect. **[5]**

b) The values of $\bar{\nu}_e$ and x_e for lower and upper states of CO are Z, 170.21 cm^{-1}, 0.0062 and 1,515.61 cm^{-1}, 0.0114 respectively. The (0, 0) transition is observed at 64746.55 cm^{-1}, calculate the energy difference of the two electronic states. **[5]**

Total No. of Questions : 7]

SEAT No. :

P3017

[Total No. of Pages :4

[4722] - 11
M.Sc.
PHYSICS
PHYUTN-501: Classical Mechanics
(2008 Pattern) (Semester - I)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Question No. 1 is compulsory and solve any Four questions from remaining.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of calculator is allowed.***

Q1) Attempt any four of the following.

a) Two particles are connected by a rod of variable length L = f(t). What is the nature of constraint? **[4]**

b) Explain the terms- Configuration space, phase space and state space and draw phase space diagram for one dimensional harmonic oscillator. **[4]**

c) Prove that generating function $F = \sum q_i p_i$, generates identity transformation. **[4]**

d) If condenser is charged to 'q' coulomb and current through circuit is 'i' ampere, find Lagrange's equation of motion for an electrical circuit comprising of an inductance L and capacitance C. **[4]**

e) Use variational principle to prove that shortest distance between two points in a plane is straight line. **[4]**

f) Using Poisson bracket, show that the transformation **[4]**

$$Q = \left(e^{-2q} - p^2\right)^{1/2}$$

$$P = \cos^{-1}\left(pe^{q}\right)$$

is canonical.

P.T.O.

Q2) a) A Particle describes circular orbit given by $r = 2a \cos\theta$ under the influence of an attractive central force directed towards a point on the circle, show that the force varies as the inverse of fifth power of distance. **[8]**

b) Evaluate the Poisson brackets **[8]**

i) $[L_x, x]$

ii) $[L_x, P_x]$

Q3) a) Obtain Lagrange's equations of motion for a particle of mass m falling freely under gravity near the surface of the earth. **[8]**

b) Apply variational principle to find the equation of motion of one dimensional oscillator. **[4]**

c) Two heavy particles of weights W_1 and W_2 are connected by light inextensible string and hang over a fixed smooth circular cylinder of radius R with horizontal axis. Find the condition for equilibrium of system by applying principle of virtual work. **[4]**

Q4) a) Write Lagrangian and Lagrange's equations of motion for compound Pendulum. **[8]**

b) Show that for relativistic free particle, Hamiltonian is expressed as

$$H = \sqrt{p^2c^2 + m_0^2c^4} + V(r)$$ **[8]**

Q5) a) What do you mean by pseudo force? Obtain an expression for coriolis acceleration for rotating co-ordinate system. **[8]**

b) A bullet is fired horizontally in the north direction with a velocity of 500m/s, at 30°N lattitude. Calculate the horizontal component of coriolis acceleration and the consequent deflection of the bullet as it hits a target 250m away. Also determine the vertical displacement of the bullet due to gravity. If mass of bullet is 10gm, find coriolis force. **[8]**

Q6) a) Find equation of motion of pendulum bob suspended by a spring allowed to swing in vertical plane. **[8]**

b) For a certain canonical transformation it is known that **[8]**

$$Q = \sqrt{(q^2 + p^2)}$$

$$F = \frac{1}{2}(q^2 + p^2)\tan^{-1}\frac{q}{p} + \frac{1}{2}qp$$

find P(q, p) and F(q, Q).

Q7) a) The system S' is rotating relative to system S having same origin and assumed to be fixed in space. The angular velocityof frame S' relative to S is $\bar{\omega} = 2t\hat{i}' + t^2\hat{j}' + 8\hat{k}'$, where 't' is time.

The position vector of the particle at instant *t* relative to frame S' is,

$r = t^2\hat{i}' - 6t\hat{j}' - 4t^3\hat{k}'$. **[8]**

Find

i) apparent velocity

ii) True velocity

iii) Coriolis acceleration at t = 1

b) Explain geosynchronous and geostationary orbits. State the uses of artificial satellites. **[4]**

c) A Particle of mass m moves on a plane in the field of force (in polar coordinates) given by **[4]**

$F = -kr \cos\theta \hat{r}$

where k -is constant and, $\hat{r}$ -is the radial unit vector.

i) Justify whether angular momentum of particle about the origin be conserved.

ii) Obtain the differential equation of the orbit of the particle.

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Total No. of Questions : 7]

SEAT No. :

P3018

[Total No. of Pages :3

[4722] - 12
M.Sc.
PHYSICS
PHY UTN - 502 : Electronics
(2008 Pattern) (Semester - I)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Question No. 1 is compulsory. Attempt any FOUR questions from the remaining.***
2) ***Draw neat diagram wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table and Calculator is allowed.***

Q1) Attempt any four of the following:

a) Design first order low pass filter for higher cutoff frequency of 1 KHz. **[4]**

b) Design a divide by 12 counter using IC-7490. **[4]**

i) Using only $R_0(1)$ and $R_0(2)$ and

ii) Using only $R_g(1)$ and $R_g(2)$

c) State and define any parameters of OPAMP. Compare the ideal values and real values for IC 741. **[4]**

d) Explain the working of sample and Hold circuit using proper circuit diagram. How the aperature time and hold time is to be used in this circuit. **[4]**

e) Design of 1ms pulse width for Monostable multivibrator using IC 555. **[4]**

f) Explain the conversion time for the followingADCs. **[4]**

i) Dual slope

ii) Simultaneous type

iii) Counter type and

iv) Successive approximation type

g) Design a $\pm$ 5V regulated power supply using IC 7805. **[4]**

P.T.O.

Q2) a) Design a combinational logic circuit which multiplies 4-bit binary number by 2 by using K-map. **[8]**

b) Design decade counter using IC 7490. **[8]**

i) 4-bit binary counter and

ii) with symmetrical and asymmetrical output.

Q3) a) Derive an output relation for 4-bit Binary R-2R ladder DAC with the necessary circuit diagram. Explain its working. What are the limitations on number of bits used? **[8]**

b) Draw circuit diagram of an symmetrical square wave. Astable multivibrator using IC 741. Explain its operation. Design a circuit to generate a rectangular wave of 50% duty cycle with 10KHz output frequency. **[8]**

Q4) a) Write BCD to Gray code truth table simplify using K-map to convert BCD to Gray Code. Draw a necessary circuit diagram for the same. **[8]**

b) Explain the working of CVCC power supply with block diagram using two OPAMPS. Also give its characteristics. **[8]**

Q5) a) Give internal block diagram of IC 8038 in detail. and explain the working of it. Also design a circuit to generate a waveform of frequency 20KHz using single resistor R. **[8]**

b) Design 10V regulator output with current limit of 1Amp. using IC 723 and external current boost transistor. How $\pm$5V be obtained from single 10V regulated output? **[8]**

Q6) a) Give internal block diagram of 3-pin voltage regulator in detail. Explain function of each block. Design adjustable voltage regulator using LM317 to have an output voltage variable from 5 to 10V. **[8]**

b) Explain with block diagram the basic operating principle of a PLL IC 565. Define: **[8]**

i) Free running frequency

ii) Lock in range and

iii) Capture range

Discuss application of PLL as frequency division.

Q7) Write short notes on any <u>four</u> of the following: **[16]**

a) Tringular wave generator using two OPAMPs.

b) Monostable multivibrator using OPAMP.

c) Voltage controlled oscillator using IC 566.

d) One shot multivibrator using IC 74121.

e) Sample and Hold circuit.

f) Shift register IC 7495.

Total No. of Questions : 7]

SEAT No. :

P3019

[Total No. of Pages :3

[4722] - 13
M.Sc. (Physics)
PHY UTN - 503: MATHEMATICAL METHODS IN PHYSICS
(2008 Pattern) (Semester - I)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Question No.1 is compulsory. Attempt any four questions from the remaining.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables and pocket calculator is allowed.***

Q1) Attempt any four of the following. **[16]**

a) Show that $\mathcal{L}\{e^{at}F(t)\} = f(s-a)$.

b) Express $v = (1,-2,5) \in R^3$ as a linear combination of u_1 = (1,1,1), u_2 = (1,2,3) and u_3 = (2, –1,1).

c) Prove that $e^x(\cos y + i \sin y)$ is an analytic function.

d) Define Fourier sine and cosine transforms.

e) Define spherical Harmonic function $Y_l^m(\theta,\phi)$ and write othogonality condition for it.

f) Generate first two Legendre functions $P_0(x)$ & $P_1(x)$ using Rodrigue's formula.

Q2) a) Let D be the differential operator $D(f) = \frac{df}{dt}$. Find the matrix of D in the bases **[8]**

i) $\{e^t, e^{2t}, te^{2t}\}$

ii) $\{1, t, \sin 3t, \cos 3t\}$

P.T.O.

b) Let $u = (x_1, x_2)$ and $v = (y_1, y_2)$ in R^2 Verify that [8]

$\langle u, v \rangle = x_1 y_1 - x_1 y_2 - x_2 y_1 + 3 x_2 y_2$ is an inner product.

Q3)a) The generating function for Hermite polynomial is

$g(x,t) = e^{2xt - t^2} = \sum H_n t^n / n!$. Derive two recurrence relations. **[8]**

b) Find the eigenvalues and corresponding orthonormal eigenvectors of the

matrix $\begin{pmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{pmatrix}$. **[8]**

Q4) a) Using Residue theorem prove that

$$\int_0^{2\pi} \frac{d\theta}{2 + \cos\theta} = \frac{2\pi}{\sqrt{3}} \qquad \text{Take } |z| = 1 \text{ .}$$ **[8]**

b) What is meant by analytic function? Derive Cauchy-Reimann condition for a function of complex variables. **[8]**

Q5) a) Solve the differential equation using Laplace transform **[8]**

$$X''(t) + 4X'(t) + 4X(t) = 4e^{-2t} \quad X(0) = 2$$
$$X'(0) = 8$$

b) State and prove convolution theorem for Fourier transform. **[8]**

Q6) a) Show that for Hermitian operator the eigenvalues are real and the eigen vectors of non-degenerate eigenvalues are orthogonal. **[8]**

b) Prove the orthogonality for Legendre function **[8]**

$$\int_{-1}^{1} p_n(x)\, p_m(x)\, dx = \frac{2}{2n+1}\,\delta_{mn}$$

Q7) a) State and prove Taylor's theorem. **[4]**

b) Write the Dirichlet conditions the $f(x)$ should satisfy in order to expand in terms of Fourier series. **[4]**

c) Find whether the following set of vectors is dependent or independent in R^3. {(1,2,3), (4,1,0), (3,–1,–2), (0,0,1)}. **[4]**

d) If H is Hermitian operater. Show the e^{iH} is unitary and if e^{iH} is unitray, H is Hermitian. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P3020

[Total No. of Pages :2

[4722] - 14
M.Sc.
PHYSICS
PHYUTN - 504 : Quantum Mechanics - I
(2008 Pattern) (Semester - I)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Question No. 1 is compulsory. Attempt any four questions from the remaining.***
2) ***Draw neat diagrams whenever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table and calculator is allowed.***

Q1) Attempt any four of the following: **[16]**

a) Using uncertainty principle, estimate the size of the hydrogen atom in the ground state.

b) Using the ground state wave function of the simple harmonic oscillator, find $\langle x \rangle$ and $\langle x^2 \rangle$.

c) Show that $\left[\hat{X}, \hat{P}\right] = i\hbar$ in the momentum space representation.

d) Prove that L_+ is a raising angular momentum operator where $L_+ = L_x + iL_y$.

e) For j = 1, obtain the matrix J_y.

f) For any operator A, show that (AA^+) and $i(A+A^+)$ are Hermitian.

Q2) a) Using the operators S_+ and S_-. compute the matrices S_x and S_y; show that $S^2 = S_x^2 + S_y^2 + S_z^2$ is the digenalized in the basis of eigen vectors of S_Z. **[8]**

b) Consider a particle in one dimensional infinitely deep potential well, with the help of time independent schrodinger equation obtain the energy eigen values and eigen functions. **[8]**

P.T.O.

Q3) a) Write a note on Dirac's bra and ket vectors. How are the norm and scalar product represented in Dirac notation? **[8]**

b) Discuss four postulates of quantum mechanics. **[8]**

Q4) a) Using ladder operators, obtain the energy eigen values of a simple harmonic oscillator. **[8]**

b) Prove the closure property: **[8]**

$$\sum_a \phi_a(\bar{x})(\phi_a^x)(\bar{x}') = \delta(\bar{x} - \bar{x}')$$

Q5) a) Obtain Clebsh-Gordan coefficients for a system of two non-interacting particles with angular momenta $j_1 = \frac{1}{2}$ and $j_2 = \frac{1}{2}$. **[8]**

b) Define spin angular momentum operator. Hence obtain Pauli spin matrices. Show that $\sigma_x \sigma_y = i\sigma_z$ **[8]**

Q6) a) Discuss and compare the schrodinger picture and the Heisenberg picture of time evolution. **[8]**

b) Show the angular momentum operator is a generator of rotational motion. **[8]**

Q7) a) What do you mean by degeneracy of the level? Explain the same case of hydrogen atom. **[4]**

b) Show that the quantity $|\psi\rangle\langle\psi|$ is a projector only when $|\psi\rangle$ is normalized. **[4]**

c) Prove that [A, [B, C]]+[B, [C,A]]+[C,[A, B]] = 0. **[4]**

d) Write a note on raising and lowering operators. **[4]**

Total No. of Questions : 8]

SEAT No. :

P3040

[Total No. of Pages : 3

[4722]-2001
M.Sc.
PHYSICS
PHYUT-601 : Electrodynamics
(New Course 2013 Pattern-4-Credits)
(Semester-II) (Credit Based System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions from the following.***
2) ***Draw neat labelled diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***All questions carry equal marks.***
5) ***Use of calculator is allowed.***

Q1) a) Show that power transferred to the electromagnetic field through the motion of charge in volume V is given by

$$-\int_V (\vec{j}\cdot\vec{E})\,dV = \frac{d}{dt}\int_V \frac{1}{2}(\vec{E}\cdot\vec{D}+\vec{B}\cdot\vec{H})\,dV + \oint (\vec{E}\times\vec{H})\cdot d\vec{s}$$ **[4]**

b) Explain the term 'momentum space' with the help of suitable example. **[3]**

c) Show that the ratio of electrostatic and magnetic energy densities is equal to unity. **[3]**

Q2) a) Derive the expression for potential at a distant point using multipole expansion for a localized charge distribution in free-space. **[4]**

b) Explain Ampere's circuital law and write Maxwell's fourth equation of e.m. field. **[3]**

c) Show that $(C^2B^2 - E^2)$ is invarient under lorentz transformations. **[3]**

Q3) a) Obtain an expression for electromagnetic field tensar $F_{\mu\gamma}$. **[4]**

b) Write the boundary conditions at the interface of a dielectric and explain them. **[3]**

P.T.O.

c) The earth receives about 1300 watt/m^2 radient energy from the sun. Assuming the energy to be in the form of plane polarized monochromatic waves and assuming normal incidence, find the magnitude of electric field vector in the sum light. **[3]**

Q4) a) Starting with Maxwell's equations derive inhomogeneous wave equations in terms of scalar potential ϕ and vector potential $\vec{A}$. **[4]**

b) Explain 'Four vector potential'. **[3]**

c) Find the phase velocity of a plane e.m. wave at a frequency of 10 GHz in polyethelene material.

Given: $\mu \simeq \mu_0 = 4\pi \times 10^{-7} \frac{Wb}{A-m}, \in_r = 2.3$,

$\in_0 = 8.85 \times 10^{-12} \, {}^{c^2}\!/_{N-m^2}$ & $\sigma = 2.56 \times 10^{-4} \frac{mho}{m}$. **[3]**

Q5) a) Derive an expression for Faraday's low of induction for moving medium. **[4]**

b) Explain Hertz potential. Show that the magnetic field can be expressed as $\vec{B} = \frac{1}{C^2} \frac{\partial}{\partial t} \left(\vec{\nabla} \times \vec{Z} \right)$. **[3]**

c) Calculate the frequency at which the skin-depth in sea water is 1 meter.

Given: $\mu = \mu_0 = 4\pi \times 10^{-7} \frac{Wb}{A-m}$ and $\sigma = 4.3 \frac{mho}{m}$. **[3]**

Q6) a) Write an expression for magnetic field intensity $\vec{B}$ at a point and show that its curl equals to $\mu_0 \vec{j}$. **[4]**

b) Explain the terms 'skin effect' and 'skin depth'. **[3]**

c) Two identical bodies move towards each other the speed of each being 0.9C. What is their speed relative to each other? **[3]**

Q7) a) Prove the relativistic addition theorem for velocities. Hence show that any velocity added relativistically to 'C' gives the resultant velocity 'C' which is Lorentz invarient. **[5]**

b) Describe Michelson-Morley experiment with a suitable diagram. Hence derive the formula for fringe shift. **[5]**

Q8) a) With the help of suitable diagram explain the magnetic interaction between two current loops. **[5]**

b) A plane electromagnetic wave is incident obliquely on an interface between the two non conducting dielectric media. Obtain an expression for Snell's law. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P3041

[Total No. of Pages :3

[4722] - 2002
M.Sc.
PHYSICS
PHYUT - 602 : Solid State Physics
(2013 Pattern) (4 Credits) (Semester - II)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table and calculator is allowed.***

Constants:

1)	***Boltzmann constant***	:	$K_B = 1.38 \times 10^{-23}$ J/K
2)	***Plank's constant***	:	$h = 6.623 \times 10^{-34}$ J.S.
3)	***Avogadro's number***	:	$N = 6.023 \times 10^{23}$/mole.
4)	***Mass of electron***	:	$m_e = 9.1 \times 10^{-31}$ Kg
5)	***Charge on electron***	:	$e = 1.6 \times 10^{-19}$C
6)	***Bohr magneton***	:	$\mu_B = 9.27 \times 10^{-24}$ A.m^2
7)	***Permeability of free space***	:	$\mu_o = 4\pi \times 10^{-7}$ H/m
8)	***Permittivity of free space***	:	8.85×10^{-12} C^2/N–m^2

Q1) a) Discuss quantum theory of paramagnetism and obtain expression for paramagnetic susceptibility. **[4]**

b) Write a note on type - I and type - II superconductors. **[3]**

c) Using the Kronig Penney Model, show that for p << 1, the energy of the lowest energy band is **[3]**

$$E = \frac{\hbar^2 P}{ma^2}.$$

Q2) a) What is Cyclotron resonance? Obtain an expression for cyclotron frequency of Bloch electrons. **[4]**

b) What is exchange interaction? How does it help to explain magnetism in iron group of atoms. **[3]**

c) Explain the term 'anisotropy energy' with reference to magnetization. **[3]**

P.T.O.

Q3) a) Explain the phenomenon of hysteresis on the basis of domain theory. **[4]**

b) Explain the phenomenon of antiferromagnetism with example. Define the Neel temperature. **[3]**

c) Show that for a simple square lattice the kinetic energy of a free electron at a corner of the first brillovin zone is higher than that of electron at mid point of the zone by a factor of 2. **[3]**

Q4) a) Explain various schemes of E-K representations. **[4]**

b) Explain Josephson tunneling in super conductors. **[3]**

c) Sodium metal with bcc structure has two atoms per unit cell. The radius of sodium atom is 1.85 A°. Estimate the order of diamagnetic susceptibility. **[3]**

Q5) a) Derive an expression for diamagnetic susceptibility using Langevin theory. **[4]**

b) Explain the meissner effect in superconductors. **[3]**

c) The density and the atomic number of niobium is 8.57×10^3 Kg/m^3 and 93 respectively. It has one electron per atom. Calculate London penetration depth of niobium. **[3]**

Q6) a) Derive an expression for effective mass of electron in crystal. **[4]**

b) State Bloch theorem. Explain the property of Bloch function. **[3]**

c) A paramagnetic material has 6.02×10^{28} atoms/m^3 and its Fermi energy is 11.63 eV. Determine Pauli's paramagnetic susceptibility. **[3]**

Q7) a) On the basis of Kronig - Penney model, show that the energy spectrum of an electron consists of allowed and forbidden energy bands. **[5]**

b) Explain Phenomenon of ferromagnetism. Derive Curie-Weiss law from Weiss molecular field theory. **[5]**

Q8) a) Derive London equation for superconducting state and obtain an expression for penetration depth. **[5]**

b) Distinguish between metals, semiconductors and insulators on the basis of band theory of solids. **[5]**

Total No. of Questions : 8]

SEAT No. :

P3042

[Total No. of Pages : 3

[4722]-2003
M.Sc.
PHYSICS
PHYUT-603 : Quantum Mechanics-I
(2013 Pattern-4-Credits) (Semester-II)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five out of eight questions.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables and electronic calculator is allowed.***

Q1) a) The wavefunction for a particle in infinite well is given as $\psi_n(x) = A \sin \frac{n\pi x}{a}$ where $0 \le x \le a$, find $< x >$ and $< Px >$. **[4]**

b) For a unitary operator $\hat{U}$, show that $< U\psi \mid U\psi > = 1$. **[3]**

c) State physical significance of eigen values and eigen functions of an observable. **[3]**

Q2) a) Using ladder operator, obtain the energy eigen values of one dimensional simple harmonic oscillater. **[4]**

b) Show that the expectation value of the Hamiltonian is an upper bound to the ground state energy E_0. **[3]**

c) State difference between normal and anomalous zeeman effect. **[3]**

Q3) a) Show that angular momentum operater is a generator of rotational motion. **[4]**

b) State the condition of validity of WKB. **[3]**

P.T.O.

c) Let S be the spin angular momentum operater on two states $\alpha=\begin{bmatrix}1\\0\end{bmatrix}$ and

$\beta=\begin{bmatrix}0\\1\end{bmatrix}$

obtain the matrix representation for S_x, S_y and S_z. **[3]**

Q4) a) What do you mean by degeneracy of the level? How many states of hydrogen atom are there with $n = 5$? **[4]**

b) Estimate the polarizability of hydrogen atom. **[3]**

c) Discuss in brief Dirac notations. **[3]**

Q5) a) Determine the orthonormal set of the eigen vectors of the matrix

$$\begin{pmatrix}0 & -i & 0\\ i & 0 & 0\\ 0 & 0 & 2\end{pmatrix}.$$

Prove the completeness condition. **[4]**

b) Calculate the expectation value of the potential energy in the ground state of the hydrogen atom. **[3]**

c) Show that there is no first order Stark effect in the ground state of an atom. **[3]**

Q6) a) Consider a one dimensional harmonic oscillater

$\hat{H}=\frac{-\hbar^2}{2m}\frac{d^2}{dx^2}+\frac{1}{2}mw^2x^2$, for the one parameter family of wave function $\psi_\alpha(x)=e^{-\alpha x^2}, (\alpha>0)$, find a wave function that minimizes $< H >$. What is the value of $< H >$ min. **[4]**

b) In case of j = 1, find the matrices representing the operators $\hat{J}^2$, $\hat{J}_z$ and $\hat{J}_\pm$. **[3]**

c) Derive 0^{th}, 1^{st} and 2^{nd} ordered fundamental equations used in time independent perturbation theory. **[3]**

Q7) a) Obtain Clebsh - Gordon coefficients by adding the angular momenta of two non-interacting electrons with $j_1 = 1/2$ and $j_2 = 1/2$ **[5]**

b) Discuss Fermi's Golden rule. **[5]**

Q8) a) Obtain the eigen value spectrum of $\hat{L}^2$ and $\hat{L}_z$ operater. **[5]**

b) Show that the eigen vector's basis of S_z digonalizes S^2. Find the eigenvalues of S^2. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P3043

[Total No. of Pages :2

[4722] - 2004
M.Sc.
PHYSICS
PHYUT - 604 : Lasers
(2013 Pattern - 4 Credit) (Semester - II)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Solve any FIVE questions out of Eight questions.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of calculator is allowed.***

Q1) a) Define three Einstein coefficients and derive the relation between them. **[4]**

b) State the requirements to be fulfill by the material used as active medium in laser. **[3]**

c) Explain the term 'population inversion' with th help of Boltzman distribution equation. **[3]**

Q2) a) Define gain factor of resonating cavity. Prove that it is proportional to the population inversion of laser states. **[4]**

b) What do you mean by spatial and temporal coherence of laser beam. **[3]**

c) Why 2-level laser systems are practically not possible? **[3]**

Q3) a) A material used in laser resonator of length 20cm has a gain factor of 0.0005 per cm. The reflectivity of one mirror is 100%. What would be the reflectivity of other mirror. **[4]**

b) State and derive the threshold condition for laser action. **[3]**

c) Define the term 'degree of non-monochromaticity' of laser beam. How is it related with Q-factor? **[3]**

P.T.O.

Q4) a) Distinguish between three-level and four-level laser system. **[4]**

b) A laser beam of 5mW power has wavelength of 6328 A°. Calculate the number of photons emitted per second. **[3]**

c) What do you mean by pumping process in laser. State three commonly used methods of pumping. **[3]**

Q5) a) Give a detail mathematical analysis of three-level laser scheme and hence derive the condition necessary. for population inversion. **[4]**

b) With reference to energy level diagram, explain the transitions of Nd: YAG laser. **[3]**

c) Explain an experiment used for measurement of Wavelength of laser beam. **[3]**

Q6) a) Explain the principle, construction and working of He-Ne laser. **[4]**

b) The gain profile of He-Ne laser has width of approximately 2×10^{-3}nm. Calculate the maximum length of cavity so as to get single longitudinal mode oscillation. **[3]**

c) What is excimer laser? Explain it in brief. **[3]**

Q7) a) A rod of certain solid state laser material of length 5×10^{-2}m. Contains 2×10^{25} ions per cubic meter. In an excited state, all ions in the upper level de-excite simultaneously emitting photons in same direction. Calculate **[5]**

i) The maximum energy contained in a radiated pulse of wavelength 6.6×10^{-7} m.

ii) If the pulse duration is 10^{-7} sec. What is the average power of the pulse during its existance.

Given h = 6.6×10^{-34} JS, C = 3×10^{8} m/s)

b) Write a note on semiconductor diode laser. **[5]**

Q8) a) Explain any two applications of laser in material processing. **[5]**

b) Explain the principle, construction and working of longitudinally excited CO_2 laser. **[5]**

Total No. of Questions : 8]

SEAT No. :

P3044

[Total No. of Pages :3

[4722] - 2005
M.Sc.
PHYSICS
PHY UT-605: Experimental Techniques in Physics - II
(2013 Pattern -4 Credits) (Semester - II)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table and calculator is allowed.***

Constants:

1. Boltzmann constant K_B = 1.38×10^{-23} J/K
2. Planck's constant h = 6.623×10^{-34} Js
3. Avogadro's number N = 6.023×10^{23}/gm mole
4. Mass of electron m_e = 9.1×10^{-31} kg
5. Charge on electron e = 1.6×10^{-19}C
6. Velocity of light c = 3×10^{8} m/s

Q1) a) Write a note on UV-VIS sources. **[4]**

b) With the help of neat diagram prove Bragg's diffraction law. **[3]**

Also explain why diffraction through solid will not be observed using visible light.

c) The electron energy levels for an iron are E_K = -7112 eV, E_L = -708eV and E_M = -53eV. Calculate K_α and K_β photon energies used in an SEM chemical analysis of iron. **[3]**

P.T.O.

Q2) a) Write the comparison between X-ray and neutron diffraction techniques. **[4]**

b) Elemental composition of a material using XPS is usually obtained only from a depth around 0-10nm on the surface. Explain why? **[3]**

c) A (1 1 1) diffraction spot from an MgO single crystal is produced with a laue camera. It occurs 1cm from the film center. Calculate the diffraction angle (2θ) and Bragg angle (θ). Assume that the sample is 3cm from the film. Also calculate X-ray wavelength (λ) that would produce first order diffraction.

[Given: MgO is cubic, lattice constant a = 0.420nm]. **[3]**

Q3) a) Write the principle of VSM. Also explain the advantages of SQUID technique over VSM. **[4]**

b) Explain different modes of vibration of an atom that are responsible for IR spectrum. Draw necessary diagrams. **[3]**

c) Calculate the conductivity of gold at 200ºC.

[Given: α = 0.0034/ºC]. **[3]**

Q4) a) To get SAED pattern of TEM, Bragg's law is modified, explain why?

Also prove the equation for inter planer distance, $d = L\lambda/R$ where symbols have their usual meaning. **[4]**

b) With the help of neat diagram explain the working of photomultiplier tube (PMT). **[3]**

c) How many lines will be observed in ESR spectrum when a coupling of two N^{14} nucleus with a spin $\frac{1}{2}$. Comment on the intensity of the lines. **[3]**

Q5) a) Draw the block diagram of NMR. **[4]**

b) Write atleast one detector for the following techniques: **[3]**

X-ray	IR
γ-ray	Microwave
UV-VIS	β-ray

c) Copper (II) sulphate pentahydrate ($CuSO_4$. $5H_2O$) is heated in thermogravimetric analyzer up to 600ºC and copper (II) oxide (Cu_2O) is formed as an end product. Plot TGA curve showing atleast three plateau regions and their respective percentage weight loss. **[3]**

[Given: Molecular weight of $CuSO_4$. $5H_2O$ = 249.685 amu

Atomic weight of Cu = 63.54 amu

Atomic weight of S = 32.06 amu

Atomic weight of H = 1.00 amu

Atomic weight of O = 16.0 amu]

Q6) a) X-ray wavelength λ=1.5406 $\mathring{A}$ is incident on a material and diffraction appears at an angle 2θ and FWHM of the peak is observed at angles 26.75º and 27.28º. The particle size of a material is calculated using Scherrer formula and found to be 50nm. Calculate diffraction angle. **[4]**

b) Write the construction and working of G.M. tube. **[3]**

c) Write the construction and working of klystern tube. **[3]**

Q7) a) What is continuous X-ray? Why is it called white X-ray? What is its origin? **[5]**

b) What is sensor? Discuss the characteristics of sensor? **[5]**

Q8) a) Discuss the principle, instrumentation and working of STM with the help of neat diagram. Also explain different modes of operation. **[5]**

b) Write principle of FT-IR. **[5]**

Explain optical system of FT-IR using Michelson interferometer.

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Total No. of Questions : 8]

SEAT No. :

P3031

[Total No. of Pages : 2

[4722]-201
M.Sc.
PHYSICS
PHYUT-601 : Electrodynamics
(2013 Pattern-5 Credits) (Semester-II) (Credit based System) (New)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions from the following.***
2) ***Draw neat labelled diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***All questions carry equal marks.***
5) ***Use of logarithmic tables and pocket calculator is allowed.***

Q1) a) Derive an expression for potential at a point due to a small linear quadrupole. **[4]**

b) Explain the terms 'skin effect' and 'skin depth'. **[3]**

c) Find the wave impedance of an electromagnetic wave travelling through free-space.

Given: $\mu_0 = 4\pi \times 10^{-7} \frac{Wb}{A-m}$ and $\in_0 = 8.85 \times 10^{-12} \frac{C^2}{N-m^2}$. **[3]**

Q2) a) Derive inhomogeneous wave equations in terms of scalar potential ϕ and vector potential $\vec{A}$. **[4]**

b) Show that $(C^2B^2 - E^2)$ is invariant under Lorentz transformations. **[3]**

c) Given the electromagnetic wave:

$$\vec{E} = \hat{i}\, E_0 \cos\omega\left(\sqrt{\in \mu}\; z - t\right) + \hat{j}\, E_0 \sin\omega\left(\sqrt{\in \mu}\; z - t\right),$$

where E_0 is constant. Find the corresponding magnetic field. **[3]**

Q3) a) Derive Faraday's law of induction for moving medium. **[4]**

b) Find the ratio of skin-depth in copper at 1KHz to 100 MHz. **[3]**

P.T.O.

c) Explain the term Hertz potential. Show that the magnetic field can be expressed as

$$\vec{B} = \frac{1}{C^2}\frac{\partial}{\partial t}\left(\vec{\nabla}\times\vec{z}\right).$$ **[3]**

Q4) a) A plane electromagnetic wave is propagating through a stationary medium. Assuming the solution of wave, show that it satisfies the relation $CB_z = E_y$. **[4]**

b) Explain the term 'Four Vector Potential'. **[3]**

c) Find the velocity at which the mass of the particle is double its rest mass.

Given: C = 3×10^8 m/sec. **[3]**

Q5) a) Obtain an expression for electromagnetic field tensor $F_{\mu\gamma}$. **[4]**

b) Write the boundary conditions at the interface of a dielectric and explain them. **[3]**

c) Show that the ratio of electrostatic and magnetostatic energy densities is equal to unity. **[3]**

Q6) a) Write the expression for magnetic field intensity $\vec{B}$ at a point and show that its curl equals to $\mu_0\vec{j}$. **[4]**

b) Explain Minkowski's space-time diagram. **[3]**

c) Explain the concept of dipole radiation and radiation resistance. **[3]**

Q7) a) Describe Michelson-Morley experiment with a suitable diagram. Hence derive the formula for fringe shift. **[5]**

b) State and prove Poynting's theorem. **[5]**

Q8) a) A plane electromagnetic wave is incident obliquely on an interface between the two non-conducting dielectric media. Obtain an expression for Snell's law. **[5]**

b) Derive the Lorentz relativistic transformation equations. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P3032

[Total No. of Pages :3

[4722] - 202
M.Sc.
PHYSICS
PHY UT - 602 : Solid State Physics
(2013 Pattern - 5 Credits) (Semester - II)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table and calculator is allowed.***

Constants:

1.	Boltzmann constant	:	$K_B = 1.38 \times 10^{-23}$ J/K
2.	Plank's constant	:	$h = 6.623 \times 10^{-34}$ JS
3.	Avogadro's number	:	$N = 6.023 \times 10^{23}$/gm mole.
4.	Mass of electron	:	$m_e = 9.1 \times 10^{-31}$ Kg
5.	Charge on electron	:	$e = 1.6 \times 10^{-19}$C
6.	Velocity of light	:	$c = 3 \times 10^{8}$m/s
7.	Bohr magneton	:	$\mu_B = 9.27 \times 10^{-24}$ A-m^2
8.	Permeability of free space	:	$\mu_o = 4\pi \times 10^{-7}$ H/m
9.	Gas constant	:	R = 1.987 cal/Mole -k.

Q1) a) Define geometrical structure factor. Calculate geometrical structure factor for bcc structure and explain the fact that the (100) reflection line vanishes for metallic sodium but not for CsCl, both having the bcc structure. **[4]**

b) State the Bloch theorem. What are Bloch functions? State the property of Bloch function. **[3]**

c) A super conducting material has a critical temperature of 3.7 K at zero magnetic field and a critical field of 0.0306 Tesla at OK. Find the critical field at 2K. **[3]**

Q2) a) Derive an expression for paramagnetic susceptibility using Langevin theory. **[4]**

b) Derive an expression for effective mass of electron in a crystal. **[3]**

P.T.O.

c) A paramagnetic substance has 10^{28} atoms/m^3. The magnetic moment of each atom is 1.8×10^{-23} A/m^2. Calculate the paramagnetic susceptibility at 300K. **[3]**

Q3) a) Discuss the Pauli spin paramagnetism of conduction electrons. **[4]**

b) What is exchange interaction? How does it help to explain magnetism in iron group of atoms. **[3]**

c) Explain the phenomenon of antiferromagnetism with example. Also define Neel temperature. **[3]**

Q4) a) Show that for Kronig-Penney potential with p<<1, the energy of the lowest energy band at k = 0 is $E = \frac{\hbar^2 P}{ma^2}$ **[4]**

b) Discuss the reduced zone, extended zone and periodic zone scheme of E – K representation. **[3]**

c) Suppose that longitudinal vibrations in a linear chain of N identical atoms obey periodic boundary conditions so that the motion of the first and last atom of the chain is identical. Find the number of vibrational modes for this system. **[3]**

Q5) a) Explain Meissner effect in a superconductor and show that perfect diamagnetism is an essential property of the superconducting state. **[4]**

b) Explain type - I and type - II superconductors. **[3]**

c) Estimate the order of the diamagnetic susceptibility of copper by assuming that only one electron peratom makes the contribution. The radius of copper atom is 1 $\mathring{A}$ and the lattice parameter is 3.608 $\mathring{A}$. **[3]**

Q6) a) Explain cyclotron resonance. Obtain expression for cyclotron frequency of Bloch electrons. **[4]**

b) Explain the following terms in case of ferromagnetic material: **[3]**

i) Anisotropy energy.

ii) Bloch wall.

c) The unit cell parameter of NaCl crystal is 5.6 $\mathring{A}$ and the modulus of elasticity along [100] direction is $5 \times 10^{10} N/m^2$. Estimate the wavelength at which an electromagnetic radiation is strongly reflected by the crystal. Atomic weight of Na = 23 and of Cl = 37. **[3]**

Q7) a) Find the dispersion relation for a linear diatomic crystal with two types of atoms and discuss the nature of the optical and acoustic modes. **[5]**

b) Explain phenomenon of ferromagnetism. Derive an expression for Curie-Weiss law from molecular field theory of ferromagnetism. **[5]**

Q8) a) Derive an expression for specific heat of solids on the basis of Einstein's model. How does the specific heat depends on temperature? **[5]**

b) Derive London equation for superconducting state and obtain expression for penetration depth. **[5]**

Total No. of Questions : 8]

SEAT No. :

P3033

[Total No. of Pages : 2

[4722]-203
M.Sc.
PHYSICS
PHY UT-603 : Experimental Techniques in Physics
(2013 : 5 Credit Based System Pattern) (Semester-II)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table and calculator is allowed.***

Constants:

1)	Boltzmann constant	$K_B = 1.38 \times 10^{-23}$ J/k
2)	Planck's constant	$h = 6.63 \times 10^{-34}$ Js
3)	Avogadro's number	$N = 6.02 \times 10^{23}$/gm mole
4)	Mass of electron	$m_e = 9.1 \times 10^{-31}$ kg.
5)	Charge on electron	$e = 1.6 \times 10^{-19}$ C
6)	Velocity of light	$C = 3 \times 10^{8}$ m/s

Q1) a) Explain the principle of STM (Scanning Tunnelling Microscope) **[4]**

b) Write a short note on microwave generator. **[3]**

c) What are different pumping concepts used in vacuum pumps? **[3]**

Q2) a) In SEM system, calculate the wavelength in nm if the applied voltage is 100 kV. **[4]**

b) Write a short note on error analysis. **[3]**

c) Write a short note on principle of XPS. **[3]**

P.T.O.

Q3) a) Calculate the average nanoparticle size using Scherrer formula. [Given = wavelength used for diffraction is Cu K_α – 0.154nm, full width at half maxima (FWHM) $\beta = 0.05$, $\theta_B = 60°$]. **[4]**

b) Explain the principle and instrumentation of UV-Vis Spectroscopy. **[3]**

c) Explain the construction and working of McLeod gauge in brief. **[3]**

Q4) a) Write a note on vacuum system design. **[4]**

b) What are auto and cross correlation functions. **[3]**

c) What are important types of sensing properties in sensors? **[3]**

Q5) a) What is pump displacement rate in case of Rotary pump? Calculate the pump displacement rate for rotary pump, if volume trapped between the two vanes is 0.005 litre and number of rotations are 500 r.p.m. **[4]**

b) Write note on periodic and Random signals. **[3]**

c) Write short note on Electron Spin Resonance (ESR). **[3]**

Q6) a) Discuss the techniques of production of UV-Visible and IR radiations. **[4]**

b) Calculate Energy in eV for photon having wavelength 500nm. **[3]**

c) What is mean free path? For air at ambient temperature with pressure 10^{-6} Torr, calculate mean free path. **[3]**

Q7) a) Define sensors. Explain different types of sensors in brief. **[5]**

b) Explain the principle, construction and working of Fourier Infra Red (FTIR) spectrometer. **[5]**

Q8) a) Discuss basic principle and applications of optical tweezers. **[5]**

b) With the help of schematic diagram, explain the basic components of Transmission Electron Microscope (TEM). **[5]**

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Total No. of Questions : 8]

SEAT No. :

P3034

[Total No. of Pages :2

[4722] - 204
M.Sc.
PHYSICS
PHY UT - 604 : Quantum Mechanics - I
(CBS 2013 Pattern - 5 Credits) (Semester - II)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions out of eight questions.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables and electronic calculator is allowed.***

Q1) a) Using Dirac notations, show that eigen values of Hermitian operators are real. **[4]**

b) Show that $\langle A^{+}A \rangle$ is always positive. **[3]**

c) Show that $[x, p^n] = n\, i\hbar\, p^{n-1}$ **[3]**

Q2) a) Using expansion postulate, show that eigen functions belonging to discrete eigenvalues are normalizable. **[4]**

b) Show that sum of projection operators is unit operator. **[3]**

c) Show that momentum operator is Hermitian. **[3]**

Q3) a) A linear operator $\hat{F}$ takes a vector $|\psi\rangle$ into $|x\rangle$ as $\hat{F}|\psi\rangle = |x\rangle$. Represent $\hat{F}$ as matrix elements in A-representation. **[4]**

b) "Associated with any degenerate eigenvalue, there is always an infinite number of eigen functions". Comment. **[3]**

c) What is unitary operator? Show that the norm of any state $|\psi\rangle$ does not change under unitary transformation. **[3]**

P.T.O.

Q4) a) Obtain the expression for ground state energy of harmonic oscillator by using variational principle. Use trial wavefunction $\psi = Ae^{-\lambda x^2}$, where λ is variational parameter. **[4]**

b) What is WKB approximation? **[3]**

c) What is spin angular momentum? Obtain Pauli's spin matrices 6*x*, 6*y*, 6*z*. **[3]**

Q5) a) Obtain matrices for J^2 and J_Z in $|j,m\rangle$ basis. **[4]**

b) Explain briefly the principle of time-independent perturbation theory. **[3]**

c) Using WKB method, obtain Bohr's quantization condition for bound state. **[3]**

Q6) a) Show that the expectation value of the Hamiltonian is upper bound to the ground state energy $\in_o$. **[4]**

b) The second-order correction to the energy of the ground state is always negative. Why? **[3]**

c) Explain, what do you mean by completeness. **[3]**

Q7) a) State and explain Fermi-Golden rule. **[5]**

b) Obtain the matrix of Clebsh-Gordan coefficients for a system having $j_1 = 1/2$ and $j_2 = 1/2$. **[5]**

Q8) a) State fundamental postulates of Quantum Mechanics. **[5]**

b) Develop the time dependent perturbation theory to obtain first order correction to transition amplitude $a_n^{(1)}(t)$. **[5]**

Total No. of Questions : 7]

SEAT No. :

P3021

[Total No. of Pages :3

[4722] - 21
M.Sc.
PHYSICS
PHY UTN- 601 : Electrodynamics
(Old Course) (2008 Pattern) (Semester - II)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Question No. 1 is Compulsory & solve any four questions from the remaining.***
2) ***Draw neat labelled diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables & calculator is allowed.***

Q1) Attempt any four of the following:

a) Calculate the magnitude of poyntings vector at the surface of the sun. **[4]**

Given:

i) The power radiated by the sun = 3.8×10^{26} Watt.

ii) Radius of the sun = 7×10^{8}m

b) Find the rest mass of an electron in ev if its rest mass is 9.11×10^{-31} kg. **[4]**

c) State Faraday's law of e.m. induction. Write its mathematical form. **[4]**

d) Two identical bodies move towards each other, the speed of each being 0.9C. Find their speed relative to each other. **[4]**

e) Prove that **[4]**

$$\vec{E}.\frac{\partial \vec{D}}{\partial t}=\frac{\partial}{\partial t}\left(\frac{1}{2}\vec{E}\cdot\vec{D}\right) \text{ and}$$

$$\vec{H}.\frac{\partial \vec{B}}{\partial t}=\frac{\partial}{\partial t}\left(\frac{1}{2}\vec{H}\cdot\vec{B}\right)$$

f) Write the expression for Lotentz's & Coulomb's gauges. Hence, explain the two conditions. **[4]**

P.T.O.

Q2) a) What is electromagnetic tensor? Obtain an expression for the e.m. field tensor given by

$$F_{uv} = \begin{vmatrix} F_{11} & F_{12} & F_{13} & F_{14} \\ F_{21} & F_{22} & F_{23} & F_{24} \\ F_{31} & F_{32} & F_{33} & F_{34} \\ F_{41} & F_{42} & F_{43} & F_{44} \end{vmatrix}$$ **[8]**

b) Show that Maxwell's equation in a charge free region is express by $\nabla^2 \vec{E} - \frac{k\,km}{c^2}\frac{\partial^2 \vec{E}}{\partial t^2} - U6\frac{\partial \vec{E}}{\partial t} = 0$. Explain which term can be ignored in a non-conducting medium. **[8]**

Q3) a) If a medium is moving with velocity $\vec{u}$, then show that the Faraday's law has the form $\vec{\nabla} \times \left(\vec{E}' - \vec{u} \times \vec{B}\right) = \frac{-\partial \vec{B}}{\partial t}$. **[8]**

b) Using the concept of e.m. energy, show that the power transferred to the e.m. field through the motion of charge in volume V is given by **[8]**

$$-\int \left(\vec{j} \cdot \vec{E}\right) dv = \frac{d}{dt}\int_v \frac{1}{2}\left(\vec{E} \cdot \vec{D} + \vec{B} \cdot \vec{H}\right) dv + \int_{C.S} \left(\vec{E} \times \vec{H}\right) \cdot d\vec{s}$$

Q4) a) What is Hertz potential? Show that the electric & magnetic field can be expressed in terms of Hertz potential as **[8]**

$$\vec{E} = \vec{\nabla} \times \left(\vec{\nabla} \times \vec{Z}\right) \text{and} \vec{B} = \frac{1}{C^2}\frac{\partial}{\partial t}\left(\vec{\nabla} \times \vec{Z}\right)$$

Where $\vec{Z}$ is Hertz potential.

b) Describe the Michelson-Morley experiment & discuss the results obtained by it. **[8]**

Q5) a) Prove that the space time internal $x^2 + y^2 + z^2$ is not invariant under Lorentz transformation, while the combined space time interval $x^2 + y^2 + z^2 - c^2 t^2$ is Lorentz invariant. **[8]**

b) Prove the relativistic addition theorem for velocities. **[8]**

Q6) a) If $\vec{C}=\vec{\nabla}\times\vec{Z}$, then show that, $C_{\phi}=\frac{P_1}{4\pi \in R}\sin\left(\frac{1}{R}-ik\right)e^{ikR}$. **[8]**

b) Explain the term 'multipole moments'. Derive an expression for potential at a distant point using multipole expansion for a localized charge distribution in free space. **[8]**

Q7) a) Explain Minkowski's space-time diagram. **[4]**

b) Write the expression for force describing magnetic interaction between two current loops & explain it. **[4]**

c) Write Maxwell's equation in differential & integral form. **[4]**

d) At what speed will the mass of a proton become double its rest mass? **[4]**

Total No. of Questions : 7]

SEAT No. :

P3022

[Total No. of Pages :2

[4722] - 22
M.Sc.
PHYSICS
PHY UTN - 602 : Atoms, Molecules and Solids
(2008 Pattern) (Semester - II)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Question No. 1 is compulsory. Solve any four questions from the remaining.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables and electronic pocket calculator is allowed.***

Given:

Rest mass of electron	=	9.109×10^{-31} kg
Charge on the electron	=	1.6021×10^{-19} Coulomb
Planck's constant	=	6.626×10^{-34} Js
Boltzmann constant	=	1.38054×10^{-23} JK^{-1}
Avogadro's number	=	6.022×10^{26} $(K\ mole)^{-1}$
Bohr magneton	=	9.27×10^{-24} $amp.m^2$
1eV	=	1.6021×10^{-19} J

Q1) Attempt any Four of the following:

a) Find the minimum magnetic field needed for Zeeman effect to be observed in a spectral line of 400 nm wavelength, when a spectrometer whose resolution is 0.010nm is used. **[4]**

b) The ground state of cholorine is $^2P_{3/2}$. Find magnetic moment of cholorine. **[4]**

c) Lead crystalizes in the fcc structure. The lattice constant is 4.95Aº. Calculate the radius of the largest sphere that can just fit into the void at the body centre of the fcc structure. **[4]**

d) The concentration of schottky defects in an ionic crystal is 1 in 10^{10} at temperature 300K. Estimate the energy of the vacancy pair. **[4]**

e) Find Lande g factor for $^2f_{5/2}$ state. **[4]**

f) An NMR signal for a compound is found to be 180Hz downward TMS peak using a spectrometer operating at 60MHz. Calculate its chemical shift in ppm. **[4]**

P.T.O.

Q2) a) State and explain Frank-Condon Principle. **[8]**

b) What are the limitations of classical theory of specific heat? Derive expression for the specific heat of solids on the basis of Einstein's model. **[8]**

Q3) a) State the principle of ESR. Explain working of ESR spectrometer with the help of neat block diagram. **[8]**

b) Explain band origin and band head in the rotational fine structure of electronic vibration spectra. **[8]**

Q4) a) What is anamolous Zeeman effect? Derive the formula for $\Delta\nu$ in this case. Explain the importance of lande 'g' factor. **[8]**

b) Derive the relation between W and K for vibrational modes in 1-D monoatomic lattice of identical atoms. **[8]**

Q5) a) Explain the Paschen-Back effect of 2S-2P transition. **[8]**

b) Write note on: **[8]**

i) Screw dislocation

ii) Edge dislocation.

Q6) a) What are schottky and frankel pairs. Derive the expression for the dependence of concentration of schottky pairs on temperature. **[8]**

b) Explain the theory of geometrical structure factor and derive an expression for bcc lattice. **[8]**

Q7) a) Obtain an expression for configurational entropy. **[4]**

b) What are normal and umklapp processes. **[4]**

c) What is meant by width of a spectral line? **[4]**

d) A free electron is placed in a magnetic field of strength 1.3T. Calculate the resonance frequency if g = 2.0023. **[4]**

Total No. of Questions : 7]

SEAT No. :

P3023

[Total No. of Pages : 3

[4722]-23
M.Sc.
PHYSICS
PHY-UTN-603 : Statistical Mechanics in Physics
(2008 Pattern) (Semester-II)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Question No. 1 is compulsory, attempt any four questions from the remaining questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables and electronic pocket calculators is allowed.***

Constants:

1) Boltzmann constant $K_B = 1.38 \times 10^{-23}$ Joule/°K
2) Planck's constant $h = 6.625 \times 10^{-34}$ Joule. sec.
3) Avogadro's number $N = 6.023 \times 10^{23}$ mole^{-1}
4) Mass of electron $m_e = 9.1 \times 10^{-31}$ kg.
5) Velocity of light $C = 3 \times 10^8$ m/s
6) Gas constant R = 1.987 cal/deg/mole

Q1) Attempt Any Four of the following:

a) Show that the partition function Z_{ij} of two independent systems i and j is given by $Z_{ij} = Z_i \cdot Z_j$, with corresponding energies E_i and E_j. **[4]**

b) For a mole of gas at NTP, calculate the kinetic energy of the gas. **[4]**

c) Show that $\left(\overline{\Delta H^2}\right) = kT^2C_p$. **[4]**

d) The table given below shows the energy parameters and accessible states for system 1 and 2

System 1	System 2
E_1 = 2, 3, 4 units	E_2 = 5, 6, 7 units
Ω_1 = 5, 25, 75	Ω_2 = 100, 150, 200

P.T.O.

The systems are kept in contact and undergo thermal interactions only. Obtain the distribution for 9 units of energy in equilibrium state and find Ω_{max}. **[4]**

e) An electric current of 1.5 Amp. passes through a wire of resistance 4Ω. The temperature of the wire is maintained constant at 27°C by running cold water. Calculate the change in entropy in 30 sec. **[4]**

f) Calculate the r.ms. speed of neutrons at 300°K

(Given mass of neutron = 1.67×10^{-27} kg). **[4]**

Q2) a) For Debye model of specific heat of solids, in case of phonon gas, show that

$$C_V = \frac{12}{5}\pi^4 NK\left(\frac{T}{\theta_D}\right)^3$$

Where θ_D is Debye temperature. **[10]**

b) Calculate the mean values $\bar{E}$ and $\overline{\Delta E}^2$ for canonical ensemble in terms of partition function. **[6]**

Q3) a) Obtain an expression for mean energy of fermions at T = 0°K. **[8]**

b) On the basis of canonical distribution, obtain the law of atmosphere

$P(z) = P(o)\ e^{-mgz/kT}$. **[8]**

Q4) a) A paramagnetic system consists of N magnetic atoms each with spin $\frac{1}{z}$. What will be its entropy **[8]**

i) at absolute zero temperature?

ii) at very high temperature?

b) Derive an expression for the compressibility of a Fermi gas at absolute zero. **[8]**

Q5) a) State the partition function for Maxwell-Boltzman statistics and show that the quantum distribution function for M.B. distribution is

$$\bar{n}_S = \frac{Ne^{-\beta\epsilon_s}}{\sum_s e^{-\beta\epsilon_s}} \qquad \textbf{[8]}$$

b) Consider a system of N diatomic molecules each having vibrational energy levels

$$E = \left(n + \frac{1}{2}\right)\hbar\omega \text{ where } \quad n = 0,\ 1,\ 2\text{----}$$

write down the partition function and derive an expression for mean energy. Hence show that at high temperature, the specific heat is given by $C_v = Nk$. **[8]**

Q6) a) Show that Maxwell-Boltzman distribution of speed is given by

$$F(v)dv = 4\pi n\left(\frac{m}{2\pi kT}\right)^{3/2} v^2\, e^{-mv^2/2kT} \cdot dv \qquad \textbf{[8]}$$

b) Show that for values of $\beta(\epsilon - \mu)$, the Fermi-Dirac and Bose-Einstein distribution curves merge into Maxwell-Boltzman distribution curve. **[8]**

Q7) a) A particle of mass m is executing simple harmonic motion. Determine its trajectory in phase space. **[4]**

b) Compare the postulates of Bose-Einstein and Fermi-Dirac statistics. **[4]**

c) State and explain the postulate of equal-a-priori probability. **[4]**

d) Explain thermal and mechanical interactions. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P3024

[Total No. of Pages :2

[4722] - 24
M.Sc.
PHYSICS
PHYUTN - 604 : Quantum Mechanics - II
(2008 Pattern) (Semester - II)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Question No. 1 is compulsory.***
2) ***Attempt any four from the remaining.***
3) ***Draw neat diagrams wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of calculators allowed.***

Q1) Attempt any four of the following:

a) What is meant by identical particles? Distinguish between bosons and fermions. **[4]**

b) Discuss the conditions of validity of Born approximation. **[4]**

c) The harmonic oscillator is perturbed by $H' = \lambda x^3$. Obtain first order correction in energy using perturbation theory. **[4]**

d) Using WKB, approximation, obtain Bohr-Sommerfeld quantization condition. **[4]**

e) Using dipole approximation, explain forbidden transitions. **[4]**

f) Show that there is no stark effect in ground state of hydrogen atom. **[4]**

Q2) a) Using the method of partial wave analysis, obtain the scattering amplitude $f(\theta)$. **[8]**

b) Using trial wave function $\psi(x) = Ae^{-\alpha x^2}$ obtain ground state energy of harmonic oscillator by variational method. Were α is variational parameter. **[8]**

P.T.O.

Q3) a) Consider a charged harmonic oscillator of charge 'q' and mass 'm' is perturbed by a homogeneous electric field $\varepsilon(t)=\varepsilon_0 e^{-t/\tau}$ along the x - axis and is switched on at $t = 0$. Find the probability that it will be found in an excited state as $t \to \infty$. The oscillator is in ground state for $t \leq 0$. **[8]**

b) Using time independent perturbation theory obtain the first and second order perturbation in energy for non-degenerate state. **[8]**

Q4) a) State and prove the Fermi-Golden rule for the transition in continum. **[8]**

b) Using partial wave analysis, show that the total scattering cross-section for scattering from hard sphere is $4\pi a^2$. Where 'a' is radius of sphere. **[8]**

Q5) a) Construct symmetric and anti-symmetric wave functions for the system of two electrons. **[8]**

b) Develop the time dependent perturbation theory to obtain first order correction to transition amplitude $a_m^1(t)$. **[8]**

Q6) a) What is Born Approximation? Using Born Approximation show that the scattering amplitude is the Fourier transform of potential. **[8]**

b) Using WKB approximation obtain the energy for harmonic potential $V(x)=\frac{1}{2} m w^2 x^2$. **[8]**

Q7) a) Obtain Slater determinant for N identical particles. **[4]**

b) Show that the variational method gives an upper bound to the ground state energy. **[4]**

c) Using WKB approximation, explain field emission of electrons from metal. **[4]**

d) Explain scattering of two identical particles. **[4]**

Total No. of Questions : 8]

SEAT No. :

P3045

[Total No. of Pages :4

[4722] - 3001
M.Sc.
PHYSICS
PHY UT - 701: Statistical Mechanics in Physics
(CBS 2014 Pattern - 4 Credits) (Semester - III)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions out of eight questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables and pocket calculator is allowed.***

Constants:-

1. Boltzmann constant $K_B = 1.38 \times 10^{-23}$ J/K
2. Planck's constant h = 6.623×10^{-34} J-sec
3. Arogadro's number N = 6.023×10^{23}/gm-mole
4. Mass of electron $m_e = 9.1 \times 10^{-31}$ kg
5. Velocity of light c = 3×10^{8} m/s
6. Charge on electron e = 1.6×10^{-19} c

Q1) a) Prove any two Maxwell's relations of thermodynamics. **[4]**

b) Using canonical ensemble, show that average pressure $\bar{p} = \frac{1}{\beta}\frac{\partial \ln z}{\partial v}$. **[3]**

c) For a mole of Ar at NTP calculate: **[3]**

i) Translational partition function.

ii) Kinetic energy of a gas

iii) Molar heat capacity at constant pressure assuming the ideal behaviour.

[Given: Gas constant R = 82.05 atm/deg/mole, Mass of Ar = 40 amu].

P.T.O.

Q2) a) Show that the dispersion in number of particles in a system in grand canonical ensemble is given by $\overline{(\Delta N)^2} = z\frac{\partial \bar{N}}{\partial z}$ where z is fugacity, $z = e^{-\alpha}$. **[4]**

b) A simple harmonic 1-D oscillator has energy levels given by $E_n = \left(n + \frac{1}{2}\right)\hbar w$, where *w* is the angular frequency of the oscillator and n is quantum no. having the values n = 0,1,2,..... Show that at high temperature C_v = 3R. **[3]**

c) The molar mass of lithium is 6.94 and its density is 0.53 gm/cm^3. Calculate the fermi energy and fermi temperature of the electrons. **[3]**

Q3) a) Discuss Gibb's paradox. **[4]**

b) Write the assumptions of Debye model. Hence calculate γ_D^3, where γ_D is Debye cut-off frequency. **[3]**

c) A system occupying a volume V consisting of N_1 moles of A and N_2 moles of B. Show that number of accessible states at equilibrium are

$$\Omega_1 \Omega_2 = BV^{(N_1+N_2)}E^{3(N_1+N_2)/2}.$$ **[3]**

Q4) a) Show that black body radiation pressure is equal to one third of the energy density. **[4]**

b) Two macroscopic systems A & A' are in thermal interaction with each other forming combined system A^o, show that a thermal equilibrium is attained by two systems. **[3]**

c) Discuss the nature of trajectory in the phase space of simple harmonic oscillator. Show that area enclosed by the trajectory is equal to the product of total energy E and the time period T. **[3]**

Q5) a) A single molecule of mass m in a spherical enclosure of volume V has energy that can vary from 0 to E. Show that number of accessible microstates ϕ of the molecule is expressed by $\phi = \frac{4\pi V}{3h^3}(2mE)^{3/2}$, where h^3 is the volume of a phase cell in μ-space. **[4]**

b) Calculate the average potential energy of a molecule of an ideal gas in thermal equilibrium at absolute temperature T, contained in a cubical box of side L, the only external field acting on the gas being the earth's uniform gravitational field. **[3]**

c) Determine whether the electron gas in copper at room temperature is degenerate or non-degenerate. (Given: Concentration of electron in copper $= 8.5 \times 10^{28}/m^3$). **[3]**

Q6) a) State and discuss the behaviour of fermi function under the following condition: **[4]**

i) $\in = \mu$

ii) $\in < \mu$

iii) $\in > \mu$

b) Show that if the energy $\in$ depends on a generalised co-ordinates q and its conjugate momentum p in such a way that $\in \to \infty$ as p or $q \to \pm\infty$, the following generalization of equipartition theorem is valid $\left\langle q_i \frac{\partial \in}{\partial q_i} \right\rangle = KT$.

[3]

c) Deduce an expression for the value of 'u' for which the probability falls to 1/2 times the maximum value. **[3]**

Q7) a) Discuss the phenomenon of sharpness of probability distribution in statistical thermodynamics and show that the final width of maximum in P(E) is given by $\frac{\Delta^* E}{\bar{E}} = \frac{1}{\sqrt{f}}$. **[5]**

b) For grand canonical ensemble, show that probability of finding the system in a particular microstate '*r*' having energy E_r and number of particles N_r is given by $P_r = \frac{e^{-\beta E_r - \alpha N_r}}{\sum_r e^{-\beta E_r - \alpha N_r}}$. **[5]**

Q8) a) Obtain Maxwell-Boltzmann velocity distribution and hence show that root mean square velocity V_{rms}, mean velocity $\bar{v}$ and most-probable velocity $\tilde{v}$ are in the ratio $V_{rms} : \bar{v} : \tilde{v} \equiv \sqrt{3} : \sqrt{\frac{8}{\pi}} : \sqrt{2}$. **[5]**

b) Show that the value of single particle momentum corresponding to the fermi energy which is referred an Fermi momentum and is given by **[5]**

$$P_f = \hbar \left[\frac{6\pi^2 N}{(2s+1)V} \right]^{1/3}.$$

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Total No. of Questions : 8]

SEAT No. :

P3046

[Total No. of Pages :5

[4722] - 3002
M.Sc.
PHYSICS
PHYUT - 702 : Quantum Mechanics - II
(2014 Pattern - 4 credits) (Semester - III)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logtables and calculators allowed.***

Q1) a) What is harmonic perturbation? Explain forbidden transitions. **[4]**

b) What are symmetric and antisymmetric wave function? Construct antisymmetric wave function for two particle system. **[3]**

c) Using WKB approximation explain field emission. **[3]**

Q2) a) State and explain Fermi-Golden rule. **[4]**

b) Using Bohr quantization condition, obtain the energy for harmonic potential $V(x)=\frac{1}{2}mw^2x^2$. **[3]**

c) Show that in Laboratory frame and CM frame the energies are related as

$$E_{CM}=\left(\frac{m_2}{m_1+m_2}\right)E_{lab}$$ **[3]**

Q3) a) Discuss the collision of identical particles. **[4]**

b) Show that there is no stark effect in ground state of hydrogen atom. **[3]**

c) For rigid sphere of radius 'a', show that the total scattering cross-section is $\sigma=4\pi a^2$ **[3]**

Q4) a) Using trial wave function $\psi(r)=Ae^{-\alpha r}$, where α is variational parameter, estimate the ground state energy of hydrogen atom. **[4]**

P.T.O.

b) Prove the optical theorem

$$\sigma_t = \frac{4\pi}{K} \text{Imf}(0)$$

Where Imf(0) is the imaginary part of the forward scattering amplitude. **[3]**

c) Explain discrete lattice translation with detail. **[3]**

Q5) a) What is dipole approximation? State the selection rules for electric dipole transitions. **[4]**

b) What is Born Approximation? State conditions of validity of Born approximation. **[3]**

c) Obtain Slater determinant of N particle system. **[3]**

Q6) a) Define exchange operator P_{12} for identical particles labeled 1 and 2. Find its eigen values and hence define symmetric and antisymmetric wave functions. **[4]**

b) Using Born approximation, determine the effective cross-section of scattering for a spherical potential well

$$\begin{aligned} V(r) &= -V_0 \quad \text{for } r < a \\ &= 0 \quad\quad \text{for } r \geq a \end{aligned}$$

[3]

c) State the conditions for validity of WKB approximation. **[3]**

Q7) a) Discuss briefly the time dependent perturbation theory. Obtain transition amplitudes of 1st and 2nd order. **[5]**

b) State connection formulae in WKB approximation. Obtain expression for Transmission coefficient for potential barrier. **[5]**

Q8) a) Describe partial wave analysis of scattering and obtain expression for scattering amplitude. **[5]**

b) Using WKB approximation for a quantum well obtain Bohr quantization condition. **[5]**

Total No. of Questions : 8]

SEAT No. : ____

P3046

[4722] - 3002
M.Sc.
PHYSICS
PHYUT - 702 : Physics of Semiconductor Devices
(2014 Pattern - 4 credits) (Semester - III)

Time : 3Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any five questions out of eight.***
2) ***Draw neat labelled diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of log tables and electronic calculator is allowed.***

Q1) a) Show that intrinsic carrier density depends on the band-gap of a semiconductor under Thermal equilibrium. **[4]**

b) What do you mean by excess carriers? Derive the expression for generation of excess carrier life-time in terms of intrinsic carrier concentration. **[3]**

c) Draw a band-diagram showing density of states, Fermi-Dirac distribution function and carrier concentration for the following in thermal equilibrium. **[3]**

i) intrinsic semiconductor.

ii) n-type semiconductor.

iii) p-type semiconductor.

Q2) a) What is Hall Effect? Obtain an expression for Hall voltage across a semiconductor slab. **[4]**

b) What are drift and diffusion currents? Derive an equation for total current density. **[3]**

c) A 1cm long Si-bar of cross-section 10^{-6} cm^2 is doped with 10^{17} cm^{-3} phosphorous. Calculate the resistance of the bar. **[3]**

(Given electron mobility $\mu_n = 700 cm^2/sec$)

Q3) a) For one-sided abrupt p-n junction, obtain the following expression for width of the depletion region: **[4]**

$$W_{DP} + W_{DN} = \sqrt{\frac{2\varepsilon_s}{q}\left(\frac{N_A + N_D}{N_A N_D}\right)\psi_{bi}}$$

b) Explain: **[3]**

i) Zener breakdown

ii) Avalanche multipication

c) Explain the current - voltage characteristics which show the ideal and practical behaviour of a p-n junction diode under different bias conditions. **[3]**

Q4) a) Derive the expression for diffusion capacitance of a p-n junction at low frequency. **[4]**

b) Compare Schottky and p-n junction diodes. **[3]**

c) Calculate the built-in potential of an Si p-n junction with n-side donor concentration of $10^{17}/cm^3$ and p-side acceptor concentration of $2 \times 10^{17}/cm^3$. (Given intrinsic - carrier density $n_i = 1.5 \times 10^{10}/cm^3$ and thermal voltage at 300K = 0.0259 volt). **[3]**

Q5) a) Define the following parameters for a n-p-n bipolar transistor: **[4]**

i) Emitter injection efficiency.

ii) Base transport factor.

iii) Common - base current.

iv) Common - emitter current gain.

b) Give the significance of Gummel number. Derive the expression for electron current at the emitter in terms of the Gummel number of n-p-n transistor biased under common - base configuration. **[3]**

c) Obtain the relationship between breakdown voltages for an n-p-n transistor biased in common-base and common-emitter configuration. **[3]**

Q6) a) Discuss on-time and off-time of a switching transistor operating in the common emitter configuration. **[4]**

b) Explain following terms involved in the action of a power transistor: **[3]**

i) Quasi-saturation

ii) Conductivity modulation

c) Explain the working of a Junction-Field Effect Transistor. **[3]**

Define:

i) Drain resistance

ii) Transconductance

iii) Amplification factor

Q7) a) Based on the assumptions of thermionic emission theory, derive the following expression for total current-density. **[5]**

$$J_n = A^*T^2 \exp\left(-\frac{q\phi_{Bn}}{kT}\right)\left[\exp\left(\frac{qV}{kT}-1\right)\right]$$

b) Draw energy-band diagrams of metal contacts with p-type and n-type semiconductor under the following conditions: **[5]**

i) Thermal equilibrium.

ii) Forward bias.

iii) Reverse bias.

Q8) a) Based on the assumptions of diffusion Theory, derive the following expression for total current density: **[5]**

$$J_n \approx q\,\mu_n\,N_c\,\xi_m \exp\left(-\frac{q\phi_{Bn}}{kT}\right)\left[\exp\left(\frac{qV}{kT}\right)-1\right]$$

b) Describe any one method to measure barrier-heights of metal-semiconductor contacts. **[5]**

Total No. of Questions :7]

SEAT No. :

P3025

[Total No. of Pages :3

[4722] - 31
M.Sc.
PHYSICS
PHYUTN -701: Solid State Physics
(2008 Pattern) (Semester - III) (Old Course)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Q.1 is compulsory and solve any four questions from the remaining.***
2) ***Figures to the right indicate full marks.***
3) ***Draw neat diagrams wherever necessary.***
4) ***Use of logarithmic table and pocket calculator is allowed.***

Given:-

Rest mass of electron	$= 9.1\times10^{-31}$ kg
Charge of electron	$= 1.602 \times10^{-19}$c
Plank's constant	$= 6.626 \times10^{-34}$ J-s
Boltzmann constant	$= 1.38 \times10^{-23}$ J/K
Avogadro's number	$= 6.023\times10^{23}$/mole
Bohr magneton	$= 9.27 \times10^{-24}$ A-m^2
Permeability of free space	$= 4\pi \times10^{-7}$ H/m
Permittivity of free space	$= 8.85 \times10^{-12}$ C^2/N-m^2

Q1) Attempt any four of the following. **[16]**

a) A paramagnetic material has 6.02×10^{28} atoms/m^3 and its fermi energy is 11.63eV. Determine the Pauli's paramagnetic susceptibility.

P.T.O.

b) Atomic weight and density of iron are 55.847 and 7.87 $\times 10^3$ kg/m^3 respectively. If iron has a magnetic moment of 2.2 Bohr magneton, determine its spontaneous magnetization.

c) A superconducting lead has a critical temperature of 7.26K at zero magnetic field and a critical field of 8×10^5 A/m at OK. Find the critical field at 5K.

d) The density and atomic number of niobium are 8.57×10^3 kg/m^3 and 93, respectively. It has one conduction electron per atom. Calculate London penetration depth of niobium.

e) Find the lowest energy of an electron confined to a cubical box of side 1 Å.

f) Determine the value of Fermi function for an energy KT above the fermi energy.

Q2) a) Set up an equation of motion for momentum per electron and hence obtain an expression for ac electrical conductivity of a metal. **[8]**

b) Explain the paramagnetic phenomenon. Derive an expression for paramagnetic susceptibility using Langevin theory of paramagnetism. **[8]**

Q3) a) For an atom placed at a general lattice site, derive an expression for local field, E_{local}. explain each term in the expression. **[8]**

b) Distinguish between metals, semiconductors and isulators on the basis of band theory of solids. **[8]**

Q4) a) Explain the phenomenon of hysteresis and hysteresis curve on the basis of domain theory. **[8]**

b) Explain with the help of neat diagrams reduced, periodic and extended zone schemes of E-K representation. **[8]**

Q5) a) Give an account of the Weiss theory of ferro magnetism, Hence derive Curie-Weiss law. **[8]**

b) Explain Meissner effect in superconductors. **[4]**

c) State the Fermi-Dirac distribution function and discuss the effect of temperature on the distribution function. **[4]**

Q6) a) State and prove Bloch theorem. **[8]**

b) Derive London equation for superconducting state and obtain an expression for penetration depth. **[8]**

Q7) a) Explain the formation of energy gap on the basis of nearly free electron model. **[8]**

b) Prove that for the Kronig-Penney potential with $P << 1$, the energy of the lowest energy band at $k = 0$ is $E = \frac{h^2 p}{4\pi^2 ma^2}$. **[4]**

c) The dipole moment of a hydrogen chloride molecule is 3.3×10^{-30} C-m. Determine the actual amount of charge transfer from the hydrogen to chlorine atom when the seperation between hydrogen and chlorine nuclei is $1.28\ \text{Å}$. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P3047

[Total No. of Pages : 2

[4722]-4001
M.Sc.
PHYSICS
PHYUT-801 : Nuclear Physics
(2013 Pattern : 4 Credits) (Semester-IV)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions from the following.***
2) ***Draw neat figures wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables & calculator is allowed.***

Q1) a) Discuss the method used to determine the size of the nucleus. **[4]**

b) List the main components of the nuclear reactors & give their uses. **[3]**

c) Find the binding energy of $^{20}_{10}Ne$ nucleus.

Given $m_p = 1.007825$ amu, $m_n = 1.0086$ amu, $m_{ne} = 19.9924$ amu. **[3]**

Q2) a) Explain the process of β-decay, positran emission & electron capture. **[4]**

b) Write short note on: Nuclear electric quadrupole moment. **[3]**

c) Calculate the K.E. of α-partile in the following decay.

$$^{239}Pu \rightarrow {}^{235}U + {}^{4}He$$ **[3]**

Given - $M(^{239}Pu) = 239.052$ amu

$M(^{235}U) = 235.0439$ amu

$M(^{4}He) = 4.00260$ amu

Q3) a) Discuss the shell model of the nucleus. What are its merits & demerits? **[4]**

b) What is the principle of a bubble chamber? Discuss its construction & working. **[3]**

P.T.O.

c) Calculate the thickness of the depletion layer of silicon detector of active area 1.6 cm^2. The capacitance of the detector is 100 PF & the dielectric constant of silicon is 12. What is the amplitude of the voltage pulse developed across this detector, when ^{16}O ion of 12 Mev is completely stopped in it? Energy required to create one electron-hole pair is 3.2 ev.

Given: Permittivity of free space $\in_0 = 8.85 \times 10^{-12}$ **[3]**

Q4) a) Discuss the proton-proton scattering at low energies. **[4]**

b) Write a note on spin dependence of n-p interaction. **[3]**

c) Evaluate the fermi energy of a typical nucleus, and use the results to determine the depth of the net nuclear potential. **[3]**

Q5) a) What is a nuclear reaction? Discuss various laws in nuclear reactions. **[4]**

b) When 1 gm of ^{235}U undergoes fission, related 2.3×10^4 kW-hr amount of energy. How much coal should be burnt to get same? **[3]**

c) In a mass spectrometer, singly charged ions are avaluated through a potential difference of 2000 volts. It then travels through a uniform magnetic field of 1000 gauss & are deflected into a circular path of 20cm in radius. What is the velocity of the ions? **[3]**

Q6) a) Describe the principle & working of cloud chamber. **[4]**

b) Describe Lithium drifted Si(Li) detector. **[3]**

c) Explain spark chamber with the help of suitable diagram. **[3]**

Q7) a) What is microtran? Give constructional detail of microtran. Explain its working & theory. **[5]**

b) Discuss the principle, construction & working of Ge(Li) detector. Give its main advantages over other detector. **[5]**

Q8) a) Determine whether the following reactions are allowed or forbidden. **[5]**

i) $K^- + n \rightarrow \Sigma^0 + \pi^-$

ii) $p^- + p \rightarrow \pi^- + \pi^+ + \pi^0 + \pi^- + \pi^+$

b) What are quarks? Explain the various types of quarks along with their properties. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P3048

[Total No. of Pages :3

[4722] - 4002
M.Sc.
PHYSICS
PHY UT - 802 : Materials Science
(2013 Pattern - 4 Credits) (Semester - IV)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Draw neat diagrams whenever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table and calculator is allowed.***

Constants:

1)	***Boltzmann constant***	$K_B = 1.38 \times 10^{-23}$ ***J/K***
2)	***Avogadro's number***	$N = 6.023 \times 10^{23}$***/gm-mole***
3)	***Gas constant***	***R = 8.314 J/mole-K***
4)	***Charge on electron***	$e = 1.6 \times 10^{-19}$***C***

Q1) a) Describe Frank-Read Generator for the multiplication of dislocation. **[4]**

b) Explain Fick's first and second law of diffusion. **[3]**

c) Generate auxillary thermodynamic functions by Legendre transformation. **[3]**

Q2) a) The diffusivity of aluminium in copper is 2.6×10^{-17} m^2/s at 500ºC and 1.6×10^{-12} m^2/s at 1000ºC. Determine Do and activation energy E for this diffusion couple. Also calculate diffusivity at 750ºC. **[4]**

b) Explain Gibb's phase rule with binary invariant system. **[3]**

c) With the help of neat diagram explain lever rule. **[3]**

Q3) a) Explain the conditions for the solution to be exhibit an Raoultian ideal solution. **[4]**

b) With the help of neat diagram explain miscibility gap in two-phase regions. **[3]**

c) When aluminium cooled rapidly from 650ºC, ρ_{A1} = 2.698 Mg/m^3. Compare the value with the theoretical density obtained from the lattice constant a = 0.4049nm. Hence obtain vacancies per unit cell.

[Given: A1 in FCC. Atomic weight of Al = 26.98 amu] **[3]**

P.T.O.

Q4) a) With the help of neat diagram explain Type II (eutectic type) phase diagram. Also write one example. **[4]**

b) A 50 mm gage length is marked on copper rod. The rod is strained so that the gage marks are 59mm apart. Calculate the strain. **[3]**

c) Explain Vegard's low for solid solution. **[3]**

Q5) a) Explain five different invariant equations with the help of neat diagram. **[4]**

b) Define the following terms: **[3]**

Specific heat, Thermal conductivity, coefficient of thermal expansion.

c) At 1000ºC, there can be 1.7 w/o carbon is solid solution with FCC iron. How many carbon atoms will there be for every 100 unit cells? **[3]**

[Given:Atomic weight of Fe = 55.85 amu

Atomic weight of C = 12.01 amu]

Q6) a) Explain Hume-Rothery rule with examples. **[4]**

b) Draw a flow chart of defects. **[3]**

c) What do you mean by Type I, II and III phase diagrams. **[3]**

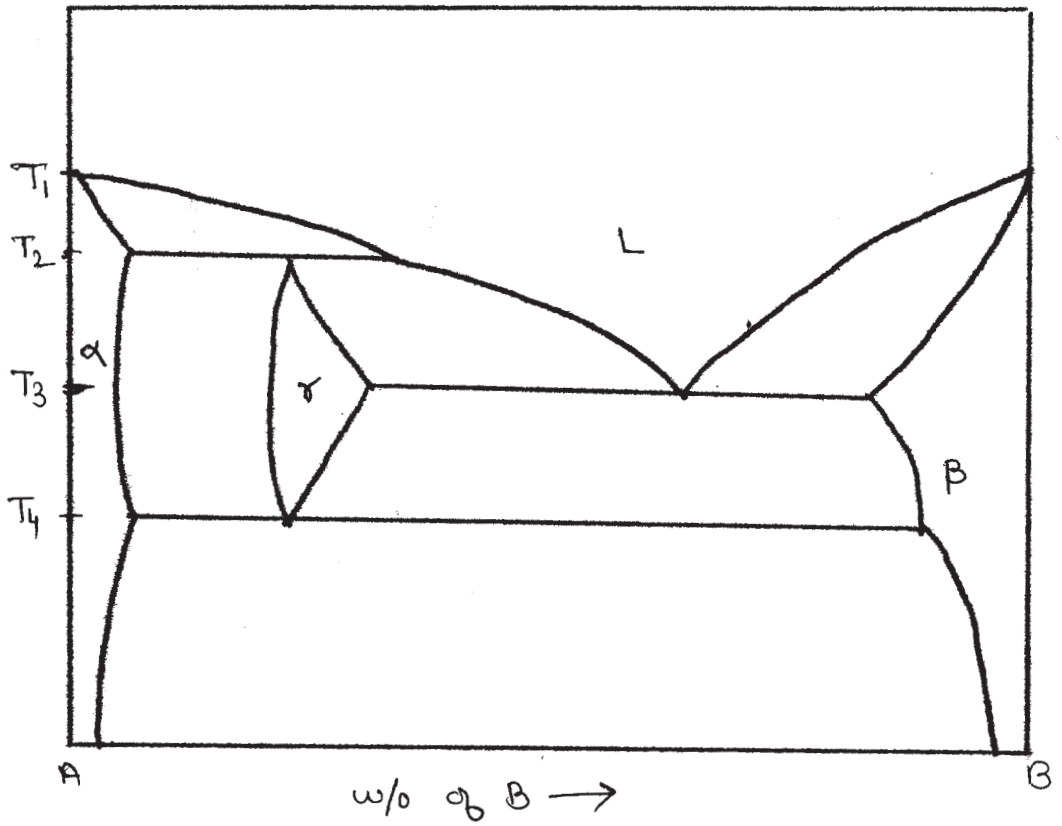
Q7) a) What is solid solution? Explain interstitial and substitutional solid solution with an example. **[5]**

b) Consider two solids A and B which are unmixed in state 1 and mixed in state 2. Calculate the change in entropy when solution is ideally mixed. **[5]**

Q8) a) What is Frenkel defect? Obtain an expression for equilibrium concentration of Frenkel defect in crystals. **[5]**

b) In the phase diagram given below, mark various phase fields.

Also write invariant equation and type of invariant equation corresponding to Temperature T_3. **[5]**



Total No. of Questions : 7]

SEAT No. :

P3026

[Total No. of Pages :3

[4722] - 41
M.Sc.
PHYSICS
PHY UTN- 801: Nuclear Physics
(2008 Pattern) (Old Course) (Semester - IV)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Question No. 1 is compulsory, attempt any four questions from the remaining.***
2) ***Draw neat figures wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables & calculator is allowed.***

Q1) Attempt any four of the following.

a) In a Bainbridge & Jordan mass spectrograph singly ionized atoms of mean-20 passed into the deflection chamber with a velocity of 10^5m/s. They are deflected by a magnetic field of flux density 8×10^{-2} Tesla. Calculate the radius of their path. (Mp = 1.67×10^{-27} kg). **[4]**

b) Find the energy release, if two $_1H^2$ nuclei can fuse together to form $_2He^4$ nucleus the binding energy per nuclean of $_1H^2$ & $_2He^4$ is 1.1 Mev & 7 mev respectively. **[4]**

c) Which of the following reactions are allowed or forbidden under the conservations of strangeness (S), Baryan number (B) & charge (Q). **[4]**

i) $\pi^+ + n \rightarrow \Lambda^o + K^+$

ii) $\pi^+ + n \rightarrow \bar{K}_o + \Sigma^+$

iii) $\pi^+ + n \rightarrow K^o + K^+$

iv) $\pi^+ + n \rightarrow \pi^- + P$

d) In a certain Beta tran the maximum magnetic field was 4000 gauss, operating at 50 cycle/sec. With a stable orbit diameter of 60 inches. Calculate average energy gained per revolution & the final energy of the electrons. **[4]**

P.T.O.

e) Calculate the total cross section for n-p scattering at neutron energy 2 Mev. **[4]**

Given: $a_t = 5.38$, $a_s = -23.7$

$r_{ot} = 1.70F$, $r_{os} = 2.40F$

f) Calculate maximum energy of Compton recoil electrons resulting from the absorption in Al of 2.19Mev γ-lays (Given: $m_o = 9.109 \times 10^{-31}$ kg). **[4]**

Q2) a) Explain the concept of nuclear magnetic moment & show that **[8]**

$$\therefore \mu = \mu_s + \mu_l$$

$$= \frac{\mu_o l}{2m}\left(g_s.s + g_l \cdot l\right)$$

b) What is straggling? Derive the formula for straggling when a charged particle is moving through the matter. **[8]**

Q3) a) Explain the working of proportional counter. State its advantages & applications. **[8]**

b) What are quarks? Explain how quarks are treated as building blocks & hadrans & mesons. **[8]**

Q4) a) With the help of partial wave analysis for low energy n-p scattering **[8]**

Show that: $\sigma_o = \frac{4\pi}{k^2}\sin^2 f_o$

where symbols have usual meanings.

b) Explain important features of Gamow's theory of α-decay. **[8]**

Q5) a) Discuss the theory of Microtran. Show that the increase in energy after each orbit is given by $\Delta E = \frac{E_o \upsilon}{\mu - \upsilon}$. **[8]**

where symbols have their usual meanings.

b) For p-p scattering at low energies, derive an expression for differential Cross-section in laboratory system. **[8]**

Q6) a) Explain the multiple radiation in case of γ decay. State the selection rule. **[8]**

b) Write a note on: Graphite-Moderated Research Reactor. **[4]**

c) What is meant by strangeness number of elementary particles. **[4]**

Q7) a) State assumptions of Fermi theory of β-decay. Find the probability of emission of $\bar{e}$ per unit time. **[8]**

b) Discuss four interactions among the elementary particles. **[8]**

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Total No. of Questions : 6]

SEAT No. :

P2975

[Total No. of Pages : 3

[4723]-1001

M.Sc.

PHYSICAL CHEMISTRY

CHP- 110: Fundamentals of Physical Chemistry -I

(2013 Pattern) (Semester - I) (New)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer book.***
2) ***All questions are compulsory.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of logarithmic table/calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2)	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3)	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4)	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Attempt the following: **[10]**

a) Explain the concept of partial molar volume.

b) State the clausius statement of the second law of thermodynamics.

c) Explain the applications of the zeroth law of thermodynamics.

d) Explain the threshold frequency concept for observing photoelectric effect.

e) State Euler's theorm. compare state and path functions.

Q2) Attempt any two of the following: **[10]**

a) Show that, as $n \to \infty$, $\Delta E \to O$.

b) Explain vant Hoff isochore.

c) Derive the Gibbs-Duhem equation.

d) State and explain the schrodinger one dimensional equation.

Q3) Solve any one of the following: **[5]**

a) A ng particle travels a Mm in a ms. Calculate its de Broglie wavelength.

b) 17 g hydrogen gas is mixed with 12g helium gas at 300k. Find the entropy change. [At. wts. H = 1, He =4]

SECTION - II

Q4) Attempt the following: **[10]**

a) What will be the rate constant of a reaction if $T \to \infty$ (where T is temperature).

b) What will be the effect of increase in ionic strength on the rate constant of each of the following reactions.

i) $[P_t (NH_3)_3 Cl]^+ + NO^-_2$

ii) $[P_t Cl_4]^{2-} + O\bar{H}$ and

iii) $[P_t (NH_3)_2 Cl_2] + O\bar{H}$

c) Give weakness of collision theory.

d) What are consecutive reactions?

e) Give advantages of stopped-flow technique.

Q5) Attempt <u>any two</u> of the following: **[10]**

a) Derive Michaelis-menten equation for enzyme catalyzed reactions.

b) Derive an equation for the velocity constant of a bimolecular reaction on the basis of absolute reaction rate theory.

c) Derive the Boltzmann distribution law for a degenerate system.

d) Discuss relaxation method to study fast reactions.

Q6) Solve <u>any one</u> of the following: **[5]**

a) 75% of reaction of the first order was completed in 32 min, when was it half complete?

b) Calculate the partition function for translational motion of N_2 molecules free to move along one dimension of a one litre cubic container at 25°C [At. wt. N = 14].

EEE

Total No. of Questions : 6]

SEAT No. :

P2976

[Total No. of Pages : 3

[4723]-1002
M.Sc. (Part-I)
INORGANIC CHEMISTRY
CHI-130 : Inorganic Chemistry-I
Molecular Symmetry and Chemistry of P-Block Elements
(2013 Pattern) (Semester-I) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Neat and labelled diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***

SECTION-I

Q1) Answer the following: **[10]**

a) List out the subgroups of D_{2h} point group.

b) Find out the product of $\sigma_{v(xz)} \times \sigma_{v(yz)}$ symmetry operations using matrix multiplication method.

c) Identify and draw different types of planes present in CO_3^{2-} ion.

d) Write down all the associative operations with S_6 axis.

e) Characters of a few symmetry operations are given below. Identify the character of the irreducible representation A_{2g}'.

	E	C_n	C_2	i	σ_h
I	1	1	1	–1	–1
II	1	1	–1	1	1
III	1	–1	–1	1	1
IV	1	1	–1	–1	1

P.T.O.

Q2) Attempt Any Two of the following: **[10]**

a) Define abelian group. Explain an abelian group with example.

b) Classify any two of the following molecules / ions into appropriate point group. Justify your answer.

i) $SiCl_4$

ii) N_3^-

iii) $[Co\ (en)_3]^{3+}$

c) Using great orthogonality theorem derive the character table for D_2 point group.

d) Sketch and describe all the S_4 operations in trans - $[Co\ (NH_3)_4\ Cl_2]$

Q3) Attempt Any One of the following: **[5]**

a) For PF_5 molecule find out reducible representation for which sigma bonds form the basis and find out which of the orbitals from the P atom will be offered for σ-bonding.

Given: Character table for D_{3h} point group-

D_{3h}	E	$2C_3$	$3C_2$	σ_h	$2S_3$	$3\sigma_v$		
A_1'	1	1	1	1	1	1		$x^2 + y^2, z^2$
A_2'	1	1	–1	1	1	–1	Rz	
E'	2	–1	0	2	–1	0	(x, y)	$(x^2 - y^2, xy)$
A_1''	1	1	1	–1	–1	–1		
A_2''	1	1	–1	–1	–1	1	z	
E''	2	–1	0	–2	1	0	(Rx, Ry)	(xz, yz)

b) Find out the normalized SALC using projection operator of Eu irreducible representation on σ_1 of the $[Pt\ Cl_4]^{2-}$ ion.

Given-

D_{4h}	E	$2C_4$	C_2	$2C_2'$	$2C_2''$	i	$2S_4$	σ_h	$2\sigma_v$	$2\sigma_d$
Eu	2	0	–2	0	0	–2	0	2	0	0

SECTION-II

Q4) Answer the following: **[10]**

a) Give classification of molecular hydrides.

b) Mention the types of crown ethers used for separation of alkali and alkaline earth metals.

c) Mention the different allotropes of carbon.

d) Explain the various processes used for activation of nitrogen.

e) Mention different types of interhalogen compound.

Q5) Attempt Any Two of the following: **[10]**

a) Write note on pseudohalogens.

b) Give an account of molecular sieves.

c) Give an account of hydrides of boron.

d) Write note on phosphazenes.

Q6) Attempt Any One of the following: **[5]**

a) Explain the structure and bonding in

i) P_4O_{10}

ii) B_2H_6

OR

a) Draw the following structures

i) IF_7

ii) $B_3N_3H_6$

iii) N_2O_5

iv) $S_4N_4SO_3$

v) $Li_4(CH_3)_4$

●●●●●

Total No. of Questions : 6]

SEAT No. :

P2977

[Total No. of Pages : 4

[4723]-1003
M.Sc. - I
ORGANIC CHEMISTRY
CHO- 150: Organic Reaction Mech. & Stereochemistry
(2013 Pattern) (Semester - I)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right side indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

Q1) Attempt any three of the following: **[9]**

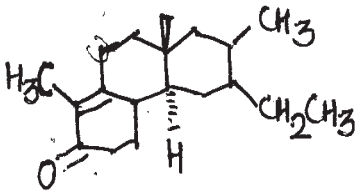
a) Picric acid is 93 times acidic than phenol.

b) Explain Hard and soft acids & bases.

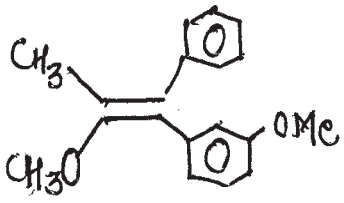
c) Give the statement of Hiickel rule. What is it's significance?

d) Assign E/z configurational labels to the following.

(i)



(ii)



Q2) a) Write short notes on(any two): **[4]**

i) Structure and stability of nitrenes.

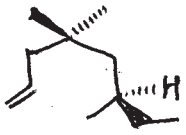
ii) Diastereomeric relationship.

iii) Regioselective reactions.

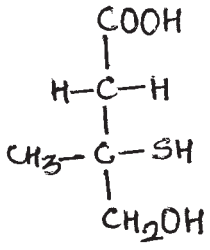
P.T.O.

b) Assign R/S configurational labels to the following. **[4]**

(i)



(ii)

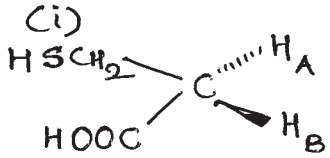


Q3) Attempt any four of the following: **[8]**

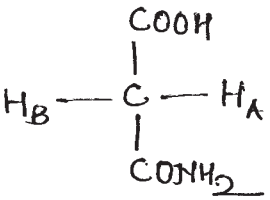
a) Draw all possible conformations of 1-methyl-4-t- butyl cyclohexane. Comment on their optical activities.

b) Assign Pro-R and Pro-S labels to H_A and H_B.

(i)

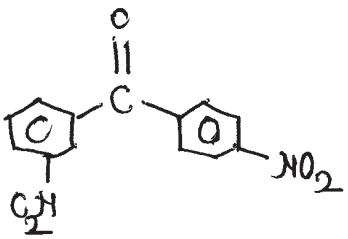


(ii)



c) Assign Re/Si face labels to the following.

(i)



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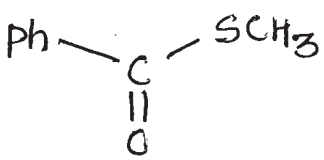
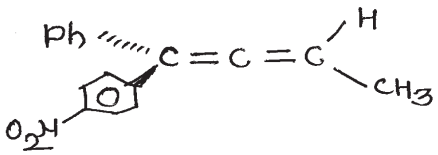


d) Comment on optical activity of the following with justification.



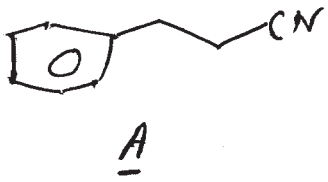
e) Comment on aromaticity of the following.

SECTION - II

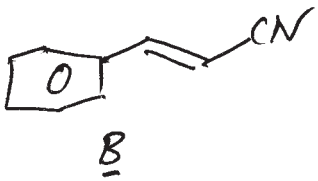
Q4) Attempt any three of the following: **[9]**

a) Give an account of SNi reaction with suitable examples.

b) Compound A undergoes electrophilic substitution predominently at ortho and para position, while compound B undergoes the same at meta position. Explain.



A



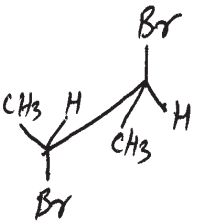
B

c) Neomenthyl chloride on treatment with $\overset{\ominus}{E}to\ \overset{\oplus}{N}a$ / EtoH gives two products. Justify.

d) Catalytical hydrogenation of cis-2, 3-diphenylbutene yields meso-2, 3-diphenylbutane, while the trans isomer yields a dl isomer. Explain.

Q5) Suggest the mechanism(Any four): **[8]**

a) Erythro $CH_3-CH(Br)-CH(OH)-CH_3 \xrightarrow{HBr}$



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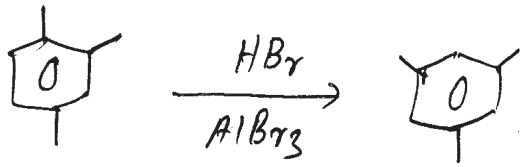

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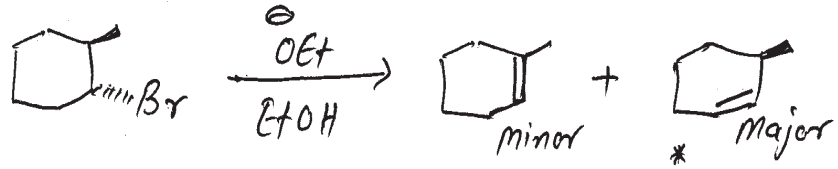
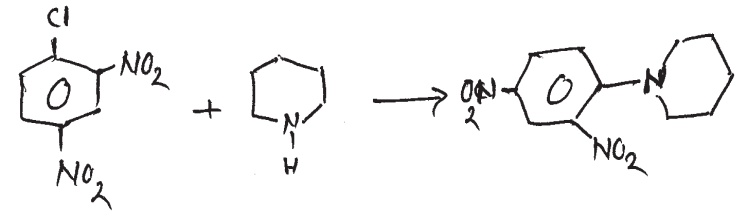
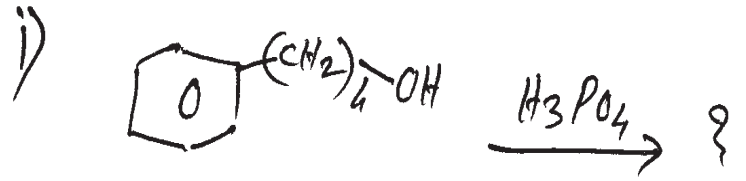
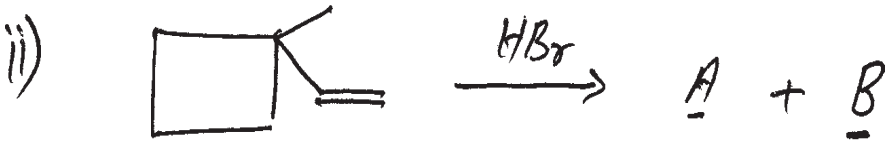


d)

e) 

Q6) a) Predict the products. **[4]**

i) 

ii) 

b) Attempt <u>any</u> <u>two</u>: **[4]**

i) 2-chloropyridine reacts with phenol in presence of alkali to yield an ether, whereas 3- chlorophenol gives no corresponding reaction. Explain.

ii) Effect of solvent on SN1 reaction.

iii) A short note on E1cB mechanism.

EEE

Total No. of Questions : 6]

SEAT No. :

P2978

[Total No. of Pages :2

[4723] - 1004
M.Sc. -I
CHEMISTRY
CHA-190: Safety in Chemical laboratory and Good Laboratory Practices
(Credit system) (2013 Pattern) (Semester - I)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answer to two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Neat diagram must be drawn wherever necessary.***

SECTION - I

Q1) Attempt the following: **[10]**

a) Give the contents of first -Aid kit.

b) Why is safety and security required in laboratory?

c) Enlist the personal safety materials used in the laboratory.

d) What is inventory management?

e) What is chemical accident drills?

Q2) Answer any two of the following: **[10]**

a) What is the strategy used for disposal of hazardous materials?

b) Give the different types of fire extinguishers and method of their use.

c) What is the importance of safety & health in the laboratory?

P.T.O.

Q3) Answer any one of the following. **[5]**

a) Explain the general safety rules used in the laboratory.

b) What will you do when following wrong things happened with person such as spills, injuries and fire?

SECTION - II

Q4) Attempt the following: **[10]**

a) What is mean by GLP?

b) Explain dry CO_2 fire extinguisher.

c) What are the OSH_A laboratory standards?

d) How to read the chemical lables?

e) Define the term pictogram.

Q5) Answer any two of the following: **[10]**

a) What are the reasons for fire accidents? What are the precautions to be taken to avoid them?

b) What are the general guidelines for chemical storage?

c) Write a short note on SOP's.

Q6) Answer any one of the following: **[5]**

a) What is the procedure used for the maintenance of lab record according to GLP?

b) Sketch and lable the structure of safety chemistry laboratory as per the safety rules. Explain it in brief.

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Total No. of Questions : 6]

SEAT No. :

P2937

[Total No. of Pages : 3

[4723]-101
M.Sc.
PHYSICAL CHEMISTRY
CH- 110: Physical Chemistry -I
(2008 Pattern) (Semester - I)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of logarithmic table/calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2)	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3)	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4)	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Attempt any three of the following: **[15]**

a) Explain the experimental evidence of Heisenberg's uncertainty principle.

b) State zeroth law of thermodynamics and explain its applications.

c) Write the expression for energy of particle in a three dimensional box. Explain the degenaracy of energy levels in the cubical box.

d) What is clausius inequality? How does it lead to the concept of Gibbs and Helmholtz free energy?

e) State the corrolary of the third law of thermodynamics. Explain unattainability of absolute zero temperature.

Q2) Attempt any three of the following: **[15]**

a) What are partial molar quantities? Explain any one method to determine partial molar quantity.

b) State and explain Raoult's law and Henry's law giving limitations of both.

c) Derive vant Hoff isochore. Give its applications.

d) Define chemical potential. Derive the expression for the change in free energy of mixing of an ideal gases.

e) Explain what are colligative properties. How is osmotic pressure measured?

Q3) Solve any two of the following: **[10]**

a) The work function of sodium is 1.82 eV. Determine its threshold frequency.

b) Calculate the number of photons by a mW bulb emanating 700 nm light in one hour.

c) Calculate the osmotic pressure at $25^{o}C$ for a solute concentration of 0.5 mol per litre in a body cell that is impermeable to the solute molecules.

SECTION - II

Q4) Attempt any three of the following: **[15]**

a) How does the concentration of intermediate be obtained for the reaction $A \longrightarrow B \longrightarrow C$?

b) Obtain the expression for second order reaction when the concentration of the reactants is same.

c) For a reaction $A \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} B$, show that $K_c = \frac{[B]_{eq}}{[A]_{eq}}$ where $[B]_{eq}$ and $[A]_{eq}$ are the equilibrium concentrations of product and reactant respectively.

d) Derive Michaelis-Menton equation for enzymatic reactions.

e) Discuss any two methods to obtain order of a reaction.

Q5) Attempt any three of the following: **[15]**

a) Explain the mechanism of explosive reactions.

b) Derive the expression for total partition function for a molecule.

c) Discuss Base-Einstein statistics.

d) For the following reaction $\begin{matrix} A \xrightarrow{k_1} B \\ A \xrightarrow{k_2} C \end{matrix}$ determine [B] / [C].

e) Explain stirling approximation and thermodynamic probability. Obtain the condition for maximum probability.

Q6) Solve any two of the following: **[10]**

a) For a first order reaction, it was observed that 90% of reactant reacts in 1.55 h. Calculate specific reaction rate and one third life of the reaction.

b) The moment of inertia of a rigid diatomic molecule is 4.6×10^{-47} kgm^2. Determine rotational partition function at 35°C.

c) Calculate the vibrational partition function at 300K and 500K when vibrational frequency of the diatomic molecule is 1500 cm^{-1}.

EEE

Total No. of Questions : 6]

SEAT No. :

P2938

[Total No. of Pages :4

[4723] - 102
M.Sc. (Part - I)
CHEMISTRY
CH - 130 : Inorganic Chemistry - I
(2008 Pattern) (Semester - I)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All the questions are compulsory.***
2) ***Answer to the two section should be written in separate answer books.***
3) ***Neat and labelled diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***

SECTION - I

Q1) Attempt any three of the following: **[15]**

a) Discuss the symmetry operations of molecules having following point groups (any two)

i) D_3h

ii) C_2V

iii) D_4h

b) Define plane of symmetry. Explain different types of planes of symmetry using PCl_5 molecule.

c) By schematic representations, give the products of following symmetry operations (any two):

i) $C_3 \times C_3^{-1}$

ii) $C_3 \times \sigma V_1$

iii) $\sigma V_2 \times \sigma V_3$

d) Develop stereographic projections for the following molecules & justify your answer:

i) $C_5H_5^-$

ii) $Pt\ Cl_4^{2-}$

P.T.O.

Q2) Attempt <u>any three</u> of the following: **[15]**

a) Classify <u>any two</u> of the molecules into appropriate point group and justify your answer

i) CO_3^{2-}

ii) SO_2

iii) BH_3

b) Give the matrix representation for C_2^z and σ_n^{xy} and prove that $S_2 = i$ using matrix multiplication method.

c) What are the conditions of a mathematical group? Explain them using C_2V point group.

d) Find out the normalized SALC using projection operator of Eu irreducible representation operating on σ_1 orbital of the $[pt\ Cl_4]^2$ ion

D_4h	E	$2C_4$	C_2	$2C_2^1$	$2C_2^{11}$	i	$2S_4$	σ_h	$2\sigma_v$	$2\sigma_d$
Eu	2	0	–2	0	0	–2	0	2	0	0

Q3) Attempt <u>any two</u> of the following: **[10]**

a) Give the general matrices for the following symmetry operations.

i) E

ii) i

iii) C_n^z

iv) σ_n^{xy}

v) C_2^z

b) Fill in the missing entries in the character table given below and label the irreducible representations with the appropriate Mulliken symbol. E is identify, A, B, C and D represent certain symmetry operations.

	E	2A	B	2C	2D
T_1	1	1	1	1	1
T_2	1	...	1	–1	–1
T_3	1	–1	1	1	–1
T_4	1	–1	1	...	1
T_5	...	0	...	0	0

c) Explain Miller indices. Draw (2 1 0), (1 1 1) and (0 0 1) planes in cubic system.

SECTION - II

Q4) Attempt any three of the following: **[15]**

a) Give characteristic reactions of dihydrogen.

b) What are different types of Crown ethers? Explain the separation of alkali and alkaline earth metals by using crown ethers.

c) Give an account of electron precise compounds.

d) What are aluminosilicates?

e) Give an account of oxides of nitrogen.

Q5) Write notes on any three: **[15]**

a) Fullerene.

b) Phosphazenes.

c) Interhalogen compounds.

d) Solution of alkali metals in liquid ammonia.

e) Borazoles.

Q6) a) Draw <u>any five</u> structures: **[10]**

i) $B_3N_3H_3Cl_3$

ii) IF_7

iii) $Xe_2\ O_2F_2$

iv) P_4O_6

v) $S_4N_4F_4$

vi) $Al_2\ Ph_2\ Et_4$

OR

a) Complete <u>any five</u> reactions: **[10]**

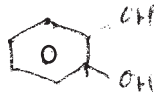
i) $As(CH_3)_2\ Br + Zn \rightarrow ?$

ii) $B_2H_6 + BH_3 \rightarrow ? + H_2$

iii) $XeF_{6\ (s)} + SiO_{2\ (s)} \rightarrow ? + ?$

iv) $LiH + BF_3 \rightarrow ? + ?$

v) $COCl_2 + RNH_2 \rightarrow ?$

vi)  $+ BR_3 \xrightarrow{\Delta} ?$

Total No. of Questions : 6]

SEAT No. :

P2939

[Total No. of Pages :4

[4723] - 103
M.Sc. - I
ORGANIC CHEMISTRY
CH-150: Organic Reaction Mechanism and Stereo Chemsitry
(2008 Pattern) (Semester - I)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right side indicates full marks.***
3) ***Answers to the two sections should be written in the separate answer books.***

SECTION - I

Q1) Attempt any four of the following. **[16]**

a) Why cyclooctatetraene is nonaromatic compound?

b) Generally anti eliminations occur readily than syn eliminations. Explain.

c) Electrophilic substitution of 2-methyl naphthalene takes place at 1-position. Justify.

d) Benzyl bromide undergoes hydrolysis easily than Bromobenzene under same conditions. Why?

e) Addition of Bromine to propene is an exothermic reaction, whereas for benzene, it is an endothermic.

Q2) Write short note on any three of the following. **[12]**

a) Catenanes.

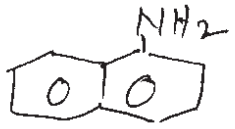
b) Pyrolytical elimination.

c) Neighbouring Group participation.

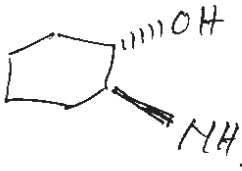
d) Factors affecting strength of bases.

P.T.O.

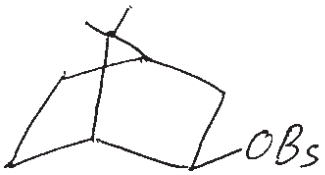
Q3) Predict the product with mechanism.(Any three). **[12]**

a) 

$\xrightarrow[H_2O]{Br_2}$?

b) 

$\xrightarrow[HCl]{NaNO_2}$?

c) 

$\xrightarrow{AcOH}$?

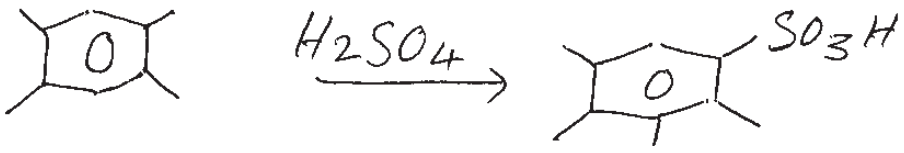
d) $Cl-CH_2-CH_2-OH$ $\xrightarrow[ii)\ CH_3MgBr/H_3O^{\oplus}]{i)\ KOH}$?

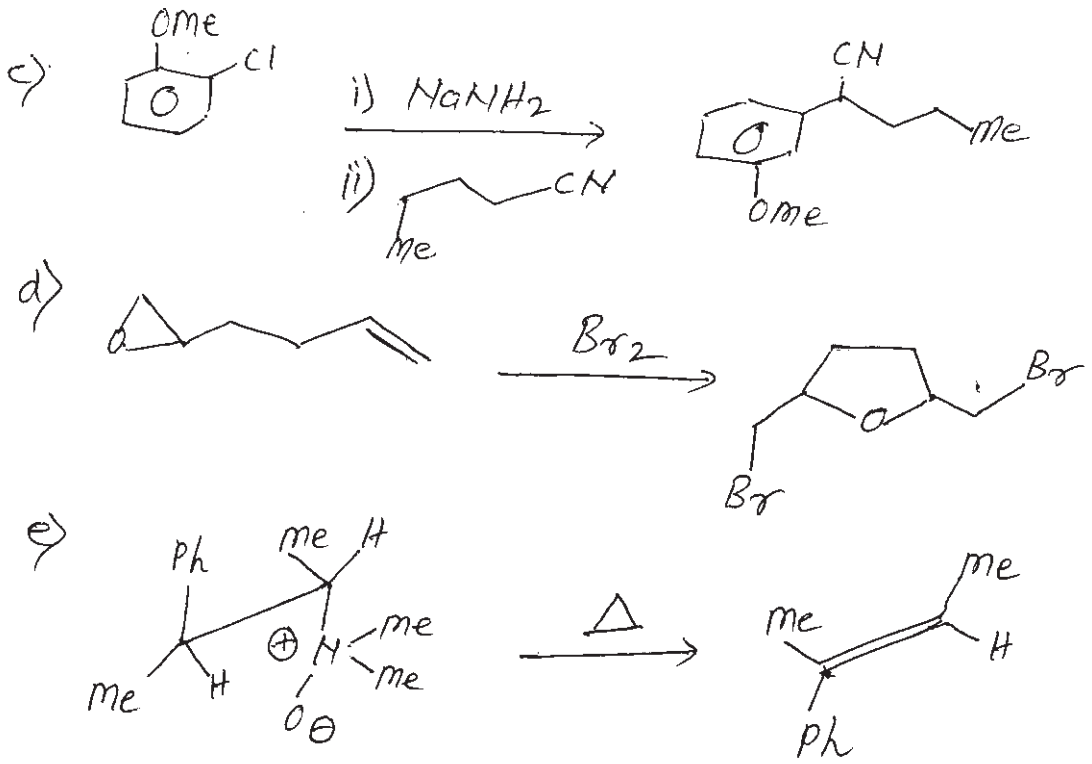
SECTION - II

Q4) Suggest mechanism for any four of the following. **[12]**

a) 

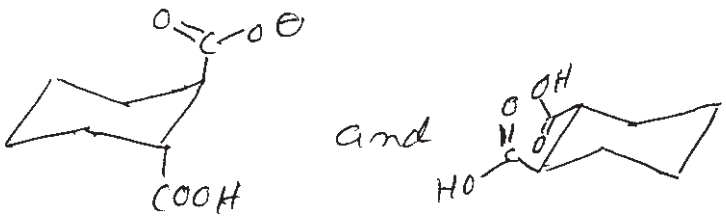
$\xrightarrow[Pyridine]{SOCl_2}$?

b) 



Q5) Attempt any four of the following. **[12]**

a) Predict which member in the following pair is more acidic. Justify.



b) Give brief account of "Ortho Effect" in SN reactions.

c) The propertion of gauche conformation of ethylene glycol is more than expected. Explain.

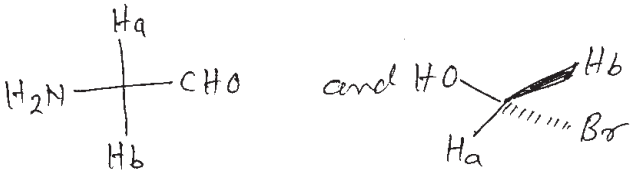
d) One of the isomers of hexachlorocyclohexane undergoes dehydro chlorination at very very slow rate as compared to the other isomers. Explain.

e) $C_6H_5COCH_2Cl$ reacts with KI in acetone about 32000 times faster than n-butyl chloride.

Q6) Attempt any eight of the following. **[16]**

a) Assign E/Z designation to the following compounds:

b) Assign pro R/S designation to the followig molecules.

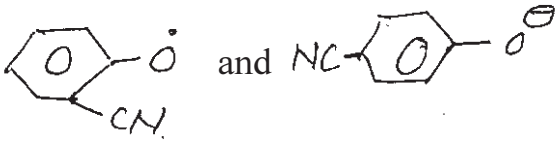


c) Explain with suitable example Re and Si faces.

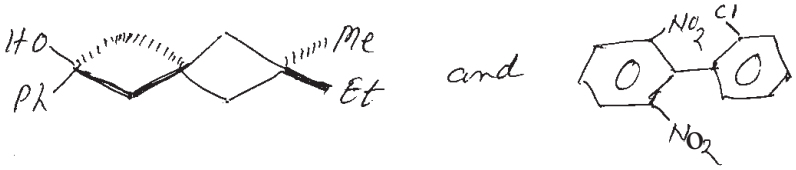
d) Define atropisomerism with suitable example.

e) Why pyrrole is stronger acid than pyrrolidine?

f) Explain stability of 

g) Draw resonance structures for 

h) Which of the following is optically active? Justify.



i) Lable the stereocentres and calculate the number of stereoisomers in the following molecules.

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Total No. of Questions : 6]

SEAT No. :

P2979

[Total No. of Pages :6

[4723] - 2001

M.Sc.

PHYSICAL CHEMISTRY

CHP- 210 : Physical Chemistry - II

(Semester - II) (2013 Pattern)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of logarithmic table calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

Physico-Chemical Constants

1.	Avogadro Number	N	=	$6.022 \times 10^{23} mol^{-1}$
2.	Boltzmann Constant	K	=	1.38×10^{-16} erg K^{-1} $molecule^{-1}$
			=	1.38×10^{-23} J K^{-1} $molecule^{-1}$
3.	Planck Constant	ħ	=	6.626×10^{-27} erg s
			=	6.626×10^{-34} JS
4.	Electronic Charge	e	=	4.803×10^{-10} esu
			=	1.602×10^{-19} C
5.	1 eV		=	23.06 k cal mol^{-1}
			=	1.602×10^{-12} erg
			=	1.602×10^{-19} J
			=	8065.5 cm^{-1}
6.	Gas Constant	R	=	8.314×10^{7} $ergK^{-1}$ mol^{-1}
			=	8.314 J K^{-1} mol^{-1}
			=	1.987 cal K^{-1} mol^{-1}
7.	Faraday Constant	F	=	96487 C $equiv^{-1}$
8.	Speed of light	c	=	2.997×10^{10} cm s^{-1}
			=	2.997×10^{8} m s^{-1}
9.	I cal		=	4.184×10^{7} erg
			=	4.184 J
10.	I amu		=	1.673×10^{-27} kg
11.	Bohr magneton	β_e	=	-9.274×10^{-24} J T^{-1}
12.	Nuclear magneton	β_n	=	5.051×10^{-27} J T^{-1}
13.	Mass of an electron	m_e	=	9.11×10^{-31} kg

P.T.O.

SECTION - I

Q1) Attempt the following: **[10]**

a) Write and explain the expression for the width of a spectral line.

b) What is the significance of force constant. Give its unit.

c) State the rule of the converse of mutual exclusion principle.

d) Write the expression for resolving power of FT-IR spectrophotometer.

e) Give the conditions for fluorescence.

Q2) Attempt any two of the following: **[10]**

a) Explain the applications of Mössbauer spectroscopy.

b) Write the expression for Morse function and explain the following for Harmonic and Anharmonic Oscillators: Selection rule, zero point energy and energy equation.

c) Compare the classical and quantum theories of the Raman effect.

d) Write a note on Fortrat diagram.

Q3) Solve any one of the following: **[5]**

a) The energy change in a transition is 4.00×10^{-22} J molecule^{-1}. Calculate number of molecules in the excited state at 27ºC, if there are 1000 molecules in the ground state.

b) The fundamental vibrational frequency for HCl is 2886cm^{-1}, and first overtone is 5668cm^{-1}. Calculate anharmonicity constant and equilibrium vibrational frequency.

SECTION - II

Q4) Attempt the following: **[10]**

a) Draw a graph showing the effect of applied voltage on current pulse height for detection and measurement of radioactivity.

b) Define the terms:

i) tracks and

ii) spurs.

c) Write a short note on excess reactivity.

d) Explain the principle underlying radiometric titrations.

e) Define elementary separation factor.

Q5) Attempt <u>any two</u> of the following: **[10]**

a) Write a note on compton scattering.

b) Explain isotope dilution and reverse isotope dilution analysis.

c) Obtain critical size of a cubical nuclear reactor.

d) How does molecular separation method be used for ^{6}Li separation?

Q6) Solve <u>any one</u> of the following: **[5]**

a) Calculate the thickness of Zn = (Z = 30, A = 64) plate required to reduce the level of radiation from 1.2 Gy/m to 1.2 m Gy/h.

[Give e^{μ} = 0.211 b/electron, density of Zn = 7.1 gcm^{-3}]

b) The half life period of a radioisotope is 24.5m. How much of it would be left after 30m if its initial amount is 1.0g?

Total No. of Questions : 6]

SEAT No. :

P2979

[4723] - 2001
M.Sc.
PHYSICAL CHEMISTRY
CHP- 210 : Physical Chemistry - II
(2013 Pattern) (Semester - II)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answers to the TWO sections should be written in SEPARATE answer books.***
2) ***ALL questions are COMPULSORY.***
3) ***Figures to the RIGHT SIDE indicate FULL marks.***
4) ***Use of logarithmic table/calculator is ALLOWED.***
5) ***Neat diagrams must be drawn wherever necessary.***

Physico-Chemical Constants

1.	Avogadro Number	N	=	$6.022 \times 10^{23} mol^{-1}$
2.	Boltzmann Constant	k	=	1.38×10^{-16} erg K^{-1} $molecule^{-1}$
			=	1.38×10^{-23} J K^{-1} $molecule^{-1}$
3.	Planck Constant	h	=	6.626×10^{-27} erg s
			=	6.626×10^{-34} J s
4.	Electronic Charge	e	=	4.803×10^{-10} esu
			=	1.602×10^{-19} C
5.	1 eV		=	23.06 k cal mol^{-1}
			=	1.602×10^{-12} erg
			=	1.602×10^{-19} J
			=	8065.5 cm^{-1}
6.	Gas Constant	R	=	8.314×10^{7} ergK^{-1} mol^{-1}
			=	8.314 J K^{-1} mol^{-1}
			=	1.987 cal K^{-1} mol^{-1}
7.	Faraday Constant	F	=	96487 C $equiv^{-1}$
8.	Speed of light	c	=	2.997×10^{10} cm s^{-1}
			=	2.997×10^{8} m s^{-1}
9.	1 cal		=	4.184×10^{7} erg
			=	4.184 J
10.	1 amu		=	1.673×10^{-27} kg
11.	Bohr magneton	β_e	=	-9.274×10^{-24} J T^{-1}
12.	Nuclear magneton	β_n	=	5.051×10^{-27} JT^{-1}
13.	Mass of an electron	m_e	=	9.11×10^{-31} kg

SECTION - I

Q1) Attempt the following: **[10]**

a) Explain the activity of the following molecules with respect to IR and microwave spectrum.

H_2, HCl, CO_2, CH_4 and CH_3Cl

b) What are symmetric and asymmetric vibrations? Explain with the example of H_2O molecule.

c) What is zero point energy? Give its significance.

d) Why is the selection rule for pure rotational Raman spectrum is $\Delta J = \pm 2$ instead of $\Delta J = \pm 1$ for pure rotational spectroscopy?

e) What is the effect of isotopic substitution on microwave spectra of linear diatomic molecule?

Q2) Attempt <u>any two</u> of the following: **[10]**

a) What is the effect of breakdown of Born-Oppenheimer approximation on P and R branches of the IR spectrum of a diatomic molecule?

b) What is Raman scattering? Describe the quantum theory of Raman effect.

c) Explain predissociation spectra using a suitable diagram.

d) What is stark effect? Discuss its applications.

Q3) Solve <u>any one</u> of the following: **[5]**

a) The first line in the rotational spectrum of $^{12}C\ ^{16}O$ molecule is $3.84235 cm^{-1}$. Find out the bond length of the molecule.

b) The fundamental vibrational frequency of $^{1}H\ ^{35}Cl$ molecule is 86.63×10^{12} Hz. Calculate the zero-point energy and force constant of HCl.

SECTION - II

Q4) Attempt the following: **[10]**

a) Write the nuclear reactions involving natural and artificial synthesis of 3H.

b) Explain the principle of isotope dilution analysis.

c) Draw a crystallographic plane that cuts the crystallographic axes at 1a, 2b, 3c.

d) Write the Bragg equation. Why X-rays are utilized to elucidate crystal structure?

e) Draw bonding and antibonding wavefunctions for H_2 molecule using valence bond theory.

Q5) Attempt <u>any two</u> of the following: **[10]**

a) Explain the assumptions in Huckel theory.

b) 'Radioisotopes can be used to determine diffusion coefficients of the diffusing species? Explain.

c) Derive the expression for bonding and antibonding wavefunctions of H_2 molecule using molecular orbit theory.

d) Write a note on

i) Isotope dilution analysis

ii) Reverse isotope dilution analysis

Q6) Solve <u>any one</u> of the following: **[5]**

a) An element with mass number 96 and density 10.3 g cm^{-3} crystallizes with cubical unit cell with edge length 0.314nm. Predict the Bravais lattice of the cube.

b) Activity of 1g Ra - 226 is found to be 1Ci. How much of it will remain after four half lives?

Total No. of Questions : 6]

SEAT No. :

P2980

[Total No. of Pages : 10

[4723]-2002
M.Sc. -I
INORGANIC CHEMISTRY
CHI- 230: Coordination and Bioinorganic Chemistry
(2013 Pattern-Old 5 Credits) (Semester - II)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Figures to the right side indicate full marks.***
4) ***Given: Atomic number: V= 23, Fe = 26, Cu = 29, Sm = 62, Yb = 70.***

SECTION - I

Q1) Answer the following: **[10]**

a) Give the appropriate term symbol for the states with values of L = 4 and S = 3/2. Also workout possible values of J.

b) Calculate degeneracy for the following terms:

i) $^3T_{1g}$

ii) 3. ^3E_g.

c) Mention the possible transitions in $[V(H_2O)_6]^{3+}$ complex ion.

d) In each of the following pairs of transitions which you would expect to be more intense? Justify.

i) $A_{2u} \rightarrow T_{2g}$.

ii) $A_{2g} \rightarrow A_{1g}$.

e) Explain the Hund's rules to determine the ground state term symbols.

P.T.O.

Q2) Answer any two of the following: **[10]**

a) Derive the allowed R-S terms and hence prepare a table of microstates for the $ns^1\ np^1$ configuration.

b) Determine the spin multiplicities of states arising from $t_{2g}^{\ 2}$ configuration when infinitely strong octahedral field is relaxed to strong field using Bethe's method of descending symmetry, correlation table and direct product table.

c) Ni^{+3} (+d) complex ion shows 18% increase in its observed magnetic moment value. Calculate spin orbit coupling constant λ for Ni^{+3} ion using following data: Dq = 850 cm^{-1}.

d) Give the splitting of ^3F R.S. term in weak cubic field using character table for pure rotational point group and reduction formula.

Q3) Answer any one of the following: **[5]**

a) For hexa aquo Co(II) complex ion two absorption bands are observed at 16024 cm^{-1} and 19399 cm^{-1}. Determine the third absorption band, crystal field parameter and inter electronic repulsion parameter. Comment on nephelauxetic ratio.

Given: B_o = 971 cm^{-1}.

b) Give the full spectroscopic symbol for the ground state term for the following ions.

i) Fe^{3+}

ii) V^{2+}

iii) Cu^{2+}

iv) Sm^{+3}

v) Yb^{3+}

SECTION - II

Q4) Answer the following: **[10]**

a) Give the biological function of following elements: Mn, Cu, Na and K.

b) Give two examples of metals in medicine.

c) Explain the concept of Irwing - Williams series.

d) Give different types of electron-transfer proteins.

e) Explain the process of coagulation of blood.

Q5) Attempt <u>any two</u> of the following: **[10]**

a) Write a short note on Iron-sulfur clusters.

b) Discuss kinetic aspects of coordination chemistry with respect to bioinorganic chemistry.

c) Describe in detail voltage-gated sodium channel.

d) Give a descriptive account of Blue copper proteins.

Q6) Draw the structures of the following (any five): **[5]**

a) Uracil

b) Cardiolyte

c) Vitamin B_{12}

d) Oxyhemerythrin

e) 18 - crown -6

f) Cis-platin.

Character Table for O rotational group

O	E	$6C_4$	$3C_2(=C_4^2)$	$8C_3$	$6C_2$		
A_1	1	1	1	1	1		$x^2+y^2+z^2$
A_2	1	−1	1	1	−1		
E	2	0	2	−1	0		$(2z^2-x^2-y^2$ $x^2-y^2)$
T_1	3	1	−1	0	−1	$(R_x, R_y, R_z); (x, y, z)$	
T_2	3	−1	−1	0	1		(xy, xz, yz)

Correlation Table for the Group O_h

Oh	O	T_d	O_{3h}	D_{2d}	C_4^V	C_2^V	D_{3d}	D_3	C_{3v}
A_{1g}	A_1	A_1	A_{1g}	A_1	A_1	A_1	A_{1g}	A_1	A_g
A_{2g}	A_2	A_2	B_{1g}	B_1	B_1	A_2	A_{2g}	A_2	B_g
E_g	E	E	$A_{2g}+B_{2g}$	A_1+B_1	A_1+B_1	A_1+A_2	E_g	E	A_g+B_g
T_{1g}	T_1	T_1	$A_{2g}+E_g$	A_2+E	A_2+E	$A_2+B_1+B_2$	$A_{2g}+E_g$	A_2+E	A_g+2B_g
T_{2g}	T_2	T	$B_{2g}+E_g$	B_2+E	B_2+E	$A_1+B_1+B_2$	$A_{1g}+E_g$	A_1+E	$2A_g+B_g$
A_{1u}	A_1	A_2	A_{2u}	B_2	A_2	A_2	A_{1u}	A_1	A_u
A_{2u}	A_2	A_1	B_{2u}	A_2	B_2	A_2	A_{1u}	A_2	B_u
E_u	E	E	$A_{2u}+B_{2u}$	A_2+B_2	A_2+B_2	A_2+A_2	E_u	E	A_u+B_u
T_{1u}	T_1	T_2	$A_{2u}+E_u$	B_2+E	A_2+E	$A_2+B_1+B_2$	$A_{2u}+E_u$	A_2+E	A_u+2B_u
T_{2u}	T_2	T_1	$B_{2u}+E_u$	A_2+E	B_2+E	$A_2+B_1+B_2$	$A_{2u}+E_u$	A_2+E	$2A_u+B_u$

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DIRECT PRODUCTS

1. Groups of the form $G \times 1$ or $G \times a_1$:
   The g, u or $'$, $''$ additions to the IR symbols in these groups satisfy
   $g \times g = u \times u = g$, $g \times u = u$, $'x' = ''x'' = x$, $'x'' = x$.

2. Products of the form $A \times A$, $B \times B$, $A \times B$:
   For all groups :
   Letter symbols : $A \times A = A$, $B \times B = A$, $A \times B = B$.
   Subscripts : $1 \times 1 = 1$, $2 \times 2 = 1$, $1 \times 2 = 2$
   except for the B representations of D_2 and D_{2h} where
   $B \times B = B$ and $1 \times 2 = 3$, $2 \times 3 = 1$, $3 \times 1 = 2$.

3. Products of the form : $A \times E$, $B \times E$:
   (a) For all groups : $A \times E_x = E_x$ irrespective of the suffix on A.
   (b) For all groups except D_{4h}, D_{4n}, S_4 :
   $B \times E_1 = E_2$, $B \times E_2 = E_1$
   irrespective of the suffix on B. (If the group has only one E representative put $E_1 = E_2 = E$.)
   (c) For D_{4d} :
   $B \times E_1 = E_2$, $B \times E_2 = E_1$, $B \times E_3 = E_3$, $B \times E_4 = E_4$, $B \times E_5 = E_5$
   irrespective of the suffix on B.
   (d) For D_{4h}, S_4 :
   $B \times E_1 = E_3$, $B \times E_2 = E_4$, $B \times E_3 = E_1$
   irrespective of the suffix on B.

4. Products of the form $E \times E$:
   (For groups which have A, B or E symbols without suffixes put $A_1 = A_2 = A$, etc. in the equations below.)
   (a) For O_h, O, T_d, D_{6h}, D_{6d}, C_{6v}, C_{6h}, C_{6v}, S_6, D_{3h}, D_{3d}, D_3, C_{3v}, C_{3h}, C_3 :
   $E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + E_2$; $E_1 \times E_2 = E_1 + E_2 + E_1$.
   (b) For D_{4h}, D_4, C_{4v}, C_{4h}, C_4, S_4, D_{2d} :
   $E \times E = A_1 + A_2 + B_1 + B_2$.
   (c) For D_{4d} :
   $E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + E_2$.
   $E_2 \times E_2 = E_1 \times E_1 = A_1 + A_2 + E_1$.
   $E_1 \times E_2 = A_1 + A_2 + B_1 + B_2$.
   $E_1 \times E_2 = E_3 \times E_3 = E_1 + E_2$, $E_1 \times E_3 = E_3 \times E_4 = E_4 + E_5$.
   $E_2 \times E_3 = E_2 \times E_4 = E_2 + E_3$, $E_2 \times E_3 = E_1 \times E_4 = E_4 + E_5$.
   $E_3 \times E_4 = B_1 + B_2 + E_3$, $E_3 \times E_4 = B_2 + B_1 + E_3$.

(*d*) D_{3d}, D_{3h}, D_3, C_{3v}, C_{3h}, C_3

$E_1 \times E_1 = A_1 + A_2 + E_2$, $E_2 \times E_2 = A_1 + A_2 + E_1$,

$E_1 \times E_2 = E_1 + E_2$.

(*e*) For D_{4d}, S_4.

$E_1 \times E_1 = E_3 \times E_3 = A_1 + A_2 + E_2$,

$E_2 \times E_2 = A_1 + A_2 + B_1 + B_2$

$E_1 \times E_2 = E_2 \times E_3 = E_1 + E_3$, $E_1 \times E_3 = B_1 + B_2 + E_2$.

5. Products involving the T (or F) representations of O_h, O and T_d

$A_1 \times T_1 = T_1$, $A_1 \times T_2 = T_2$, $A_2 \times T_1 = T_2$, $A_2 \times T_2 = T_1$,

$E \times T_1 = E \times T_2 = T_1 + T_2$.

$T_1 \times T_1 = T_2 \times T_2 = A_1 + E + T_1 + T_2$.

$T_1 \times T_2 = A_2 + E + T_1 + T_2$.

6. The complete results for O are :

O	A_1	A_2	E	T_1	T_2
A_1	A_1	A_2	E	T_1	T_2
A_2	A_2	A_1	E	T_2	T_1
E	E	E	A_1+A_2+E	T_1+T_2	T_1+T_2
T_1	T_1	T_2	T_1+T_2	$A_1+E+T_1+T_2$	$A_2+E+T_1+T_2$
T_2	T_2	T_1	T_1+T_2	$A_2+E+T_1+T_2$	$A_1+E+T_1+T_2$

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Total No. of Questions : 6]

[4723] - 2002
M.Sc. - I (Semester - II)
INORGANIC CHEMISTRY
CHI - 230 : Coordination and Bioinorganic Chemistry
(2013 Pattern) (New 4 Credits)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Neat and labelled diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***

SECTION - I

Q1) Answer the following questions : **[10]**

a) Give the appropriate term symbols for the states with following values of L and S. Find possible values of J also.

i) L = 4 S = $\frac{3}{2}$ ii) L = 3 S = 1

b) Write the formula for magnetic moment of Lanthanides and give the significance of the terms involved in it.

c) $[CoCl_A]^{2-}$ is intense in colour, while $\left[Co\left(H_2O\right)_6\right]^{2+}$ is faint in colour. Justify.

d) Calculate the total degeneracy for the following terms/states/configurations.

i) P^2d^3 ii) 3^3T_{2g}

e) What is Laporte selection rule for electronic transition? State whether the following transition is Laporte allowed or Laporte forbidden.

$^3T_{2g} \rightarrow {}^3T_{1g}$

Q2) Attempt any two of the following : **[10]**

a) Prepare microstate table for S^1P^2 configuration and hence assign R-S term symbols.

b) Give the splitting of ^4F term in weak cubic field using character table for pure rotational point group 'O'.

c) Write note on Tanabe-Sugano diagram with respect to d^2 configuration.

d) Explain whether the following complexes exhibit orbital contribution to the magnetic moment.

i) $\left[Fe(H_2O)_6\right]^{3+}$ ii) $\left[Fe(H_2O)_6\right]^{2+}$

Q3) Attempt <u>any one</u> of the following : **[5]**

a) C_o^{2+} tetrahedral complex shows 23% increase in magnetic moment compared to its spin only value. Calculate spin orbit coupling constant for Co(II) ion. [Given 10 Dq = 3000 cm^{-1}]

b) Hexa.aquo Cr^{3+} ion exhibits following spin bandsat 17,400 cm^{-1} and 24,600 cm^{-1}. Calculate nephelauxetic ratio using following data. comment on M-L bond.

Given: $B^o = 918cm^{-1}$

$$B = \frac{2\gamma_1^2 + \gamma_2^2 - 3\gamma_1\gamma_2}{15\gamma_2 - 27\gamma_1}$$

SECTION - II

Q4) Answer in short : **[4]**

a) i) Explain role of calcium in biological system.

ii) Draw the structures of DNA.

b) Draw structures of : (<u>Any three</u>) : **[6]**

i) Corrin

ii) Adenine

iii) Enterobactin

iv) Auranofin

Q5) Write short notes on (<u>Any two</u>) : **[10]**

a) Zinc fingers

b) Ferritin

c) Classification of biomolecules

d) Role of Mn in Photosynthesis.

Q6) Attempt the following (Any One) : **[5]**

a) Match the following :

i)	Calcium	a)	Soft acid
ii)	Fe – S	b)	Hemocyanin
iii)	Pt^{+4}	c)	Rubredoxin
iv)	Cu	d)	Chlorophyll
v)	Mg	e)	Calmodulin

b) Give an account of Irving - William Series.

DIRECT PRODUCTS

1. Groups of the form $G \times I$ or $G \times \sigma_h$:
   The g, u or $'$, $''$ additions to the IR symbols in these groups satisfy
   $g \times g = u \times u = g$, $g \times u = u$, $' \times ' = '' \times '' = '$, $' \times '' = ''$.
2. Products of the form $A \times A$, $B \times B$, $A \times B$:
   For all groups :
   Letter symbols : $A \times A = A$, $B \times B = A$, $A \times B = B$
   Subscripts : $1 \times 1 = 1$, $2 \times 2 = 1$, $1 \times 2 = 2$
   except for the E representations of D_3 and D_{3h} where
   $E \times E = E$ and $1 \times 2 = 3$, $2 \times 3 = 1$, $3 \times 1 = 2$.
3. Products of the form : $A \times E$, $B \times E$:
   (*a*) For all groups : $A \times E_i = E_i$ irrespective of the suffix on A.
   (*b*) For all groups except D_{4d}, D_{4h}, S_4 :
   $B \times E_1 = E_2$, $B \times E_2 = E_1$
   irrespective of the suffix on B. (If the group has only one E representative put $E_1 = E_2 = E$.)
   (*c*) For D_{4d} :
   $B \times E_1 = E_2$, $B \times E_2 = E_3$, $B \times E_3 = E_2$, $B \times E_4 = E_1$
   irrespective of the suffix on B.
   (*d*) For D_{4h}, S_4 :
   $B \times E_1 = E_2$, $B \times E_2 = E_3$, $B \times E_3 = E_1$
   irrespective of the suffix on B.
4. Products of the form $E \times E$:
   (For groups which have A, B or E symbols without suffixes put $A_1 = A_2 = A$, etc. in the equations below.)
   (*a*) For C_n, C_i, T, T_h, D_n, D_{nh}, C_{nv}, C_{nh}, $C_n S_n$, D_{nd}, D_n, D_3, C_{nv}, C_{3v}, C_3 :
   $E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + E$, $E_1 \times E_2 = E_1 + E_2 + E$.
   (*b*) For D_{4n}, D_{2d}, C_{2v}, C_{4v}, C_{2h}, S_4, D_{2d} :
   $E \times E = A_1 + A_2 + B_1 + B_2$.
   (*c*) For D_{4d} :
   $E_1 \times E_1 = E_3 \times E_3 = A_1 + A_2 + E_2$,
   $E_2 \times E_2 = E_4 \times E_4 = A_1 + A_2 + E_2$,
   $E_3 \times E_3 = A_1 + A_2 + B_1 + B_2$,
   $E_1 \times E_2 = E_3 \times E_4 = B_1 + B_2 + E_3$, $E_1 \times E_3 = E_2 \times E_3 = E_2 + E_4$,
   $E_1 \times E_4 = E_2 \times E_3 = E_2 + E_3$, $E_2 \times E_3 = E_2 \times E_4 = E_1 + E_3$,
   $E_1 \times E_3 = B_1 + B_2 + E_2$, $E_2 \times E_4 = B_1 + B_2 + E_2$.

(*d*) D_{3d}, D_{2d}, D_3, C_{3v}, C_{2v}, C_3

$E_1 \times E_1 = A_1 + A_2 + E_2$, $E_2 \times E_2 = A_1 + A_2 + E_2$,

$E_1 \times E_2 = E_1 + E_2$.

(*e*) For D_{4d}, S_8.

$E_1 \times E_1 = E_3 \times E_3 = A_1 + A_2 + E_2$,

$E_2 \times E_3 = A_1 + A_2 + B_1 + B_2$

$E_1 \times E_2 = E_2 \times E_3 = E_1 + E_3$, $E_1 \times E_3 = B_1 + B_2 + E_2$.

5. Products involving the T (or F) representations of O_h, O and T_d

$A_1 \times T_1 = T_1$, $A_1 \times T_2 = T_2$, $A_2 \times T_1 = T_2$, $A_2 \times T_2 = T_1$,

$E \times T_1 = E \times T_2 = T_1 + T_2$,

$T_1 \times T_1 = T_2 \times T_2 = A_1 + E + T_1 + T_2$,

$T_1 \times T_2 = A_2 + E + T_1 + T_2$.

6. The complete results for O are :

O	A_1	A_2	E	T_1	T_2
A_1	A_1	A_2	E	T_1	T_2
A_2	A_2	A_1	E	T_2	T_1
E	E	E	A_1+A_2+E	T_1+T_2	T_1+T_2
T_1	T_1	T_2	T_1+T_2	$A_1+E+T_1+T_2$	$A_2+E+T_1+T_2$
T_2	T_2	T_1	T_1+T_2	$A_2+E+T_1+T_2$	$A_1+E+T_1+T_2$

Character Table for O rotational group

O	E	$6C_4$	$3C_2(=C_4^2)$	$8C_3$	$6C_2$		
A_1	1	1	1	1	1		$x^2+y^2+z^2$
A_2	1	−1	1	1	−1		
E	2	0	2	−1	0		$(2z^2-x^2-y^2$ $x^2-y^2)$
T_1	3	1	−1	0	−1	(R_x, R_y, R_z): (x, y, z)	
T_2	3	−1	−1	0	1		(xy, xz, yz)

Correlation Table for the Group O_h

Oh	O	Td	D_{4h}	D_{2d}	C_{4v}	C_{2v}	D_{3d}	D_3	C_{3v}
A_{1g}	A_1	A_1	A_{1g}	A_1	A_1	A_1	A_{1g}	A_1	A_2
A_{2g}	A_2	A_2	B_{1g}	B_1	B_1	A_2	A_{2g}	A_2	B_2
E_g	E	E	$A_{1g}+B_{1g}$	A_1+B_1	A_1+B_1	A_1+A_2	E_g	E	A_2+B_2
T_{1g}	T_1	T_1	$A_{2g}+E_g$	A_2+E	A_2+E	$A_{2g}+B_{2g}$	$A_{2g}+E_g$	A_2+E	A_2+2B_2
T_{2g}	T_2	T	$B_{2g}+E_g$	B_2+E	B_2+E	$A_2+A_2+B_2$	$A_{2g}+E_g$	A_2+E	$2A_2+B_2$
A_{1u}	A_1	A_2	A_{2u}	B_2	A_2	A_2	A_{1u}	A_2	A_2
A_{2u}	A_2	A_1	B_{2u}	A_2	B_2	A_2	A_{2u}	A_2	B_2
E_u	E	E	$A_{2u}+B_{2u}$	A_2+B_2	A_2+B_2	A_2+A_2	E_u	E	A_2+B_2
T_{1u}	T_1	T_2	$A_{1u}+E_u$	B_2+E	A_2+E	$A_2+B_2+B_2$	$A_{2u}+E_u$	A_2+E	A_2+2B_2
T_{2u}	T_2	T_1	$B_{2u}+E_u$	A_2+E	B_2+E	$A_2+B_2+B_2$	$A_{2u}+E_u$	A_2+E	$2A_2+B_2$

Total No. of Questions : 6]

SEAT No. :

P2981

[Total No. of Pages : 10

[4723] - 2003
M.Sc. -I
ORGANIC CHEMISTRY
CHO-250: Synthetic Organic Chemistry & Spectroscopy
(2013 Pattern - Old - 5 Credits) (Semester - II)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Figures to the right indicate full marks.***

SECTION - I

Q1) Attempt any three of the following. **[9]**

a) Explain cross over Experiment with suitable example.

b) Baeyer-Villiger rearrangement is a good method for the preparation of acetates. Explain.

c) Methyl magnesium bromide gives 1,2-addition product on reaction with cyclohexenone where as dimethyl lithium cuprate gives 1,4-addition product. Explain.

d) Explain the uses of Organo Zinc compounds.

e) Give the uses of DIBAL in Organic synthesis.

Q2) Explain any four of the following. **[8]**

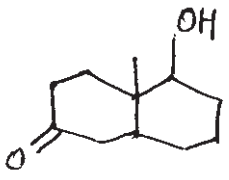
a) Migrating group retains its configuration in Beckmann rearrangement.

b) Write note on Dakin Reaction.

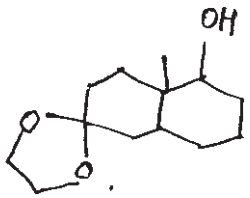
c) What are the limitations of BH_3 as hydroborating reagent?

P.T.O.

d) Jones reagent can be used for oxidation of compound A but not for compound B.

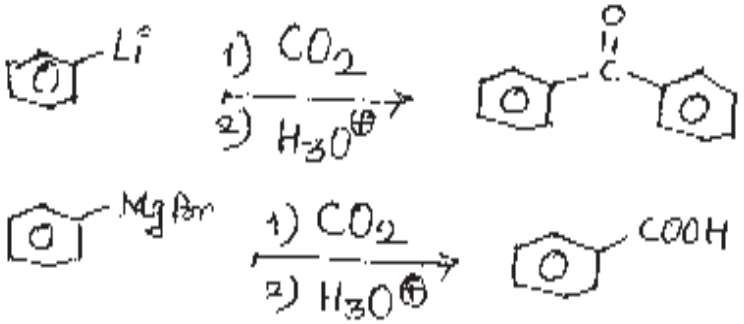


Compound A

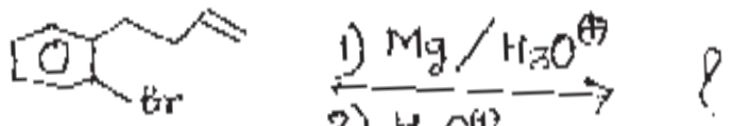


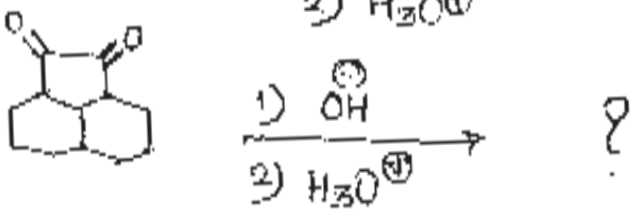
Compound B

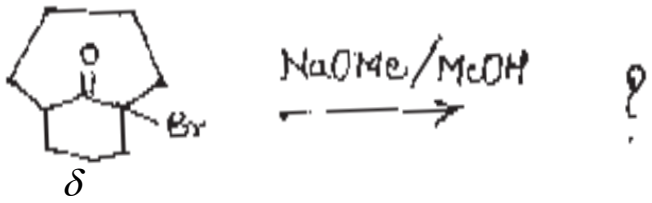
e) Explain the following observations.



Q3) a) Predict the products (<u>any two</u>). **[4]**

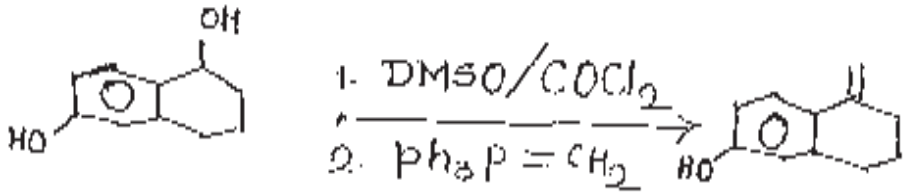
i) 

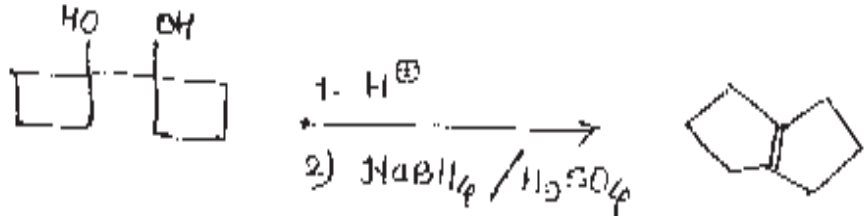
ii) 

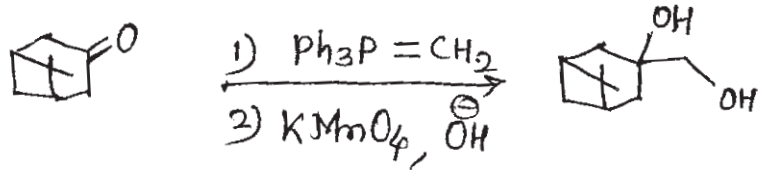
iii) 

δ

b) Suggest the mechanism (any two). **[4]**

i) 

ii) 

iii) 

SECTION - II

Q4) Deduce the structure from spectral data and justify your answer. (any three). **[9]**

a) M.F. - C_7H_8NBr

IR: 3400,3300,3200,2900,1620,1600,1500,880,820cm^{-1}.

PMR: 2.30 δ (s, 3H)

3.50 (bs, 2H, removed on adding D_2O)

6.30 δ (dd, J = 9, 3.5Hz, 1H)

6.50 δ (d, J = 3.5Hz, 1H)

7.20 δ (d, J = 9Hz, 1H)

b) M.F. - $C_8H_{14}O$

IR: 3500, 3300, 2100 cm^{-1}

PMR: 1.0 δ (d, 6H)

1.5 δ (s, 3H)

1.6 δ (d, 2H)

1.9 δ (m, 1H)

2.3 δ (s, 1H)

3.1 δ (s, 1H, exchangeable with D_2O)

c) M.F. - $C_{10}H_{13}NO_2$

IR: 3402,3318,3025,1695,1602,1580 cm^{-1}.

PMR: 1.25 δ (d, 6H)

4.20 δ (bs, 2H)

4.75 δ (septet, 1H)

6.70 δ (d,2H)

7.90 δ (d, 2H)

d) M.F. - $C_5H_8O_2$

UV: No intense UV absorption above 200 nm

IR: 1780 cm^{-1}

PMR:1.15 δ (d, 3H)

2.35 δ (m, 1H)

2.20 δ (m, 2H)

4.00 δ (t, 2H)

Q5) Attempt <u>any four</u> of the following. **[8]**

a) When acetone is treated with a base, a product 'A' is formed. It showed the following spectral properties.

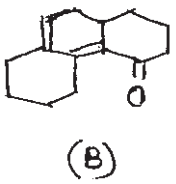
IR: 1695, 1620 cm^{-1}

PMR: 1.90 δ (s, 3H), 2.10 δ (s, 6H), 6.0 δ (s, 1H)

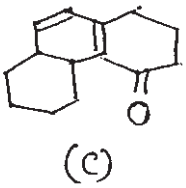
UV: λ_{max} = 238 nm ($\in$ 11700)

Predict the structure of 'A'.

b) An unknown compound is believed to have either structure 'B' or 'C'.



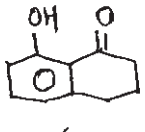
(B)



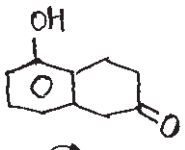
(C)

Its UV spectrum shows λ_{max} (EtOH) = 320nm. What could be its most likely structure?

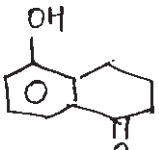
c) A compound is supposed to have either of the following structures I, II or III. The IR spectrum of the compound records bands at 1680cm^{-1} and 3300cm^{-1}. Suggest which one is the most probable structure?



(I)

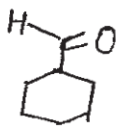


(II)

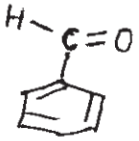


(III)

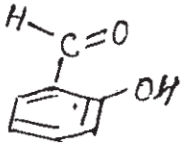
d) Predict the frequency shift of carbonyl absorption in the following compounds.



(i)



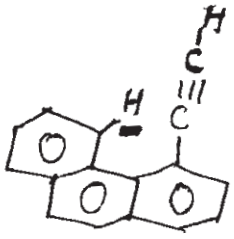
(ii)



(iii)

e) In the compound given below, the underlined proton shows chemical shift 1.71 δ downfield from the resonance peak of same proton in phenanthrene.

Explain.



Q6) Attempt any four of the following. **[8]**

a) Explain MacLafferty rearrangement with suitable examples.

b) The chemical shift value of cyclopentadienyl anion is 5.42δ whereas that of cycloheptatrienyl cation is 9.17δ. Explain.

c) Integration is used in PMR and not in CMR. Explain.

d) What are enantiotropic and diastereotropic protons? Explain why the former have same chemical shifts while the latter have different chemical shifts.

e) How will you distinguish among primary, secondary and tertiary alcohols by PMR spectroscopy?

☼ ☼ ☼

Total No. of Questions : 6]

[4723] - 2003
M.Sc. - I (Semester - II)
CHEMISTRY
CHO - 250 : Synthetic Organic Chemistry and Spectroscopy
(2013 Pattern - New - 4 Credits)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Figures to the right side indicate full marks.***

SECTION - I

Q1) Attempt any three of the following : **[9]**

a) Write a note on 'cope rearrangement'.

b) What is the reaction of methyl lithium and methyl magnesium bromide on 2-Cyclohexenone?

c) Explain the use of peracid in epoxidation and lactonization.

d) Write the use of diborane in organic synthesis.

Q2) Explain any four of the following : **[8]**

a) Advantage of using Wittig Horner reaction over Wittig reaction.

b) Comment on the migratory aptitude of p-chlorophenyl, Phenyl and p-anisyl groups in Beckmann rearrangement.

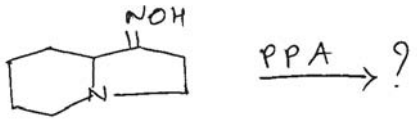
c) Write a short note on ozonolysis.

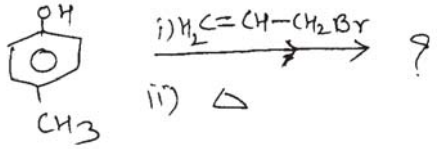
d) Hydroboration of 1-methyl cyclopentene followed by oxidation with H_2O_2/NaOH gives trans-2-methyl - cyclopentanol.

e) Use of diazomethane in organic synthesis.

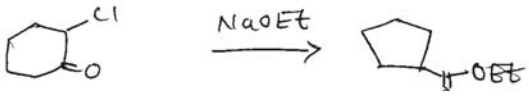
Q3) a) Predict the products (Any Two) : **[4]**

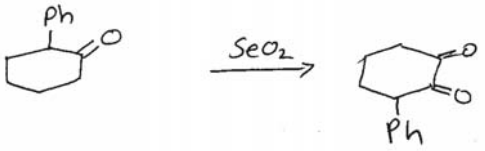
i) $PhNHCoNH_2 \xrightarrow[Br_2]{NaOH} ?$

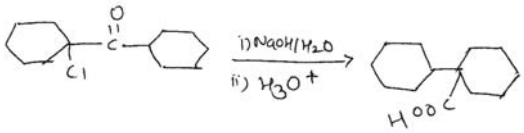
ii) 

iii) 

b) Suggest mechanism (Any Two) : **[4]**

i) 

ii) 

iii) 

SECTION - II

Q4) Deduce the structure from spectral data and justify your answer (Any three): **[9]**

a) $C_{10}H_{11}O_2Cl$

U.V. : 245nm ($\in$ =18000)

I.R. : 3000-2920, 1745, 1600, 1580, 820cm^{-1}.

P.M.R : 2.00 δ (S, 60 mm)
2.80 δ (t, J = 6Hz, 20 mm)
4.01 δ (t, J = 6Hz, 20 mm)
7.01 δ (d, J = 8Hz, 20 mm)
7.30 δ (d, J = 8Hz, 20 mm)

b) $C_8H_8O_2$

U.V. : 260nm

I.R. : 2700-3300 (Broad), 1700, 1600, 1500, 920 cm^{-1}.

P.M.R : 3.5 δ (S, 12 mm)
7.2 δ (S, 30 mm)
12.3 δ (S, 6 mm)

c) $C_5H_{11}Br$

U.V. : Transparent above 200 nm.

I.R. : No significant peak.

P.M.R : 1.02 δ (d, J = 6Hz, 24 mm)

1.66 δ (m, 4 mm)

1.85 δ (q, 8 mm)

3.40 δ (t, J = 6Hz, 8mm)

d) $C_{10}H_{12}O$

U.V. : 250, 262 nm

I.R. : 1745 cm^{-1}

P.M.R : 2.10 δ (S, 3H)

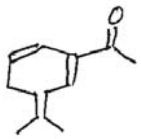
2.75 δ (t, 2H)

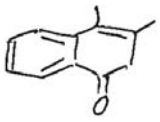
2.85 δ (t, 2H)

7.20 δ (m, 5H)

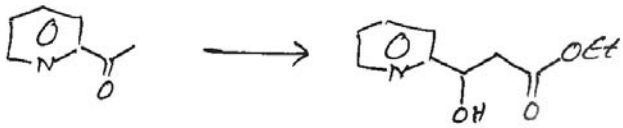
Q5) Attempt any four of the following : **[8]**

a) Calculate λ_{max} of the following :

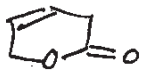
i) 

ii) 

b) How will you follow the reaction using IR spectroscopy?



c) Arrange following compounds in increasing order of their $\nu_{C=O}$ frequency.

i) 

ii) 

iii) 

d) Draw two possible structures of compound having molecular formula $C_5H_8O_2$ with positive iodoform test.

e) Distinguish Ph-$CH(CH_3)$-CH_2Br and Ph-$C(CH_3)_2$-Br by PMR spectroscopy.

Q6) Attempt any four of the following : **[8]**

a) What are the advantages of mass spectrometry?

b) Discuss in brief carbon spectroscopy [^{13}C].

c) What are the factors affecting chemical shifts in PMR.

d) Explain why Mecome is not used as a solvent in U.V. spectrometry?

e) What do you meant by "First Order Spectra" in PMR?

Total No. of Questions : 3]

SEAT No. :

P2982

[Total No. of Pages : 27

[4723]-2004
M.Sc.-I
ANALYTICAL CHEMISTRY
CHA - 290 : General Chemistry
New Course Based on Credit & Semester System
(2013 Pattern - Old 5Credits) (Semester - II)

PART - A : Modern Separation Methods and Hyphenated Techniques (2.5 Credit / 25 marks)

PART - B : Basic Biochemistry (5.0 Credit / 50 marks)

PART - C : Concept of Analytical Chemistry (2.5 Credit / 25 marks)

PART - D : Industrial Methods of Analysis (2.5 Credit / 25 marks)

PART - E : Organometallic and Inorganic Reaction Mechanism (2.5 Credit / 25 marks)

PART - F : Mathematics for Chemists (2.5 Credit / 25 marks)

PART - G : Pericyclic, Photochemistry and Free Radical Reactions (2.5 Credit / 25 marks)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions of respective section / part are compulsory.***
2) ***Figures to right hand side indicate full marks.***
3) ***Neat labelled diagram must be drawn wherever necessary.***
4) ***Use of log table / non programmable calculator is allowed.***
5) ***Students should attempt any <u>two parts</u> fromPart-A, C, D, E, F and G <u>or</u> full paper of biochemistry (Part-B) of 5 credit / 50 marks.***
6) ***Write the answers of <u>two parts</u> on separate answer books.***

<u>PART -A</u>

Modern Separation Methods and Hyphenated Techniques

Q1) Answer the following. **[10]**

a) What is 'parent ion peak' in mass spectrum? Give its analytical significance?

P.T.O.

b) What is meant by 'normal phase and reverse phase' HPLC techniques?

c) Define the retention time? Give its analytical significance.

d) How does gas -liquid and gas-solid chromatographic techniques differs?

e) State and explain the analytical principal of the mass spectrometry.

Q2) Answer <u>any two</u> of the following: **[10]**

a) Draw the schematic diagram of ionization chamber. Explain chemical ionization method of generation of ion fragments.

b) What are the type of detectors used in HPLC? Explain working of UV-detector.

c) Describe the physical difference between packed column and open tubular columns. What are the advantages and disadvantages of each?

d) Describe in brief the plate theory model of separation. Explain how plate height 'H' and plate count 'N' can be used as a quantitative measures of column efficiency?

Q3) Answer <u>any one</u> of the following: **[5]**

a) Draw the schematic diagram of the modern HPLC apparatus. Explain the isocratic elution and gradient elution processes.

b) LC-MS analysis of p-xylene (C_8H_{10}) Oxidation gave four peaks in the mass spectrum at m/z 106,136,150 and 166 respectively. Predict the product and draw the corresponding chromatographic peaks for them when a reversed phase column is used.

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Total No. of Questions : 6]

SEAT No. :

P2982

[4723] - 2004
M.Sc. - I
ANALYTICAL CHEMISTRY
CHA-290: General Chemistry
Part -B
Basic Biochemistry
(Compulsory for Drug Chemistry Students)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate maximum marks.***
3) ***Answers to the two sections should be written on separate answer sheets.***

SECTION - I

Q1) Answer any three of the following: **[9]**

a) Differentiate between two major periodic structures found in proteins i.e, α-helix and β-pleated sheets.

b) Explain the energy yielding reactions of glycolysis.

c) Write in brief:

i) What is nucleocytoplasmic communication

ii) Why lysosomes are called as suicidal bags.

d) Explain Ninhydrin reaction.

Q2) Discuss any two of the following: **[8]**

a) What is meant by active transport? Explain Na^+-K^+ pump.

b) Tertiary structure of globular proteins.

c) β-oxidation of palmitic acid.

Q3) Attempt any two of the following. **[8]**

a) What are the mechanisms for drug resistance in microbes? Expalin any one.

b) Classify amino acids based on their R group.

c) Discuss the following in brief:

i) Amino acid Therapy.

ii) Structure and function of phosphoglycerides.

SECTION - II

Q4) Answer any three of the following: **[9]**

a) How does temperature and pH affect the rate of enzymatic reaction.

b) How proteins are synthesized? Add a note on initiation step.

c) Explain in brief: Central Dogma of Molecular biology.

d) Explain biochemical reactions involving NAD.

Q5) Explain any two of the following: **[8]**

a) Salient features of DNA replication.

b) Kwashiorkar and Marasmus.

c) Explain Gene therapy and methods involved in gene therapy.

Q6) Attempt any two of the following: **[8]**

a) Discuss in brief:

i) Structure and function of vitamin K

ii) Genetic disorders (any one)

b) Explain with suitable example, types of reversible inhibition of enzymes.

c) Importance of penicillin acylase in 6-APA production.

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Total No. of Questions : 3]

SEAT No. :

P2982

[4723] - 2004
M.Sc. - I
ANALYTICAL CHEMISTRY
CHA-290: General Chemistry
Part -C
Concept of Analytical Chemistry

Q1) Answer the following: **[10]**

a) Calculate the absolute standard deviations of the result of the following calculation.

$$Y = \log\left[2.00\,(\pm 0.02)\times 10^{-4}\right] = -3.6940 \pm ?$$

b) Classify the following errors in its Main and sub class.

i) Loss of precipitate during washing.

ii) End point and Equivalence point do not coincide.

c) Give any two advantages of solvent extraction.

d) Explain the term confidence interval.

e) Define and explain what do you mean by nanomaterials?

Q2) Attempt any two of the following. **[10]**

a) Define significant figure and give the expressions of standard deviation for propagation of errors in case of

i) Addition a subtraction

ii) Multiplication

iii) Logarithm and

iv) Antilogarithm

b) Describe the various steps involved in preparation of a laboratory sample.

c) XRD is a powerful technique to identify the difference between nanosized and microsized materials. Justify this statement with suitable examples.

d) What is fractional distillation? Explain with the help of neat diagram the principle and working of a fractionating column.

Q3) Attempt any one of the following. **[5]**

a) Two barrels of wine are analyzed for their alcohol content to determine whether they were from different sources. On the basis of six analysis the average content of the 1st barrel was established to be 12.61% ethanol. Four analysis of the 2nd barrel gave a mean of 12.53% ethanol. The standard pool deviation of 10 analysis was 0.070%. Show whether the data indicates difference between wines. [Given 't' at 95% confidence level = 2.31].

b) Write a note on Craig's counter current extraction.

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Total No. of Questions : 3]

SEAT No. :

P2982

[4723] - 2004
M.Sc. - I
ANALYTICAL CHEMISTRY
CHA-290: General Chemistry
Part -D
Industrial Methods of Analysis

Q1) Answer the following: **[10]**

a) Explain the role of NH_4Cl with respect to common ion effect in qualitative analysis.

b) Explain the term stability constant.

c) What are the responsibilities of the laboratory staff for quality and problems?

d) Calculate the number of millimoles present in 1.12gm of KOH (At. Wt. K = 39, O = 16, H = 1).

e) A solution has $[OH^-] = 1\times10^{-9}$ moles/liter. Calculate its pH.

Q2) Answer any two of the following. **[10]**

a) $CuSO_4.5H_2O$ is converted into $[Cu(NH_3)_4]SO_4$. Calculate the theoretical percentage of copper in the complex (Given: At. Wt. Cu = 63.5, N = 14, S = 32, O = 16, H = 1).

b) What is acidic buffer? Explain the buffer action of acidic buffer with suitable example.

c) Write a note on gas chromatography.

d) Write a note on oxygen analyzer.

Q3) Answer any one of the following. **[5]**

a) Write a note on automatic elemental analyzer.

b) 0.2gm of bauxite sample was dissolved by suitable method. The solution was diluted to 100ml. From an aliquot of 25ml, aluminium was precipitated as $Al(OH)_3$. The ppt. of $Al(OH)_3$ was ignited when it gave 0.080 gm of Al_2O_3. Calculate the percentage of Al in the sample.

(Given: At. Wt. Al = 27, O = 16).

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Total No. of Questions : 3]

SEAT No. :

P2982

[4723] - 2004
M.Sc. - I
ANALYTICAL CHEMISTRY
CHA-290: General Chemistry
Part -E
Organometallic and Inorganic Reaction Mechanism

Q1) Answer the following: **[10]**

a) CH_3 –Mn $(CO)_5$ + P (CH_3) $(C_6H_5)_2$ $\rightarrow$ No gases are evolved.

b) Explain with suitable reactions inert and labile compounds.

c) Discuss the evidence for dissociative mechanism.

d) State complex $Fe(CO)_5$ obeys 18 e^- rule or not.

e) What are alkyne complexes? Give suitable reactions.

Q2) Anwer any two of the following. **[10]**

a) Write a short note on Monsanto acetic acid process.

b) Discuss the factors which affect the substitution reaction rate of tetrahedral complexes.

c) Why hydrolysis of $[Co(NH_3)_5Cl]$ complex ion in presence of base is much faster than that of $[Co(PY)_5\ Cl]^{+2}$ complex ion.

d) Give an account of polymerization using Zeiglar Natta catalyst.

Q3) Attempt any one of the following. **[5]**

a) Draw the structures:-

i) $\mu - Co - \left[- \left(\eta^4 - C_4H_4 \right) Fe \left(CO \right)_2 \right]$

ii) $\left[\left(\eta^5 - CP \right) Mo \left(CO \right)_3 \right]_2$

iii) $\left[\left(\eta^5 - C_5H_5 \right)_2 Co \right]^+$

iv) $Mo \left(PF_3 \right)_3 \left(CO \right)_3$

v) $\left[ptCl_2 \left(pph_3 \right) \left(NH_3 \right) \right]$

b) Explain the role of IR technique in characterisation of organometallic complexes.

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Total No. of Questions : 3]

SEAT No. :

P2982

[4723] - 2004
M.Sc. - I
ANALYTICAL CHEMISTRY
CHA-290: General Chemistry
Part -F
Mathematics for Chemists

Q1) Answer the following: **[10]**

a) State the Taylor-Maclaurin Theorem.

b) Solve the following:-

i) If $A = \begin{bmatrix} 3 & 2 & 8 \\ 1 & 2 & 2 \\ 4 & 4 & 4 \end{bmatrix}$ then $4A = ?$

ii) Multiply $A = \begin{bmatrix} 1 & 2 & 3 & 2 \\ 5 & 6 & 7 & 2 \\ 8 & 9 & 10 & 1 \end{bmatrix}$ $B = \begin{bmatrix} 1 & 2 \\ 5 & 6 \\ 8 & 9 \\ 3 & 7 \end{bmatrix}$

c) Define probability distribution, variance and mode.

d) What are combinations? Give the steps in calculating combinations.

e) Define:-

i) Quadrant

ii) Dependent variable

Q2) Attempt <u>any two</u> of the following. **[10]**

a) Solve the following:-

i) $4^2 . 4^6$

ii) $49^{3/2}$

iii) $(3^3)^4$

iv) $\frac{5^4}{5^2}$

v) 6^{-2}

b) i) Find out the determinant of:- $\begin{bmatrix} 2 & 4 & 6 \\ 3 & 2 & 1 \\ 8 & 1 & 1 \end{bmatrix}$

ii) Find out the cofactor of:- $\begin{vmatrix} 3 & 3 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix}$

c) Solve the following:-

i) If there are six new year greeting cards and you want to send them to your of your friends, in how many ways this can be done.

ii) There are three questions in a question paper. If the questions have 4,3 and 2 solutions respectively, find the total number of solutions.

d) Solve the following:-

i) In how many ways can an animal trainer arrange five lions and four tigers in a row so that no two lions are together.

ii) A box contains six red, five blue and two green marbles. If three marbles are picked at random, what is the probability that at least one is blue?

Q3) Attempt any one of the following. **[5]**

a) Solve the following:-

i) Differentiate $y = x^{\frac{3}{2}} - 7x^4 + 10e^{-3x} - 5$.

ii) $y = x^{11} \cdot e^{6x}$ differentiate

iii) Solve with respect to x $f(x) = x^3 - 21x^2 + 135x - 220 = 0$.

b) Solve the following:-

i) Using Falk's scheme compute the following:-

$$A = \begin{bmatrix} 4 & 8 \\ 2 & 3 \end{bmatrix} \quad B = \begin{bmatrix} 2 & 8 & 6 \\ 1 & 2 & 3 \end{bmatrix} \quad AB = ?$$

ii) $\int_0^2 (x+1)(x^3 - 3)\, dx.$

iii) Following reading were taleen on polarimeter. 37.0, 36.8,36.7,37.1,36.9,37.2. Find the average and standard deviation.

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Total No. of Questions : 3]

SEAT No. :

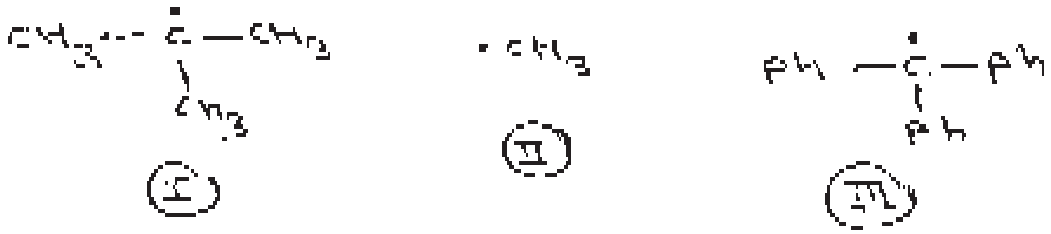
P2982

[4723] - 2004
M.Sc. - I
ANALYTICAL CHEMISTRY
CHA-290: General Chemsitry
Part -G
Pericyclic, Photochemistry and Free Radicals

Q1) Attempt any three of the following: **[9]**

a) What is the product of cyclo addition reaction of butadiene and ethylene. Predict whether this reaction is thermally or photo chemically allowed using FMO approach.

b) Arrange following free radicals in the increasing order of stability. Justify.



c) Prove the formation of photo enolised product from photo irradiation of ortho methyl benzophenone.

d) Irradiation of 2,2,5,5-tetraphenyl cyclo - pentanone gives two products. Explain.

Q2) a) Predict the product/s and explain (any two). **[4]**

i) 

ii) 

iii) 

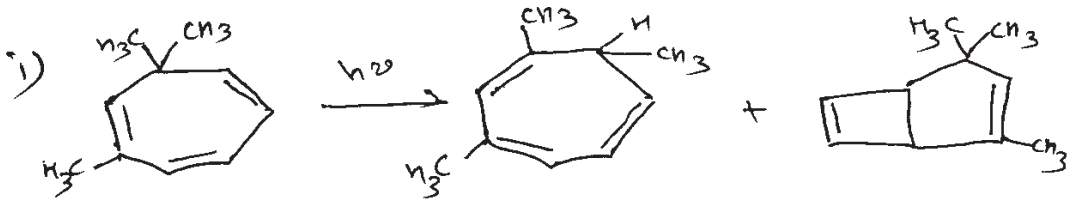
b) Answer any two of the following. **[4]**

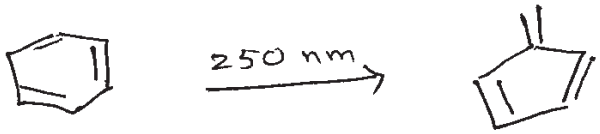
i) Explain Di-π methane rearrangement with suitable example.

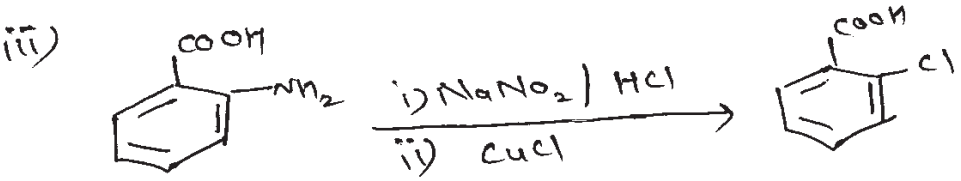
ii) Write the mechanism of claisen rearrangement with suitable example.

iii) Explain the meaning of 'Alder ene reaction' with suitable example.

Q3) a) Explain the mechanism for the following reactions. (any two). **[4]**

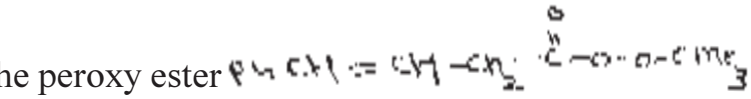
i) 

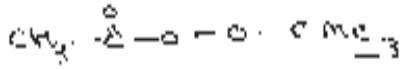
ii) 

iii) 

b) Attempt <u>any two</u> of the following. **[4]**

i) What do you mean by quantum yield and explain its significance in photochemical reaction.

ii) The peroxy ester  decomposes about 5000 times faster than t-butyl peroxy acetate



iii) Predict whether dimerisation of ethylene is thermal or photochemical using aromatic transition state concept.

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Total No. of Questions : 3]

P3877

[4723] - 2004
M.Sc. - I (Semester - II)
ANALYTICAL CHEMISTRY
CHA - 290 : General Chemistry
(2013 Pattern - New 4 Credits)

Part A : Modern separation methods and Hyphenated techniques (2.0 credit / 25 marks)

Part B : Basic Biochemistry (4.0 credit/50 marks)

Part C : Concepts of Analytical Chemistry (2.0 credit/25 Marks)

Part D : Industrial Methods of Analysis (2.0 credit/25 Marks)

Part E : Orgonometallic and Inorganic Reaction Mechanism (2.0 credit / 25 marks)

Part F : Mathematics for Chemists (2.0 credit/25 marks)

Part G : Pericyclic, Photochemistry and Freeradical Reactions (2.0 credit / 25 marks)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***All questions of respective section/part are compulsory.***

2) ***Figures to right hand side indicates full marks.***

3) ***Neat labelled diagram must be drawn wherever necessary.***

4) ***Use of log table / non - programmable calculator's is allowed.***

5) ***Students should attempt any two parts from Part A, C, D, E, F & G or full paper of biochemistry (Part B)***

6) ***Write the answers of two parts on separate answer book.***

Part A : Modern Separation Methods and Hyphenated Techniques (2.0 Credit)

Q1) Answer the following: **[10]**

a) Give the fragmentation pattern of the following molecules in mass spectrometry.

i) Anisole

ii) 2 - Chloropropane

b) Give the characteristics of support coated open tubular column (SCOT).

c) Sketch and labelled basic components of HPLC.

d) Give in short applications of Mass spectrometry.

e) What is retention time?

Q2) Attempt any two of the following: **[10]**

a) Draw the schematic diagram of ionization chamber. Explain electron impact ionization method of generation of ion fragments.

b) Explain the size exclusion chromatography.

c) Give outline of gas chromatography and explain it's essential components.

d) Enlist the Mass analyser. Explain any one of them.

Q3) Answer any one of the following: **[5]**

a) The Gas chromatographic spectrum was obtained after analysis of xylene. The recorder speed was 3.68 cm/min. The carrier gas flow rate was 50.0ml/min. The retention time for xylene was 4.0 cm and that of air was 6.2cm. Calculate -

i) The uncorrected retention time in minutes

ii) The uncorrected retention volume in ml.

iii) The adjusted retention time.

iv) The adjusted retention volume for xylene under these conditions.

b) Give the block diagram of HPLC. Explain it's various components.

Total No. of Questions : 6]

P3877

[4723] - 2004
M.Sc. - I (Semester - II)
CHEMISTRY
Part B : CHA - 290 : Basic Biochemistry
(2013 Pattern)

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answer to the two sections to be written in separate answer books.***
3) ***Draw diagrams wherever necessary.***
4) ***Figures to the right indicate full marks.***

SECTION - I

Q1) Answer any four of the following: **[12]**

a) What are conjugated proteins? How are they classified further?

b) What are the general mechanisms for translocation of drugs across the cell membrane? Explain any one with suitable example.

c) Give the structure and function of nucleus.

d) Discuss nutritional classification of amino acid.

e) Describe the following in brief

i) How fatty acids are activated and transported into the mitochondria for β - oxidation?

ii) Acid base property of amino acids.

Q2) Attempt any two of the following: **[8]**

a) Explain the energy yielding reactions of aerobic and anaerobic glycolysis.

b) Explain in detail secondary structure of proteins.

c) Discuss the structure and importance of glycogen and starch.

Q3) Write in brief any five of the following: **[5]**

a) Globular proteins

b) Ninhydrin reaction

c) Differences in Prokaryotic & Eukaryotic cell

d) Fluid Mosaic model of cell membrane

e) Denaturation of proteins

f) Significance of Gluconeogenesis

g) Advantages of protein Engineering

SECTION - II

Q4) Answer any four of the following: **[12]**

a) Discuss the stages of RNA synthesis.

b) What are the factors affecting rate of enzyme reaction? Explain the effect of temperature on rate of enzyme reaction.

c) What is balanced diet? Discuss the major components of balanced diet.

d) Give an account on structure and function of nucleotides.

e) i) What are the characteristics of fat soluble vitamins?

ii) Comment on biochemical functions of pantothenic acid.

Q5) Attempt any two of the following: **[8]**

a) What is replication fork? Discuss the events that take place during movement of replication fork.

b) What is enzyme immobilization? Discuss any two techniques of enzyme immobilization.

c) Comment on the stages of translation process in Prokaryotes.

Q6) Explain the following terms. (any four) **[5]**

a) Reverse transcriptase

b) DNA recombination

c) Pellagra

d) Gene therapy

e) AUG CODON

f) Non competitive inhibition of enzymes

g) Exons

Total No. of Questions : 3]

P3877

[4723] - 2004
M.Sc. - I (Semester - II)
ANALYTICAL CHEMISTRY
CHA - 290 : General Chemistry
(2013 Pattern)
Part C : Concepts of Analytical Chemistry (2.0 credit)

Q1) Answer the following: **[10]**

a) What do you mean by test of significance?

b) Mentioned any two properties of nanomaterials.

c) Define Nernst distribution law and its Mathematical equation.

d) Distinguish between accuracy and precision.

e) How many significant figures does each of the following.

i) 0.02670

ii) 528.0

Q2) Attempt any two of the following: **[10]**

a) Describe sol-gel method for the synthesis of nanomaterials.

b) What are errors? Explain determinate and indeterminate error with suitable examples.

c) Derive the relation between distribution ratio and distribution coefficient. Explain the effect of pH on the extraction of benzoic acid.

d) Describe the physical difference between open tubular and packed column. What are the advantages and disadvantages.

Q3) Attempt any one of the following: **[5]**

a) The standard deviation in measuring the diameter 'd' of a sphere is ± 0.02cm. What is the standard deviation in the calculated volume V of the sphere if d = 2.15cm?

b) Draw a neat labelled diagram of fractionating column and explain its principle and working.

Total No. of Questions : 3]

P3877

[4723] - 2004
M.Sc. - I (Semester - II)
ANALYTICAL CHEMISTRY
CHA - 290 : General Chemistry)
(2013 Pattern)
Part D : Industrial Methods of Analysis (2.0 credit)

Q1) Answer the following: **[10]**

a) Explain continuous flow method.

b) How will you prepare 10 ppm potassium solution from potassium chloride. (Give Molecular wt. of KCl = 74.0)

c) Define the terms -

i) Normality

ii) Molarity

d) Explain the term benefit of quality system.

e) Define microsensor. Give its two types.

Q2) Attempt any two of the following: **[10]**

a) Write note on automatic elemental analyser.

b) Explain the term total quality management in detail.

c) Describe the concept of mmole and gmole with suitable example.

d) Explain stability and instability constant.

Q3) Attempt any one of the following: **[5]**

a) Write note on continuous online process control.

b) Calculate the solubilities of silver chromate in 0.001 M and 0.01 M silver nitrate solutions and 0.001 M and 0.01 M potassium chromate solutions.

Given silver chromate has $K_{sp} = 1.7 \times 10^{-12}$ mole^{3}L^{-3} and its solubility in water = 5.5×10^{-5} mole L^{-1}).

Total No. of Questions : 3]

P3877

[4723] - 2004
M.Sc. - I (Semester - II)
ANALYTICAL CHEMISTRY
CHA - 290 : General Chemistry
(2013 Pattern)

Part E : Orgonometallic and Inorganic Reaction Mechanism (2.0 credit)

Q1) Answer the following: **[10]**

a) Which of the following obey the EAN rule.

i) $I_r(PPh_3)_2$ COCl

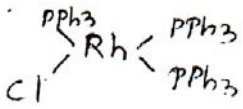
ii) Co_2 $(CO)_3$

iii) Fe $(CO)_5$

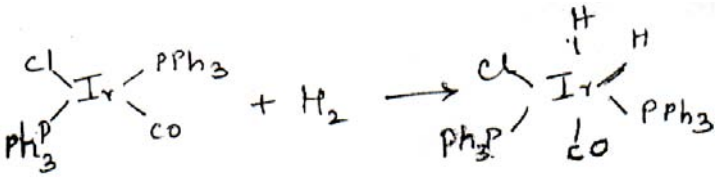
iv) $[(\eta^{5-}C_5H_5)_2Co]^+$

b) Which of the following square planar complexes have $16e^-$ valence shell configuration.

i) cis–Pt $(NH_3)_2$ Cl_2

ii) 

c) Predict the type of reaction.



d) What is substitution reaction in coordination compounds? Give examples.

e) What is meant by inert & labile complexes. Give suitable examples.

Q2) Attempt any two: **[10]**

a) Explain the bonding in metal alkene compounds.

b) Differentiate between associative and dissociative machanism in substitution reactions.

c) Comment on the IR data of some metal carbonyls given below.

		$\nu C = 0$ (cm^{-1})
i)	$[Ti(CO)_6]^{--}$	1748
ii)	$[V(CO)_6]^{-}$	1859
iii)	$[Fe(CO)_6]^{+2}$	2204

d) $\nu C = C$ in C_2H_4 is observed at $1600cm^{-1}$ while in $K[PtCl_3(C_2H_4)]$ it is seen at $1513cm^{-1}$, Explain.

Q3) Write notes on any one: **[5]**

a) M – L bonding in metal alkenes and metal carbenes,

b) Stereochemistry of substitution reactions in square planar complexes.

Total No. of Questions : 3]

P3877

[4723] - 2004
M.Sc. - I (Semester - II)
ANALYTICAL CHEMISTRY
CHA - 290 : General Chemistry - II
(2013 Pattern) (2 Credits)
Part F : Mathematics For Chemists (2.0 credit)

Q1) Answer the following: **[10]**

a) Define

i) Inexact differential equation

ii) Column and Row vectors

b) i) If $A = \begin{bmatrix} 6 & 9 & 8 \\ 2 & 4 & 3 \end{bmatrix}$ 3A = ?

ii) Add the following matrices : $\begin{bmatrix} 3 & 3 \\ 2 & 1 \end{bmatrix}$ $\begin{bmatrix} 4 & 2 \\ 6 & 8 \end{bmatrix}$

c) Give the power rule for differentiation

d) i) If $y = -3e^{2x}, \frac{dy}{dx} = ?$

ii) Define linear differential equation. Give example.

e) i) If $Y = x^{3/2} - 7x^4 + 10e^{-3x} - 5, \frac{dy}{dx} = ?$

ii) What is a dependent variable? Give example.

Q2) Attempt any two of the following: **[10]**

a) Discuss the method of averages for plotting graphs.

b) Evaluate :

i) $y = \frac{x^2}{3x-1}, \frac{dy}{dx} = ?$

ii) $x^{-2}(4 + 3x^{-3})$

c) Enlist any four rules for integration.

d) Find the determinant of the following:

i) $\begin{bmatrix} 3 & 2 & 6 \\ 1 & 2 & 3 \\ 4 & 5 & 7 \end{bmatrix}$ ii) $\begin{bmatrix} 8 & 4 \\ 2 & -1 \end{bmatrix}$

Q3) Attempt any one of the following: **[5]**

a) Integrate the following:-

i) $\int x \sin x \, dx.$

ii) $\int \frac{x+1}{x-1} dx$

b) What is a series? Discuss any one method of solving a converging series.

Total No. of Questions : 3]

P3877

[4723] - 2004
M.Sc. - I (Semester - II)
ANALYTICAL CHEMISTRY
CHA - 290 : General Chemistry
(2013 Pattern)

Part G : Pericyclic,Photochemistry and Free Radical Reactions (2.0 credit)

Q1) Attempt any two of the following: **[8]**

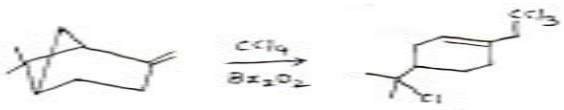
a) Explain with the help of FMO approach whether $a[\pi^4 s + \pi^2 s]$ cycloaddition reaction is thermally allowed or photochemically allowed.

b) Discuss photorearrangement of Benzene.

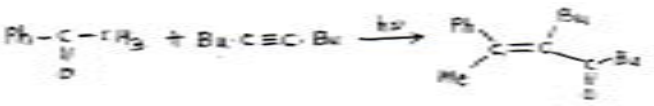
c) Explain the role of antioxidants in inhibition of autoxidation.

Q2) Explain the mechanism for any three of the following: **[9]**

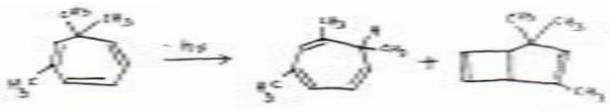
i)



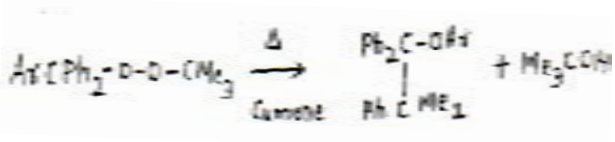
ii)



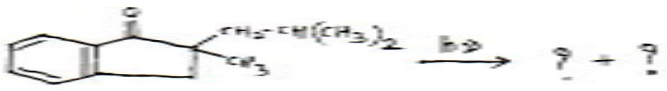
iii)



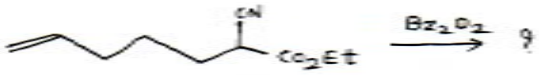
iv)



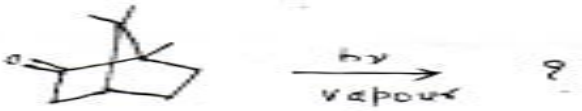
3) Predict the products for any four of the following and indicate the mechanism involved.

a) 

b) 

c) 

d) E,Z,E – 2, 4, 6 – octatriene $\xrightarrow{132^{o}C}$?

e) 

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Total No. of Questions : 6]

SEAT No. :

P2940

[Total No. of Pages : 3

[4723]-201

M.Sc.

PHYSICAL CHEMISTRY

CH-210 : Physical Chemistry-II

(2008 Pattern) (Old) (Semester-II)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right side indicate full marks.*
4) *Use of logarithmic table/calculator is allowed.*
5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1.	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2.	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3.	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4.	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5.	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6.	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7.	Faraday Constant	F	$= 96487$ C equiv^{-1}
8.	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9.	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10.	1 amu		$= 1.673 \times 10^{-27}$ kg
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION-I

Q1) Attempt Any Three of the following: **[15]**

a) Explain the factors influencing the width and intensity of spectral lines.

b) Discuss the general rules governing the number of lines observed in the ESR spectrum.

c) What is centrifugal distortion? Explain the effect of centrifugal distortion on the rotational energy levels of a diatomic molecule.

d) Discuss the principle of IR spectroscopy in the molecular structure elucidation.

e) What is the significance of zero point energy? Obtain an expression for zero point energy of an anharmonic oscillator.

Q2) Attempt Any Three of the following: **[15]**

a) Write a note on Birge sponer extrapolation.

b) Sketch and explain the Fortrat diagram.

c) Explain the quantum theory of Raman effect.

d) Discuss the theory of pure rotational Raman spectra of linear molecule. Sketch the energy levels and the spectrum arising from transition between them.

e) What is Franck-condon principle? How is dissociation energy of a diatomic molecule determined from vibrational coarse structure in its electronic spectrum?

Q3) Solve Any Two of the following: **[10]**

a) Calculate the force constant for HCl molecule, as it shows absorption band at 2890 cm^{-1} [Given At. wt: Cl = 35.5, H = 1.008]

b) If $H^{36}Cl$ is irradiated with 435.8mm Hg lines, calculate the Raman line in nm, if the fundamental vibrational frequency of $H^{35}Cl$ is $8.667 \times 10^{13} S^{-1}$.

c) For a certain molecule, B = 200 m^{-1}. Estimate the relative population of the molecule in the first excited state to that in the ground state at 300°C.

SECTION-II

Q4) Attempt Any Three of the following: **[15]**

a) Describe the different types of radioactive decay processes. Give one example of each.

b) Give an account of nuclear waste management.

c) Explain seperation of isotopes by the gaseous diffusion method.

d) Discuss the four factor formula used in reactor technology.

e) Give the classification of nuclear reactor.

Q5) Attempt Any Three of the following: **[15]**

a) Enlist the different modes of interaction of gamma radiation with matter. Describe in detail any one of them.

b) Discuss the method of preparation of ^{14}C and ^{35}S isotopes.

c) What is principle of Frike dosimeter? Explain the mechanism of radiolysis of Frike solution.

d) Explain the principle of neutron activation analysis. Write the expression of induced activity.

e) What are the different units for the measurement of radiation energy? How are they related with each other?

Q6) Solve Any Two of the following: **[10]**

a) Calculate the number of atoms of uranium that must fission per second to generate 20 MW power.

Given-energy released per uranium fission is 200 MeV.

b) 0.1 mg of ^{239}Pu produces 1.4×10^7 dpm. Calculate the half life and average life of ^{239}Pu.

c) Calculate the mass, molecular and linear absorption coefficient of

i) Cyclohexane and

ii) Toluene.

Given - $e\mu = 0.211$ barn / electron.

densities of cyclohexane and toluene are 0.779 and 0.885 9 cm^{-3} respectively.

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Total No. of Questions : 6]

SEAT No. :

P2941

[Total No. of Pages : 6

[4723]-202
M.Sc.-I
INORGANIC CHEMISTRY
CH-230 : Inorganic Chemistry-II
(2008 Pattern) (Semester-II)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log tables and calculators is alowed.***
6) ***Atomic numbers [Cr = 24, Mn = 25, Ni = 28, Co = 27]***

SECTION-I

Q1) Attempt Any Three of the following: **[15]**

a) Prepare the microstate table for np^2 configuration and hence derive the allowed R-S terms for the same.

b) Determine the ground state for the following complexes (Any Two):

i) $[Cr(H_2O)_6]^{3+}$

ii) $[Ni(en)_3]^{2+}$

iii) $[MnCl_4]^{2-}$

c) Classify the following transitions as vibronically allowed, orbitally allowed and forbidden in an octahedral complex. Justify your answer.

i) $A_{1g} \rightarrow T_{2u}$

ii) $A_{2g} \rightarrow A_{1g}$

iii) $Eg \rightarrow Eg$

d) Calculate the degeneracy for following terms/states/configurations.

i) $p^2\ d^2$ ii) ^3Eg

iii) ^5D iv) $t_{2g}^2\ e_g^2$

v) f^3

P.T.O.

e) Arrange the following in increasing order of energy and justify your answer.

i) ^2H, ^2G, ^4F, ^4P and ^2P

ii) ^4F, ^2P, ^1G, ^6H, ^3I and ^6D.

Q2) Answer Any Three of the following: **[15]**

a) Determine the spin multiplicities of states arising from e_g^2 configuration when infinitely strong octahedral field is relaxed to strong field using Bethe's descent in symmetry rule, correlation table and direct product rule.

b) For hexa aquo Co(II) compelx ion two absorption bands are observed at 16,000 cm^{-1} and 19,417 cm^{-1}. Determine the third band with the help of the following data. Also calculate crystal field parameter and nephelauxetic ratio. Comment on metal-ligand bond.

Given:

i) $B = \frac{\upsilon_2 + \upsilon_3 - 3\upsilon_1}{15}$.

ii) $10Dq = \upsilon_2 - \upsilon_1$.

iii) $B_0 = 971\ cm^{-1}$.

iv) $B = 825\ cm^{-1}$.

c) Explain the following (Any Two):

i) $[NiCl_4]^{2-}$ complex ion is more intense in colour than $[Ni(H_2O)_6]^{2+}$ complex ion.

ii) In electronic spectra of d^9 complexes, a shoulder is observed on main transition band.

iii) Rare earth-metal complexes show sharp absorption bands while 3d transition metal complexes show broad bands.

d) How would you account for the magnetic moment listed against each of the following complexes?

i) $[Ni(NH_3)_6]SO_4$, $\mu = 2.84$ BM

ii) $[Co(H_2O)_6]SO_4$, $\mu = 5.1$ BM

e) Give the splitting of the ground state in $[NiCl_4]^{2-}$ and interpret the transitions in terms of crystal field splitting parameter Dq and Racah parameter.

Q3) Write notes on Any Two of the following: **[10]**

a) Racah parameters.

b) Selection rules in d-d transitions.

c) Nephelauxetic effect and nephelauxetic series.

d) Quenching of orbital angular momentum.

SECTION-II

Q4) Answer Any Three of the following: **[15]**

a) Describe the uptake of chromium through chromate ion.

b) What is bioinorganic chemistry? Mention the functions of various metal ions that are used in biomolecules.

c) What are the beneficial and toxic effects of metals.

d) What are the binding sites of amino acids in biomolecules?

e) Give an account of model compounds and spontaneous self-assembly.

Q5) Write short notes on Any Three: **[15]**

a) HSAB concept.

b) Classification of metalloproteins.

c) Acetycholine receptors.

d) Mercury detoxification.

e) Iron-sulfur clusters.

Q6) Draw structures of: **[10]**

a) Adenin.

b) Thymine.

c) Oxy-haemoglobin.

d) Aurinofin.

e) Corrin.

Character Table for O rotational group

O	E	$6C_4$	$3C_2(=C_4^2)$	$8C_3$	$6C_2$		
A_1	1	1	1	1	1		$x^2+y^2+z^2$
A_2	1	−1	1	1	−1		
E	2	0	2	−1	0		$(2z^2-x^2-y^2$ $x^2-y^2)$
T_1	3	1	−1	0	−1	$(R_x, R_y, R_z); (x, y, z)$	
T_2	3	−1	−1	0	1		(xy, xz, yz)

Correlation Table for the Group O_h

Oh	O	Td	D_{4h}	D2d	C_4^v	C_2^v	D2d	D_3	C2h
A1g	A1	A1	A1g	A1	A1	A2	A1g	A1	Ag
A2g	A2	A2	B1g	B1	B1	A2	A2g	A2	Bg
Eg	E	E	A1g+B1g	A1+B1	A1+B1	A1+A2	Eg	E	Ag+Bg
T1g	T1	T1	A2g+Eg	A2+E	A2+E	A2+B1+B2	A2g+Eg	A2+E	Ag+2Bg
T2g	T2	T	B2g+Eg	B2+E	B2+E	A1+B1+B2	A2g+Eg	A1+E	2Ag+Bg
A1u	A1	A2	A2u	B1	A2	A2	A1u	A1	Au
A2u	A2	A1	B2u	A1	B2	A1	A2u	A2	Bu
Eu	E	E	A2u+B2u	A1+B1	A2+B2	A1+A2	Eu	E	Au+Bu
T1u	T1	T2	A2u+Eu	B2+E	A1+E	A1+B1+B2	A2u+Eu	A2+E	Au+2Bu
T2u	T2	T1	B2u+Eu	A2+E	B1+E	A2+B1+B2	A2u+Eu	A1+E	2Au+Bu

=

DIRECT PRODUCTS

1. Groups of the form $G \times I$ or $G \times \sigma_h$:
   The g, u or $'$, $''$ additions to the IR symbols in these groups satisfy
   $g \times g = u \times u = g$, $g \times u = u$, $' \times ' = '' \times '' = '$, $' \times '' = ''$.

2. Products of the form $A \times A$, $B \times B$, $A \times B$:
   For all groups :
   Letter symbols : $A \times A = A$, $B \times B = A$, $A \times B = B$.
   Subscripts : $1 \times 1 = 1$, $2 \times 2 = 1$, $1 \times 2 = 2$
   except for the B representations of D_2 and D_{2h} where
   $B \times B = B$ and $1 \times 2 = 3$, $2 \times 3 = 1$, $3 \times 1 = 2$.

3. Products of the form : $A \times E$, $B \times E$:
   (a) For all groups : $A \times E_k = E_k$ irrespective of the suffix on A.
   (b) For all groups except D_{4h}, D_{4d}, S_8 :
   $B \times E_1 = E_2$, $B \times E_2 = E_1$
   irrespective of the suffix on B. (If the group has only one B representative put $B_1 = B_2 = B$.)
   (c) For D_{4d} :
   $B \times E_1 = E_2$, $B \times E_2 = E_1$, $B \times E_3 = E_3$, $B \times E_4 = E_4$, $B \times E_5 = E_5$
   irrespective of the suffix on B.
   (d) For D_{4h}, S_8 :
   $B \times E_1 = E_3$, $B \times E_2 = E_4$, $B \times E_3 = E_1$
   irrespective of the suffix on B.

4. Products of the form $E \times E$:
   (For groups which have A, B or E symbols without suffixes put $A_1 = A_2 = A$, etc. in the equations below.)
   (a) For O_h, O, T_d, D_{6h}, D_6, C_{6v}, C_{6h}, C_6, S_6, D_{3d}, D_{3h}, D_3, C_{3v}, C_{3h}, C_3 :
   $E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + E_2$; $E_1 \times E_2 = E_1 + E_2 + E_1$.
   (b) For D_{4h}, D_4, C_{4v}, C_{4h}, C_4, S_4, D_{2d} :
   $E \times E = A_1 + A_2 + B_1 + B_2$.
   (c) For D_{4d} :
   $E_1 \times E_1 = E_3 \times E_3 = A_1 + A_2 + E_2$,
   $E_2 \times E_2 = E_4 \times E_4 = A_1 + A_2 + E_4$,
   $E_3 \times E_3 = A_1 + A_2 + B_1 + B_2$,
   $E_1 \times E_2 = E_3 \times E_4 = E_1 + E_3$, $E_1 \times E_3 = E_2 \times E_4 = E_2 + E_4$,
   $E_1 \times E_4 = E_2 \times E_3 = E_2 + E_3$, $E_2 \times E_3 = E_1 \times E_4 = E_1 + E_4$,
   $E_1 \times E_3 = B_1 + B_2 + E_2$, $E_2 \times E_4 = B_1 + B_2 + E_2$.

(*d*) D_{5d}, D_{5h}, D_5, C_{5v}, C_{5h}, C_5

$E_1 \times E_1 = A_1 + A_2 + E_2$, $E_2 \times E_2 = A_1 + A_2 + E_1$,

$E_1 \times E_2 = E_1 + E_2$.

(*e*) For D_{4d}, S_8.

$E_1 \times E_1 = E_3 \times E_3 = A_1 + A_2 + E_2$,

$E_2 \times E_2 = A_1 + A_2 + B_1 + B_2$

$E_1 \times E_2 = E_2 \times E_3 = E_1 + E_3$, $E_1 \times E_3 = B_1 + B_2 + E_2$.

5. Products involving the T (or F) representations of O_h, O and T_d

$A_1 \times T_1 = T_1$, $A_1 \times T_2 = T_2$, $A_2 \times T_1 = T_2$, $A_2 \times T_2 = T_1$,

$E \times T_1 = E \times T_2 = T_1 + T_2$.

$T_1 \times T_1 = T_2 \times T_2 = A_1 + E + T_1 + T_2$.

$T_1 \times T_2 = A_2 + E + T_1 + T_2$.

6. The complete results for O are :

O	A_1	A_2	E	T_1	T_2
A_1	A_1	A_2	E	T_1	T_2
A_2	A_2	A_1	E	T_2	T_1
E	E	E	A_1+A_2+E	T_1+T_2	T_1+T_2
T_1	T_1	T_2	T_1+T_2	$A_1+E+T_1+T_2$	$A_2+E+T_1+T_2$
T_2	T_2	T_1	T_1+T_2	$A_2+E+T_1+T_2$	$A_1+E+T_1+T_2$

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Total No. of Questions :6]

SEAT No. :

P2942

[Total No. of Pages : 5

[4723]-203
M.Sc. - I
ORGANIC CHEMISTRY
CH - 250: Synthetic Organic Chemistry and Spectroscopy
(2008 Pattern) (Semester - II)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

Q1) Explain any four of the following: **[16]**

a) In Baeyer Villiger oxidation t-butyl group migrates in preference to methyl.

b) Conversion of cyclohexanone in to methylene cyclohexane could be achieved by using Wittig reaction rather than Grignard's reaction.

c) Triisopropyl carbinol can be prepared only by using organolithium reagent, but not by using Grignard reagent. Explain.

d) The reduction of chiral carbonyl compounds with sodium borohydride proceeds without racemisation. Explain.

e) What are the different applications of SeO_2 in organic synthesis.

Q2) Write short note on any three of the following: **[12]**

a) Significance of Wittig Reagent.

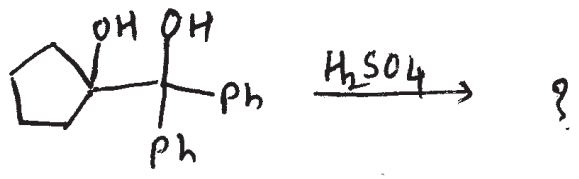
b) Reformatsky reaction.

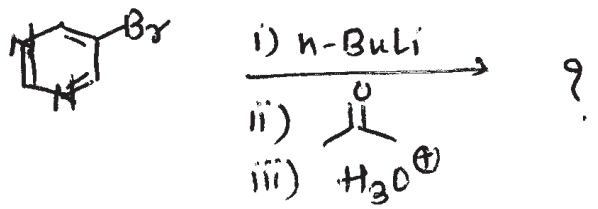
c) Swern oxidation.

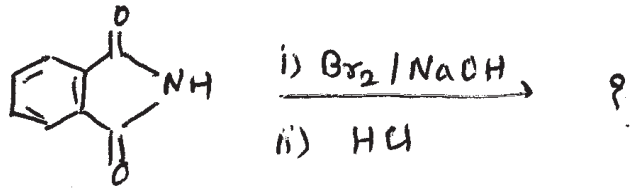
d) Wilkinson's catalyst.

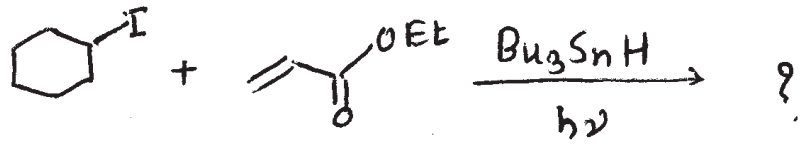
P.T.O.

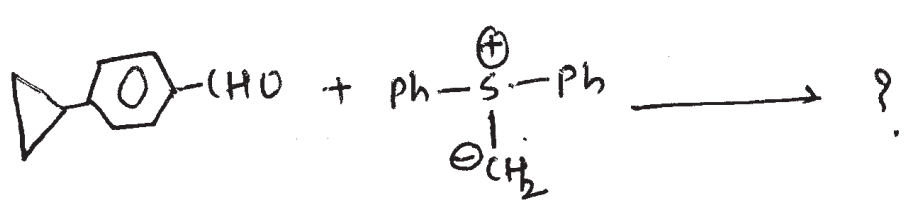
Q3) Predict the product and suggest the mecahnism for any four of the following: **[12]**

a) 

b) 

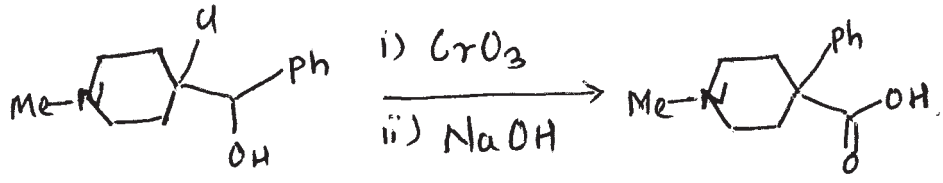
c) 

d) 

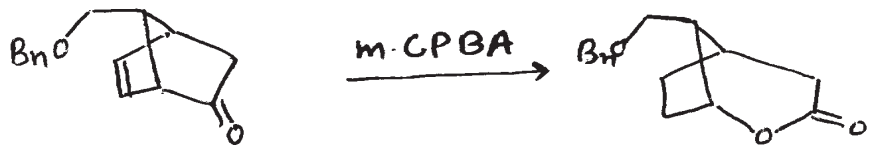
e) 

SECTION - II

Q4) Suggest mechanism for any four of the following: **[12]**

a) 

b)



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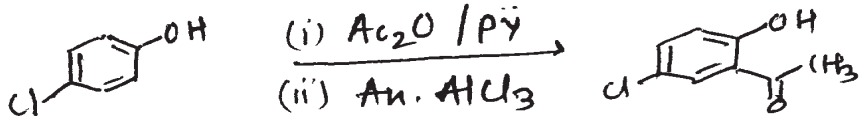
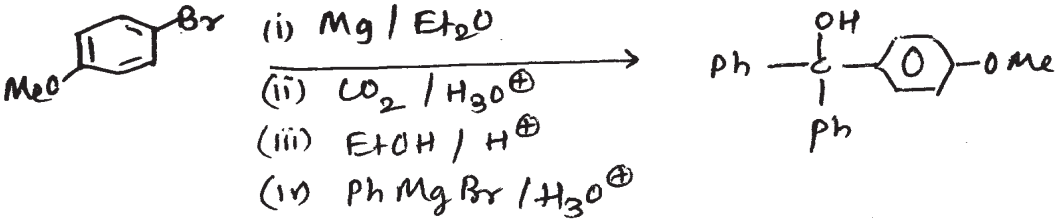


d)



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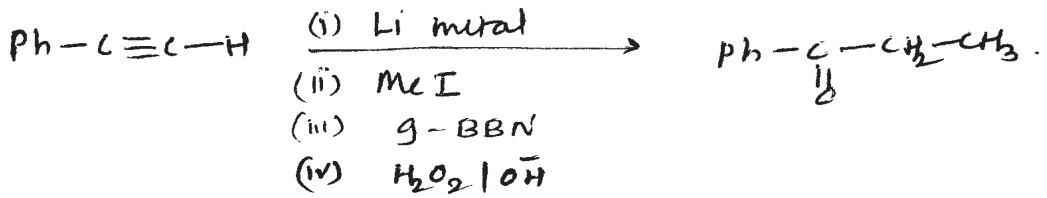
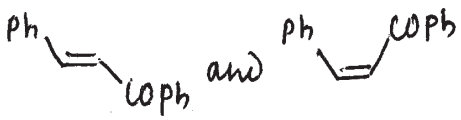


Q5) Attempt any four of the following: **[16]**

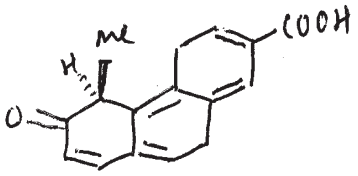
a) How will you distinguish following compounds by IR spectroscopy.

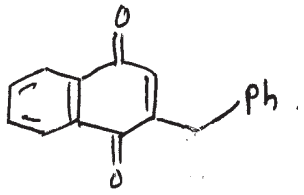
i)

ii)



b) Calculate $\lambda_{max.}$ for the following compounds. Clearly show your calculations.

i) 

ii) 

c) Write note on spin-spin coupling.

d) m-Nitrophenol in neutral solution absorbs at 330 nm while in alkaline solution absorbs at 380 nm, in contrast p-nitrophenol has λ_{max} = 320 nm in neutral solution and 400 nm in alkaline solution. Explain.

e) Explain the terms with suitable examples

i) Hypsochromic shift.

ii) Bathochromic shift.

Q6) Deduce the structures of <u>any three</u> of the following compounds using spectral data and justify your answer. **[12]**

a) MF = $C_{12}H_{14}O_4$

UV = 220 nm (ϵ = 11000)

IR = 1735, 1600, 1490, 990 cm^{-1}

PMR = 1.25δ (t, J = 6 Hz, 6H)

4.25δ (q, J = 6 Hz, 4H)

7.45δ (dd, J = 2 & 8 Hz, 2H)

7.65δ (dd, J= 2 & 8 Hz, 2H)

b) MF = $C_7 H_{14} O$

UV : Feathureless above 220 nm

IR : 1720 cm^{-1}

PMR : 0.9δ (t, 30 mm)

1.6δ (Sextet, 20 mm)

2.4δ (t, 20 mm)

c) MF = $C_6 H_{13} O_2 Br$

IR = 1060, 1120 cm^{-1}

PMR = 1.3 (t, J = 7 Hz, 18 mm)

3.3 (d, J= 6 Hz, 6 mm)

3.55 (q, J = 7 Hz, 12 mm)

4.7 (t, J = 6 Hz, 3 mm)

d) MF = $C_{11} H_{16} O$

IR = 3500, 1550, 770, 830 cm^{-1}

PMR = 1.4 (s, 9H)

2.27 (s, 3H)

4.75 (bs, 1H, exch.)

6.52 (d, 8 Hz, 1H)

6.84 (dd, 8 & 2 Hz, 1H)

7.05 (d, 2 Hz, 1H)

EEE

Total No. of Questions : 6]

SEAT No. :

P2983

[Total No. of Pages : 4

[4723]-3001

M.Sc.

PHYSICAL CHEMISTRY

CHP- 310: Quantum Chemistry and Solid State Chemistry

(2013 Pattern) (Semester - III) (New)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right side indicate full marks.*
4) *Use of logarithmic table, calculator is allowed.*
5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2)	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3)	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4)	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Attempt the following: **[10]**

a) Evaluate $\left[z^3, \frac{d}{dz}\right]$.

b) State the expression for the raising operator.

c) State the conditions for the operator to be linear.

d) What are the conditions for the wavefunction to be acceptable?

e) Write the secular equation for butadiene.

Q2) Attempt any two of the following: **[10]**

a) Formulate the Hamiltonian operators for

i) H_2 molecule and

ii) H_2^+ ions.

State the terms involved in each of these.

b) What is the need of approximate methods in quantum chemistry? Compare perturbation method with the variation method.

c) If $\hat{A} = 3x^2$ and $\hat{B} = \frac{d}{dx}$, then show that $\hat{A}\hat{B} \neq \hat{B}\hat{A}$.

d) Set up the secular determinant and write the secular equation for benzene.

Q3) Solve any one of the following: **[5]**

a) Arrange in the increasing order of aromaticity on the basis of the Huckel rule. Justify your answer.

i) Cyclooctatetrane

ii) C_7H_7 and

iii) Naphthalene

b) Classify with justification whether the following operators are linear or nonlinear?

i) $\frac{3x^2 d^2}{dx^2}$

ii) $(\ )^2$

iii) $\int dx$

iv) exp and

v) $\sum_{x=1}^{n}$

SECTION - II

Q4) Attempt the following: **[10]**

a) Define magnetorestriction. What are hard and soft lines of magnetization?

b) Define mean free path and relaxation time. Give their relationship.

c) What is a lattice imperfection? Give its classification.

d) State Bravais - Donnay - Harker rule for crystal habits.

e) State the factors affecting reactivity of solids.

Q5) Attempt any two of the following: **[10]**

a) Deduce $E_o = \frac{1}{2}[E_v + E_c]$.

b) Discuss Hall effect in semiconductors.

c) If E_p is the energy required to move pair of ions from crystal's interior to the surface, derive the expression for number of Schottky defects produced in a crystal at temperature T.

d) Explain the kinetic rate laws for nucleation for the decomposition of a single solid.

Q6) Solve any one of the following: **[5]**

a) Calculate the specific heat capacity for Na at 4.0 K. [Gvien: $\theta_D = 159K$]

b) If 1 eV is required to move an atom from the crystal's interior to the surface in a monoatomic crystal, what is the proportion of vacancies present in the crystal at 1000K?

EEE

Total No. of Questions : 6]

SEAT No. :

P2984

[Total No. of Pages : 3

[4723]-3002

M.Sc.

PHYSICAL CHEMISTRY

CHP-311 : Nuclear, Radiation and Photo-Chemistry

(2013 Pattern) (New) (Semester-III)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right side indicate full marks.*
4) *Use of logarithmic tables and calculator is allowed.*
5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2)	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3)	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4)	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION-I

Q1) Answer the following: **[10]**

a) Differentiate between fissile and fissionable nuclides.

b) State the applications of Rutherford back scattering spectrometry.

c) What are the different types of nuclear research reactors?

d) State the properties of good scintillator.

e) Explain the term 'magic number'.

Q2) Attempt Any Two of the following: **[10]**

a) Discuss the discontinuities observed in nuclear properties with reference to magic number with typical examples.

b) Explain the mechanism of radiolysis of ceric sulphate solution and give expression for $G_{ce^{3+}}$.

c) Describe the working of surface barrier semiconductor detector.

d) Discuss the principle, construction and working of PIXE technique.

Q3) Solve Any One of the following: **[5]**

a) On the basis of semiempirical mass equation predict the stable nuclide of isobaric series A = 140.

b) Calculate the gamma-ray dose absorbed by CH_3OH in two hours if dose absorbed by Fricke solution at the same position is 2.0 Gy/min.

Given: Z/A of Fricke solution is 0.553.

SECTION-II

Q4) Answer the following: **[10]**

a) Explain the terms stimulated emission and spontaneous emission.

b) Distinguish between dark reactions and photochemical reactions.

c) Define triplet state. Write the characteristics of the triplet state.

d) What is meant by quenching and state its importance.

e) Define oscillator strength. How is it related to natural radioactive life time of the atom or molecule?

Q5) Attempt Any Two of the following: **[10]**

a) Discuss the mechanisms of delayed fluorescence.

b) Describe the working of Ruby and Nd/YAG laser.

c) Discuss the applications of fluorescence.

d) What are the types of electronic transitions in organic molecules? Explain Kasha's tests for the identification of transitions.

Q6) Attempt Any One of the following: **[5]**

a) Derive Stern-Volmer equation for kinetics of quenching.

b) In the photochemical combination of $H_2(g)$ and $Cl_2(g)$, a quantum efficiency of about 1×10^6 is obtained with a wavelength of 4800 $\mathring{A}$. How many moles of HCl would be produced under these conditions per calorie of radiant energy absorbed?

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Total No. of Questions : 6]

SEAT No. :

P2985

[Total No. of Pages : 3

[4723]-3003

M.Sc.

PHYSICAL CHEMISTRY

CHP- 312: Physico-Chemical Methods of Analysis

(2013 Pattern) (Semester - III) (New)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right side indicate full marks.*
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5) *Neat diagrams must be drawn wherever necessary.*

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5)	1 eV		$= 23.06$ k cal mol^{-1}
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6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
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			$= 4.184$ J
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12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Answer the following: **[10]**

a) Define the term 'absorptive edge' used in x-ray absorption. Write the equation for mass absorptive coefficient of a mixture.

b) Draw a neat labelled diagram of cylindrical mirror analyzer used in ESCA technique.

c) Explain in brief electron shake up and shake off processes with example observed in ESCA.

d) Calculate the potential difference between the filament and the target in an x-ray tube which has a short-wavelength cutoff at 0.109 nm.

e) Draw a neat labelled block diagram of a thermobalance.

Q2) Answer any two of the following: **[10]**

a) Explain in brief x-ray fluorescence method.

b) Discuss the analysis of solid, liquid and gaseous samples by x-ray fluorescence method. Draw a neat labelled diagram of wavelength- and energy-dispersive instrument.

c) Describe electrostatic field analyzers used in ESCA.

d) What is DTA? How are DTA peaks helpful to analyse the test sample. Explain.

Q3) Solve any one of the following: **[5]**

a) 140.0 mg sample containing a mixture of table salt and $CaC_2O_4.H_2O$ (Mol.wt.146.12) showed a loss of 8.34 mg at 140°C on TG curve. Determine the percentage of calcium oxalate in the sample.

b) X-rays of wavelength 2.3 Å were used to eject electrons from calcium. The kinetic energy of electron was 1.201keV. Calculate the binding energy of electrons in the calcium atom. [Given: Work function of spectrometer = 4.5 eV].

SECTION - II

Q4) Answer the following: **[10]**

a) Give two applications of chemiluminescence.

b) State the principle of ICP - AES technique.

c) State the advantage of constant current coulometry over controlled potential coulometry.

d) Differentiate between normal pulse and differential pulse voltammetry.

e) What is hydrodynamic voltammetry?

Q5) Answer any two of the following: **[10]**

a) How the technique of chemiluminescence used for the determination of gaseous air pollutants?

b) Describe the sample introduction into the ICP in ICP-AES technique.

c) Discuss briefly about the current -voltage relationship used in coulometry.

d) Write a note on cyclic voltammetry.

Q6) Solve any one of the following: **[5]**

a) At what value should the cathod potential be controlled if it is desired to separate silver from 0.005M solution of Cu^{2+} ions?

[Given: $E^{o}_{oxi} Cu^{2+} = -0.337v$]

b) A constant current of 15.0 mA was passed through a chloride solution for 250sec. Calculate the weight of chloride reacting with Ag anode.

[Given: At wt of CL = 35.5]

EEE

Total No. of Questions : 6]

SEAT No. :

P2986

[Total No. of Pages : 3

[4723]-3004
M.Sc.
PHYSICAL CHEMISTRY
CHP-313 : Polymer Chemistry
(New) (Semester-III) (2013 Pattern)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right side indicate full marks.*
4) *Use of logarithmic table/calculator is allowed.*
5) *Neat diagrams must be drawn wherever necessary.*

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9)	1 cal		$= 4.184 \times 10^{7}$ erg
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10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION-I

Q1) Attempt the following: **[10]**

a) Define excluded volume.

b) Define regular and strictly regular solutions.

c) Give limitations of Krigbaum's theory.

d) Why is a polymeric solution not ideal?

e) Define athermal solutions.

Q2) Attempt Any Two of the following: **[10]**

a) How is polarity used to predict polymer solubility?

b) Explain the relations of ΔE and ΔS with polymer solubility.

c) Discuss limitations of Guggenheims solubility model.

d) Explain membrane osmometry technique to predict polymer solubility.

Q3) Attempt Any One of the following: **[5]**

a) Compare regular and irregular solutions.

b) Why is heat of solution less for dissolution of polymers?

SECTION-II

Q4) Attempt the following: **[10]**

a) Define creep.

b) Define Deborah number.

c) Define weisenberg number.

d) State WLF equation.

e) Explain theta temperature.

Q5) Attempt Any Two of the following: **[10]**

a) Explain wet spinning process.

b) Write a note on membrane Osmometry.

c) Describe the voigt model of viscoelastic behaviour.

d) Explain what is a Bingham plastic.

Q6) Attempt Any One of the following: **[5]**

a) Distinguish between Hookean elasticity and thixotropy. What is shear thinning?

b) How are k and α determined from the mark Houwink equation?

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Total No. of Questions : 6]

SEAT No. :

P2987

[Total No. of Pages : 3

[4723]-3005

M.Sc.

PHYSICAL CHEMISTRY

CHP-314 : Modern Trends in Physical Chemistry

(New) (2013 Pattern) (Optional) (Semester-III)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right side indicate full marks.*
4) *Use of logarithmic tables and calculator is allowed.*
5) *Neat diagrams must be drawn wherever necessary.*

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			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION-I

Q1) Answer the following: **[10]**

a) Define the term phase and give examples of a single phase and two phases.

b) Explain the term degree of freedom with examples.

c) Write mass balance on carbonate in 0.1M H_2CO_3.

d) Write charge balance for a solution of NaH_2PO_4.

e) Write proton condition for K_2CO_3.

Q2) Answer Any Two of the following: **[10]**

a) Calculate the pH and concentrations of all the species for 0.1N CH_3COOH. ($K_{a_1} = 1.8 \times 10^{-5}$).

b) Discuss vapour pressure diagram for two component system.

c) Write a note on ultrapurity and controlled impurity.

d) Describe liquid-solid phase diagram with a neat labelled diagram.

Q3) Solve Any One of the following: **[5]**

a) Find the concentrations of H_2S, HS^- and S^{2-} in 0.1M solution of a salt of sulfide.

[Given: pH = 8.21, $K_{a_1} = 1.0 \times 10^{-7}$ and $K_{a_2} = 1.20 \times 10^{-13}$]

b) Draw a logarithmic concentration diagram for 0.1N H_2CO_3 solution.

[Given: $K_{a_1} = 4.46 \times 10^{-7}$ and $K_{a_2} = 5.62 \times 10^{-11}$].

SECTION-II

Q4) Answer the following: **[10]**

a) Explain magnetostrictine materials with an example.

b) What is the vacuum required in the electronic column of SEM? Why?

c) State the characteristics of backscattered electron images.

d) Calculate the wavelength of electron emitted in cathode ray tube operating at 10,000 V.

e) Write in brief the working of Sushi sensor.

Q5) Answer Any Two of the following: **[10]**

a) What is a smart material? Explain with two examples.

b) What is meant by nanocrystals? Explain the catalytic aspects of nanocrystals.

c) Discuss the defects observed in SEM image and methods used to overcome these defects.

d) Describe the optical properties of nanoparticles.

Q6) Attempt Any One of the following: **[5]**

a) Explain the construction of scanning electron microscope.

b) Discuss the characteristics of passive smart materials with examples.

●●●●●

Total No. of Questions : 4]

SEAT No. :

P2988

[Total No. of Pages : 3

[4723]-3007
M.Sc. II
INORGANIC CHEMISTRY
CHI- 326: Organo Metallic Chemistry and Homogeneous Catalysis
(2013 Pattern) (Semester - III)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of log tables and calculators is allowed.***

Q1) Answer the following: **[20]**

a) Arrange the following organometallic compounds in descending order of carbonyl streching frequencies.

i) $Ni(CO)_3\ PF_3$

ii) $Ni(Co)_3\ PMe_3$

iii) $Ni(Co)_3\ PPh_3$

b) Which of the two metallocenes will be more reactive and why?

i) $Cp_2\ Co^+$

ii) $Cp_2\ Ti$

c) Write the difference between fischer and schrock carbenes with respect to metal, carbon and metal-carbon bonds.

d) What is meant by olefin metathesis? Name the main types of olefin metathesis reactions.

e) What is Tollman's cone angle? What is its significance?

f) Draw the structures of ferrocene and Ruthenocene what is the conformational difference between them. Give reasons for the difference.

P.T.O.

g) Draw the structures of the following compounds and write the number of M-M bonds in them.

i) $Ru_6(CO)_{17}C$

ii) $[H(Co_6(CO)_{15})]^{--}$

h) Write the examples of the following reactions.

i) Oxidative addition

ii) Migratory insertion

i) Define the following terms:

i) Turnover Number

ii) Turnover frequency

j) Define hapticety of a ligand and give suitable examples.

Q2) Attempt any two: **[10]**

a) Explain the bonding in metal-alkene compounds.

b) Discuss the cativa process for manufacture of Acetic Acid.

c) Write an account of important reactions of ferrocene.

d) Explain the mechanism of suzuki coupling.

Q3) Answer any two: **[10]**

a) Describe the methods of synthesis of metal-alkene compounds.

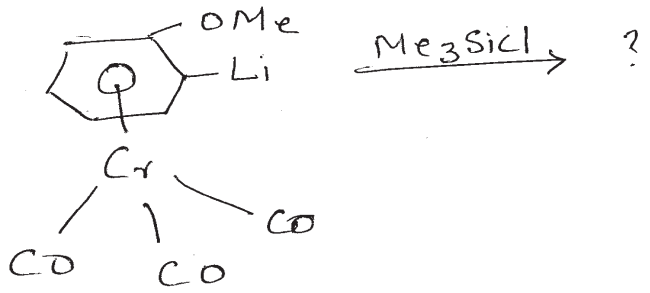
b) Explain the role of organometallic compounds in organic synthesis.

c) Write an account of synthesis and properties of metal-arene compounds.

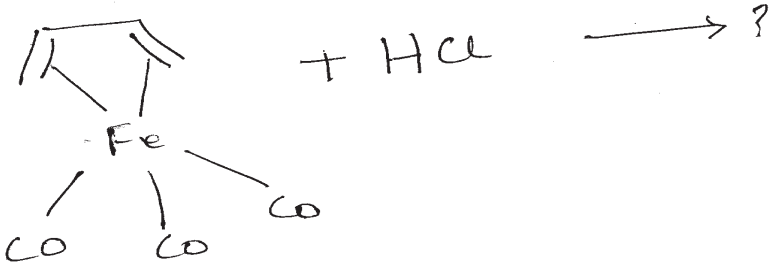
d) What is meant by "fluxionality of a molecule"? Explain with help of suitable examples.

Q4) Attempt any two: **[10]**

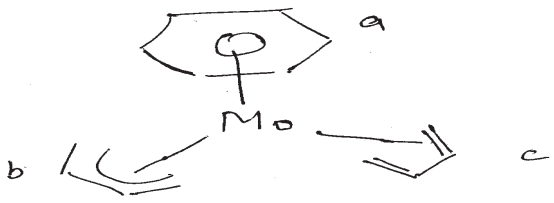
A) a) Predict the products:

i) 

ii) $Co(\eta^5\text{-}C_5H_5)_2 + PhC{\equiv}CPh \longrightarrow ?$

iii) 

b) Give the sequence in which nucleophilic attack on ligands a, b,& c will take place in the following compound and why?



B) a) Draw the catalytic cycle for polymerization of alkenes using metallocene catalyst.

b) Draw the catalytic cycle for Negeshi coupling.

C) Write short note on Metal - phosphine compounds.

EEE

Total No. of Questions : 4]

SEAT No. :

P2989

[Total No. of Pages : 2

[4723]-3008
M.Sc.-II
INORGANIC CHEMISTRY
CHI-330 : Inorganic Reaction Mechanism, Photochemistry & Magnetic Properties of Coordination Compounds
(Semester-III)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Neat diagrams must be draw whenever necessary.***
3) ***Use of logarithmic table and calculator is allowed.***

Q1) Attempt the following: **[20]**

a) Explain thermodynamic stability and kinetic labile and inertness of the complexes.

b) Which of the following oh substitution reaction is faster. Give reason.

$[NiCl(NH_3)_5]^+ + H_2O \rightarrow [Ni\ H_2O\ (NH_3)_5]^{2+} + Cl^-$

$[NiCl(NH_3)_5]^+ + NH_3 \rightarrow [Ni\ (NH_3)_6]^{2+} + Cl^-$

c) What do you meant by quantum yield in photochemical reaction?

d) What is redox reaction? Give its classification.

e) Which analytical technique can be used for differentiating following linkage isomers. Give explaination in support of your answer.

$[CO(NH_3)_5\ NO_2]^{2+}\ Cl_2$ and $[CO(NH_3)_5\ (ONO)]^{2+}\ Cl_2$

f) Explain halogenation of coordinated nitrogen atom in nonchelate ring forming reaction.

g) With the help of "Trans effect" how would you synthesize cis-chlorolodobis (pyridine) platinum (II) starting from $K_2Pt\ Cl_4$.

h) Why four coordinated td and square planer complexes reacts rapidly than oh complexes?

i) State the significance of Neel and curie temperature.

j) Why $Fe_2(CO)_9$ is diamagnetic?

P.T.O.

Q2) Attempt Any Two of the following: **[10]**

a) Substitution in square planer complexes takes place with retension of configuration. Explain.

b) Discuss the possible intramolecular mechanism proposed for the recemisation reaction of frischelate complexes.

c) Explain the electrophilic behaviour of the coordinated ligands with suitable example.

d) Write a note on anamolous magnetic behaviour of coordination compounds.

Q3) Answer the following (Any Two): **[10]**

a) Give an account of photochemical reactions of Cr(III) complexes.

b) Explain inner sphere electron transfer reactions with suitable example.

c) Predict the type of magnetic exchange which occurs via the 90° exchange pathway in the system $d^1 - d^1$, $d^2 - d^2$, $d^3 - d^3$, $d^8 - d^8$ and $d^9 - d^9$.

d) Differentiate between stoichiometric and intimate mechanism.

Q4) Write a note on (Any Two): **[10]**

a) Oxidative addition reaction.

b) Anation reaction.

c) Use of Isotope labeling technique in studying kinetics and mechanism of reactions.

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Total No. of Questions : 4]

SEAT No. :

P2990

[Total No. of Pages : 3

[4723]-3009
M.Sc. II
INORGANIC CHEMISTRY
CHI- 331: Physical Methods in Inorganic Chemistry
(2013 Pattern) (Credit System) (Semester - III)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Use of log tables and calculators is allowed.***
4) ***Draw neat diagrams wherever necessary.***

Q1) Answer the following: **[20]**

a) What is hyperfine splitting in ESR?

b) Define

i) Lattice plane

ii) Millerindices

c) Draw the following planes in a cubic unit cell.

i) 210

ii) 011

d) Which radiations are used Mössbauer spectroscopy? What is their wavelength?

e) Name the 2 compounds used as standard in CV.

f) What is a thermocouple? Where is it used? Which thermocouple can be used at a temperature of 1200^{o}C?

P.T.O.

g) Which of the following will given an ESR spectrum: $C_6H_6^{--}$ Cp^-, O_2, H_2 Na^+, CO_2.

h) ^{57}Fe Mössbauer spectra are recorded for $K_3[Fe(CN)_6]$ and $K_4[Fe(CN)_6]$. Which of the two will give a single line spectrum and why?

i) Name the different creptar systems.

j) Compute the miller indices for the faces having the intercepts as $\frac{1}{2}, \frac{1}{3}, 1$.

Q2) Attempt any two: **[10]**

a) Name the parameters determined by Mössbauer spectroscopy and explain the significance of one of them with suitable examples.

b) Explain the ESR of Mn(II) complexes.

c) Sketch the DTA curve of decomposition of $CaC_2O_4.H_2O$ in

i) air

ii) CO_2

atmosphere and give reasons for the differences in two curves.

d) With the help of cyclic voltametry how will you determine whether the reaction is reversible, irreversible or quasireversible.

Q3) Answer the following (any four): **[10]**

a) Determine the wavelength of diffracted beam, when a beam of X-rays having wave lengths in the range 0.2 -1 $\mathring{A}$, incident at an angle of 9^o with a cube face of a rock crystal. (d = 2.814 $\mathring{A}$)

b) Calculate the magnetic field at which resonance occurs if the 'g' value for the benzene redical anion is 2.0025 and ESR spectrometer operates at 9302 MHz.

c) Explain the process of electron transitions involved in photoelectron spectroscopy.

d) Thermogram of 25.14 mg of sample containing $CaC_2O_4 . H_2O$ (MW 146.12) and a thermally stable salt had a mass loss Δm of 1.39 mg at an onsest temperature of about 140°C corresponding to vaporization of water. Determine the % age (W/W) of $CaC_2O_4.H_2O$ in the sample.

Q4) Write short notes(any two): **[10]**

a) X-ray diffraction technique.

b) Comparison between TG, DTA and DSC.

c) Significance of 'g' and 'G' in ESR.

EEE

Total No. of Questions : 5]

SEAT No. :

P2943

[Total No. of Pages : 4

[4723]-301

M.Sc.

PHYSICAL CHEMISTRY

CH- 310: Quantum Chemistry and Solid State Chemistry

(2008 PATTERN) (SEMESTER - III)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right side indicate full marks.*
4) *Use of logarithmic table calculator is allowed.*
5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2)	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3)	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4)	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Attempt any Four of the following: **[20]**

a) Which of the following functions are eigen functions of the operator $\frac{d^2}{dx^2}$,

i) e^x ii) $\sin x + \cos x$ iii) x^2

Give the corresponding eigen values.

b) Using the trial eigen function, $\phi = \frac{z'^3}{\pi} e^{-z'}(R_1 + R_2)$ where z' is between 1 and 2. Obtain the expression for the energy of Helium atom according to the variation method.

c) Explain the following integrals.

i) Coulomb

ii) Exchange

iii) Overlap and

iv) Normalized

d) Derive an expression for the first order correction to the energy of the non-degenerate unperturbed level.

e) Explain the term symbols for the configurations

i) $2s'2p'$ and ii) $2p'3d'$.

f) Evaluate the commutator $\left[\hat{x}, \hat{P}_x\right]$ operating on function $f(x)$.

Where $\hat{P}_x = \hbar/i \frac{\partial}{\partial x}$, x is the operator for position.

Q2) Attempt any four of the following: **[20]**

a) Deduce the secular equation for butadiene and sketch the HMO energies for the first four levels.

b) State Hückel (4m + 2) rule. Explain the mnemonic model used for mono cyclic conjugated polyenes to deduce the separation of the MO energy levels.

c) Set up the secular determinants for benzene, cyclobutadiene and ethylene molecule.

d) What were the drawbacks for Hückel's method of calculating delocalization energies of conjugated hydrocarbons? How did Hess and Schaad's model predict the aromaticity of these compounds more reliably?

e) Derive the equation for first order perturbation correction to the wave function for non-degenerate systems in a generalized situation.

f) Discuss the perturbation theory for n-fold degenerate energy level.

SECTION - II

Q3) Attempt any three of the following: **[15]**

a) Discuss with a suitable example, how the forbidden bandgap can be determined by studying optical properties.

b) Explain the various types of crystal growth from melt.

c) Draw and explain the screw dislocation in a crystal.

d) Write a note on: transistors and their applications.

e) Derive the expression for the number of Frenkel defects present in a crystal of a given temperature.

Q4) Attempt any three of the following: **[15]**

a) Draw and explain the sigmoid shape curve obtained in thermal

decomposition of a single solid.

b) Discuss the addition reactions in the solid-solid type of reactions giving a suitable example.

c) Write a note on: 'Piezoelectricity in ionic crystals'.

d) Explain how growth twins are formed in a crystal. Which conditions favour their development?

e) Discuss briefly the occurance of photo-chemical processes used in photography.

Q5) Solve <u>any two</u> of the following: **[10]**

a) Calculate the ratio of Frenkel defect at 25°C and 305°C in 1g of crystal. The average energy required to produce Frenkel defects in a crystal A^{2+} B^{-} in 1.4 eV.

b) The intrinsic resistivity of Ge at 800K is 47 Ohm cm. What is intrinsic carrier concentration when electron and hole mobilities in Ge at 300K are 3900 $cm^2\ V^{-1}S^{-1}$ and 1900 $cm^2V^{-1}S^{-1}$ respectively.

c) How deep will aluminium penetrate in silicon at 1200°C in half an hour.

[Given: $D_o = 1.55 \times 10^{-4}\ cm^2/s$]

EEE

Total No. of Questions : 4]

SEAT No. :

P2991

[Total No. of Pages : 3

[4723]-3010
M.Sc.-II
INORGANIC CHEMISTRY
CHI-332 : Bioinorganic and Inorganic Medicinal Chemistry
(2013 Pattern) (Semester-III) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Draw neat diagrams wherever necessary.***

Q1) Answer the following: **[20]**

a) Which are the different oxidation states of Manganese found in biological systems? State their locations.

b) What is the role of super oxide dismutase in the body? Which metals are present in it?

c) Is chromium necessary for human beings? If yes what is its role?

d) Which is the bioinorganic compound that has a M-C bond? Draw its structure.

e) Name the metals present in the following

i) Concovalin A

ii) Rubredoxin

iii) Cytochrome oxidase

iv) Xanthine oxidase

Mention their oxidation states.

f) What is meant by "bone density measurement"? Which element is used for this purpose?

g) What is Dopamine? How is it produced in the body?

P.T.O.

h) Why are Ga and In used as a radiopharmaceutical agents?

i) Draw the reaction pathway for diol-dehydrase reaction catalysed by coenzyme B-12.

j) Mention the significant roles of the following elements in biological process Mn, Zn, Co, Cu.

Q2) Answer Any Two: **[10]**

a) Name the metal ion present in the enzyme carboxypeptidase and explain the mechanism of its function.

b) Explain the role of copper in monooxygenation and oxidation reaction of tyrosinase.

c) Explain the antagonism between copper and molybdenum.

d) Give an account of complexes of techniturm used for imaging kidney structure and function.

Q3) Attempt Any Two: **[10]**

a) "Radionuclides can be used as effective radiodiagnostic tools". Justify the statement with the help of suitable examples.

b) What do you understand by MRI? Name the important MRI contrast reagents and explain their functions.

c) What are non-haem iron proteins. Explain their structure and functions.

d) Explain the structure and function of zinc fingers.

Q4) Attempt Any Two : **[10]**

a) Write notes on:

i) Manganese containing proteins.

ii) Anticancer drugs.

b) i) Match the following:

Haemerythrin	Zinc
Purple acid phosphatase	Manganese
Monooxygenase	Hydrolysis of PO_4^{3-}
Arginase	O_2 carrier
alkaline phosphatase	methane $\rightarrow$ methanol
Nitrogenase	Molybdenum
	Cobalt

ii) Give two examples each of:

I) Copper enzymes

II) Antitumor agents

c) Draw structures of:

i) Methyl cobalamin

ii) Type I, II and III copper proteins

iii) Ferredoxin

●●●●●

Total No. of Questions : 6]

SEAT No. :

P2992

[Total No. of Pages : 4

[4723]-3011
M.Sc. -II (Chemistry)
ORGANIC CHEMISTRY
CHO- 350: Organic Reaction Mechanism
(2013 Pattern) (Semester - III)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

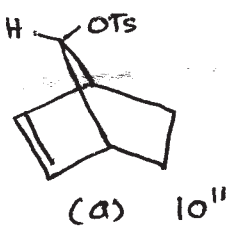
1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

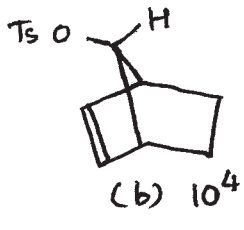
Q1) Explain in brief any three of the following: **[9]**

a) Which is more stable-cyclopentadienyl anion or cycloheptatrienyl anion.

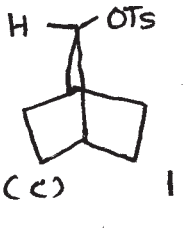
b) Explain relative rates of acetolysis for the following.



(a) 10^{11}



(b) 10^{4}



(c) 1

c) NADH is natures reducing agent explain with one example.

d) Diacetyl exists exclusively as the keto form whereas 1,2-cyclopentanedione is almost 100 percent enolized.

Q2) a) Write short notes on any two of the following: **[4]**

i) Hunsdiecker reaction.

ii) Robinson annulation.

iii) Curtius rearrangement.

P.T.O.

b) Explain <u>any two</u> of the following: **[4]**

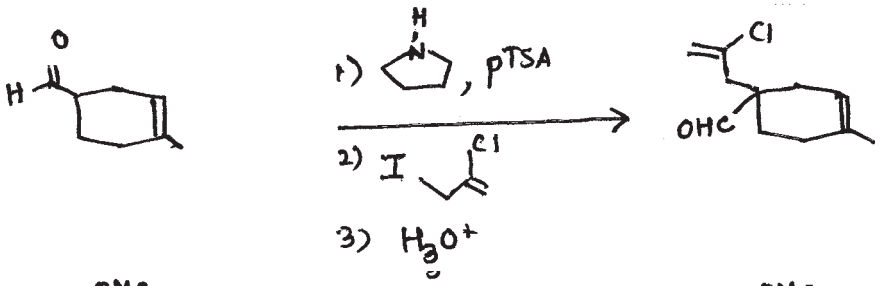
i) Role of azobis isobutyronitrile.

ii) Sandmeyer reaction.

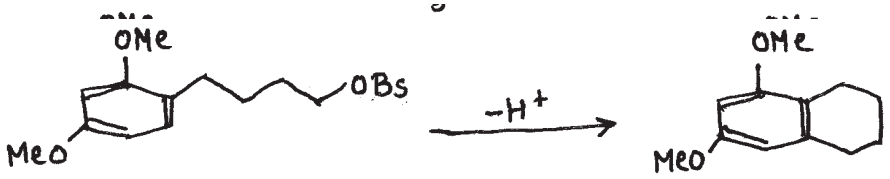
iii) Advantages of enamine approach over enolate approach.

Q3) Suggest the mechanism of <u>any four</u> of the following: **[8]**

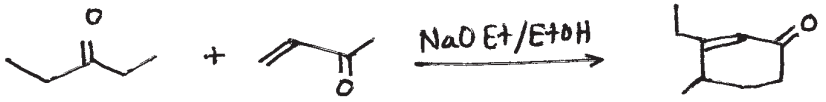
a)



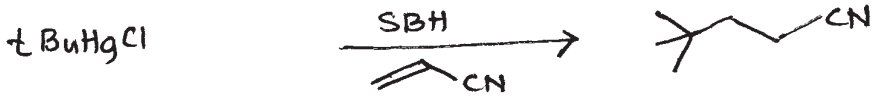
b)



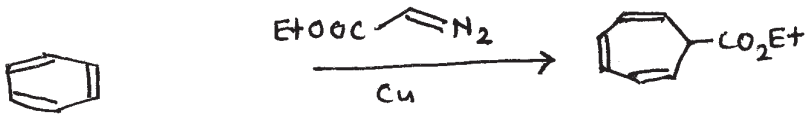
c)



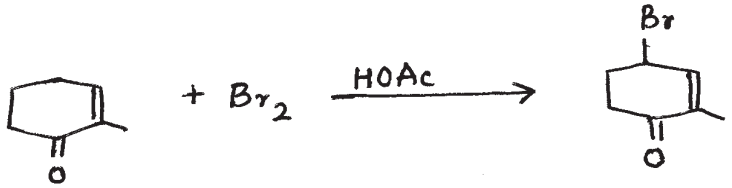
d)



e)



f)



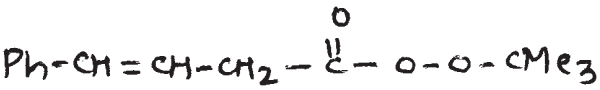
SECTION - II

Q4) Explain in brief <u>any three</u> of the following: **[9]**

a) Explain with suitable example pyridoxal transmination.

b) 2-Quinolylacetic acid undergo decarboxylation faster than Quinoline- 2-carboxylic acid.

c) Hydrolysis of $PhSCH_2CH_2Cl$ is considerably slower than that of E+S CH_2CH_2Cl.

d) The peroxyester  decomposes about 5000 times as rapidaly as t-butyl peroxyacetate.

Q5) a) Write notes on <u>any two</u> of the following: **[4]**

i) Autooxidation.

ii) Generation of carbenes.

iii) Pinacol rearrangement.

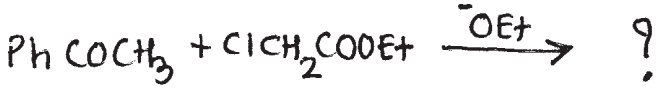
b) Explain <u>any two</u> of the following: **[4]**

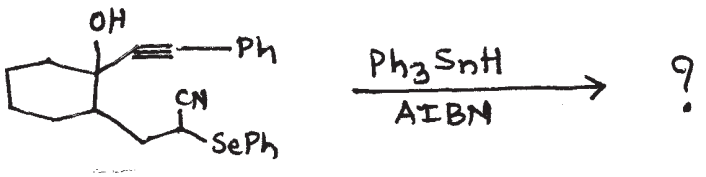
i) Use of stetter reagent.

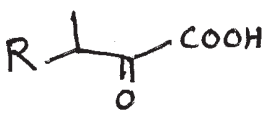
ii) Any one use of RHgH in organic synthesis.

iii) Benzoin condensation takes place by cyanide ions and not by hydroxyl ions.

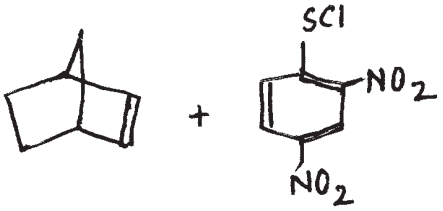
Q6) Predict the product/s from the following <u>any four</u>: **[8]**

a) 

b) 

c) 

Pyridoxal
transamination
?

d) 

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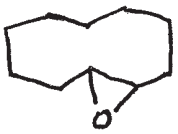
e) 

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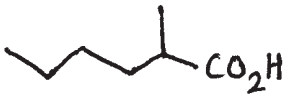
f) 

1) LDA, THF
2) nC4H9Br
3) H3O+
?

ℰℰℰ

Total No. of Questions : 6]

SEAT No. :

P2993

[Total No. of Pages : 9

[4723]-3012
M.Sc.
ORGANIC CHEMISTRY
CHO-351 : Spectroscopic Methods in Structure Determination
(2013 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to right indicate full marks.***
3) ***Answers to the two sections to be written in separate answer books.***

SECTION-I

Q1) A) Answer Any Three of the following: **[6]**

a) Explain the spin system of aliphatic protons in 

. Draw its approximate PMR spectra along with the justification on chemical shift & coupling constant values.

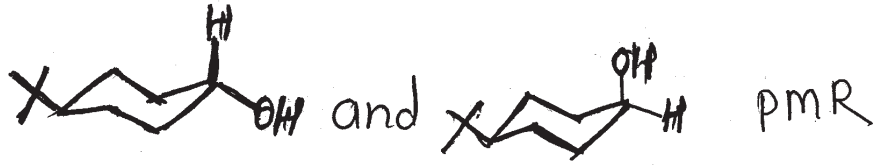
b) NOE is a good technique to study the stereochemistry of molecules. Explain with a suitable example.

c) Discuss in a brief how molecular weight and molecular formula can be obtained from the MS. Explain with a suitable example.

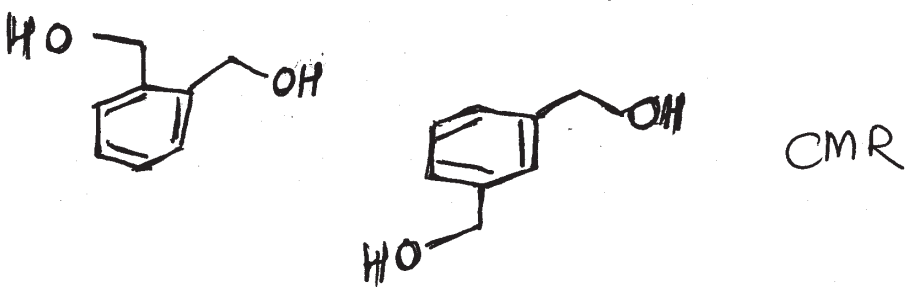
d) COSY could be used to simply and interprete a complex spectra.

B) How will you distinguish following pairs by the indicated spectral method. **[3]**

i) 

ii) 

P.T.O.

iii) 

Q2) Deduce the structure of the molecule by analysing the given spectral data (Any Three): **[9]**

a) MF: $C_{10}H_{11}NO_2$

IP: 2250, 1600 cm^{-1}

PMR: 3.65 s, 8 mm

3.85 s, 24 mm

6.36 t, J = 2Hz 4 mm

6.45 d, J = 2Hz 4 mm

b) MF: $C_8H_{12}O$

IR: 1685, 1618 cm^{-1}

PMR: 1.5 s, 6 mm

1.83 t, J = 2Hz 2 mm

2.50 dt J = 7 & 26 Hz 2 mm

6.78 t 2.6Hz 1 mm

9.82 s, 1 mm.

CMR: 189.2(d), 153.4(d), 132.7(s), 43.6(t) 40.8(s), 30.3(t), 25.9(q str)

c) MF: $C_{10}H_{16}O$

IR: 1690, 1620 cm^{-1}

PMR: 1.2 s, 6H

1.9 d, J = 1.5, 3H

2.1 s, 3H

4.9 dd, J = 1.5 & 10Hz, 1H

5.1 dd, J = 1.5 & 16Hz, 1H

5.6 dd, J = 10 & 16Hz, 1H

6.1 q, J = 1.5Hz, 1H

d) MF: $C_6H_{12}O_2$

UV -λ max 283 nm

IR - 1705, 3400 cm^{-1}

CMR: 29(q); 31(q); 53(t); 68(s); 210(s)

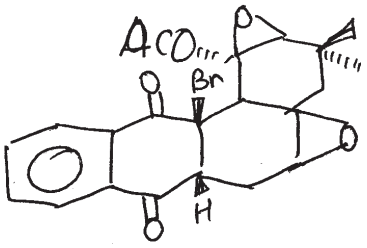
PMR: 1.2 s, 24 mm

2.2 s, 12 mm

2.62 s, 8 mm

3.83 s, 4 mm

Q3) The PMR spectra of the compound shown below, exhibites the following signals. Assign the signals to the various protons. Use the decoupling & NOE data for the assignments. Justify your assignments. **[7]**



0.71, d, J = 13.8Hz, 1H; 1.2 s, 3H; 1.2, 5, 3H; 1.95, s, 3H; 1.96 ddd, J = 1.2, 12.6, 14Hz 1H, 2.27 d, J = 13.8Hz, 1H; 2.40, s, 3H; 2.43 ddd, J = 2.4, 4.2, 14Hz 1H; 2.96 dd, J = 1.2, 2.4 Hz, 1H; 3.35, s, 1H; 3.73 dd, J = 4.2, 12.6Hz 1H; 3.76, bs, 1H; 7.4, dd, J = 1.2, 7.5 Hz 1H, 7.79 t, J = 7.5Hz 1H; 7.96, dd, J = 1.2, 7.5Hz 1H;

Decoupling expt:

Irradiation:	Change at
1.96δ	2.43 ddd → dd J = 2.4, 4.2Hz
	2.90 dd → d, J = 2.4Hz
	3.73 dd → d = J – 4.2Hz
3.73δ	2.43 ddd → dd J = 2.4, 14Hz
	1.96 ddd → dd J = 1.2, 14Hz

NOE

Irradiation 7.4 → 17% enhancement at 7.79δ

10% enhancement at 2.4δ

SECTION-II

Q4) A) Answer Any Three of the following: **[6]**

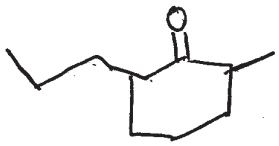
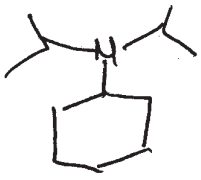
a) Isomeric compounds A, B & C (MF: C_3H_6O) have the following MS data derive their structures.

A: 43(100%), 58 (37%)

B: 27(34%), 28(62%) 29(100%), 58(64%)

C: 27(45%); 28(25%); 29(80%) 57(100%) 58(26%)

b) Predict the important peaks in

 and  in MS.

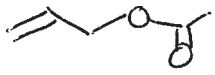
c) A cyclohexanone derivative $C_{10}H_{18}O$ shows the following important ions in its MS. Deduce a structure based on the M.S. pattern.

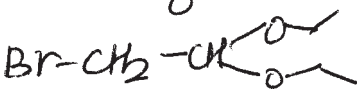
154(18%), 112(100%), 97(25%) 69(75%).

d) Explain the working of analyser in MS, Discuss how double focusing helps in resolutions.

B) Explain the genesis of the following ions in the given molecules (Any Two): **[4]**

a) N-ethyl-cyclopentamine — 113, 98, 85, 84

b)  — 100, 58, 57, 43

c)  — 198, 196, 169, 167, 151

Q5) Write short notes on Any Three of the following: **[6]**

a) Karplus equation.

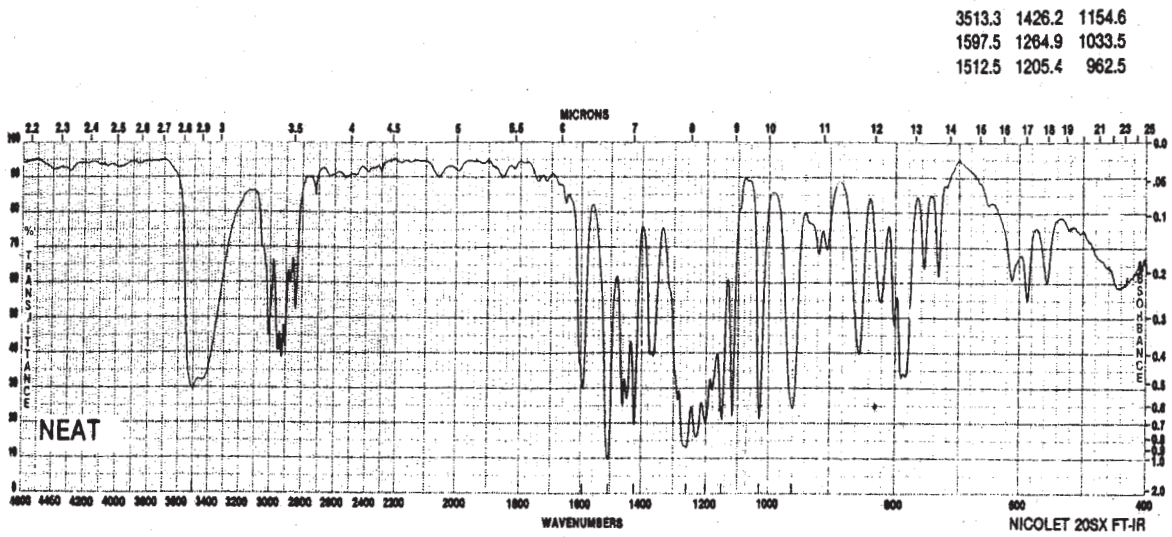
b) Soft ionisation in MS.

c) Distortionless Enhancement by Polarisation Transfer.

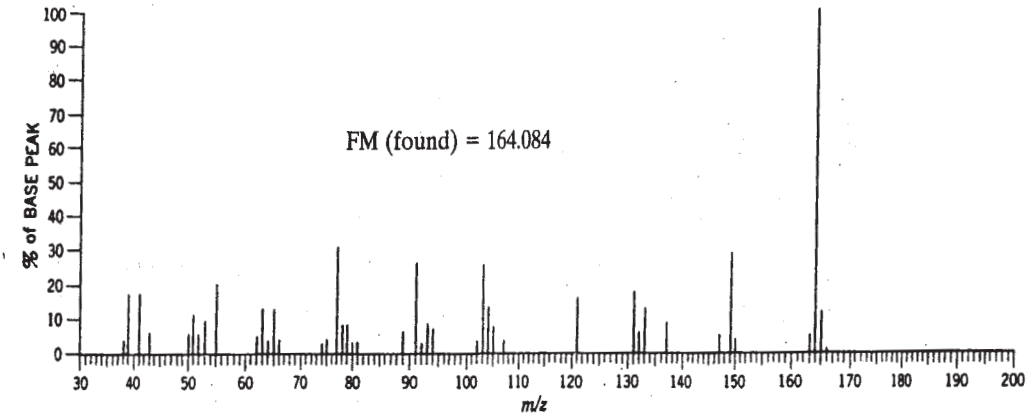
d) HETCOR in structure determination of Organic Compounds.

Q6) You are provided the spectra of a compound on the opposite page. Analyse the spectra and arrive at a structure consistent with the data. Justify your assignment. **[9]**

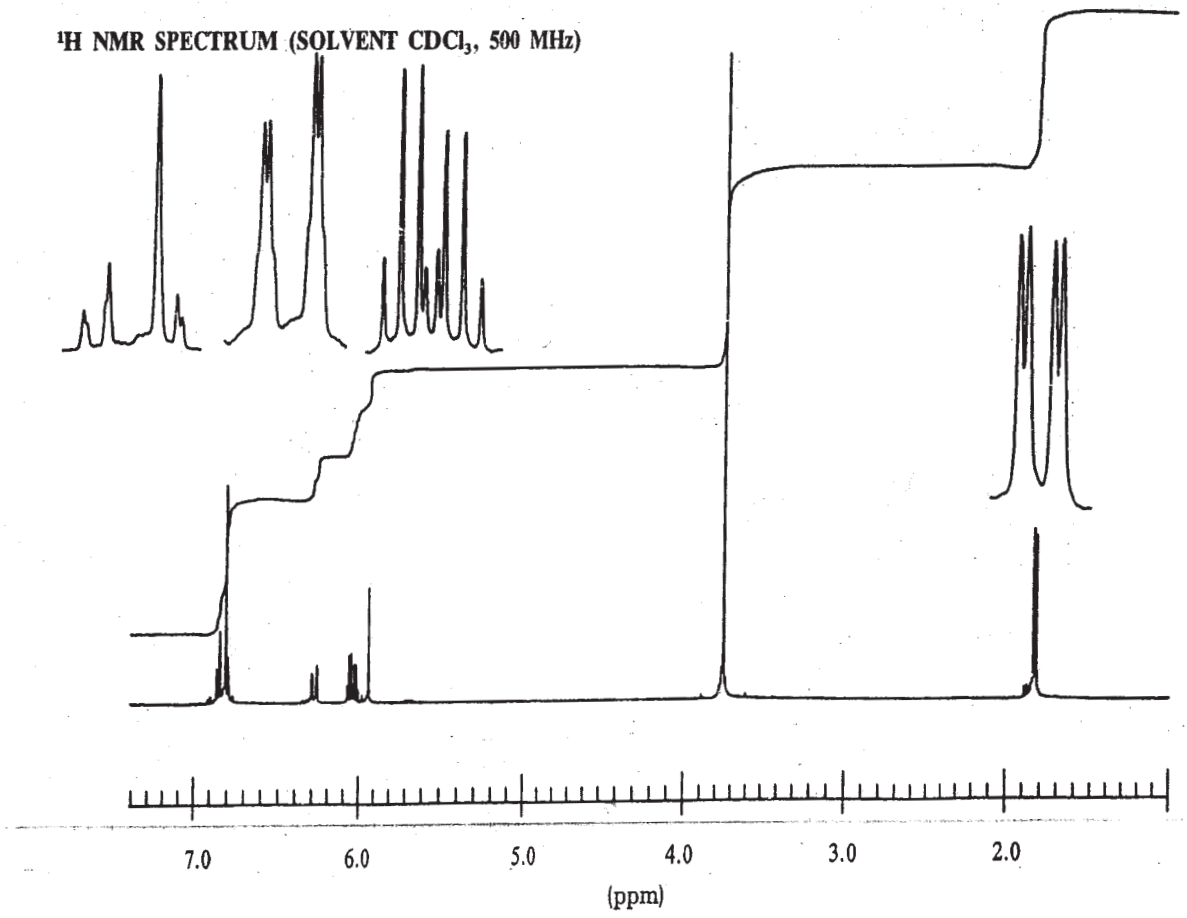
INFRARED

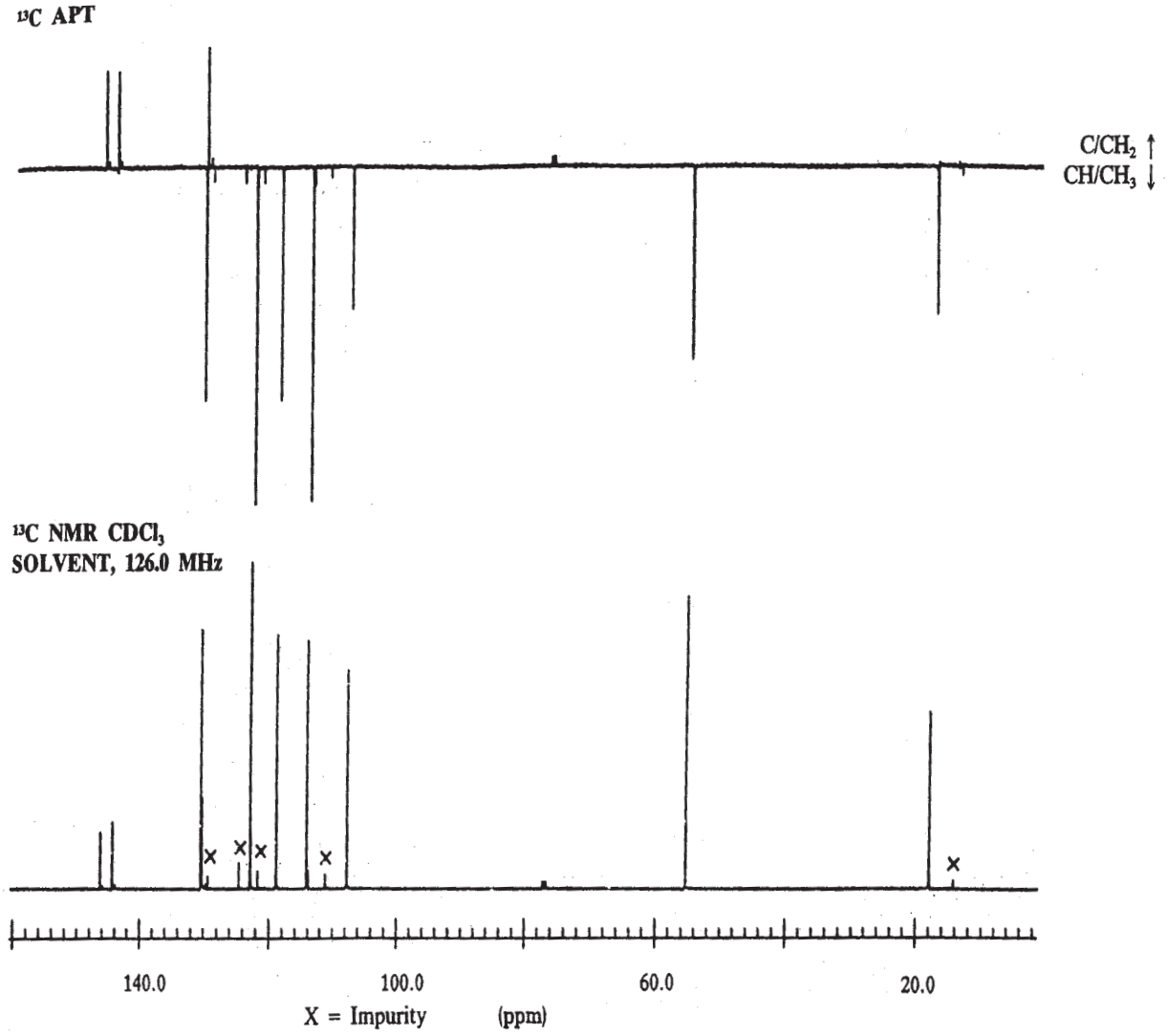

3513.3 1426.2 1154.6
1597.5 1264.9 1033.5
1512.5 1205.4 962.5
MICRONS
NEAT
WAVENUMBERS
NICOLET 20SX FT-IR

MASS

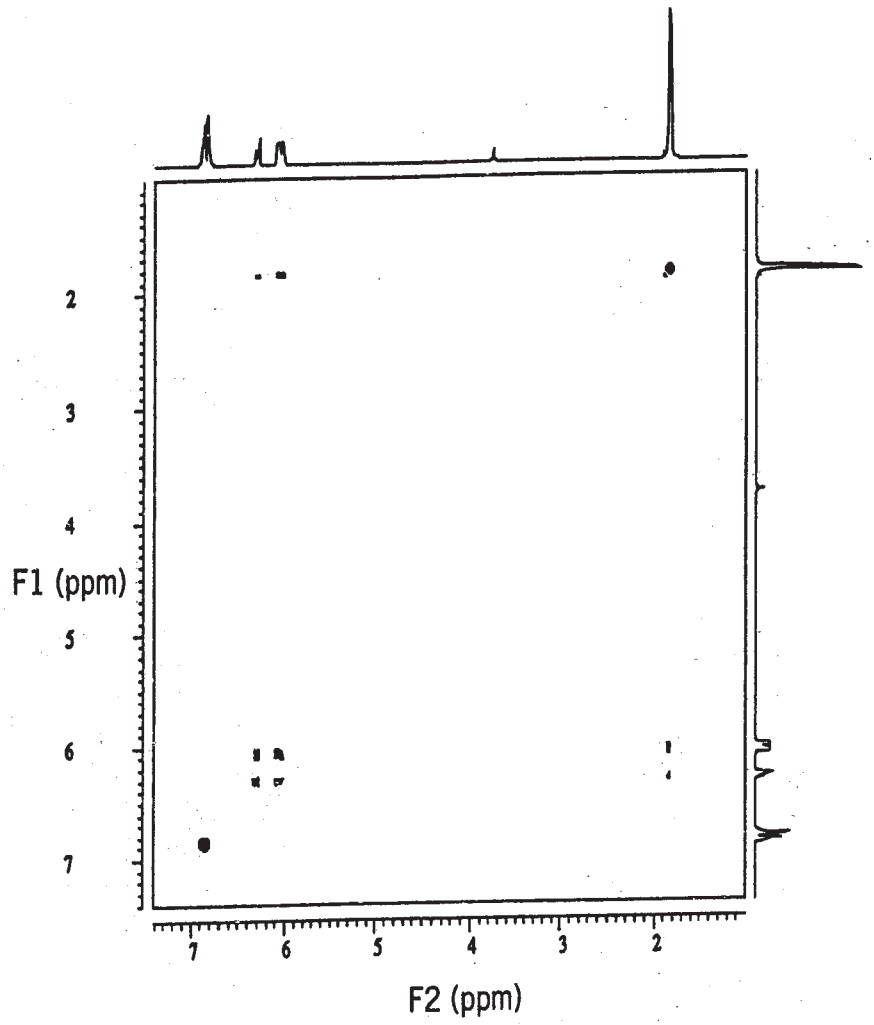


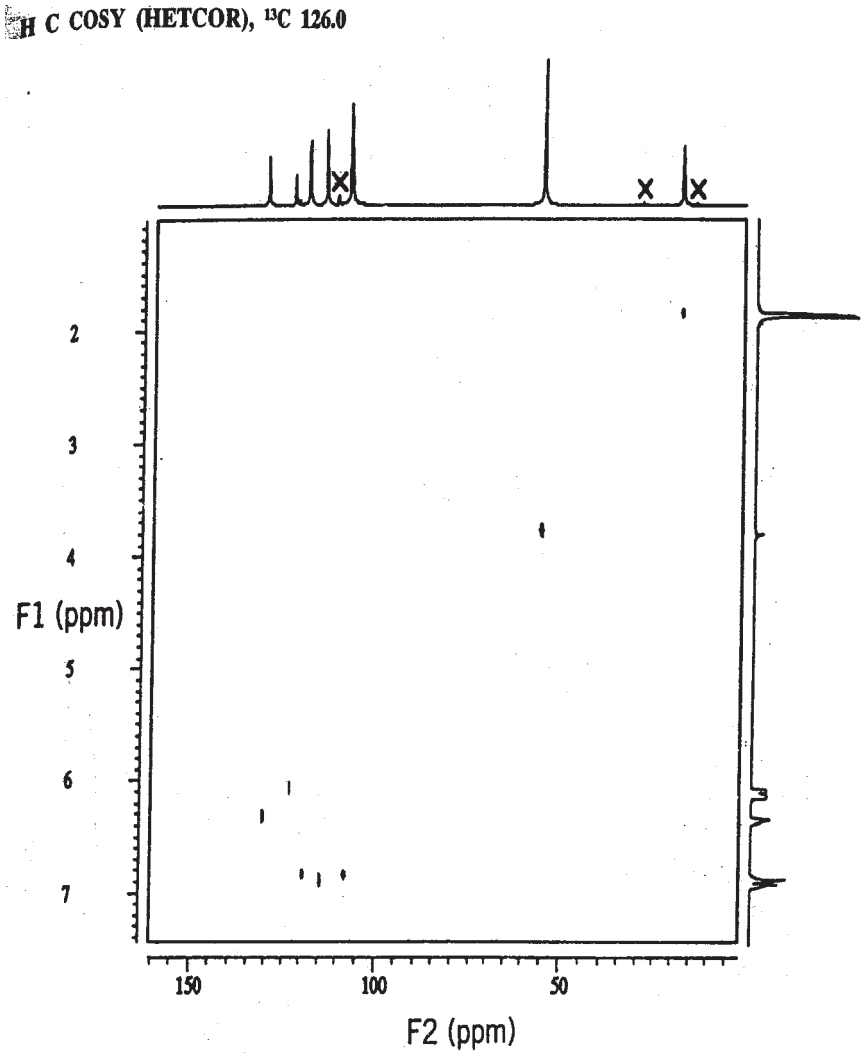
^{1}H NMR SPECTRUM (SOLVENT $CDCl_3$, 500 MHz)




^{13}C APT
C/CH$_2$ ↑
CH/CH$_3$ ↓
^{13}C NMR CDCl$_3$
SOLVENT, 126.0 MHz
140.0
100.0
60.0
20.0
X = Impurity
(ppm)

H H COSY, 500 MHz




H C COSY (HETCOR), 13C 126.0
2
3
4
F1 (ppm)
5
6
7
150
100
50
F2 (ppm)

●●●●●

Total No. of Questions : 6]

SEAT No. :

P2994

[Total No. of Pages : 4

[4723]-3013
M.Sc.
ORGANIC CHEMISTRY
CHO- 352: Organic Stereochemistry
(2013 Pattern) (Semester - III)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answers to the two sections should be written is separate answer books.***
3) ***Figures to the right side indicate full marks.***

SECTION - I

Q1) Answer any four of the following: **[8]**

a) Cis and trans 1, 2 - dibromocyclohexanes undergo NaI catalyzed debromination. The cis isomer reacts 11 times slower than the trans isomer. Explain.

b) Reduction of camphor with LAH gives mainly isoboneol. Explain with stereostructures.

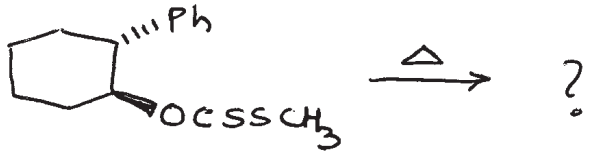
c) In 1-methyl-1- phenylcyclohexane, conformer with axial phenyl and equatorial methyl is preferred over the other by 1.33 kJ/mole. Explain.

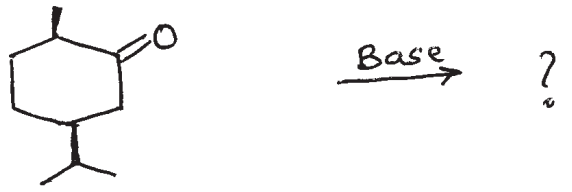
d) Give the stable conformations for the following compounds and comment on their $\nu_{c=0}$ (strech.) in IR and absorption in UV.

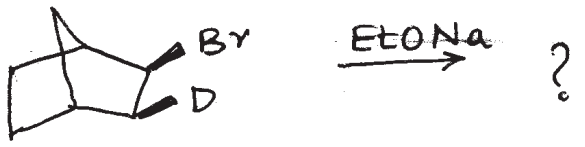
e) Cis - decalin is less stable than trans-decalin. Explain with the stereostructures.

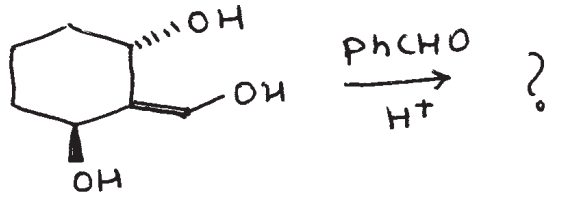
P.T.O.

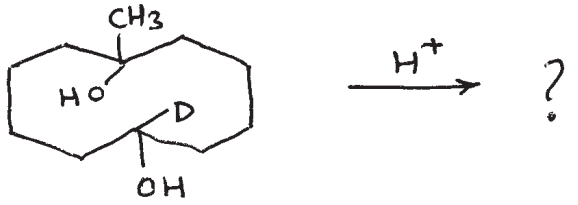
Q2) Predict the product in <u>any four</u> of the following and explain stereochemical principles involved. Justify. **[8]**

a) 

b) 

c) 

d) 

e) 

Q3) Answer <u>any three</u> of the following: **[9]**

a) Describe the stability of hydrindanes as a function of temperature. Justify.

b) Concept of I-strain.

c) Write short note on properties of racemic modifications.

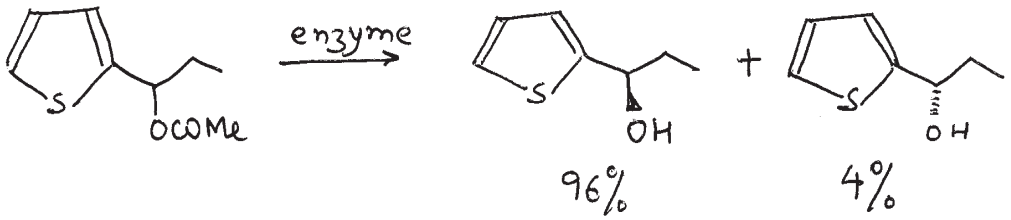
d) Van Arkel rule.

SECTION - II

Q4) Answer the following(any three): **[9]**

a) Resolution by formation of Diastereomers.

b) Explain the diastereomeric excess and calculate de in the following enzyme catalyzed hydrolysis of ester.



c) Short note on physical properties of geometrical isomers.

d) 8-10% racemization occurs in the catalytic hydrogenation of (–) -3-phenyl-1-butene to (–)-2-phenyl butane. Explain.

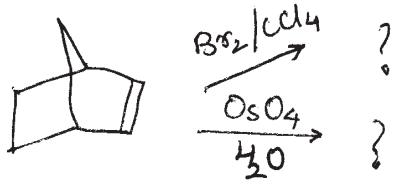
Q5) Answer <u>any four</u> of the following: **[8]**

a) Draw stereochemical diagram for

i) 2E, 4Z - hexa -2, 4 -diene

ii) (E) - 2- Bromopent - 2-ene.

b) Write the products



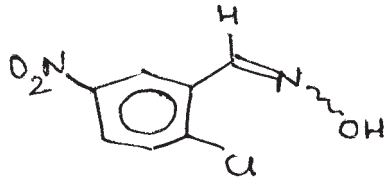
c) Explain the terms:

i) Circular birefrencence

ii) Circular dichroism

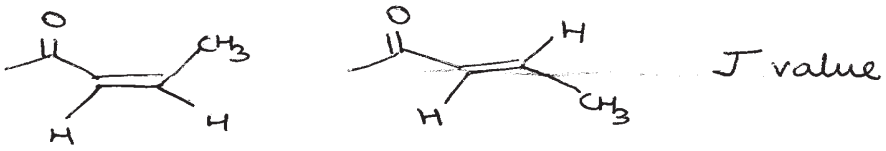
d) Explain why maleic acid gives mesotartaric acid while fumaric acid gives dl pair upon oxidation with $KMnO_4$.

e) How can the configuration of the following oxime determined.

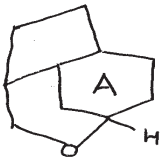


Q6) a) Answer <u>any two</u> of the following: **[4]**

i) Distinguish the following pair of structures by the method indicated.

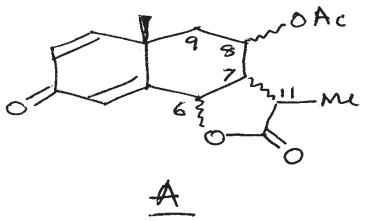


ii) Draw the stereochemical diagram. Ring A is in chair form.



iii) Distinguish q-methyl decalin (cis & trans isomers) by PMR.

b) The PMR spectrum of <u>A</u> shows vicinal coupling constants as $J_{6,7}$ = 11.6Hz; $J_{8,9_{(ax)}} = J_{8,7} = 10.9Hz$ and $J_{7,11} = 1.5$ Hz. Determine the structure of <u>A</u> with correct stereochemistry at C_6,C_7, C_8 & C_{11}. **[4]**



<u>A</u>

EEE

Total No. of Questions : 6]

SEAT No. :

P2995

[Total No. of Pages : 2

[4723]-3014
M.Sc.
ORGANIC CHEMISTRY
CHO-353 : Photochemistry, Pericyclic Reactions & Heterocyclic Chemistry
(2013 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION-I

Q1) Explain Any Three of the following: **[9]**

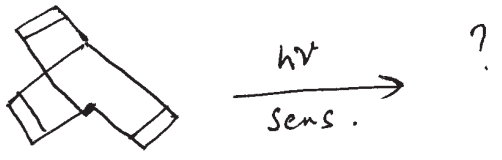
a) Irradiation of o-xylene yields a mixture of m-xylene and p-xylene.

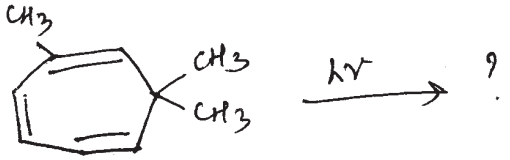
b) Correlation diagram for connotatory interconversion of cyclobutene-butadiene system.

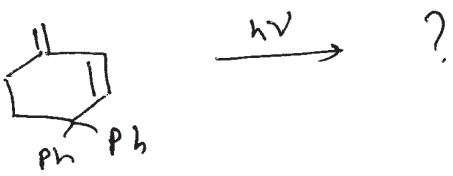
c) Irradiation of benzophenone in the presence of $(Ph)_2$ CHOH gives benzpinacol as the only product.

d) Both connotatory processes for the thermal electrocyclic conversion of (2E, 4E) - 2, 4-hexadiene into 3, 4-dimethyl cyclobutene are equally alike.

Q2) Predict the product/s suggesting suitable mechanism for Any Two: **[8]**

a) 

b) 

c) 

P.T.O.

Q3) Write notes on Any Two: **[8]**

a) Claisen and Cope rearrangement.

b) Photochemistry of benzene.

c) Cycloaddition reactions.

SECTION-II

Q4) Explain Any Three of the following: **[9]**

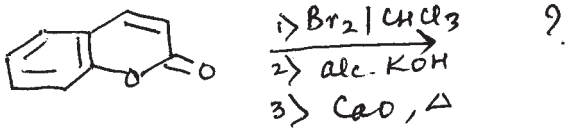
a) Furan is less aromatic than pyrrole and thiophene.

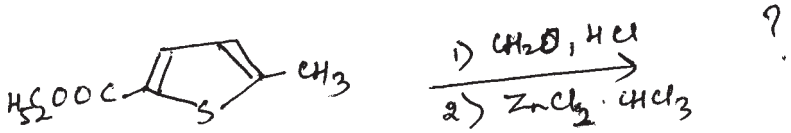
b) Pyridine N-oxide readily undergoes electrophilic substitution at 4-position as compared to pyridine.

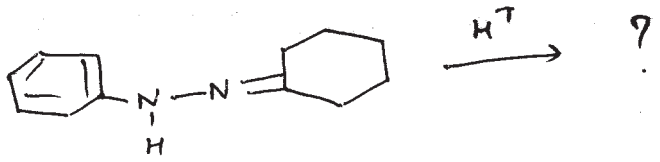
c) Electrophilic attack on pyrazole is hindered in acid medium.

d) Furan undergoes electrophilic substitution at 2-position whereas pyridine it is 3-position.

Q5) Predict the product/s suggesting suitable mechanism for Any Two: **[8]**

a) 

b) 

c) 

Q6) Write notes on Any Two: **[8]**

a) Tschitschibabin reaction.

b) Hinsberg thiophene synthesis.

c) Reissert Indole synthesis.

●●●●●

Total No. of Questions : 6]

SEAT No. :

P2996

[Total No. of Pages : 3

[4723]-3015
M.Sc. II
ANALYTICAL CHEMISTRY
CHA- 390: Electroanalytical and Radioanalytical methods of Analysis
(2013 Pattern) (Credit System) (Semester - III)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of logarithmic table/calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

SECTION - I

Q1) Answer the following: **[10]**

a) State the factors affecting polarographic wave in polarography.

b) Explain the purpose of electrodeposition step in stripping analysis.

c) Explain the difference between pulse polarography and square wave polarography.

d) Draw schematic diagram of cell used in coulometric titration.

e) State the principle of amperometric titration.

Q2) Attempt any two of the following: **[10]**

a) Explain how polarographic technique is useful in analysis of copper from water sample.

b) Draw the block diagram and explain working of controlled potential coulometer.

c) Explain construction and working of rotating ring microelectrode. Explain it's advantages over dropping mercury electrode.

d) State the advantages and limitations of amperostatic coulometry.

P.T.O.

Q3) Solve any one of the following: **[5]**

a) Calculate the diffusion current of cd^{2+} ion in a solution having concentration 7.1 mM. If drop time was measured at the rate of 3.47 s/drop. The mercury flow rate was 1.72 mg per sec. (Given: Diffusion coefficient of cd^{2+} is 6.7×10^{-6} cm^2 s^{-1})

b) A sample of copper ore weighing 2.132 gm is dissolved in acid and the copper is electrolysed using constant current 2A for 8.04 min. Calculate the percentage of copper in the ore (Given: At . wt. of Cu = 63.54)

SECTION - II

Q4) Answer the following: **[10]**

a) State the principle of Isotope dilution analysis. Enlist the different types of Isotope dilution analysis.

b) Give the advantages of radiometric titration.

c) Explain comparator method of NAA.

d) Explain the principle of thermogravimetry.

e) Give the applications of DTA technique.

Q5) Attempt any two of the following: **[10]**

a) Explain the principle of radiometric titration. Discuss complexometric titration with suitable example.

b) Draw block diagram of DSC technique. Explain the components of DSC in brief.

c) Explain the terms:

i) Isotopic abundance

ii) Neutron flux and

iii) Neutron capture cross-section.

d) Draw a typical TGA curve, describe it's important features and factors affecting the nature of the curve.

Q6) Solve any one of the following: **[5]**

a) The vitamin B-12 content of multivitamin tablet is determined by dissolving ten tablets in water. The dissolved tablets are transfored to a 100 ml volumetric flask and diluted to volume. A 50 ml portion is removed and treated with 500 mg of radioactive vitamin B-12 in the sample is isolated and purified, producing 18.6 mg with an activity of 361 cpm. Calculate avarage concentration of vitamin B-12 in the tablet.

b) A thermogram of a magnesium compound shows a loss of 91 mg from a total of 175 mg used for analyte. Identify the compound either as MgO, Mg CO_3 or MgC_2O_4.

EEE

Total No. of Questions : 6]

SEAT No. :

P2997

[Total No. of Pages : 2

[4723]-3016
M.Sc.-II
ANALYTICAL CHEMISTRY
CHA-391 : Pharmaceutical Analysis
(2013 Course) (Semester-III) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answer to the two sections should be written in seperate answer books.***
3) ***Use of logarithmic table/non-programmable calculator is allowed.***

SECTION-I

Q1) Answer the following: **[10]**

a) What is substandard drug?

b) What are the types of sterilization?

c) Give the composition of Karl Fischer reagent.

d) Explain the different stages in new drug development.

e) What is limit test? Why are these taken?

Q2) Attempt Any Two of the following: **[10]**

a) Explain the limit tests for lead and sulphate.

b) Give biological assay of insulin in solution.

c) Explain microbiological assay by cup-plate method.

d) Explain sterilization by heating with bactericides.

Q3) Attempt Any One of the following: **[5]**

a) Give dissolution test for tablet.

b) Explain assay design.

P.T.O.

SECTION-II

Q4) Answer the following: **[10]**

a) How does the reaction between container and pharmaceutical contents constitutes hazards?

b) Give a method for ash determination in ginger.

c) Give any four disadvantages of aerosols.

d) Explain particulate contaminations.

e) What are binders?

Q5) Attempt Any Two of the following: **[10]**

a) Differentiate between ointments and creams.

b) Explain lubricants and additives used in tablet preparations.

c) Describe in brief sources of impurities in raw materials.

d) A normal saline solution was analyzed for sodium chloride content. When 50.0 ml saline solution was titrated with 0.5N silver nitrate gave burette reading 9.6ml. Calculate percentage of sodium chloride in saline solution.

[Atomic wt Na = 23, Cl = 35.5]

Q6) Attempt Any One of the following: **[5]**

a) Give an assay of aspirin.

b) 0.275g of ointment sample containing benzoic acid ($C_7H_6O_2$) was dissolved in alcohol and titrated with 0.1 N sodium hydroxide solution. Gave burette reading 8.9 ml. 10 ml standard 0.1N oxalic acid when titrated with 0.1N sodium hydroxide gave burette reading 11.2 ml. Calculate percentage of benzoic acid in ointment.

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Total No. of Questions : 6]

SEAT No. :

P2998

[Total No. of Pages : 3

[4723]-3017
M.Sc. II
ANALYTICAL CHEMISTRY
CHA- 392: Advanced Analytical Techniques
(2013 Pattern) (Credit System) (Semester - III)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of logarithmic table, non-programmable calculator is allowed.***

SECTION - I

Q1) Answer the following: **[10]**

a) What is solvent extraction? What are the different types of solvent extraction?

b) How long the fibre be exposed in sampling mode?

c) What are the typical operating conditions for microwave assisted extraction (MAE).

d) How can an emulsion be removed?

Q2) Attempt any two of the following: **[10]**

a) Sketch schematic diagram of a pressurised microwave - assisted extraction device. Explain it's working.

b) Draw a schematic diagram of supercritical fluid extraction (SFE) system.

c) What are the problems with the liquid-liquid extraction processes? How are these removed?

d) Explain principle, Instrumentation and applications of supercritical fluid extraction (SFE).

P.T.O.

Q3) Attempt <u>any one</u> of the following: **[5]**

a) Give the applications of solid phase extraction.

b) Explain the theory and interferences of Atomic fluorescence spectroscopy (AFS).

SECTION - II

Q4) Answer the following: **[10]**

a) Enlist the various interferences in atomic spectroscopy.

b) State the principle of mass spectroscopy.

c) Sketch and label the diagram of an inductively coupled argon plasma.

d) Define sputtering and stopwise fluorescence.

e) What do you mean by the term LASER.

Q5) Attempt <u>any two</u> of the following: **[10]**

a) Give the applications of AAS and FES.

b) Write a short note on inductively coupled plasma sources in atomic spectroscopy.

c) Explain Resonant Ionization spectroscopy with suitable diagram.

d) Explain with a neat labelled diagram time of flight mass analyser.

Q6) Solve <u>any one</u> of the following: **[5]**

a) The internal standard method was used for the analysis of copper by FES. A series of standard solutions of copper were prepared that contained 3.00 µg/mL of cadmium. The sample solution was prepared by adding 10.0 ml of the analyte solution and 10.0 ml of a 7.50 µg/ml cd solution to a 25 ml volumetric flask. The flask was filled to the mark with deionized water. The relative emitted intensities of copper and cadmium respectively were measured at 327.4 and 326.1 nm in each of the solutions. Determine the concentration of copper in the analyte solution.

Copper concentration	Relative	Intensites
µg/mL	327.4 nm	326.1nm
1.20	18.7	31.5
2.40	38.6	32.7
3.60	52.7	29.8
4.80	71.7	30.4
6.00	93.9	31.3
sample	45.3	30.2

b) A time - of - flight mass spectrometer has a flight path of 100.0cm and uses an accelerating potential of 2500V. Calculate the time required for ionic fragments with m/z 100 and 101 to strike the detector - calculate the difference in time of arrival of the two ions at the detector.

EEE

Total No. of Questions : 9]

SEAT No. :

P2999

[Total No. of Pages : 4

[4723]-3018
M.Sc.-II
ANALYTICAL CHEMISTRY
CHA-380 : Section-I, II and III
(2013 Pattern) (Semester-III) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any two sections.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***All questions from respective sections are compulsory.***
4) ***Neat diagrams must be drawn wherever necessary.***
5) ***Use of logarithmic tables, non-programmable calculator is allowed.***

SECTION-I

(Analytical Method Developments and validation)

Q1) Answer the following: **[10]**

a) What is method validation? Who validates the analytical methods?

b) What are Random errors?

c) Explain the term "limit of quantitation".

d) Explain the step 1 and 2 in ICH process.

e) Sketch and label the USP apparatus for dissolution studies of type-1.

Q2) Attempt Any Two of the following: **[10]**

a) Discuss the essential principles of method transfer according to method modification and revalidation.

b) Explain the terms, "mean deviation and standard deviation".

c) Explain linear regression and discuss the determination of errors in the slope and intercept by linear regression analysis.

P.T.O.

d) The following standardization data were provided for a series of external standards of Cd^{2+} that had been buffered to a pH of 4.6.

$[Cd^{2+}]$ (nM) 15.4 30.4 44.9 59.0 72.7 86.0

Current (nA) 4.8 11.4 18.2 26.0 32.3 37.7

by a linear regression analysis.

Q3) Attempt Any One of the following: **[5]**

a) The percentage of chloride in $MgCl_2$ was reported by different persons as 32.64, 32.54, 32.61 and 32.53%. Calculate the mean deviation, standard deviation and relative mean deviation.

b) Write a note on single-point test versus dissolution profile.

SECTION-II

(Geochemical and Alloy Analysis)

Q4) Answer the following questions: **[10]**

a) What is an alloy? Give examples aluminium based alloys.

b) Explain in brief principle of estimation of carbonate from soil.

c) What is an Ore? Mention the ores containing iron.

d) How is tin estimated from solder alloy?

e) Give the composition of Nichrome and Gunmetal.

Q5) Attempt Any Two of the following: **[10]**

a) Discuss the analytical method of estimation of Nitrogen from soil sample.

b) Outline the analytical method of estimation of copper from brass sample.

c) Explain the analytical procedure for determination of Iron from Hematite ore.

d) A sample of cupronickel alloy weighing 0.502gm was analysed for estimation of nickel gravimetrically. After removal of copper the filtrate was diluted to 100 ml. An aliquot of 50 ml gave 0.3750 gm of ppt. of $Ni(DMG)_2$. Calculate the percentage of Nickel.

[Given: Mole. wt. $Ni(DMG)_2$ = 288.7]

At. wt. Ni = 58.71

Q6) Solve Any One of the following: **[5]**

a) 0.480 gm of Dolomite sample was treated with conc. HCl. After removal of silica the filtrate was diluted to 100 ml. 10 ml aliquot of diluted solution required 9.5 ml of 0.025 M EDTA solution for the titration using Eriochrome black-T indicator. 10 ml of aliquot solution required 5.2 ml of 0.025 M EDTA solution for the titration using Patton Reeder indicator. Calculate the percentage of Ca and Mg in the Dolomite sample.

[Given: At. wt. Ca = 40, Mg = 24.31]

b) 0.235 gm of Brass sample was dissolved by acid treatment and the solution was diluted to 100 ml. An aliquot of 10 ml solution required 5.8 ml of $Na_2S_2O_3$ solution. For standardisation of $Na_2S_2O_3$ solution, 10 ml 0.025 N $K_2Cr_2O_7$ required 8.5 ml of $Na_2S_2O_3$, calculate percentage of copper in the brass sample.

[Given: At. wt. Cu = 63.5]

SECTION-III

(Laboratory Automation and Sensor Based Techniques)

Q7) Answer the following questions: **[10]**

a) Define chemical sensor.

b) What is control loop? Give their types.

c) Why are ceramics used in sensor?

d) Enlist the optical sensors.

e) What is biosensor?

Q8) Attempt Any Two of the following: **[10]**

a) Explain in detail the continuous flow analyzer.

b) Discuss in detail the calorimetric sensors.

c) Explain the piezoelectric quartz crystal resonator.

d) What are the serial and parallel integration?

Q9) Attempt Any One of the following: **[5]**

a) Draw a schematic diagram of automated laboratory analyzer and explain it's components.

b) Explain the process control analyzer.

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Total No. of Questions : 6]

SEAT No. :

P2944

[Total No. of Pages :3

[4723] - 302

M.Sc. (Physical Chemistry)

CH - 311 : NUCLEAR AND RADIATION CHEMISTRY

(2008 Pattern) (Semester - III)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answers to the TWO sections should be written in SEPARATE answer books.***
2) ***ALL Questions are COMPULSORY.***
3) ***Figures to the RIGHT SIDE indicate FULL marks.***
4) ***Use of logarithmic tables and calculator is ALLOWED.***
5) ***Neat diagrams must be drawn WHEREVER necessary.***

Physico - Chemical Constants

1.	Avogadro Number	N	$= 6.022 \times 10^{23} mol^{-1}$
2.	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1} $= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3.	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s $= 6.626 \times 10^{-34}$ J s
4.	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu $= 1.602 \times 10^{-19}$ C
5.	1 eV		$= 23.06$ k cal mol^{-1} $= 1.602 \times 10^{-12}$ erg $= 1.602 \times 10^{-19}$ J $= 8065.5\ cm^{-1}$
6.	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1} $= 8.314$ J K^{-1} mol^{-1} $= 1.987$ cal K^{-1} mol^{-1}
7.	Faraday Constant	F	$= 96487$ C $equiv^{-1}$
8.	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1} $= 2.997 \times 10^{8}$ m s^{-1}
9.	1 cal		$= 4.184 \times 10^{7}$ erg $= 4.184$ J
10.	1 amu		$= 1.673 \times 10^{-27}$ kg
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Attempt any three of the following: **[15]**

a) What is sponteneous fission? List sponteneous fission neutron sources.

b) Discuss the principle of breeder reactor.

c) Expain the process of neutron evaporation.

d) Give classification of nuclear reactors.

e) Write four factor formula and explain each term in it.

Q2) Attempt any three of the following: **[15]**

a) Write a note on photonuclear reactions.

b) Give an account of conservation in nuclear reactions.

c) Derive Breit Wigner formula.

d) What are the salient features of collective model.

e) Discuss Fermigas model.

Q3) Solve any two of the following: **[10]**

a) $^{7}L_{i}$ is bombarded with 8 MeV protons. Find out the energy of protons scattered at 90°.

b) How many fissions per sec are required to produce 300 KWatt power?

Given : 1 fission generates 200 MeV energy.

c) Calculate approximate critical dimensions of a spherical shape reactor to function at steady state (K = 1.04).

Given :migration area = $0.038 m^2$.

SECTION - II

Q4) Attempt any three of the following: **[15]**

a) Give a comparative account of scintillation and HPGe detectors.

b) Write down short term effects of radiations.

c) What are the causes and effects of three miles island nuclear accident.

d) Discuss the working of photo multiplier tube.

e) Describe how dose rate of CO-60 gamma source can be determined.

Q5) Attempt any three of the following: **[15]**

a) Write a note on depth profiling technique.

b) Write mechanism of radiolysis of Fricke Solution.

c) Discuss the working of linear accelarator.

d) Give an account of Szilard-Cholmer's reaction.

e) What are the variance reasons of retention in Szilard Chalmer's reaction

Q6) Solve any two of the following **[10]**

a) Find out dose due to 500 mci 56_{Mn} at a distance of 5 meters. Given: gamma energy = 847, 1110, 2111 KeV.

b) Find out thickness of lead required to reduce the activity from 40,000 CPM to 200 CPM.

Given: Z of Pb = 82, A of Ph = 207, density of Pb = 11.35 g/cm^3.

c) Find out dose absorbed by propanol when exposed to gamma radiations for 4 hours.

Given: Z/A of Fricke solution = 0.553, dose absorbed by Fricke solution at some position = 20 Gy/min.

Total No. of Questions : 6]

SEAT No. :

P2945

[Total No. of Pages :4

[4723] - 303
M.Sc.
PHYSICAL CHEMISTRY
CH-312: Advanced Instrumental Methods of Analysis
(2008 Pattern) (Semester - III)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of logarithmic table calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

Physico-Chemical Constants

1.	Avogadro Number	N	=	6.022×10^{23} mol^{-1}
2.	Boltzmann Constant	k	=	1.38×10^{-16} erg K^{-1} molecule^{-1}
			=	1.38×10^{-23} J K^{-1} molecule^{-1}
3.	Planck Constant	h	=	6.626×10^{-27} erg s
			=	6.626×10^{-34} J s
4.	Electronic Charge	e	=	4.803×10^{-10} esu
			=	1.602×10^{-19} C
5.	1 eV		=	23.06 k cal mol^{-1}
			=	1.602×10^{-12} erg
			=	1.602×10^{-19} J
			=	8065.5 cm^{-1}
6.	Gas Constant	R	=	8.314×10^{7} erg K^{-1} mol^{-1}
			=	8.314 J K^{-1} mol^{-1}
			=	1.987 cal K^{-1} mol^{-1}
7.	Faraday Constant	F	=	96487 C equiv^{-1}
8.	Speed of light	c	=	2.997×10^{10} cm s^{-1}
			=	2.997×10^{8} m s^{-1}
9.	1 cal		=	4.184×10^{7} erg
			=	4.184 J
10.	1 amu		=	1.673×10^{-27} kg
11.	Bohr magneton	β_e	=	-9.274×10^{-24} J T^{-1}
12.	Nuclear magneton	β_n	=	5.051×10^{-27} J T^{-1}
13.	Mass of an electron	m_e	=	9.11×10^{-31} kg

P.T.O.

SECTION - I

Q1) Attempt any three of the following. **[15]**

a) What is energy dispersive device? Explain briefly gas-ionization detector used in x-ray absorption.

b) State the various sources used in x-ray analysis technique. Explain x-ray tube with neat labelled diagram.

c) What is activation analysis? Discuss the advantages of NAA.

d) Describe briefly chemiluminescence.

e) Define cross section of nuclear reaction and explain various types of cross section.

Q2) Attempt any three of the following. **[15]**

a) Write the radioactivity production equation and explain the terms involved in it.

b) What is fragmentation? Explain how mass spectrum is used for chemical analysis.

c) Write a short note on x-ray fluorescence.

d) Describe magnetic mass analyzer used in mass spectrometry.

e) Discuss briefly factors affecting photoluminescence.

Q3) Solve any two of the following. **[10]**

a) A time of flight mass spectrometer has a flight path 90.0cm and uses an accelerating potential of 2.4KV. Calculate the time required for ionic fragments with M/z equal to 101 and 102 to strike the detector. Calculate the difference in time of arrival of the two ions of the detector.

b) Estimate the thickness of foil of an alloy consisting of 76.0 percent Fe, 6.0 percent Ni, 8.0 percent Cu and 2, 0 percent Zn, at 0.436 nm if the detector recorded 10,848 counts/min of transmitted x-rays when foil was not in the path of x-ray and 1023 counts/min when foil was placed in the path. The mass absorptive coefficients for the pure elements at 0.436 nm are 610, 715, 760 and 910 cm^2/g respectively for Fe, Ni, Cu and Zn. The density of alloy is 8.0122 g/cm^3.

c) Calculate geometrical cross-section for copper atom (Given $R_o = 1.4 \times 10^{-13}$ cm, Atomic weight of Cu = 63).

SECTION - II

Q4) Attempt any three of the following. **[15]**

a) What is the basic difference between DSC and DTA.

b) Discuss briefly applications of ESCA.

c) What is plasma? Explain briefly the principle underlying inductively coupled plasma atomic emission spectroscopy.

d) Write a short note on Thermometric titrations.

e) With neat diagram explain sample introduction in ICP spectrometer.

Q5) Attempt any three of the following. **[15]**

a) Enlist the applications of controlled potential coulometric methods.

b) Discuss briefly the essential components in ESCA apparatus.

c) Draw and explain typical cyclic voltammogram.

d) State the principle of hydrodynamic Voltammetry. Describe different electrodes used in the technique.

e) Discuss briefly the current voltage relationship in coulometry.

Q6) Solve any <u>two</u> of the following. **[10]**

a) 10.65 g sample containing $CuSO_4 5H_2O$ was heated in TGA apparatus. when the monohydrate formation was complete at about 200ºC, the loss in mass was 1.2mg. Find the percentage of $CuSO_4 5H_2O$ in the sample.

Given: Atomic weight of Cu = 63.55, S = 32, O = 16, H = 1

b) Calculate the binding energy of 1s electron of nitrogen in tetra methyl ammonium ion from the incident x-ray photon that was used to create the inner shell vacancy had wavelength 952.1 pm. The work function of spectrometer was 7.2eV and kinetic energy of electron was 889.4eV.

c) A constant current of 10mA passed through a chloride solution for 200S. Calculate the weight of chloride reacting with silver anode.

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Total No. of Questions : 5]

SEAT No. :

P2946

[Total No. of Pages :3

[4723] - 304
M.Sc.
PHYSICAL CHEMISTRY
CH-314: Polymer Chemistry
(2008 Pattern) (Semester - III)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of logarithmic tables calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

Physico - Chemical Constants

1.	Avogadro Number	N	=	6.022×10^{23} mol^{-1}
2.	Boltzmann Constant	k	=	1.38×10^{-16} erg K^{-1} molecule^{-1}
			=	1.38×10^{-23} J K^{-1} molecule^{-1}
3.	Planck Constant	h	=	6.626×10^{-27} erg s
			=	6.626×10^{-34} J s
4.	Electronic Charge	e	=	4.803×10^{-10} esu
			=	1.602×10^{-19} C
5.	1 eV		=	23.06 k cal mol^{-1}
			=	1.602×10^{-12} erg
			=	1.602×10^{-19} J
			=	8065.5 cm^{-1}
6.	Gas Constant	R	=	8.314×10^{7} erg K^{-1} mol^{-1}
			=	8.314 J K^{-1} mol^{-1}
			=	1.987 cal K^{-1} mol^{-1}
7.	Faraday Constant	F	=	96487 C equiv^{-1}
8.	Speed of light	c	=	2.997×10^{10} cm s^{-1}
			=	2.997×10^{8} m s^{-1}
9.	1 cal		=	4.184×10^{7} erg
			=	4.184 J
10.	1 amu		=	1.673×10^{-27} kg
11.	Bohr magneton	β_e	=	-9.274×10^{-24} J T^{-1}
12.	Nuclear magneton	β_n	=	5.051×10^{-27} J T^{-1}
13.	Mass of an electron	m_e	=	9.11×10^{-31} kg

P.T.O.

SECTION - I

Q1) Attempt any three of the following. **[15]**

a) Define the terms-Polymer, degree of polymerization, Homochain polymer, configuration.

b) Discuss the classification of polymers.

c) Describe the secondary bond forces of the polymer.

d) Describe Flory-Krigbaum theory of dilute polymer solution.

e) Distinguish between homopolymer and co-polymer what are the advantages of copolymer.

Q2) Attempt any three of the following. **[15]**

a) What is Rheology? Discuss the different phenomenon of Rheological behaviour of polymer.

b) What is glass transition temperature? Describe any one method of its determination.

c) Discuss the presence of defects in Crystalline polymers.

d) Distinguish between addition and condensation polymerization.

e) Describe Entropy and heat of mixing of polymer solution.

Q3) Solve any two of the following. **[10]**

a) A Suspension of polymer has molecular weight 1,00,000. Another polymer with molecular weight 60,000 is added, 20% by weight. Calculate $\overline{X}_n$ and $\overline{X}_w$.

b) Calculate relative viscosity at C = 0.30g/dl when a polymer with M = 1,00,000 obeys Mark-Houwink equation Given K= 1×10^{-4} and α = 0.80.

c) One mole of Vinylacetate is co-polymerised with three moles of Vinyl chloride. Calculate the instantaneously composition of polymer when the monomer reactivity ratios are 0.23 and 1.68 respectively.

[At. wt. of C = 12, H = 1, O = 16, Cl = 35.5].

SECTION - II

Q4) Attempt any four of the following. **[20]**

a) Discuss the use of TGA technique in the analysis of polymers.

b) Describe the principle of vapour-phase-Osmometry.

c) What is Extrusion. Explain plastic extrusion.

d) Discuss the conduction mechanism of conducting polymer.

e) Discuss the use of carbon black as a reinforcement filler for rubber.

f) Discuss the process of calendering with neat diagram.

Q5) Attempt any four of the following. **[20]**

a) Explain the method to determine the Molecular weight by viscosity measurement.

b) What is molding. Discuss the compression molding.

c) Discuss the process of Vulcanization.

d) What is the effect of irradiation on dehydration and cross-linking of the polymer.

e) Define the following textile terms. Fibre, Denier, Tenacity, moisture regain and crimp.

f) Explain NMR spectroscopy is useful in analysis of polymer.

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Total No. of Questions : 4]

SEAT No. :

P2947

[Total No. of Pages : 3

[4723]-305

M.Sc.

PHYSICAL CHEMISTRY

CH-315 : Special Topics in Physical Chemistry

(2008 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right side indicate full marks.*
4) *Use of logarithmic table, calculator is allowed.*
5) *Neat diagrams must be drawn wherever necessary.*

Physical - Chemical Constants

1.	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2.	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3.	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4.	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5.	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6.	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7.	Faraday Constant	F	$= 96487$ C equiv^{-1}
8.	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9.	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10.	1 amu		$= 1.673 \times 10^{-27}$ kg
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION-I

Q1) Attempt Any Four of the following: **[20]**

a) Why are ceramics used in sensors? What are the necessary requirement for conducting electrodes for normal operations of sensors.

b) Write a note on potentiometric sensors.

c) Draw a logarithmic concentration diagram for 0.1M H_3PO_4.

Given: $PKa_1 = 2.23$, $PKa_2 = 7.21$, $PKa_3 = 12.33$

d) Explain the dependence of rate constant for oximation of acetone on pH at 25°C.

e) Discuss adsorption isotherm used in sensors.

f) Write charge balance and proton condition for 0.03M NaHSe.

Q2) Attempt Any Four of the following: **[20]**

a) Draw and discuss mechanism of phenol-acetone condensation reaction to give bisphenol-A.

b) Discuss catalysis in concentrated strong acid solutions.

c) Calculate pH and concentration of all species for 0.1M H_3PO_4

Given: $Ka_1 = 5.89 \times 10^{-3}$, $Ka_2 = 6.1 \times 10^{-8}$, $Ka_3 = 4.78 \times 10^{-13}$.

d) Derive the rate expression for Michalis-Menten kinetics.

e) What are active and passive sensors?

f) Define inhibitors, activity, selectivity, stability and poison.

SECTION-II

Q3) Attempt Any Four of the following: **[20]**

a) How carbon nanotubes are produced? Give their applications.

b) Describe lithographic method of preparing nano-particles.

c) Explain the term active smartness with suitable example.

d) Discuss the characteristics of passively smart materials.

e) Describe briefly thermal properties of nanoparticles.

f) Give an account of scanning tunneling microscope.

Q4) Attempt Any Four of the following: **[20]**

a) Give an account of sushi sensor.

b) Write a note on fullerin.

c) What are various applications of aerogels and aerosols?

d) What are azeotropes? Describe one such system.

e) Write a note on smart rooms.

f) Derive Raoults law for solutions.

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Total No. of Questions : 4]

SEAT No. :

P2948

[Total No. of Pages :3

[4723]-307
M.Sc. -II
INORGANIC CHEMISTRY
CH- 330: Coordination Chemistry, Magnetism and Reaction Mechanism
(2008 Pattern) (Semester - III)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory and carry equal marks.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Use of logarithmic table and calculator is allowed.***

Q1) Answer any four of the following: **[20]**

a) Discuss the factors that affect the crystal field stabilization energy in T.M. complexes.

b) Write a note on 'Highspin - Lowspin' equilibria.

c) Write about super exchange model for an antiferromagnetic interaction.

d) $Mn_2 (CO)_{10}$ is diamagnetic. Explain.

e) Explain the terms:

i) Canting

ii) Magnetic domain

Q2) Attempt any four of the following: **[20]**

a) Give the nomenclature for the following molecules.

i) $Ru(PPh_3)_2 (CO)_2$

ii) $Fe (CO)_2 (\eta' - C_5H_5)$

iii) $[Co(NH_3)_5Cl] Cl_2$

iv) $Na_2 [Fe (CN)_5 NO]$

v) $Li [Co (NCCH_3)_4]$

P.T.O.

b) What are mixed valence compounds? How they are classified? Why many of them are intensely coloured.

c) Explain why certain Ni(II) complexes shows anomalous magnetic moment.

d) Differentiate between magnetically dilute system and magnetically concentrated system.

e) Explain the experimental magnetic moment of the following ions.

Mn^{3+} μB.M. expt. = ~ 4.9 B.M.

Co^{2+} μB.M. expt. = 4.1 to 5.2 B.M.

(Given: Atomic number of Mn = 25 and Co = 27)

Q3) Attempt <u>any</u> <u>four</u> of the following: **[20]**

a) Explain the main reaction types with suitable example.

b) What is mixed-order substitution reaction? Explain it with suitable examples.

c) Write a note on oxidative addition reactions.

d) What is electron transfer reaction. Discuss the mechanism of electron transfer reaction with reference to inner - sphere reactions.

e) Explain in brief the various steps involved in photographic process.

Q4) Attempt <u>any</u> <u>four</u> of the following: **[20]**

a) What is trans effect? Explain it with suitable examples.

b) Explain in brief the mechanism of insertion reaction with suitable examples.

c) Explain the isomerisation in $[Co(en)_2Cl_2]^+$.

d) Write a note on acid hydrolysis.

e) Complete the following chemical equations.

i) $2\ FeCl_3 + SnCl_2 \rightarrow \square + \square$

ii) $[Co(CN)_5Cl]^{3-} + H_2O \rightarrow \square + \square$

iii) $(CH_3)_3\ B + N\ (CH_3)_3 \rightleftharpoons \square$

iv) $Cr\ (CO)_6 + Py \rightarrow \square + \square$

v) $BF_3 + F^- \rightarrow \square$

EEE

Total No. of Questions : 4]

SEAT No. :

P2949

[Total No. of Pages : 2

[4723]-308
M.Sc.-II
INORGANIC CHEMISTRY
CH-331 : Structural Methods in Inorganic Chemistry
(2008 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

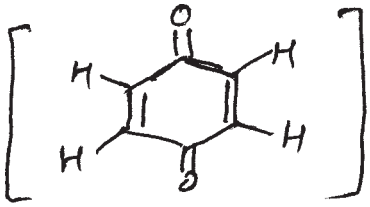
1) ***All questions are compulsory.***
2) ***All questions carry equal marks.***

Q1) Attempt Any Four of the following: **[20]**

a) Explain the following observation by using Mössbauer spectroscopy.

	Compound	ΔE_Q	δ(mm sec^{-1})
i)	$K_4[Fe(CN)_6]. 3H_2O$	0.00	–0.13
ii)	$FeSO_4. 7H_2O$	3.2	1.19

b) Explain the ESR- spectrum for



Radical.

c) Explain the 19F-NMR spectrum for ClF_3 molecule and draw the structure as support of VSEPR theory.

d) Explain the principle of NQR spectroscopy.

e) Explain the cyclic voltamogram of reduction of electrophilic substrate with suitable example.

Q2) Attempt Any Four of the following: **[20]**

a) How will you differentiate the isomers of $[CO(POCH_3)_3\ (CO)_3]^{3+}$ by using ^{31}P-NMR spectroscopy.

b) Draw the NQR spectrum of a nucleus having I = 7/2 and calculate the transition energy in terms of e^2Qq.

P.T.O.

c) What is meant by Hyperfine, superfine, zero field splitting and kramer degeneracy?

d) Explain the Mössbauer spectrum for $Fe_3(CO)_{12}$ metal cluster.

e) Write the role of supporting electrolyte used in cyclic voltametry and explain the advantages and disadvantages of cyclic voltametry.

Q3) Attempt Any Four of the following: **[20]**

a) Calculate the percentage weight changes, for each of the following reactions which occurs on heating the parent materials:

i) $Ca(OH)_{2(S)} \xrightarrow{\Delta} CaO_{(S)} + H_2O_{(g)}$

ii) $6\ PbO_{2(S)} + O_{2(g)} \xrightarrow{\Delta} 2Pb_3O_{4(S)}$

[At. wt. Ca = 40.10, H = 1.00, O = 15.99, Pb = 207.2]

b) Explain the DTA. Curve for $CaC_2O_4 . H_2O$ in presence of oxygen at 8°C/min as heating rate.

c) Calculate the 'g' value for an individual electron having $S = \frac{1}{2}$, $l = 0$ & $J = \frac{1}{2}$.

d) Calculate the interplanar spacing of a set of planes, of the angle for 1st order diffraction is 22.5°, when x-ray wavelength is 1.53 °A are used.

e) Prove: $n\lambda = 2d \sin\theta$.

Q4) Attempt Any Four of the following: **[20]**

a) Explain the instrumentation of DSC.

b) Explain the principle of x-ray photoelectron spectroscopy.

c) Write short note on Auger-effect.

d) Diffrentiate between SEM and TEM.

e) Explain the effect of the following on DTA curve.

i) Instrumental factors.

ii) Gaseous Environment.

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Total No. of Questions : 4]

SEAT No. :

P2950

[Total No. of Pages :2

[4723] - 309
M.Sc. -II
INORGANIC CHEMSITRY
CH-332:Bio Inorganic Chemistry: Inorganic Elements in the Chemistry of Life
(2008 Pattern) (Semester -III)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***

Q1) Answer any four: **[20]**

a) Discuss the biological consequences of pt-DNA binding.

b) "Metal complexes can act as spectroscopic probes". Explain.

c) Name the important enzymes of Zinc and explain the function of any one in detail.

d) Explain how transformation of catechol derivatives to light absorbing qvinones is catalysed by copper enzymes.

e) What is the fundamental requirement of a metal centre to particepate in redox metallo enzymes. Explain with the help of suitable examples.

Q2) Attempt any four. **[20]**

a) Discuss the reactions of Vit. B_{12}.

b) What is the function of superoxide Dismutase? Explain the structure and function.

c) Comment on the chemistry of Gadolinium complexes used as contrast reagents in MRI.

d) Which are different instrumental techniques used to follow Metal-DNA interactions? Explain any one technique in detail.

P.T.O.

e) i) Name the metals present in the following enzymes: Ureases; Hydrogenases; hydrolytic enzymes; Carboxy peptidase; Cytochrome oxidase.

ii) Draw the structures of two model compounds for enzymes. and explain how they help to understand the function of those enzymes.

Q3) Answer the following.(any four). **[20]**

a) Explain the role of cluster compounds in water oxi-dation.

b) Give an account of Bone Scanning.

c) Explain the regulatory role of metals in biological systems.

d) Write an account on Metallo foot - printing agents.

e) Name the different modes of binding of metal complexes to DNA and explain any one in detail.

Q4) Write short notes on: (any four) **[20]**

a) Metals in medicines.

b) Photosystem I & II.

c) Zinc fingers.

d) Fenton Reaction.

e) Copper proteins.

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Total No. of Questions : 4]

SEAT No. :

P2951

[Total No. of Pages : 3

[4723]-310
M.Sc.-II
INORGANIC CHEMISTRY
CH-326 : Organometallic Compounds of Transition Metals and Homogeneous Catalysis
(2008 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory and carry equal marks.***
2) ***Figures to the right indicate full marks.***
3) ***At. No: Cr = 24, Mn = 25, Fe = 26, Co = 27.***

Q1) Attempt Any Four of the following: **[20]**

a) What is EAN rule? Do the following compounds obey the 18 $\bar{e}$ rule.

i) $[Mn(CO)_4NO]$

ii) $(\eta^2 - C_4H_6)\ Fe(CO)_4$

iii) $[Cr(CO)_4\ (PPh_3)_3]$

iv) $Co(\eta^5 - C_5H_5)_2$

b) Explain the nature of metal - olefin interactions in transition metal olefin complexes.

c) Describe the systematic classification and synthesis of η^5-cyclopentadienyl T.M. derivatives.

d) Give the principal steps in the catalytic cycle for the hydrogenation of an alkene using Wilkinson's catalyst.

e) Explain the typical reactions of Bisnaphthalene chromium (O).

Q2) Attempt Any Four of the following: **[20]**

a) The variable temp. ^{1}HNMR of $[C\eta^5 - C_5H_5)\ Fe(CO)_2]_2$ shows one sharp signal at +28°C, while two sharp signals are seen in the ^{1}HNMR at –70°C. Explain.

P.T.O.

b) "$Co_2(CO)_8$ and $Fe_2(CO)_9$ are considered as carbonyl deficient compound's". Explain.

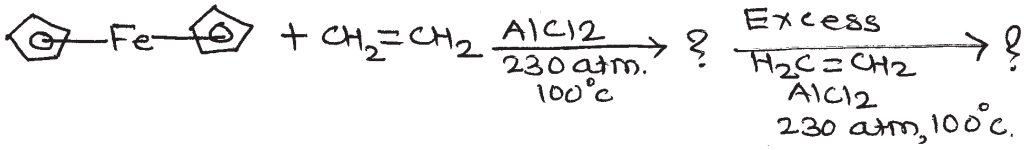
c) Complete the following reactions:

i) $Co_2(CO)_8 + NO \rightarrow ?$

ii) $2C_5H_5 + FeCl_2 + 2Et_2NH \rightarrow ?$

iii) $(\eta^6 - C_6H_6)\ Cr(CO)_3 + CH_3COCl + AlBr_3 \rightarrow ?$

iv) $[Ru(NH_3)_5\ H_2O]^{+2} + N_2 \rightarrow ?$

v) 

d) Explain ethylene oxidation reaction using Pd(II) compound as catalyst.

e) How does vibrational spectra help to understand bonding in metal carbonyls.

Q3) Attempt <u>Any Four</u> of the following: **[20]**

a) Explain the utility of OMC's in agriculture and horticulture.

b) What are the similarities and differences between Suzuki and Heck coupling reactions.

c) Explain the interdependence of Inorganic and organometallic materials in the environment.

d) Explain - In a metal alkyne complex $\nu C \equiv \nu C$ is observed at 1850 cm^{-1}, while in the free alkyne $\nu C \equiv \nu C$ is observed approximately at 2200cm^{-1}.

e) Draw the structures:

i) $Fe(CO)_3\ (\eta^4 - C_8H_8)$

ii) Dimeric $Mn_2(CO)_{10}$

iii) $Os_6(CO)_{18}$

iv) $H\ Re_2\ Mn(CO)_{14}$

v) $[Mo(C_5H_5)_3NO]$

Q4) Write short notes- Any Four: **[20]**

a) Organometallic compounds as protecting agents.

b) Sandwich compounds.

c) Fluxional organometallic compounds.

d) Industrial applications of the Heck reaction.

e) Wacker process.

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Total No. of Questions : 6]

SEAT No. :

P2952

[Total No. of Pages : 4

[4723]-311
M.Sc. -II
ORGANIC CHEMISTRY
CH- 350: Organic Reaction Mechanism
(2008 Pattern) (Semester - III)

Time : 3 Hours] *[Max. Marks :80*

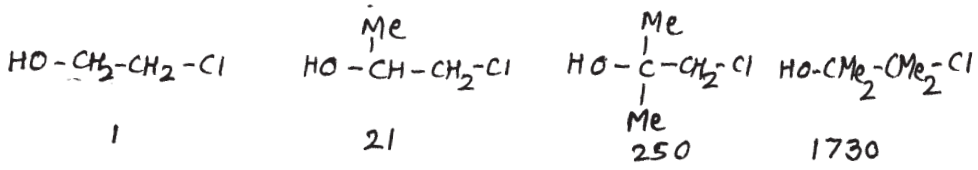
Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right side indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

Q1) Attempt any four of the following: **[12]**

a) Epoxide formation is facilitated by alkyl substitutions. Explain with following examples.



b) Benzoin condensation of P-methoxy benzaldehyde and benzaldehyde gives major product as Ph CH(OH) COPh.

c) The ρ value for base catalysed elimination of HF from series of 1-aryl -2-fluoro ethane increases from monofluoro to trifluoro compounds.

Example	$ArCH_2CF_3$	$ArCH_2CHF_2$	$ArCH_2CH_2F$
ρ	4.04	3.5	3.24

d) With suitable example explain Hammett equation is a linear free energy relation.

e) The pka of P-chlorobenzoic acid is 3.98 and that of benzoic acid is 4.19. Calculate σP^{-cl}.

P.T.O.

Q2) Write short notes on <u>any three</u> of the following: **[12]**

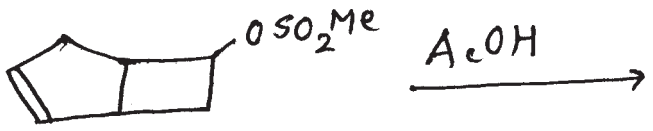
a) Hoffman rearrangement.

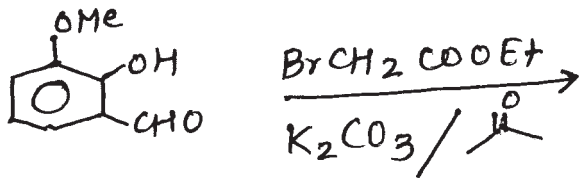
b) Non classical carbocation.

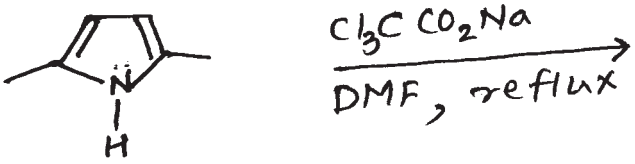
c) Haloform reaction.

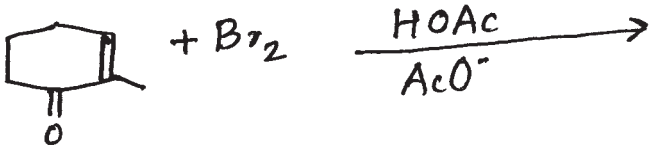
d) Crossover experiments.

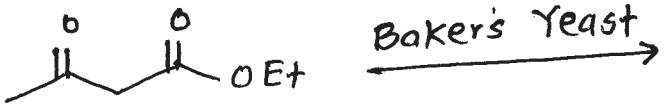
Q3) Predict the products with mechanism for <u>any four</u> of the following: **[16]**

a) 

b) 

c) 

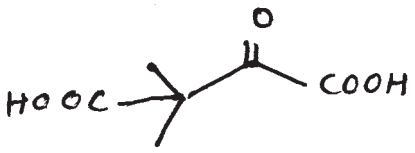
d) 

e) 

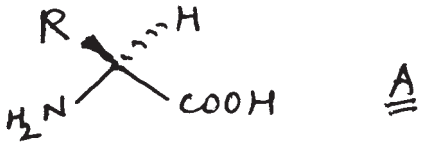
SECTION - II

Q4) Explain <u>any four</u> of the following: **[12]**

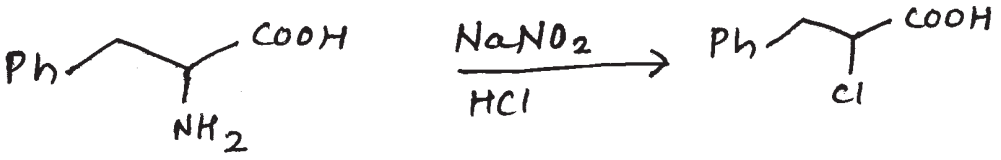
a) Cu^{2+} ions are effective in decarboxylation of the following dicarboxylic acid.



b) Mechanism of racemisation of amino acid A using pyridoxal phosphate as a reagent.

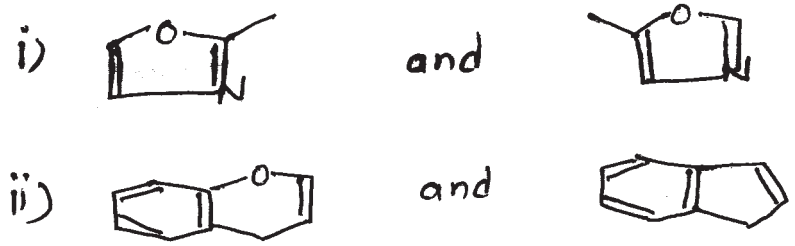


c) What are the limitations of benzoin condensation explain with suitable examples.

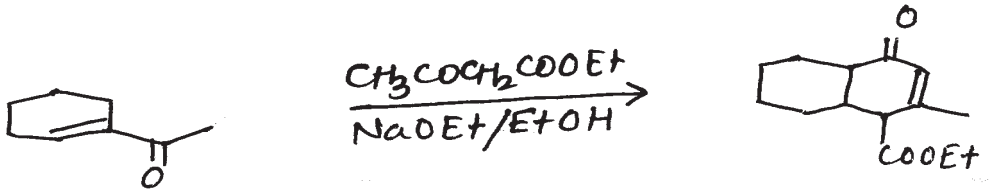
d) 

Explain the reaction mechanism in above conversion.

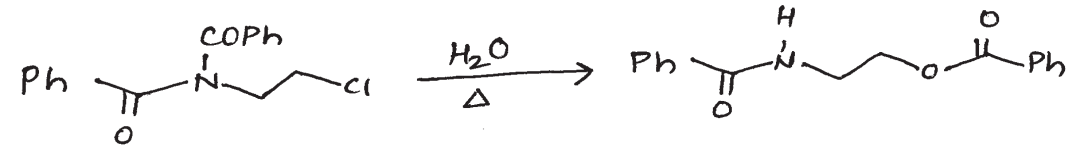
e) Which member in each of the following pair is stronger acid?

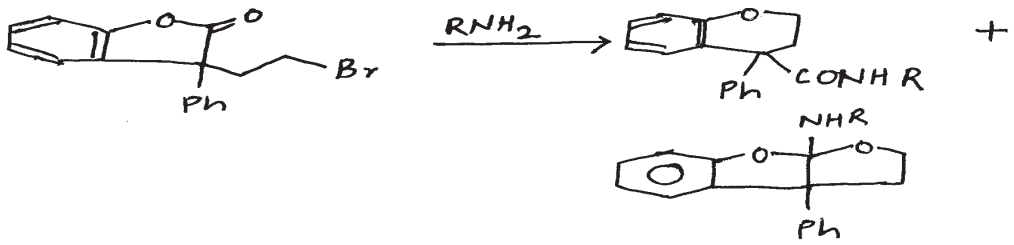


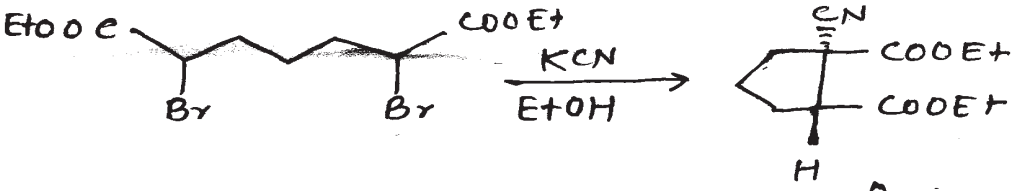
Q5) Suggest mechanism in <u>any four</u> of the following conversions. **[16]**

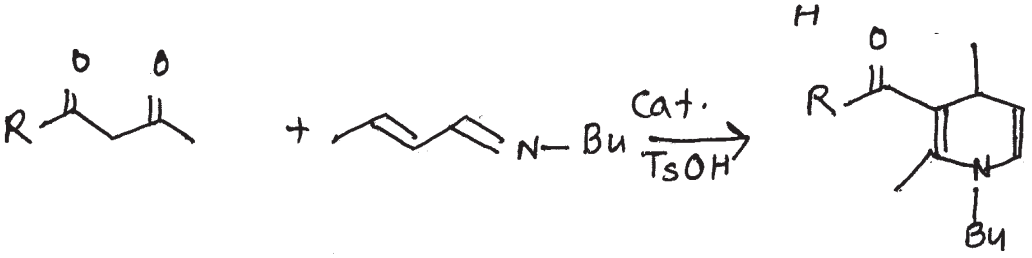
a) 

b) 

c) 

d) 

e) 

f) 

Q6) Answer <u>any four</u> of the following: **[12]**

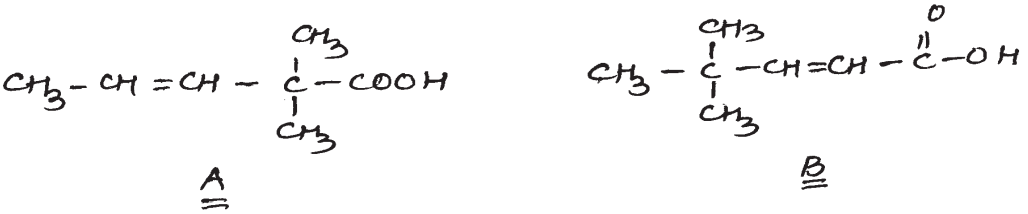
a) Trifluoroacetic acid is an excellent catalyst for esterification of certain unreactive carboxylic acids. Justify.

b) Substitution at β - position reduces the rate of hydrolysis of AAC^2 mechanism. Explain.

c) Explain the role of Biotin as a carrier for carbon dioxide.

d) Write a note on trapping of intermediates.

e) The acid A and not B undergoes thermal decarboxylation. Explain.



A B

EEE

Total No. of Questions : 6]

SEAT No. :

P2953

[Total No. of Pages : 6

[4723]-312
M.Sc.-II
ORGANIC CHEMISTRY
CH-351 : Spectroscopic Methods in Structure Determination
(2008 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 80*

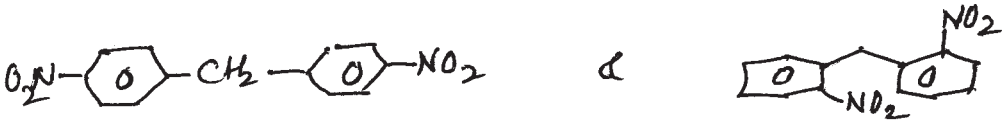
Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections to be written in separate answer books.***

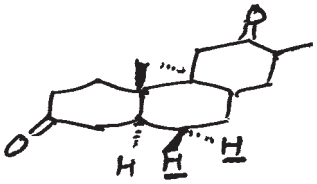
SECTION-I

Q1) A) Attempt Any Four of the following: **[8]**

a) Differentiate the following pair by ^{13}C NMR.



b) Discuss the multiplicities & J values of the underlined protons in the following structure.



c) Distinguish the following pairs by mass spectrometry

d) Discuss the benefits of saft ionization techniques in mass spectrometry.

e) Explain the coupling constants observed in pyrrole

$J_{H_1 H_2} = 2.5Hz, J_{H_2 H_3} = 3.5Hz$

$J_{H_1 H_2} = 1.5Hz$

P.T.O.

B) An aminoacid soluble in aqueous base exhibits the following peaks in its PMR & CMR. Assign the correct structure & justify your assignment. **[4]**

(Note: Three exchanging protons on Nitrogen & one on oxygen are not shown)

M.F.: $C_6H_9NO_4$

CMR: 34(d), 40(t), 45(t), 56.2(s), 184(s), 186(s)

PMR: 2.2-2.68(m, 4H); 3.37(dd, J = 9 & 5.5 Hz 1H)

Q2) Deduce the structure of the compounds from the spectroscopic data provided (any four) justify. **[16]**

a) M.S: 130(M^+), 115, 100, 73, 43

CMR: 208(s), 75(s), 54(t), 50(q), 33(q), 25(q, strong)

PMR: 1.3, s, 30mm; 2.2, s, 15mm; 2.5, s 10mm, 3.6 s 15mm

b) M^+: 58

IR: 3320, 1645, 1130 cm^{-1}

CMR: 63(t), 115(t), 137(d)

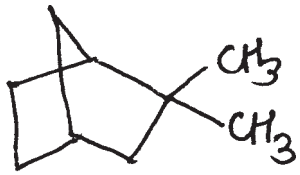
PMR: 4.15(ddt, J = 10, 5 & 1.5Hz, 5mm)

4.74(ddt, J = 15, 2 & 1.5Hz 5mm)

5.10(dt J = 5 & 2Hz 10mm)

5.72(ddt J = 15, 10 & 5Hz 5mm)

c) The structure of a compound A was partially derived except the position of exocyclic double bond. Assign the correct position to the double bond using following spectral observations.



Compound A

PMR: 1.01 (s), 3H

1.05 (s), 3H

4.51 (bs), 1H

4.65 (bs), 1H

1.5-2.3 (complex multiplet) 12H

On irradiating signal at 1.0δ, 16% NOE enhancement of the signal at 4.41 was observed.

d) M.F.: $C_9H_{10}O_2$

IR: 2982, 1718, 1451, 1367, 1275, 1176, 710 cm^{-1}

PMR: 1.35(t, 6Hz 30mm), 4.36(9, 6Hz, 20mm), 7.40(t, 8Hz, 20mm) 7.48(t, 8Hz, 10mm), 8.0(d, 8Hz, 20mm)

CMR: 14.4(q), 60.8(t), 128.4(d), 129.7(d), 130(s) 132.8(d), 166(s)

e) A compound with M^+ 53 & ions at 27 & 26 shows strong IR absorptions at 2250 & 1610 cm^{-1}. The PMR shows 3 signals all as doublets of doublets. CMR exhibits 3 signals. Deduce the structure from the above data.

Q3) Write short notes on Any Three of the following: **[12]**

a) Factors affecting germinal coupling.

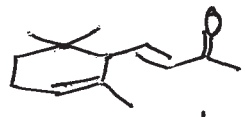
b) Applications of NOE in determination of stereochemistry.

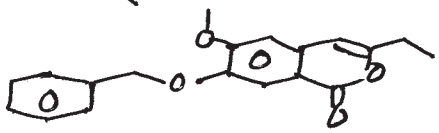
c) Double focussing mass spectrometry.

d) Benefits of FT pulse NMR over continuous wave NMR.

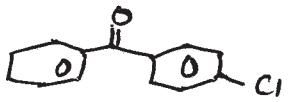
SECTION-II

Q4) A) Give the generic of important ions in any three of the following: **[6]**

a)  192, 136, 121, 92

b)  310, 219, 135, 107, 91

c)  85, 84, 70, 56

d)  218, 216, 141, 139, 105, 77

B) Answer Any Two of the following: **[6]**

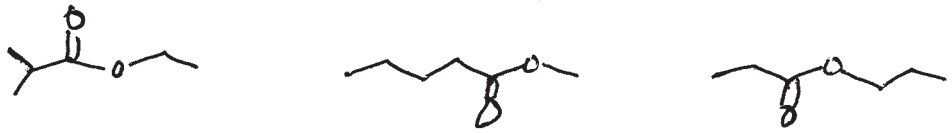
a) Trans-2-pentene on reaction with B_2H_6 / H_2O_2-NaOH yields two products A & B. Their mass spectral pattern are shown below. Identify A & B.

A: 73(19%), 55(10%), 45(100%), 43(14%), 31(6%)

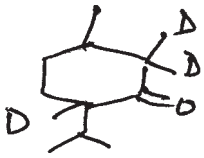
B: 73(4%), 59(100%), 41(40%), 31(82%)

b) Select the structure which matches the mass spectral data given below. Justify your selection.

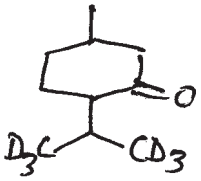
Mass m/2 116, 57, 43, 29



c) Menthone (M^+–154) shows the peaks at 154, 139, 112 & 69. Its following deutero derivatives give peaks as shown next to them. From this abservations write the mechanism for the formation of the peaks at 112 & 139 in menthone

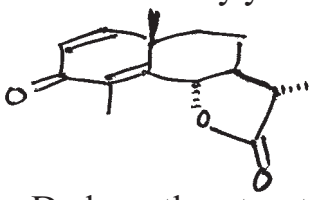


157, 142, 115, 70



160, 142, 113, 69

Q5) a) Assign the CMR signals to the various carbons in the structure shown below. Justify your assignment. **[4]**

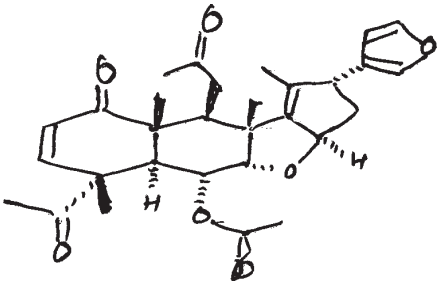


10.6(q), 12.8(q), 22(t), 24(q)
37(t), 40(d), 42(s), 53(d), 81(d)
125(d), 126(s), 153(s), 157(d), 178(s) 185(s)

b) Deduce the structure of a compound $C_{11}H_{14}O_2$ where CMR spectra shows the following peaks. **[4]**

13(q), 19(t), 32(t), 64(t), 127(d, str), 129(d, str), 131(s, weak) 134(d), 167(s, weak).

c) Assign the signals to the various protons in the following structure. Use the NOE data for assigning the Proximity of some protons. **[8]**



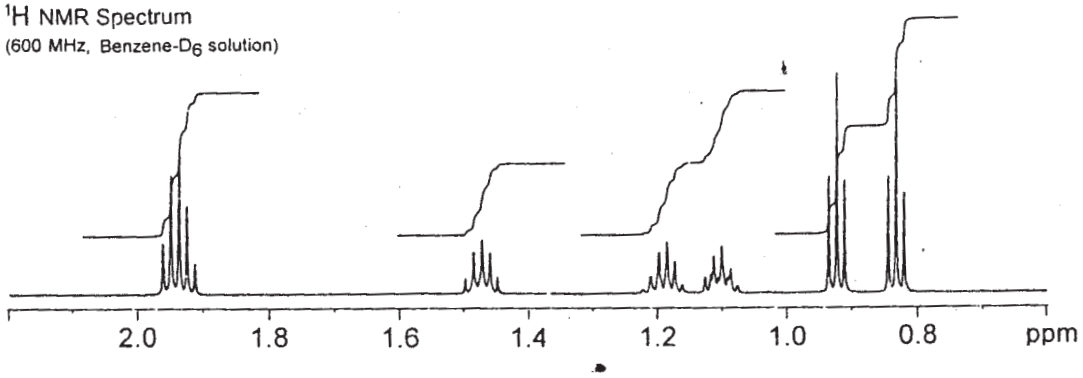
1.02, (s, 6H); 1.60, (s, 3H);
1.70(s, 3H); 1.80(s, 3H);
1.8 - 2.2(m 3H);
2.4 - 2.6 (m, 3H);
3.3(t, 6Hz, H); 3.7(s, 3H);
3.9(s, 3H); 4.79(m, 2H)
5.0(t 6Hz 1H), 5.15(d 10.1 Hz 1H)
5.85(d, 10.1Hz 1H) 6.3(m, 1H) 6.80(m, 2H)

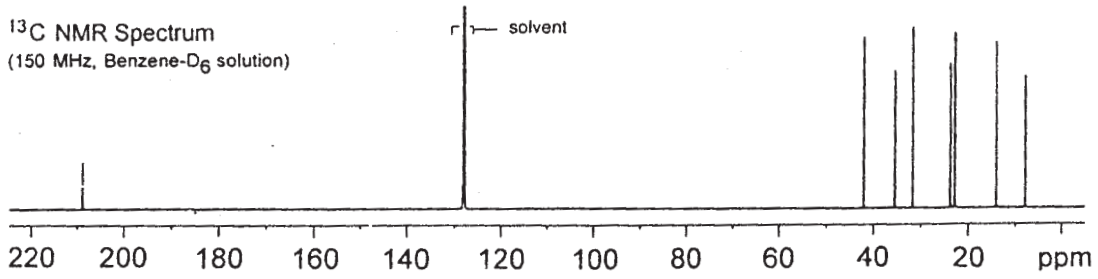
NOE EXPT:

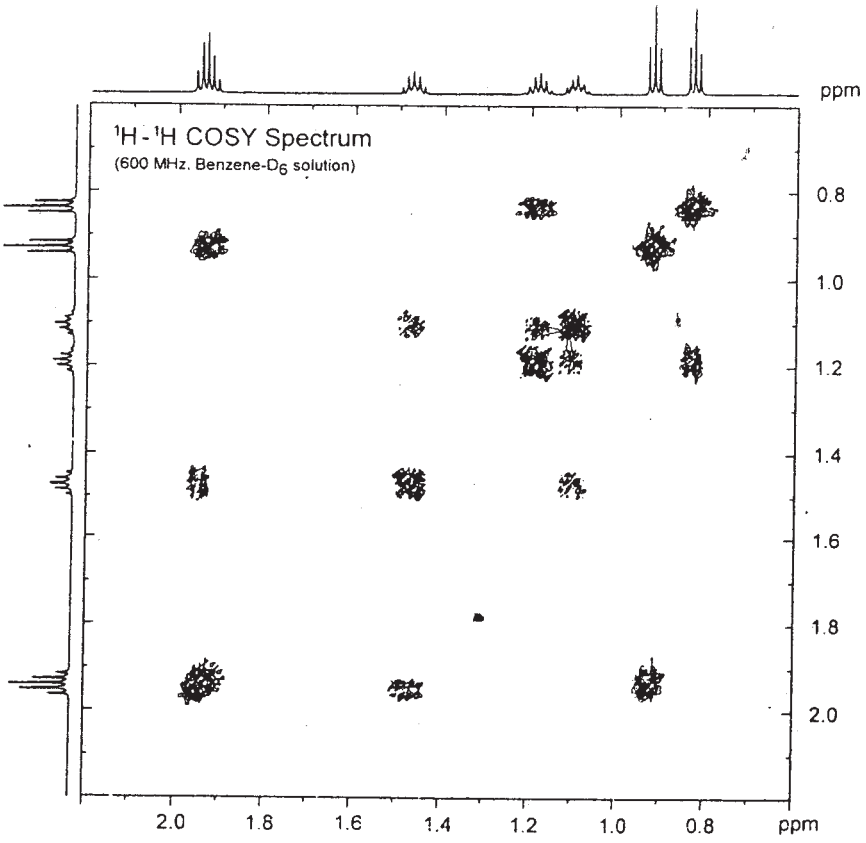
Irradiation of 1.70 enhances
signal at 1.02 & 6.2 by 18%.

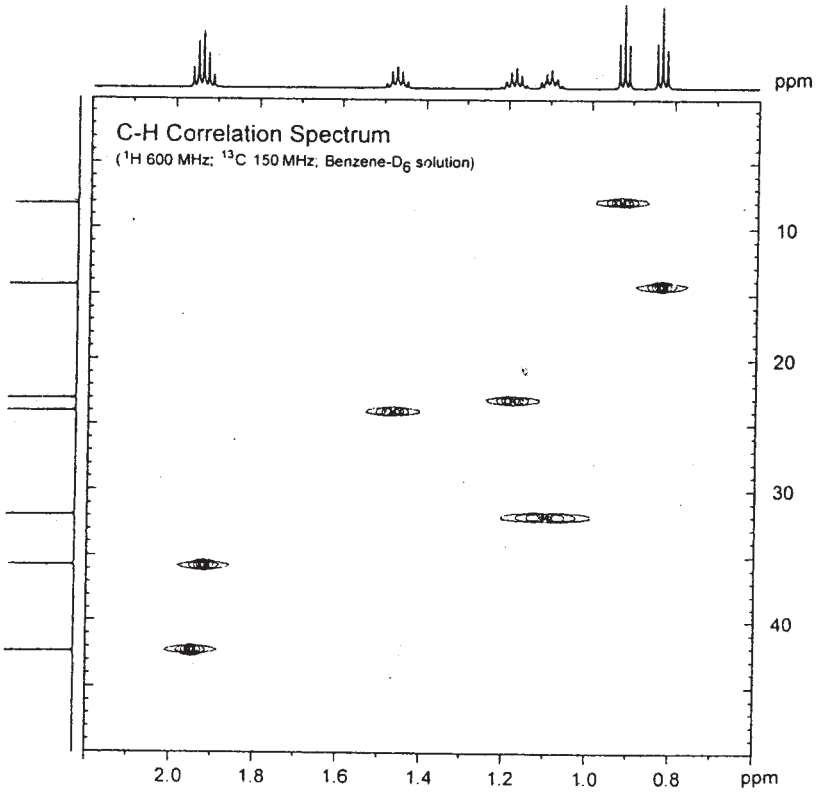
Q6) The spectras of an unknown compound are given on the adjacent page. Analyse the spectras & use this data to arrive at a structure consistent with the data. Justify your structure. **[12]**

M.F. : $C_8H_{16}O$


^{1}H NMR Spectrum
(600 MHz, Benzene-D_6 solution)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
ppm


^{13}C NMR Spectrum
(150 MHz, Benzene-D_6 solution)
solvent
220
200
180
160
140
120
100
80
60
40
20
ppm


ppm
^{1}H - ^{1}H COSY Spectrum
(600 MHz, Benzene-D$_6$ solution)
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.0
1.8
1.6
1.4
1.2
1.0
0.8
ppm


ppm
C-H Correlation Spectrum
(^{1}H 600 MHz; ^{13}C 150 MHz; Benzene-D$_6$ solution)
10
20
30
40
2.0
1.8
1.6
1.4
1.2
1.0
0.8
ppm

●●●●●

Total No. of Questions : 6]

SEAT No. :

P2954

[Total No. of Pages :5

[4723] - 313
M.Sc. - II
ORGANIC CHEMISTRY
CH-352: Organic Stereochemistry
(2008 Pattern) (Semester -III)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

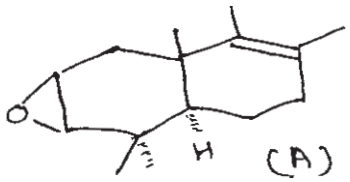
1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

Q1) Answer any four of the following: **[16]**

a) Bromocamphor fail to undergo hydrobromination on treatment with base. Explain.

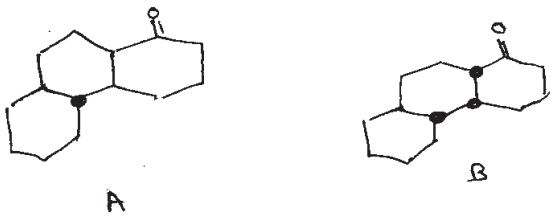
b) 2,3-Epoxylanost -8-ene (A) furnish diequitorial opening with HBr. Explain.



c) The Facile migration of benzoyl group from N $\rightarrow$ O is observed in nor-ψ -Tropine.

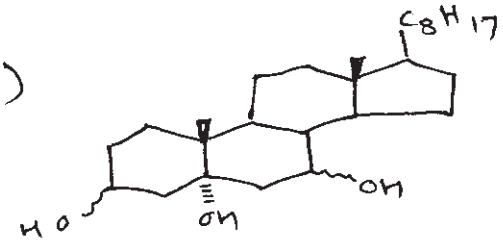
d) For cyclohexane -1,2-dicarboxylic acid (pKa_2 - pKa_1) is greater for cis than its trans isomer explain.

e) Compound (A) undergoes epimerisation on treatment with base, whereas (B) does not. Explain.



P.T.O.

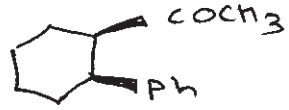
Q2) Predict the product in any four of the following and explain stereochemical principles involved. Justify. **[12]**

a) 

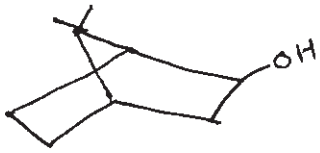
$\xrightarrow[ClCOOC_2H_5]{\text{Excess}}$

i) 3β, 7β ⟶ ?

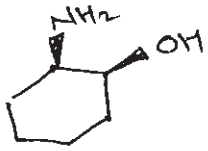
ii) 3β, 7α ⟶ ?

b) 

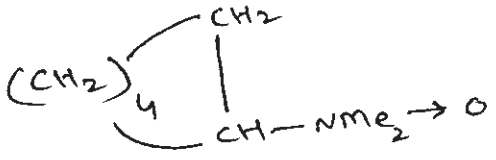
$\xrightarrow[Br_2]{NaOC_2H_5}$?

c) 

$\xrightarrow[-H_2O]{H^{\oplus}/\text{Heat}}$?

d) 

$\xrightarrow[HCl]{NaNO_2}$?

e) 

$\xrightarrow{\Delta}$?

n = 6, 7, 8, 9

Q3) Attempt <u>any three</u> of the following. **[12]**

a) Write short note on Prelog's rule.

b) Explain the resolution of enantiomers by diastereo isomer formation method.

c) Write short note on I–strain.

d) Give methods for formation of Raccemic modifications.

SECTION - II

Q4) Answer the following. (any three). **[12]**

a) Give the absolute configuration of C_6 and C_7 of enhydrin. Explain with evidence.

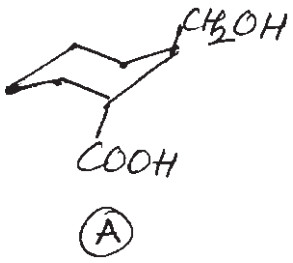
b) Prove that C_8-C_9 bond and C_3 Vinyl bond are on the same side in Cinchonine and quinidine.

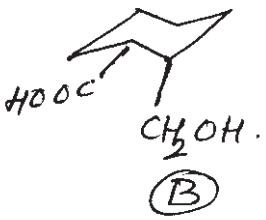
c) Explain the stereochemistry of C_6–OH and C_{13}–C_{15} bond in codeine and in isocodeine give the chemical evidence.

d) Prove that cinchonine and cinchodine have different configuration at C_8.

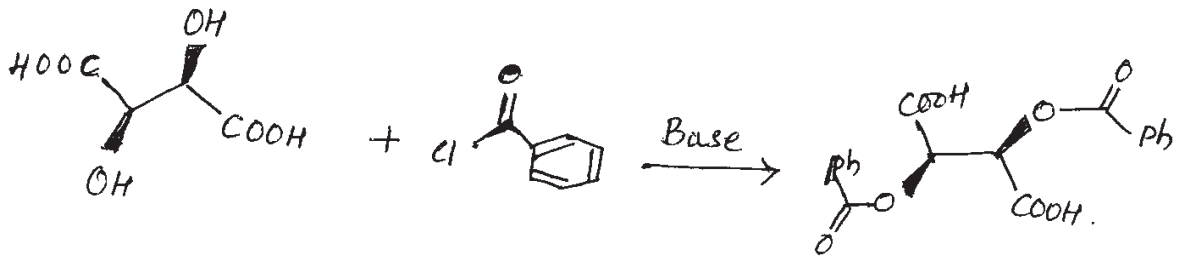
Q5) Attempt the following (any four). **[12]**

a) What is the stereochemical realtionship between the carboxylic acid and hydroxymethylene (CH_2-OH) groups in following compounds? Is it possible to form a lactone from these hydroxy acid?

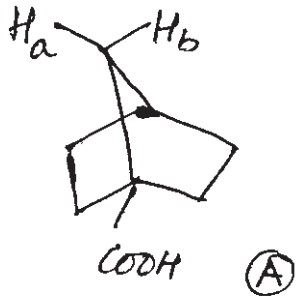




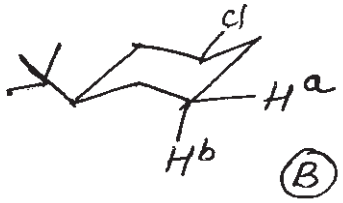
b) Propose mechanism for the reaction and explain the Stereochemistry of the products (All compounds are enantiomerically pure).



c) In the followig structures, state with reasons whether the hydrogens marked H^a and H^b are homotopic, enantiotopic or diastereotopic.

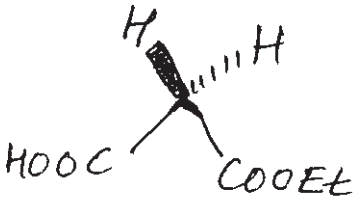


(A)

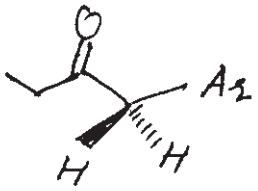


(B)

d) Identify pro 'R' and pro 'S' hydrogen atoms in the following compounds.



(A)

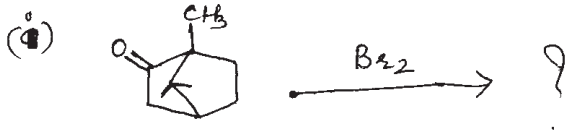


(B)

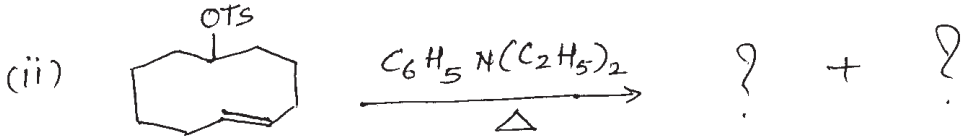
e) Pure cholesterol has a specific rotation of –32°. A sample of cholesterol prepared in the lab had a specific rotation of –16°. What is the enantiomeric excess of this sample of cholesterol?

Q6) a) Predict the product/s in the following reactions. Explain the stereochemistry and mechanism in details. (any four). **[8]**

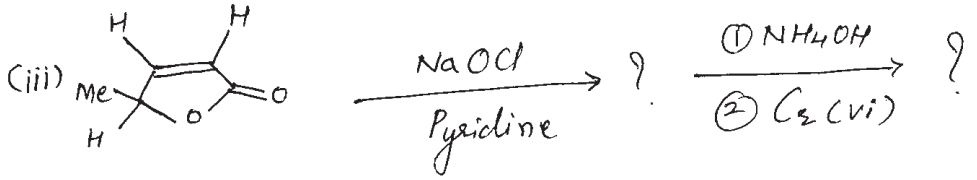
(i)

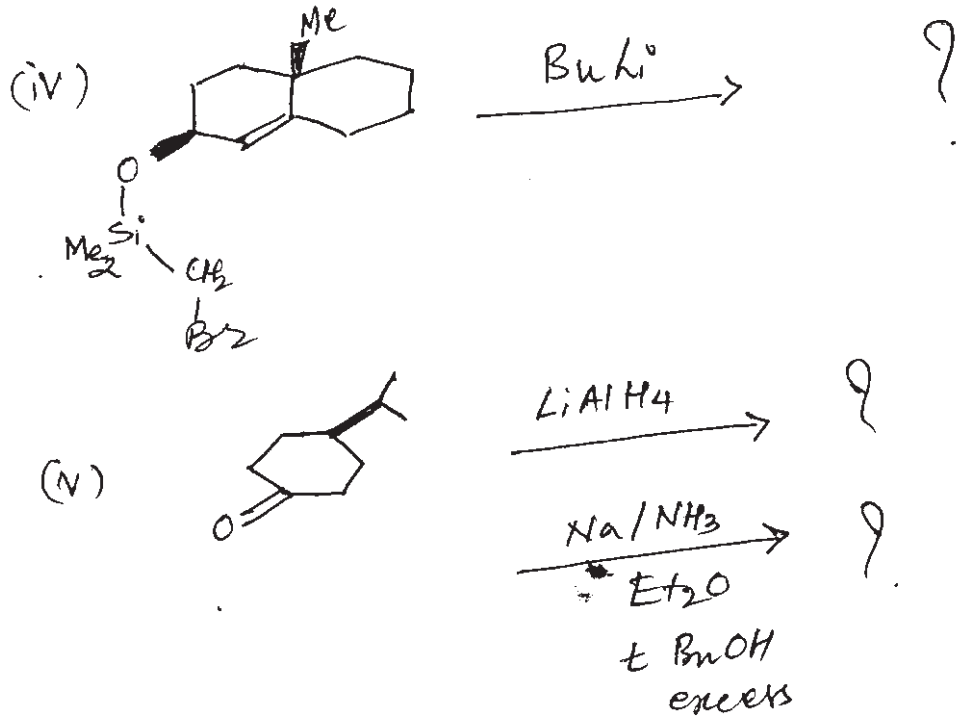


(ii)

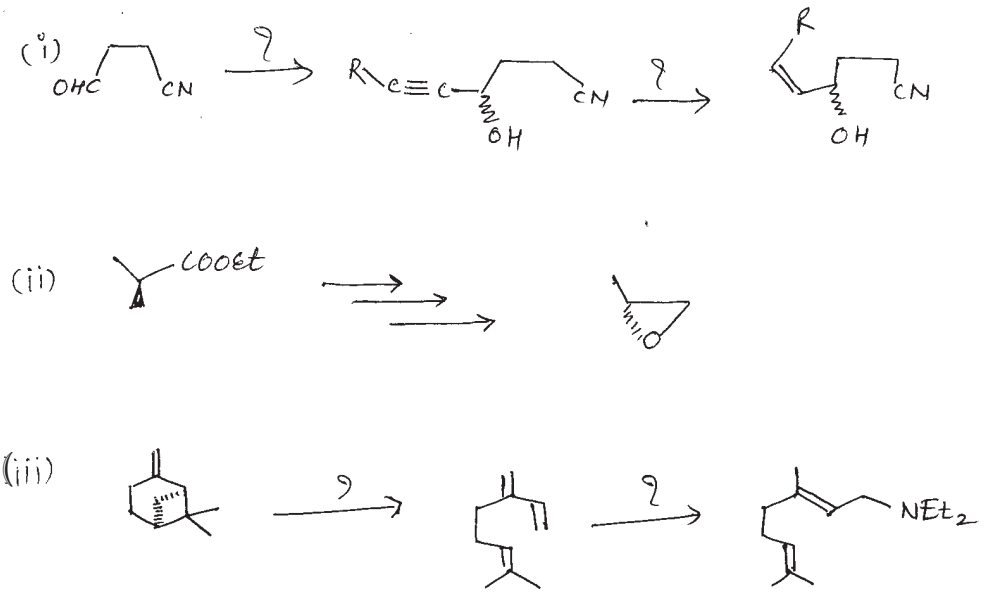


(iii)





b) Suggest the reagent/s and stereochemistry of the following reactions. (any two). **[8]**



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Total No. of Questions : 6]

SEAT No. :

P2955

[Total No. of Pages : 4

[4723]-314
M.Sc.-II
ORGANIC CHEMISTRY
CH-353 : Free Radicals, Photochemistry and Pericyclic Reactions & their Applications
(2008 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicates full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION-I

Q1) a) Write short notes on Any Two of the following: **[8]**

i) Di - JJ - methane rearrangement.

ii) Photochemical cis-trans isomerisation.

iii) Detection methods of free radicals.

b) Explain Any Two of the following: **[6]**

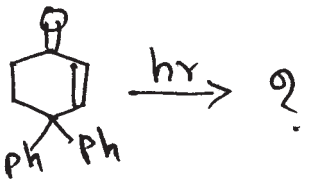
i) Photolysis of 5, 5, 5-trideutero-2-pentanone gave deuterated ethylene and undeuterated acetone, while the photolysis of 1, 1, 1-trideutero-2-pentanone afforded undeuterated ethylene and deuterater acetone.

ii) When the erythro form of Ph CHD-CH Br Ph is treated with NBS, deuterium atoms are formed to be removed mainly twice as hydrogen atoms.

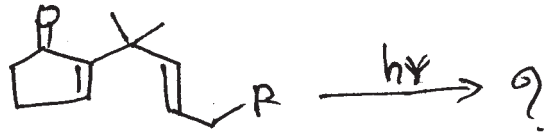
iii) Reaction of 6-bromo-1-hexene on heating with Bu_3SnH & AIBN gives mixture of 1-hexene, methyl cyclopentane & cyclohexane.

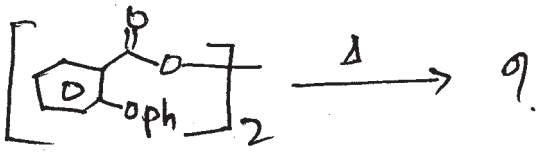
P.T.O.

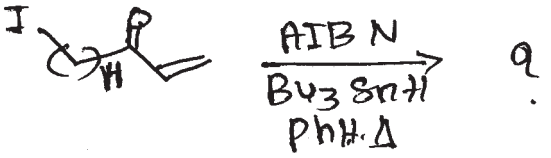
Q2) Predict the product/s indicating mechanism in Any Four of the following: **[12]**

a) 

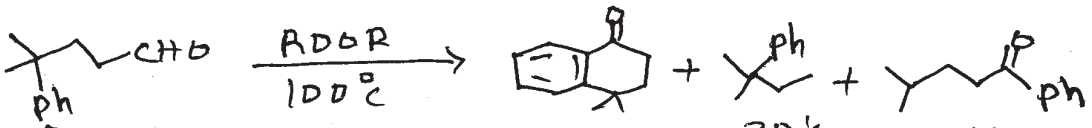
b) 

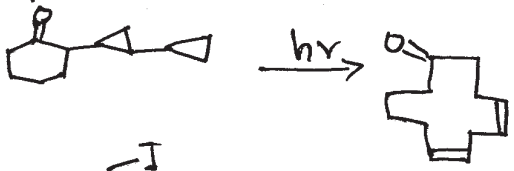
c) 

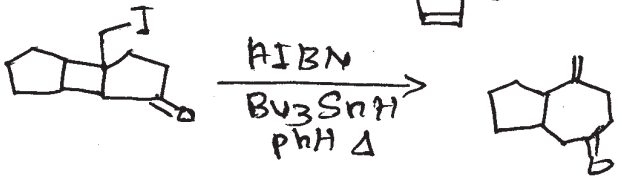
d) 

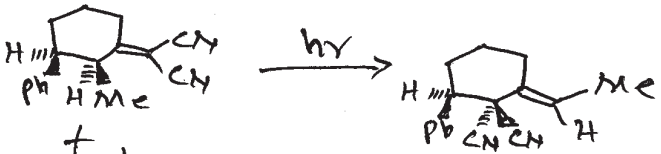
e) 

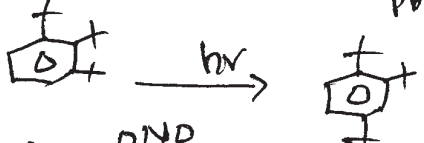
Q3) a) Suggest suitable mechanism for Any Five of the following: **[10]**

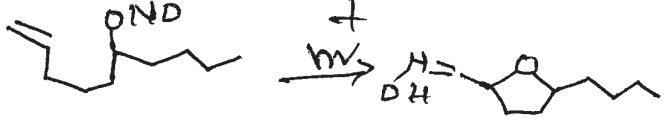
i) 

ii) 

iii) 

iv) 

v) 

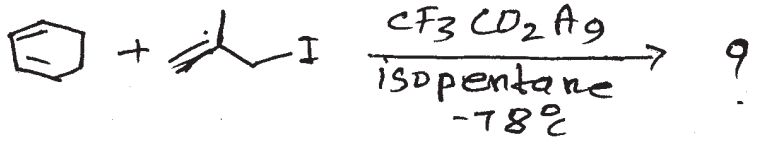
vi) 

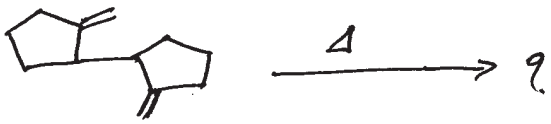
b) With suitable example, explain the quenching process in photochemistry. **[4]**

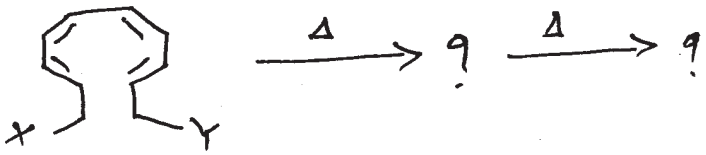
SECTION-II

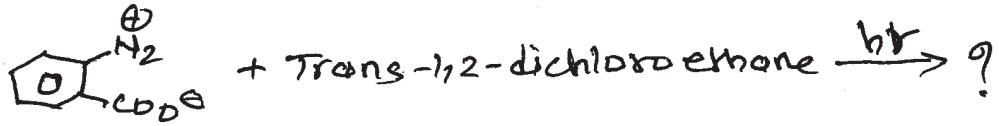
Q4) a) Construct the correlation diagram for the conrotatory opening of 1, 3-cyclohexadiene to 1, 3, 5-hexatriene and predict whether it is thermally allowed or photochemically allowed. **[6]**

b) Predict the product/s in Any Four of the following reactions. Explain their stereochemistry and mechanism. **[8]**

i) 

ii) 

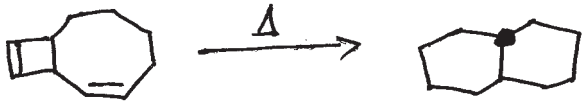
iii) 

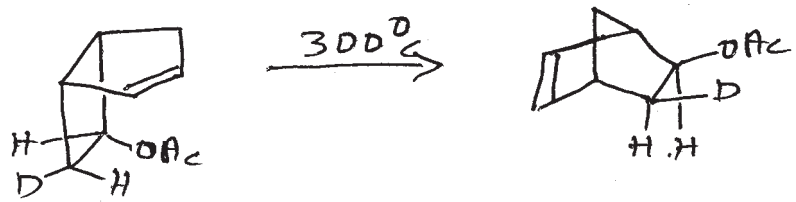
iv) 

v) 

Q5) a) Using FMO approach predict whether the addition of Allyl carbanion and ethylene to give cyclopentyl anion will be thermally allowed or photochemically allowed. **[4]**

b) Explain the mechanism for Any Four of the following: **[8]**

i) 

ii) 

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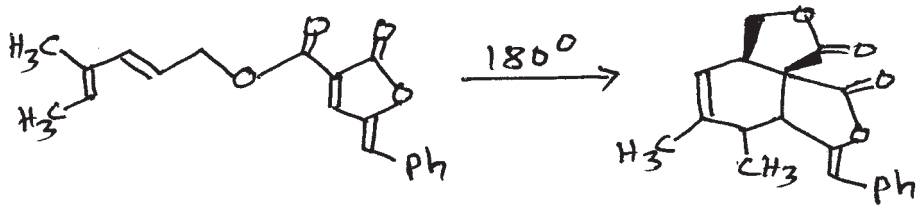

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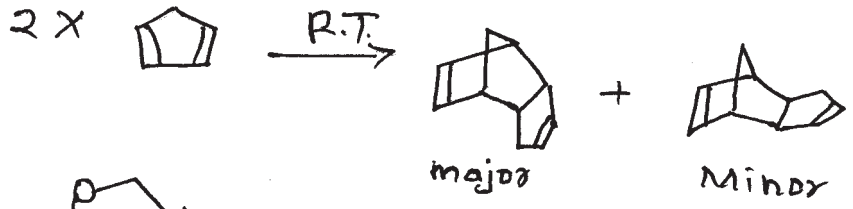

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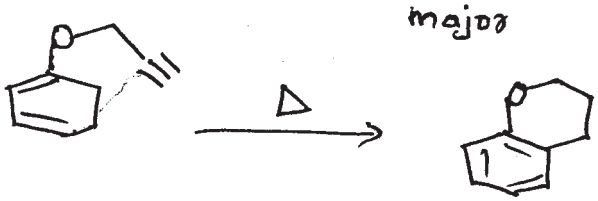
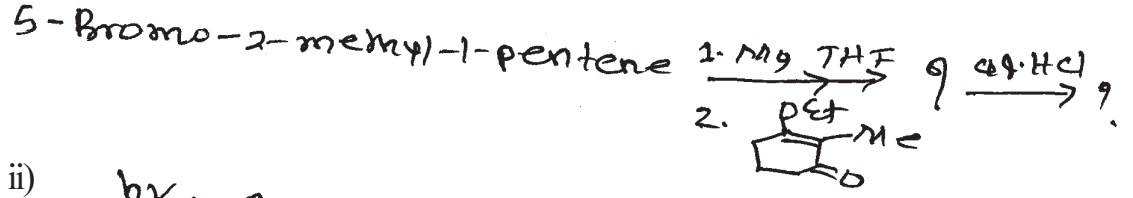


Q6) a) Explain the Retrosynthetic analysis of Endiandric acids A-D. **[6]**

b) Answer <u>Any Two</u> of the following: **[8]**

i) Complete the following synthetic sequences indicating all intermediates and the final product.



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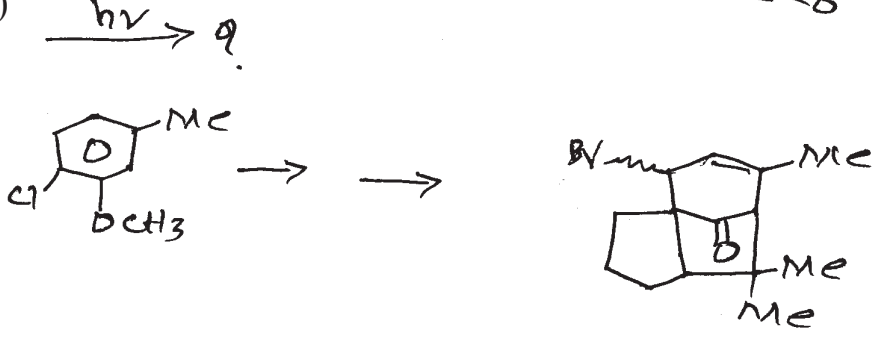

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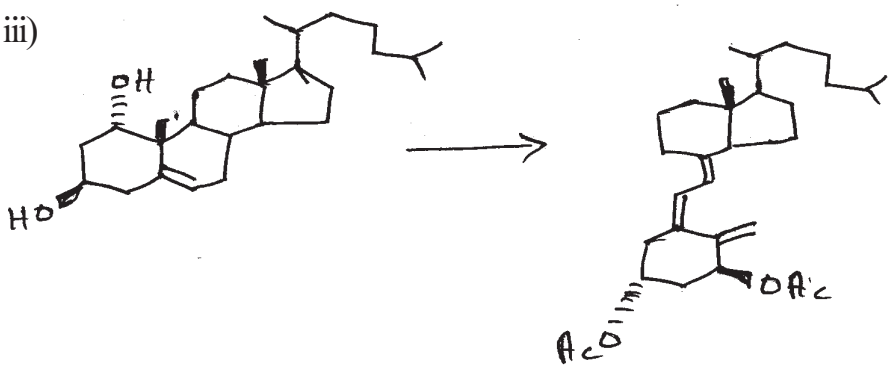

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Total No. of Questions : 4]

SEAT No. :

P2956

[Total No. of Pages : 3

[4723]-315
M.Sc. II
ANALYTICAL CHEMISTRY
CH- 390: Electro-Analytical and Current Analytical methods in Industries
(2008 Pattern) (Semester - III)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer book.***
2) ***All questions are compulsory and carry equal marks.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of logarithmic table/calculator (non-programmable) is allowed.***

SECTION - I

Q1) Attempt any four of the following: **[20]**

a) Define the diffusion current. Describe the various factors affecting the diffusion current.

b) Distinguish between differential -pulse polarography and square-wave polarography.

c) Discuss the principle of cyclic voltammetry. Draw a schematic diagram of instrument used in cyclic voltammetry and explain its different components.

d) The polarogram of Pb (II) solution had a diffusion current 7.12 μA and diffusion coefficient of 2.678×10^{-5} cm^2/s. The drop time was measured at the rate of 3.47 s/drop, the mercury flow rate was 1.42 mg/s. Calculate the concentration of Pb(II) ions in the solution.

e) 2.312 g of ore containing aluminium is dissolved in acid and aluminium is electrolysed. The electrolysis is completed in 9.05 minutes after passing constant current of 2.5 A. Calculate the percentage of aluminium in the ore (Given: At. wt.of A1 = 27).

P.T.O.

Q2) Attempt any four of the following: **[20]**

a) What is meant by stripping voltammetry? Discuss the principle of cathodic stripping voltammetry.

b) State and explain the working of chronopotentiometry.

c) Explain the principle of amperometric titrations. Discuss the nature of amperometric titration curve when an electroactive reagent is added into an electroinactive solution.

d) What are nanomaterials? Give it's general applications.

e) A 25 ml aqueous sample of Fe(II) was assayed in a 0.15 M Ce(III) solution by controlled potential coulometry. At the end point, area under the current -time curve was 26.18 mA. min. Determine the concentration of Fe(II) in sample. The over-all electrode reaction was

$$Ce^{4+} + Fe^{2+} \rightarrow Ce^{3+} + Fe^{3+}$$

SECTION - II

Q3) Attempt <u>any four</u> of the following: **[20]**

a) Give the principle and technique of neutron activation analysis. Discuss in brief the steps involved in neutron activation analysis.

b) Discuss the principle of double isotope dilution analysis. give the applications of isotope dilution analysis.

c) State and explain the principle of radiometric titrations. Discuss the applications of radiometric titrations for estimation of ions from their mixture.

d) A 2g of ancient silver coin was irradiated by neutron flux of 1×10^{12} n cm^{-2} s^{-1} for 1 hr, when $^{107}A_g$ was converted into $^{108}A_g$ of half life 2.42 min. The activity measured 10 min after the irradiation was 1.26×10^{10} dps. calculate the percentage of silver in ancient silver coin.

[Given: Neutron capture cross-section of $^{107}A_g$ = 40 b, and Isotopic abundance of $^{107}A_g$ is 51.82%]

e) A 0.5 mg of labelled selenium having activity 8550 counts for 10 minutes, was mixed with 100 cm^3 of human blood serum. After through mixing 5mg of selenium was extracted gave an activity 2500 cpm. Calculate the amount of selenium present in human blood serum, if background activity is 100 counts for 10 minutes.

Q4) Attempt any four of the following: **[20]**

a) State the principle of DTA. Discuss with neat labelled diagram the working of differential thermal analysis.

b) Draw the schematic diagram of a nephelometer and turbidimeter. explain the difference in the working of two instruments.

c) Discuss the principle and applications of chemically modified electrodes.

d) Explain the characteristics of thermometric titrations. How it differs from conventional titrations?

e) An impure sample of calcium oxalate monohydrate was analysed using TGA technique. TG curve of the sample indicates total mass change from 85 mg to 40.7 mg when the sample was heated upto 900^{o}C. Calculate the percentage purity of the sample. [At.wt. Ca = 40, C= 12, O = 16, H =1]

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Total No. of Questions : 4]

SEAT No. :

P2957

[Total No. of Pages : 3

[4723]-316
M.Sc.-II
ANALYTICAL CHEMISTRY
CH-391 : Environmental and Analysis of Industrial Materials
(2008 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory and carry equal marks.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of logarithmic tables, non-programmable calculators is allowed.***

SECTION-I

Q1) Attempt Any Four of the following: **[20]**

a) Discuss any one method for the determination of phosphorous from fertilizer.

b) Describe a method for determination of anyone colouring constituent in the glass.

c) Explain the term detergent. Describe the method used for the estimation of iron from detergent.

d) What are cosmetics? Give the procedure for the estimation of zinc from cosmetics.

e) A sample of face powder weighing 2.550 gm was dissolved in acid and the solution was diluted to 250 ml. An aliquot of 50 ml solution was analysed for SO_4^{2-} and gave 0.310 gm of $BaSO_4$. Calculate the percentage of sulphate and sulphur from given sample.

[Given At. wts. Ba = 137, S = 32, O = 16]

Q2) Attempt Any Four of the following: **[20]**

a) Explain the term with suitable example

i) Homogenizers

ii) Stabilizers

iii) Antioxidants

P.T.O.

b) Discuss in brief estimation of chromium from the sample of pigment.

c) Give a sampling procedure for explosives.

d) From 0.290 gm of sample containing calcium was dissolved in acid and calcium was precipitated as calcium oxalate. The precipitate was dissolved in dil H_2SO_4 solution and the solution is diluted to 100 ml. An aliquot of 10ml was titrated with 0.025 N$KMnO_4$ and gave burette reading 7.1ml. Calculate the percentage of calcium in the given sample.

[Given At. wt. Ca = 40.08, O = 16, Mn = 54.93, K = 39]

e) 0.2 gm of yellow-chrome pigment was disintegrated and soluble chromate was extracted with H_2SO_4. The solution was diluted to 100ml. An aliquot of 10ml required 11.5ml of 0.05N $Na_2S_2O_3$ solution in iodometric titration. Calculate the percentage of chromium and CrO_3 in the given sample.

[Given At. wts. Cr = 52, O = 16]

SECTION-II

Q3) Attempt Any Four of the following: **[20]**

a) Give the composition of brass and explain the analytical procedure for the estimation of zinc from the brass sample.

b) Discuss the method of extraction and estimation of iron from a sample of steel.

c) Outline the analytical procedure for the determination of any one of the following:

i) Nickel from cupronickel alloy.

ii) Calcium from Dolomite ore.

d) 0.140gm of bauxite ore was disintegrated by suitable method. After removal of impurities the filtrate containing Al^{+3} ions was diluted to 100ml. An aliquot of 25 ml required 27ml of 0.0098M EDTA solution for complete reaction. Calculate percentage of Al_2O_3.

[Given At. wt. Al = 26.98]

e) 1.4 gm sample of ilmenite ore was dissolved in con. H_2SO_4. After removal of insoluble matter filtrate was diluted to 250 ml. An aliquot of 100ml is used to precipitate Ti & Fe. The precipitate on ignition gave 0.421gm of mixed oxide of Ti & Fe. A 25ml of stock solution was titrated against 0.1 N $K_2Cr_2O_7$ solution and burette reading was 8.3 ml. Calculate percentage of TiO_2 & Fe_2O_3 in sample.

[Given At. wt. Fe = 55.85, Ti = 47.90, O = 16]

Q4) Attempt Any Four of the following: **[20]**

a) Write note on (Any One):

i) estimation of COD

ii) estimation of DO

b) Describe Activated sludge process for waste water treatment.

c) Explain the principle, construction and working of cyclone separator. Discuss merits and demerits of cyclone separator.

d) Mention the meaning of the following terms:

i) BOD

ii) Aerosole

iii) Mist

iv) Dust

v) Suspended particulate matters

e) How does catalytic converter reduce the air pollution from petrol powered vehicle?

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Total No. of Questions : 4]

SEAT No. :

P2958

[Total No. of Pages :3

[4723] - 317

M.Sc. -II (Analytical Chemistry)

CH-392: ADVANCED ANALYTICAL TECHNIQUES

(2008 Course) (Semester -III)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory and carry equal marks.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of logarithmic tables/non-programmable calculator is allowed.***
5) ***Use of graph paper is allowed.***

SECTION - I

Q1) Attempt any four of the following: **[20]**

a) State and explain Ohm's law and Kirchoff's law. Explain with suitable example, how these laws are useful in circuit analysis.

b) Draw the circuit symbols of the following.

i) LDR

ii) LED

iii) Zener diode

iv) P-N junction diode

v) Photo transistor

c) Write a critical note on Discrete sample analyzer.

d) Draw the schematic diagram for operational amplifier. Explain the function of various component.

e) Substract 15 from 42 using two s-complement arithmetic. Assume that an eight -bit accumulator is used for the substraction. Convert the answers to its decimal equivalent.

P.T.O.

Q2) Attempt any four of the following. **[20]**

a) Explain the use of RC circuits in the filters. Discuss the frequency response of the filters.

b) Draw the outline of microprocessor control in liquid chromatography.

c) What are bipolar junction transistors (BJT)? Describe how the current amplification can be achieved using p-n-p junction transistor.

d) Parallel combination of three resistances of value $10\,\Omega$, $15\,\Omega$, $30\,\Omega$ are connected across 50V battery. Find out total resistance, total current and current flowing through each circuit of resistance.

e) A constant current flows between two platinum electrode in a silver nitrate solution for 3 minutes and 45 seconds. Before electrolysis, the mass of one of the two pt electrodes was 10.337 gm. During electrolysis silver plated on electrode and mass increased 10.452 gm. Calculate no. of colombs and no. of Faradays during electrolysis of constant current used.

SECTION -II

Q3) Attempt any four of the following. **[20]**

a) Explain the following terms

i) Pressure broadening

ii) Doppler broadening

iii) Plasma

iv) Electron multiplier

b) Write a note on laser enhanced ionization.

c) Mention the elements required as micro nutrients for the growth of crops. Explain any one suitable method for determination of copper from the soil sample.

d) Compare the atomic mass spectrometry and molecular mass spectrometry with respect to principle and method of analysis.

e) The soil samples were analysed for the determination of manganese at 279.5nm in air-acetylene flame by AAS, following observations are made

Manganese in ppm	Absorbance
0	0
0.2	0.0545
0.4	0.1101
0.6	0.166
0.8	0.221
1.0	0.278
Sample	0.1249

Calculate the concentration of Mn in ppm for the soil sample.

Q4) Attempt any four of the following. **[20]**

a) Write a note on single immunodiffusion and double immunodiffusion.

b) Discuss the technique of super critical fluid extraction. Mention it's important applications.

c) Give a brief account of Enzyme linked immunosorbent assay with respect to principle practical aspects and applications.

d) Explain clinical application of the radio-immuno assay of progesterone.

e) A well water sample is analysed flame photometrically for sodium at 589.5nm. The emission signal is 4.5 units on the emission scale. A series of standard solution gives the following results.

Standard Na in ppm	emission Reading
0.2	0.32
1.0	1.40
5.0	6.50

Calculate the sodium level in ppm in well water sample.

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Total No. of Questions : 4]

SEAT No. :

P2959

[Total No. of Pages : 2

[4723]-318
M.Sc.-II
ANALYTICAL CHEMISTRY
CH-380 : Pharmaceutical Analysis
(2008 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory and carry equal marks.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Use of logarithmic table/non-programmable calculator is allowed.***

SECTION-I

Q1) Attempt Any Four of the following: **[20]**

a) Discuss the impurities associated through raw materials and method of manufacture in pharmaceutical products.

b) Write note on " Product Stability".

c) Discuss biological assay of tetanous antitoxin.

d) Give limit test for lead.

e) How amylase activity is determined?

Q2) Attempt Any Four of the following: **[20]**

a) Outline analytical procedure for assay of steroids.

b) Explain dissolution tests for tablets.

c) How acid insoluble ash is determined from vegetable drug?

d) Explain membrane filtration method for sterility.

e) Discuss "bio-availability of drug".

P.T.O.

SECTION-II

Q3) Attempt Any Four from the following: **[20]**

a) Give the role of scientific advisary board of company in investigation of new drug.

b) What are the tablets? Mention its different types.

c) Give the assay of Rifampicin.

d) Explain the term emulsion. How emulsions are prepared? Give the advantages of emulsions.

e) 0.340 gm of oxyphenbutazone [$C_{19}H_{20}N_2O_3.H_2O$] was dissolved in 25 ml of acetone. This solution was titrated with 0.1N NaOH using bromothymol blue indicator, gave burette reading 9.6 ml. Calculate percentage of oxyphenbutazone in given sample.

(Given At. wt. of C = 12, N = 14, H = 1, O = 16)

Q4) Attempt Any Four from the following: **[20]**

a) How dimethicone from cream is determined by I.R.? Explain in detail.

b) Write note on GMP.

c) Explain different types of water used in pharmaceutical industries.

d) Give the assay of Aspirin.

e) In an assay of local anaesthetic [Benzocaine, $C_9H_{11}NO_2$] was dissolved in a mixture of 25 ml HCl and 50 ml distilled water. After cooling to 5°C, acryflavin indicator was added and immediately titrated with 0.1N sodium nitrite solution. The burette reading was 17.7 ml. Calculate the percentage of benzocaine in given sample.

(Given At. wt. of C = 12, H = 1, N = 14, O = 16).

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Total No. of Questions : 4]

SEAT No. :

P2960

[Total No. of Pages : 2

[4723]-319
M.Sc.-II
ANALYTICAL CHEMISTRY-II
CH-381 : Medicinal Chemistry
(2008 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory and carry equal marks.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Draw diagrams wherever necessary.***

SECTION-I

Q1) Attempt Any Four of the following: **[20]**

a) Explain the factors affecting bioactivity.

b) Explain the concept of prodrug and soft drug.

c) Write a note on rate theory.

d) Describe electronic ionisation constant.

e) Explain evolution method of Hansch analysis.

Q2) Attempt Any Four of the following: **[20]**

a) Describe pharmocophonic active pharmaceutical ingredient chiral drug.

b) Explain the development of new procedures followed in drug design.

c) Write a note on induced fit theory.

d) Explain method of chemical assay of a drug with suitable example.

e) Discuss biological assay of drug.

P.T.O.

SECTION-II

Q3) Attempt Any Four of the following: **[20]**

a) Write a note on hormones.

b) Explain the synthesis of ampicillin and chloramphenicol.

c) Explain the general mode of action of local antifective drugs with suitable examples.

d) Give the two examples of cardiovascular local antifective psychoactive drug each.

e) What are psychoactive drugs? Discuss the classification of psychoactive drugs.

Q4) Attempt Any Four of the following: **[20]**

a) Explain the factors affecting on the basis of bioisosteris and spatial considerations.

b) Write a note on cardioactive drugs.

c) What are antibiotics? Explain the method of synthesis of penicillin-G.

d) How are diazepam and barbiturates synthesized?

e) Write a critical note on hormones.

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Total No. of Questions : 6]

SEAT No. :

P3000

[Total No. of Pages :3

[4723] - 4001

M.Sc.

PHYSICAL CHEMISTRY

CHP - 410 : Molecular Structure and Spectroscopy

(New) (2013 Pattern) (Semester - IV)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Answers to the two sections should be written in separate answer books.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right side indicate full marks.*
5) *Use of logarithmic tables / calculator is allowed.*

Physico-Chemical Constants

1.	Avogadro Number	N	$= 6.022 \times 10^{23}\ mol^{-1}$
2.	Boltzmann Constant	k	$= 1.38 \times 10^{-16}\ erg\ K^{-1}\ molecule^{-1}$
			$= 1.38 \times 10^{-23}\ J\ K^{-1}\ molecule^{-1}$
3.	Planck Constant	h	$= 6.626 \times 10^{-27}\ erg\ s$
			$= 6.626 \times 10^{-34}\ J\ s$
4.	Electronic Charge	e	$= 4.803 \times 10^{-10}\ esu$
			$= 1.602 \times 10^{-19}\ C$
5.	1 eV		$= 23.06\ k\ cal\ mol^{-1}$
			$= 1.602 \times 10^{-12}\ erg$
			$= 1.602 \times 10^{-19}\ J$
			$= 8065.5\ cm^{-1}$
6.	Gas Constant	R	$= 8.314 \times 10^{7}\ ergK^{-1}\ mol^{-1}$
			$= 8.314\ J\ K^{-1}\ mol^{-1}$
			$= 1.987\ cal\ K^{-1}\ mol^{-1}$
7.	Faraday Constant	F	$= 96487\ C\ equiv^{-1}$
8.	Speed of light	c	$= 2.997 \times 10^{10}\ cm\ s^{-1}$
			$= 2.997 \times 10^{8}\ m\ s^{-1}$
9.	1 cal		$= 4.184 \times 10^{7}\ erg$
			$= 4.184\ J$
10.	1 amu		$= 1.673 \times 10^{-27}\ kg$
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24}\ J\ T^{-1}$
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}\ J\ T^{-1}$
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31}\ kg$

P.T.O.

SECTION - I

Q1) Attempt the following: **[10]**

a) State the factors associated with magic angle spinning.

b) Why is the derivative mode preferred in esr spectra?

c) State and explain McConnell equation.

d) Explain the factors affecting width of esr spectra.

e) Define relaxation time in nmr.

Q2) Attempt any two of the following: **[10]**

a) Discuss the effects of quadrupolar relaxation in nmr spectra.

b) Compare ftnmr with nmr spectroscopy.

c) Discuss the factors affecting chemical shift.

d) Write a note on multiplicity of peaks in nmr spectra.

Q3) Attempt any one of the following: **[5]**

a) The NO group in N-N-dimethyl nitrosoamine rotates about the N-N bond at 390 Hz frequency in a 600 MHz instrument. At what rate of interconversion will a single line be observed.

b) At what temperature would the imbalance in lower and upper levels electron spin populations differ by 5in 100 at 0.30 T?

$[g_e = 2.0023, \mu_B = 9.274 \times 10^{-24} JT^{-1}]$

SECTION - II

Q4) Attempt the following: **[10]**

a) Enlist the applications of a neutron diffraction technique.

b) Explain the advantages of Electron diffraction.

c) Write a Langevins formula and explain the terms their in.

d) Define the terms: Ferromagnetism and ferrimagnetism.

e) How the structure factor is used to determine the electron density distribution.

Q5) Attempt any two of the following: **[10]**

a) Derive the Van-Velck formula for magnetic susceptibility.

b) Describe the experimental arrangement for the study of electron diffraction of gases.

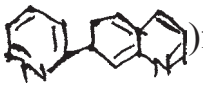
c) What are the advantages of non uniform field method over uniform field method?

d) What is neutron diffraction? Describe the instrumentation of neutron diffraction technique with a suitable diagram.

Q6) Solve any one of the following: **[5]**

a) Calculate the mass and volume paramagnetic susceptibilities of a sample of a complex salt with three unpaired electrons at 25ºC.

[Given: density = 2.87 gcm^{-3}, molar mass = 324.4 $gmol^{-1}$].

b) Calculate the molar susceptibilities of pyridine () and phenanthroline ()from the following data:

Pascal constant (χ_A) in cgs unit

C: -6.0×10^{-6}

H: -2.93×10^{-6}

ring N : -4.61×10^{-6}

Constitutive corrections (λ)

C in ring: -0.24×10^{-6}

C shared by 2 ring: -3.07×10^{-6}.

Total No. of Questions :6]

SEAT No. :

P3001

[Total No. of Pages : 3

[4723]-4002

M.Sc.

PHYSICAL CHEMISTRY

CHP- 411: Surface Chemistry and Electrochemistry

(2013 Pattern) (Semester - IV) (New)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Answers to the two sections should be written in separate answer books.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right indicate full marks.*
5) *Use of logarithmic table / calculator is allowed.*

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2)	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3)	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4)	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

(Surface Chemistry)

Q1) Answer precisely the following: **[10]**

a) Define the terms:

i) Surface free energy and

ii) Surface tension

b) Write Young equation for contact angle situation in wetting and explain the terms involved in it.

c) Explain briefly the mechanism of chemisorption in case of transition metals.

d) What is condensed film? Give its equation.

e) What is hysteresis of adsorption? Explain.

Q2) Answer any two of the following: **[10]**

a) Explain with necessary equations the adsorption behaviour at liquid surfaces.

b) Derive the equation for differential energy of adsorption at constant temperature and volume.

c) Give a critical comparison of various multilayer models of multilayer adsorption.

d) Describe the mercury porosimeter method to determine the pore size distribution.

Q3) Solve any one of the following: **[5]**

a) The volume of gas at $20^{o}C$ and 1.00 bar adsorbed on the surface of 1.50g of a sample of silica at $0^{o}C$ was 1.60 cm^3 at 52.4 kPa and 2.73 cm^3 at 104 kPa. Determine the value of V_{mon}.

b) A 0.015 M of an acid solution in benzene is dropped on a water surface, the benzene evaporates and acid form monomolecular film of solid type. What volume of the above solution would be required to cover 500 cm^2 surface area of water with monomolecular layer of acid? Area covered by single acid molecule is 0.2 nm^2.

SECTION - II

(Electrochemistry)

Q4) Answer the following: **[10]**

a) Define ionics and electrodics.

b) What is meant by Born charging contribution? Write its equation.

c) Write the equation for heat of solvation of negative ion having coordination number four.

d) Explain the ways of transport of ions.

e) Write the overall cell reaction taking place during charging and discharging of lead acid accumulator.

Q5) Answer any two of the following: **[10]**

a) Deduce the expression for mean-ionic activity coefficient for finite-sized ions.

b) Explain the Gouy-Chapman diffuse layer theory.

c) Derive Fick's law for steady state diffusion.

d) Describe with a neat labelled diagram $H_2 - O_2$ fuel cell.

Q6) Solve any one of the following: **[5]**

a) Calculate the thickness of ionic atmosphere at 25°C in 0.01 M solution of KBr. The dielectric constant of water is 78.54.

b) The diffusion coefficients of H^+ and Cl^- in a dilute solution at 25°C were measured as 9.3×10^{-9} m^2 s^{-1} and 2.25×10^{-9} m^2 s^{-1} respectively. Calculate the equivalent conductance of dilute HCl solution at 25°C.

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Total No. of Questions : 6]

SEAT No. :

P3002

[Total No. of Pages : 3

[4723]-4003

M.Sc.

PHYSICAL CHEMISTRY

CHP- 412: Materials Chemistry and Catalysis

(2013 Pattern) (Semester - IV) (New)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of logarithmic table/calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2)	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3)	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4)	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Attempt the following: **[10]**

a) Define anisotropy.

b) Explain Langmuir - Blodgett film.

c) Define photolithography.

d) Give two applications of hi-tech materials.

e) Enlist the optical properties of solids.

Q2) Attempt any <u>two</u> of the following: **[10]**

a) Describe the operation of a p-n-p transistor with the aid of a neat sketch.

b) Discuss the term 'reactive sputtering'. Give its consequences.

c) How do perovskites account for defects in crystals?

d) Describe the structure and operation of a capacitor with a diagram.

Q3) Attempt <u>any one</u> of the following: **[5]**

a) Explain the sol-gel method to prepare thin films.

b) 89% light passes through a 20 cm solid. Evaluate the absorption coefficient of the solid.

SECTION - II

Q4) Attempt the following: **[10]**

a) Define 'catalytic activity'.

b) Define 'poisoning'.

c) What are zeolites? Give an example.

d) Explain catalyst deactivation.

e) Which catalyst is used in diesel oxidation reaction?

Q5) Attempt any two of the following: **[10]**

a) Describe the process of catalytic poisoning.

b) Explain the mechanism of photocatalysis in semiconductors.

c) What are VOCs? How are various catalysts used to remove them?

d) Describe the impregnation method of preparing a catalyst.

Q6) Attempt any one of the following: **[5]**

a) Explain the mechanism of heterogeneous catalysis proposed by Langmuir and Hinshelwood. Deduce the unimolecular rate constant expression for surface reactions.

b) Deduce K and V_m from the following data.

P/Pa	524	1731	3058	4534
$V/cm^3\ g^{-1}$	0.99	3.04	5.08	7.04

Total No. of Questions : 6]

SEAT No. :

P3003

[Total No. of Pages :3

[4723] - 4004

M.Sc.

PHYSICAL CHEMISTRY

CHP-413: Biophysical Chemistry

(2013 Pattern) (New) (Sem.-IV)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) *Answers to the TWO sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right side indicate full marks.*
4) *Use of logarithmic table/calculator is allowed.*
5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2)	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
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			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Attempt the following. **[10]**

a) Which of the twenty alpha amino acids is not a chiral molecule? Give its structure.

b) Explain briefly what are solubilizers.

c) State the importance of nucleic acids.

d) State Braggs law and explain what is order.

e) Explain what are chaperones.

Q2) Attempt any two of the following. **[10]**

a) Give an account of the size and complexity of biopolymers.

b) Outline the isotope exchange experiment showing the formation of ATP in the absence of a proton motive force.

c) Discuss the determination of molecular weight of proteins by SDS method.

d) Phototrophs harvest free energy from light to generate ATP while chemotrophs generate ATP by the oxidation of fuel molecules. Explain.

Q3) Attempt any one of the following. **[5]**

a) Explain the powder camera method to obtain XRD images of biomolecules.

b) Explain the strategy in studying biophysical chemistry.

SECTION - II

Q4) Answer precirely the following: **[10]**

a) Draw a neat labelled diagram of a cross-section of cell membrane.

b) Explain 'all or none law' applicable to all nerves.

c) What are biopolymers? State their characteristics.

d) What are extracellular and intracellular enzymes?

e) What are nucleic acids? Give their two important functions.

Q5) Answer any two of the following. **[10]**

a) Explain how ions are transported through the cell membrane.

b) Describe the light scattering method to determine the size of biopolymers.

c) Discuss the factors affecting the enzyme activity.

d) Discuss the typical application of CD spectrometry.

Q6) Solve any one of the following: **[5]**

a) A biopolymer sample contains equal number of molecules with molecular weight 10,000 and 20,000. Calculate $\bar{M}_n$ and $\bar{M}_w$.

b) The following viscosity data were obtained for a sample of cellulose acetate in acetone at 25ºC.

c(g/100ml)	0	0.114	0.351	0.703
η,millipoise	3.16	4.06	6.64	13.02

Given: K = 1.87 $\times 10^{-5}$ dl/g, α = 1.03. Calculate the viscosity average molecular weight of a polymer.

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Total No. of Questions : 6]

SEAT No. :

P3004

[Total No. of Pages :4

[4723] - 4005

M.Sc.

PHYSICAL CHEMISTRY

CHP-414: Special Topics in Nuclear and Radiation Chemistry

(2013 Pattern) (New) (Semester -IV)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) *Answers to the TWO sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right side indicate full marks.*
4) *Use of logarithmic table/calculator is allowed.*
5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
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			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3)	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4)	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Answer the following. **[10]**

a) Give an account of photonuclear reactions.

b) What are the causes of chernobyl accident?

c) Distinguish between somatic and genetic effects of nuclear radiations.

d) Define the terms, 'recoil atom' and 'recoil energy'.

e) What is meant by ''therapeutic uses of radiation''?

Q2) Attempt any two of the following. **[10]**

a) Explain Szilard-Chalmers reaction with an example.

b) Write a note on various types of personal dosimeters.

c) Explain the In-Vitro diagnostic procedure of radiopharmaceuticals.

d) Explain the various stages involved in interaction of radiations with biological cells.

Q3) Attempt any one of the following. **[5]**

a) Find the biologically effective dose in Sieverts for a radiation dose of 0.1 rad due to α-particles and 0.02 rad due to fast neutrons.

b) Find the recoil energy of an atom with mass number 200 in eV for 2MeV photon emission.

SECTION - II

Q4) Answer precisely the following: **[10]**

a) Explain competition kinetics with an example.

b) Explain the terms,

i) Cosmochemistry and

ii) PPI process

c) Compare the yield of radiolysis products of primary, secondary and tertiary aliphatic hydrocarbons.

d) Discuss the use of Zeolites in LILW treatment.

e) Draw a neat and labelled diagram of the instrument used in neutralization radiometric titration.

Q5) Answer any two of the following. **[10]**

a) Discuss the synthesis of Be, B and Li in cosmos.

b) Explain a chain reaction and its types in detail.

c) Describe the titration of a mixture of three ions (I^-, Br^-, Cl^-) in which

i) ions precipitating first and last are labelled.

ii) ions precipitating first and second are labelled.

d) What are the main sources of radioactive liquid and gaseous effluents? How are these treated?

Q6) Answer any one of the following: **[5]**

a) 10ml KCl labelled by ^{36}Cl was titrated with 0.01M $AgNO_3$. Addition of 1ml titrant showed a loss of activity from 10,000 counts per five minutes to 1500 counts per two minutes. Calculate the amount of KCl in the original solution.

[Given: At. Wt of K = 39.1, Cl = 35.5]

b) Write a note on the radiolysis of aromatic hydrocarbons with reference to radiolysis of benzene.

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Total No. of Questions : 4]

SEAT No. :

P3005

[Total No. of Pages :2

[4723] - 4006
M.Sc. - II
INORGANIC CHEMISTRY
CHI- 430 : Inorganic Polymers & heterogeneous Catalysis
(2013 Pattern) (Semester - IV)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table and calculator is allowed.***

Q1) Answer the following: **[20]**

a) What is Sabatier principle in chemical catalysis? State its significance.

b) Define promotor & poison with suitable examples of each.

c) How do you prepare pt/Al_2O_3 catalyst by wet impregnation method.

d) Mention the names of different types of reactors.

e) Discuss in short oxidation of olefines using BiM_OO_4 catalyst.

f) What do you mean by forming of the catalyst? Give its advantages.

g) Draw the flow sheet for synthesis of ZSM-5.

h) Give the classification of porous materials.

i) Comment on the position of extra framework species in zeolite structure.

j) Define inorganic polymers. Give their characteristics.

Q2) Answer any two of the following: **[10]**

a) Explain the role of semiconducting oxidesin photo-catalysis.

b) Give an account of surface characterisation methods used for supported metal catalysts.

c) What are the different methods of determining acidic sites in zeolites. Discuss any one of them in detail.

d) Discuss the catalytic applications of heteropolyacids.

P.T.O.

Q3) Attempt the following (any two): **[10]**

a) Give an account of use of pervoskite oxide in heterogeneous catalysis.

b) Explain the various methods of immobilisation of transition metal complexes.

c) Write a note on, MFI & MEL type zeolite.

d) Discuss the importance of zeolites as catalyst in petroleum industry.

Q4) Answer any two of the following: **[10]**

a) Give an account of industrial applications of heterogeneous catalysts.

b) Explain the following methods of preparation of heterogeneous catalyst.

i) Precipitation and co-precipitation.

ii) High Temperature alloy leaching.

c) Give an outline of the effect of various parameters in zeolite synthesis.

d) What is polysilylenes? Give their methods of preparation.

Total No. of Questions : 4]

SEAT No. :

P3006

[Total No. of Pages : 2

[4723]-4007
M.Sc. (Part -II)
INORGANIC CHEMISTRY
CHI- 431: Material Science - I
Inorganic Solid State Materials
(2013 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Use of log tables & calculators is allowed.***
4) ***Figures to the right indicate full marks.***

Q1) Answer the following: **[20]**

a) What is diffusion? List the different types of diffusion in solids.

b) Give four important applications of magnetic materials.

c) What is permanent magnet?

d) What are intermetallic superconductors?

e) Define

i) Critical temperature for superconductor.

ii) Domain.

f) Define

i) Ageing

ii) Gelation

g) What is Asphalt? What is meant by Asphalt mixes?

P.T.O.

h) Explain the orthopaedic applications of biomaterials.

i) Give the full form of C_3AF & C_3S.

j) A piece of wood containing moisture weighed 95.3 gm & after oven drying showed constant weight of 80.5 gm. Calculate the percentage of moisture in it.

Q2) Attempt any two of the following: **[10]**

a) What is saturation magnetisation? Explain how it is useful to determine saturation magnetisation.

b) Explain the following:

i) Perovskite.

ii) Meissners effect.

c) Distinguish between the piezo, pyro & ferro-electric materials.

d) State & explain Fick's laws of diffusion.

Q3) Attempt any two of the following: **[10]**

a) What is hysteresis loop? Explain the hysteresis loop of ferromagnetic substances.

b) What is concrete? Explain different concrete mixture used.

c) Explain Bioactive glasses & Bioactive glass ceramics.

d) Draw the structure of FCC, BCC & HCP in solids. Calculate number of atom per unit cell in each.

Q4) Write short notes (any Two): **[10]**

a) Fullerene

b) Sol-gel process

c) Portland & nonportland cement.

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Total No. of Questions : 4]

SEAT No. :

P3007

[Total No. of Pages : 2

[4723]-4008
M.Sc. -II
INORGANIC CHEMISTRY
CHI- 432: Material Science - II
Nanomaterials
(2013 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Use of calculator is allowed.***
4) ***Figures to the right indicates full marks.***

Q1) Answer the following: **[20]**

a) What is meant by nanotechnology.

b) Define stokes and antistokes lines in Raman spectroscopy.

c) What are nanoporous materials?

d) What are biosensors? How do they function?

e) Name the properties of nanocrystals which depends on their size.

f) Give the methods for synthesis of oxide nanoparticles.

g) Define

i) Exciton

ii) Surface plasma Resonance

h) What are rectifires.

i) What are semiconducting nanomaterials? Give method of preperation of semiconducting sulphides.

j) What do you understand by SWCNT and MWCNT? How do they differ from each other.

P.T.O.

Q2) Answer the following (Any Two): **[10]**

a) Explain the nonaqueous sol-gel method for synthesis of metal oxide nanoparticles.

b) Give reactions showing synthesis of carbon nanotubes. Explain how they are functionalized.

c) Explain use of SEM for studying nanomaterials.

d) Explain the following size dependent properties of Nanomaterials.

i) Magnetic susceptibility

ii) M.P

iii) Conductivity

iv) Color

Q3) Attempt any Two of the following: **[10]**

a) What are inorganic nanotubes? Give examples and describe the synthesis of any one.

b) Explain photo induced charge transfer processes in semiconductor nano clusters.

c) What is electronic effect? Explain with reference to nanostructured metal oxide films.

d) Discuss the modifications of nanostructured metal oxide films with dyes.

Q4) Write a notes on (Any Two): **[10]**

a) Nanomaterials as sensors.

b) Physical methods of nanoparticle synthesis.

c) Photoinduced transformations of metal nanoparticles.

d) Bimetallic nanoparticles.

EEE

Total No. of Questions : 9]

SEAT No. :

P3008

[Total No. of Pages :4

[4723] - 4009
M.Sc. - II
INORGANIC CHEMISTRY
CHI-445: Inorganic Chemistry: Applications in Industry, Environment and Medicine
(2013 Pattern) (Semester -IV)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any two sections of the following.***
2) ***Both sections should be written in the same answer book.***
3) ***All questions are compulsory.***
4) ***Figures to the right indicate full marks.***
5) ***Neat diagrams must be drawn wherever necessary.***

SECTION - I

(INDUSTRY)

Q1) Answer the following. **[10]**

a) What do you understand by the term pigment?

b) What is meant by "Acid Bath"? Where is it used?

c) What is meant by synthetic pigments? Give two examples.

d) Give the names & structures of two coordination compounds which modify the electrode behaviour in electrodeposition.

e) What is the use of extender pigments in paints?

Q2) Answer the following. (any two). **[10]**

a) Explain the methods of electroplating of precious metals.

P.T.O.

b) Explain the following properties of Inorganic pigments

i) Color

ii) Hiding power

iii) Chemical resistance

iv) Ease of wetting and despersion

v) Heat resistance

c) Explain the process of electroplating of tin.

d) Complete the following table.

Pigment	Preparation and Characteristic Properties	Applications
i) TiO_2		
ii) Lithopone		
iii) Iron oxides		
iv) Red Lead		

Q3) Write a note on (any one). **[5]**

a) Prussian Blue modified Electrodes.

b) Natural earth color pigments

c) Use of polymers in electroplating.

SECTION - II

(ENVIRONMENT)

Q4) Answer the following in brief. **[10]**

a) What is meant by ‘‘Oxygen consuming waste’’ in a water sample.

b) What do you understand by "Acid Rain"?

c) What does tertiary treatment in a sewage treatment plant remove from waste water stream.

d) How is water containing pathogens treated?

e) Draw the schematic diagram of Molten Carbonate Fuel cell.

Q5) Answer any two. **[10]**

a) Explain in detail the use of Biotechnology for waste water treatment.

b) Explain in detail the construction and working of phosphoric Acid Fuel cell.

c) What is meant by cola vapor AAS technique? Explain the determination of Mercury from polluted water using this technique.

d) Explain in detail removal of phenol and cyanide from Waste water.

Q6) Write note on any one. **[5]**

a) BOD & COD

b) Biomass - A source of Energy

c) Biorefractory organic pollutants.

SECTION - III

(MEDICINE)

Q7) Answer the following. **[10]**

a) Name the bismuth compounds which are used as antiulcer agents.

b) Name the diseases in which Lithium salts can be administered for treatment.

c) Name and draw structures of two model compounds of Vanadium.

d) Cis-platin acts as an anticancer drug while trans-platin does not. Why?

e) What is meant by PET? Which isotopes are used in this technique?

Q8) Answer any two. **[10]**

a) ''Au (III)complexes show anticancer activity''. Explain.

b) Explain the modes of binding of metal complexes to DNA.

c) How are Bi(III)compounds synthesised from nitrate solutions. Explain giving appropriate chemical reactions.

d) How are hydroxyl radicals useful for study of DNA-Protein complexes?

Q9) Write note on any one. **[5]**

a) Model compounds of Vanadium.

b) Bactericidal Activity of Bismuth compounds against H. Pylori.

c) Metal complexes as chemical Nucleases.

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Total No. of Questions : 6]

SEAT No. :

P2961

[Total No. of Pages : 3

[4723]-401

M.Sc.

PHYSICAL CHEMISTRY

CH-410 : Molecular Structure and Spectroscopy

(Old) (Semester-IV) (2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Answers to the two sections should be written in separate answer books.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right side indicate full marks.*
5) *Use of logarithmic tables/calculator is allowed.*

Physical - Chemical Constants

1.	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2.	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3.	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4.	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5.	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6.	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7.	Faraday Constant	F	$= 96487$ C equiv^{-1}
8.	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9.	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10.	1 amu		$= 1.673 \times 10^{-27}$ kg
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION-I

Q1) Attempt Any Three of the following: **[15]**

a) Discuss the factors influencing the coupling constant in nmr spectra.

b) Explain the terms-chemical shift, coupling constant, Larmor Frequency and spin-spin relaxation in nmr spectroscopy.

c) What do you understand by nqr group frequencies? Explain their use in molecular structure determination.

d) Explain the theory of spin-spin interaction for A_2 type systems. Explain why two protons in a CH_2 group donot cause splitting of each others signal.

e) Write a note on: FT nmr spectroscopy.

Q2) Attempt Any Three of the following: **[15]**

a) Explain the principle of esr spectroscopy. Why are microwave radiations used to observe esr signals?

b) What is Mc Connell relationship? Explain the terms involved their in. Discuss its applications.

c) Define the terms-spin polarization, zero field splitting, unpaired spin density and hyperfine coupling constant.

d) With the help of a schematic diagram, explain the technique of photo acoustic spectroscopy (PAS).

e) What is g-value? Discuss the factors affecting the g-value.

Q3) Solve Any Two of the following: **[10]**

a) Predict the intensity distribution in hyperfine lines of the esr spectrum by the radicals $\dot{C}H_3$ and $\dot{C}D_3$.

b) Calculate the nmr frequency of ^{35}Cl in magnetic field of intensity 1.86 Tesla.

[Given: I = 3/2, μ = 1.06 in units of β_n]

c) Calculate the frequency separation of the nuclear spin states in ^{13}C nucleus with a magnetic field of 14.8 Tesla, the magnetogyric ratios being $6.73 \times 10^7\ T^{-1}S^{-1}$.

SECTION-II

Q4) Attempt Any Three of the following: **[15]**

a) Compare the usefulness of XRD and electron diffraction techniques.

b) Give a brief account of Braggs method used in the elucidation of crystal structure.

c) Describe the experimental arrangement for the study of electron diffraction of gases.

d) State the phase problem and outline the techniques for overcoming it.

e) How is the Fourier synthesis used to determine a unit cell?

Q5) Attempt Any Three of the following: **[15]**

a) Derive the Van-Velck formula for magnetic susceptibility.

b) Explain the working of Faraday balance with suitable diagram.

c) Distinguish between Gouy and Faraday methods.

d) What is electron diffraction? Give its applications.

e) What are the advantages and disadvantages of Faraday method over Gouy method?

Q6) Solve Any Two of the following: **[10]**

a) Calculate the volume and mass susceptibilities of a sample of a complex with five unpaired electrons at 300 K.

[Given: density = 2.87 gcm^{-3}, molar mass = 324.4$gmol^{-1}$]

b) Calculate the glancing angle.

[Given: d = 400pm, λ = 153.9 pm, n = 1]

c) The gram susceptibility of $Ni(en)_3 S_2O_3$ is 11.03×10^{-6} cgs units at 17°C. Find the susceptibility at 30°C.

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Total No. of Questions : 6]

SEAT No. :

P3009

[Total No. of Pages :4

[4723] - 4010

M.Sc. - II

ORGANIC CHEMISTRY

CHO - 450 : Chemistry of Natural Products

(New Course) (2013 Pattern) (Semester - IV)

Time : 3Hours] *[Max. Marks : 50*

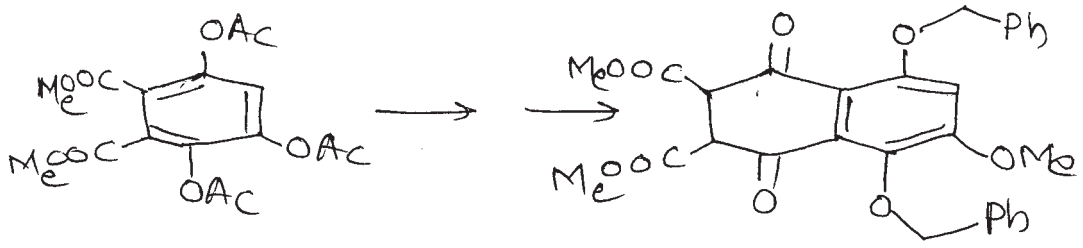
Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

Q1) Outline the steps involved in the following synthetic sequences. Indicate the reagents used and discuss the mechanism and stereochemistry involved (any three). **[9]**

a)



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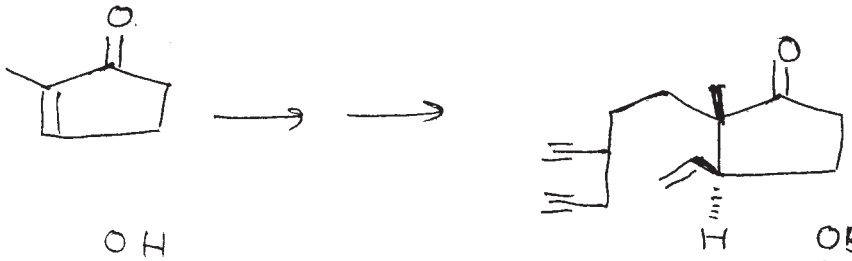

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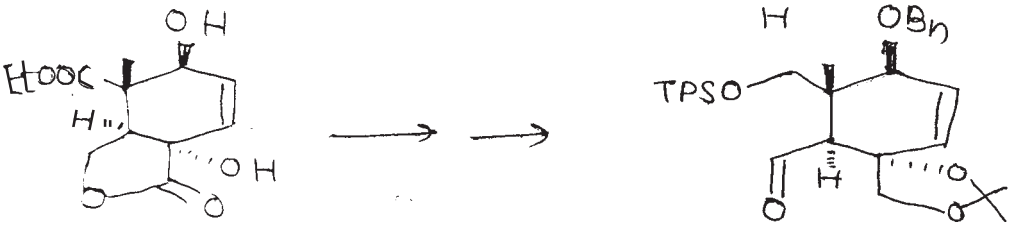

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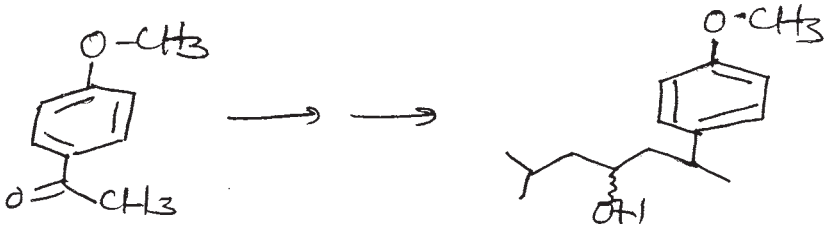


P.T.O.

Q2) Answer the following (any two) **[8]**

a) Give evidences in support of

i) Monosubstituted furan ring

ii) α,β -unsaturated carboxylic acid in Hardwickiic acid.

b) Write the structures of compounds obtained by permanganate oxidation of podophyllic acid and how this reaction was useful in determining the structure of podophyllic acid?

c) Using spectral methods explain the presence of

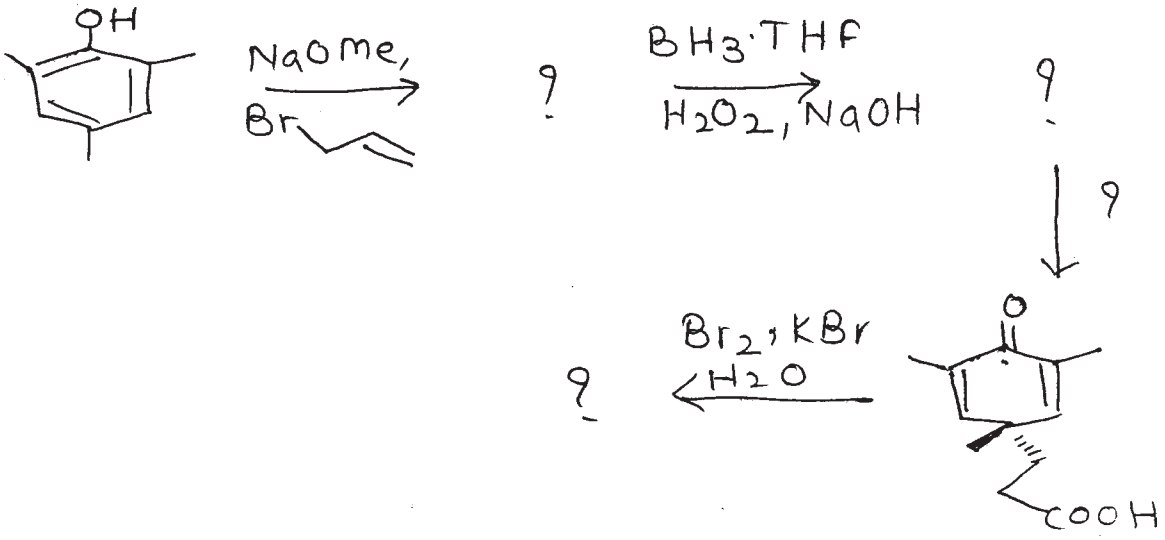
i) quinoline ring conjugated to pyridone ring.

ii) tertiary alcohol.

iii) prochiral methylene group in camptothecin.

Q3) Answer the following (any two): **[8]**

a) Place the appropriate missing reagents/ intermediates in the following conversion and explain the steps.



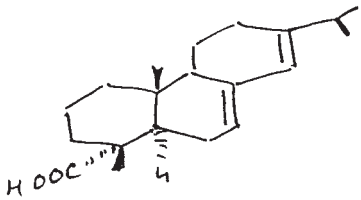
b) Write a note on Mc Murry coupling.

c) How will you establish the stereochemistry of ring fusion in Hardwickiic acid?

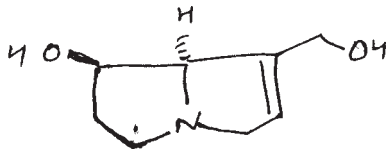
SECTION - II

Q4) Suggest biogenetic scheme for <u>any three</u> of the following: **[9]**

a) GGPP ⟶

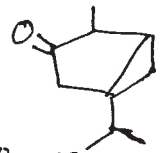


b) Ornithine - 2 - C^{14} ⟶

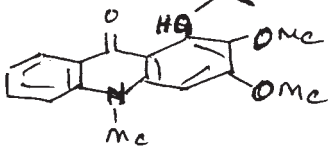


Indicate the position of labelled carbon.

c) Neryl pyrophosphate ⟶



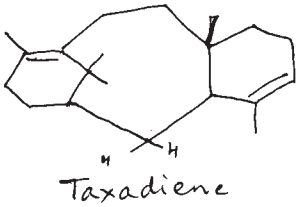
d) Tryptophan ⟶



Q5) Attempt <u>any two</u> of the following: **[8]**

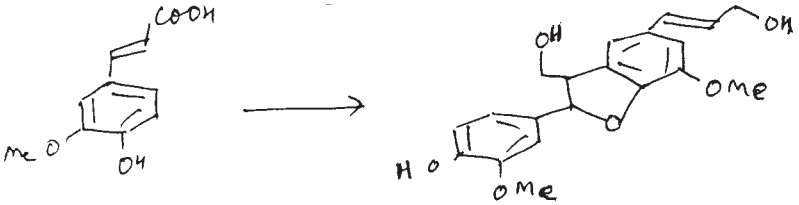
a) Outline the biogenetic steps in the following conversion:

Geranyl geranyl pyrophosphate ⟶



Taxadiene

b) Suggest the biogenetic steps for the following scheme:

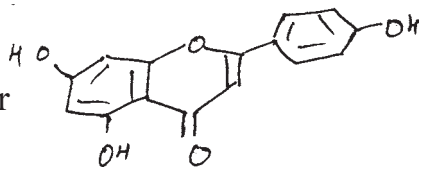


c) Write the biogenesis of squalene from farnesylpyrophosphate.

Q6) Attempt <u>any two</u> of the following: **[8]**

a) Write a note on role of Pyridoxal phosphate in the biogenesis of alkaloids.

b) Write the stepwise biogenetic scheme for conversion of FPP to Humulene.

c) Suggest the biogenetic pathway for  from Phenylalanine.

Total No. of Questions : 6]

SEAT No. :

P3010

[Total No. of Pages : 5

[4723]-4011
M.Sc. II
ORGANIC CHEMISTRY
CHO- 451: Advanced Synthetic Organic Chemistry
(2013 Pattern) (Semester - IV)

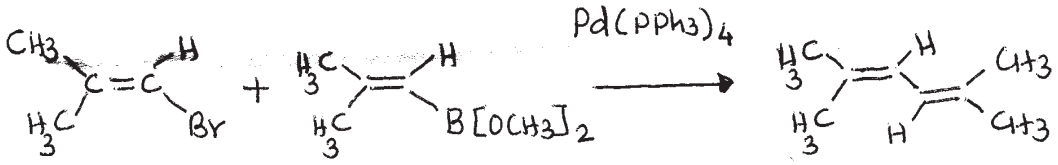
Time : 3 Hours] *[Max. Marks :50*

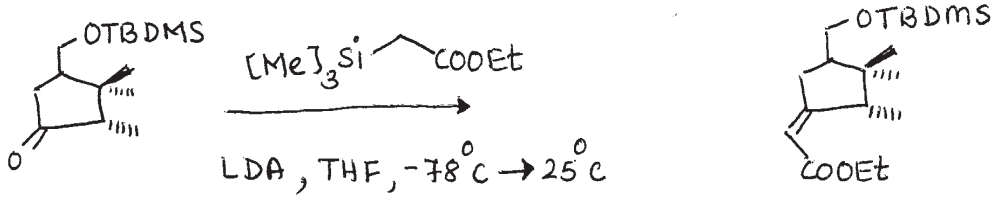
Instructions to the candidates:

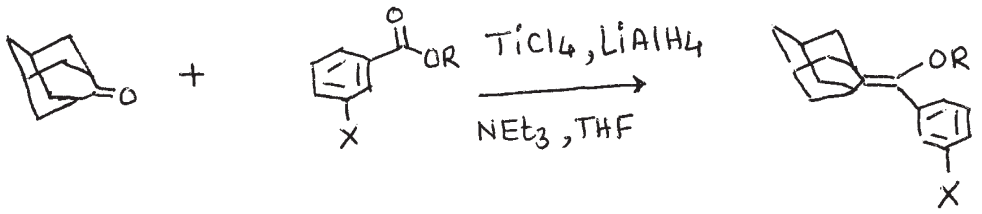
1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

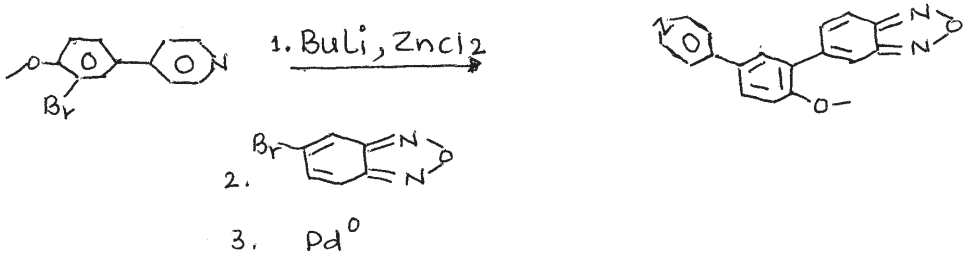
SECTION - I

Q1) Suggest the mechanism for any three of the following: **[9]**

a) 

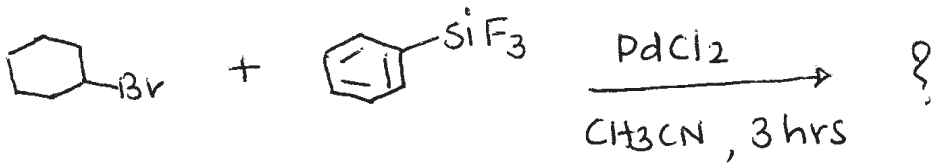
b) 

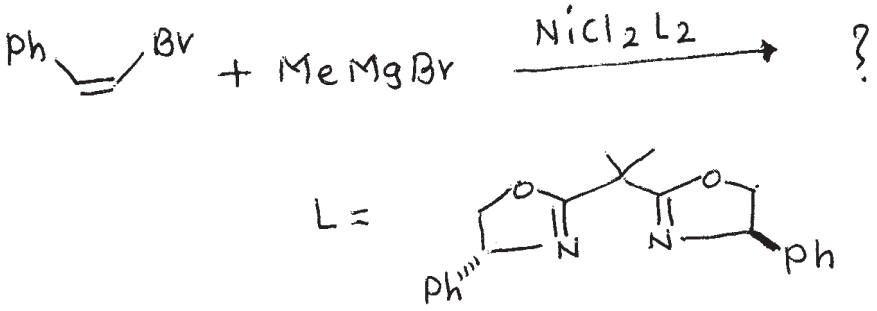
c) 

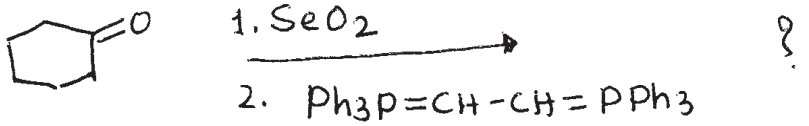
d) 

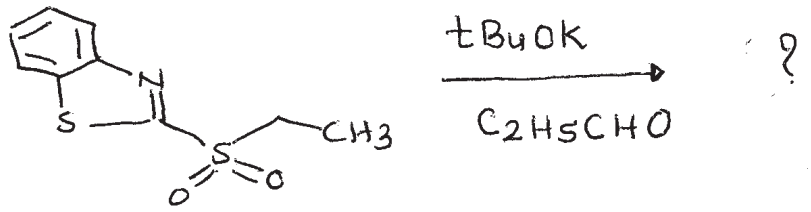
P.T.O.

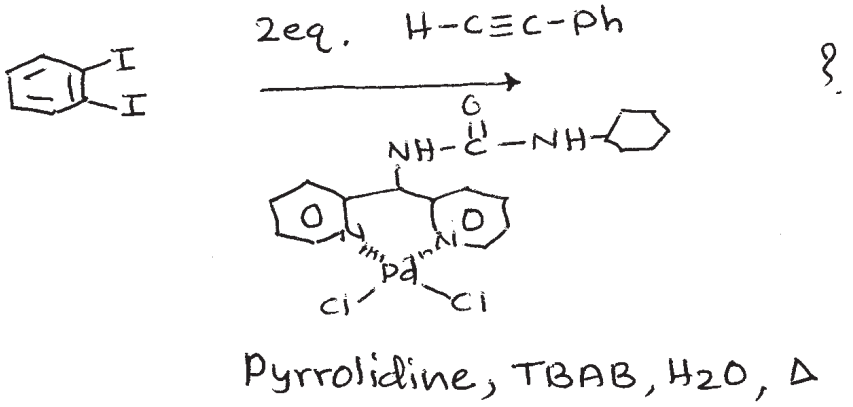
Q2) Predict the products in <u>any four</u> of the following: **[8]**

a) 

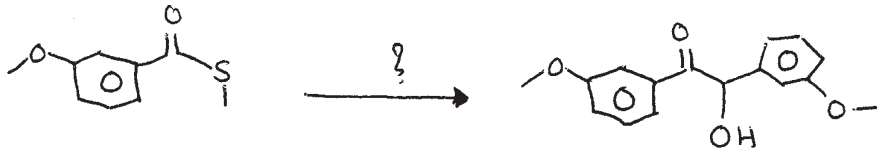
b) 

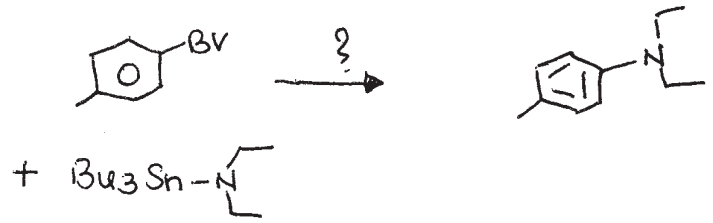
c) 

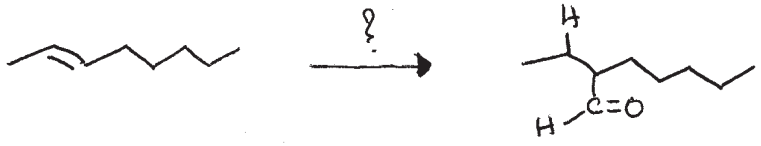
d) 

e) 

Q3) a) Complete <u>any two</u> of the following conversions using appropriate organometallic reagents. **[4]**

i) 

ii) 

iii) 

b) Write short notes on <u>any two</u> of the following: **[4]**

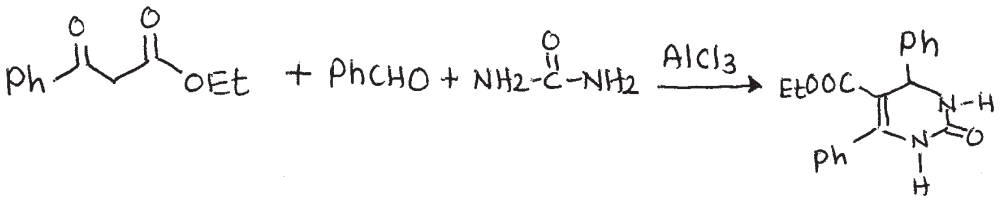
i) Petasis reaction.

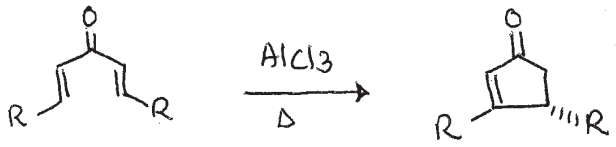
ii) Heck arylation.

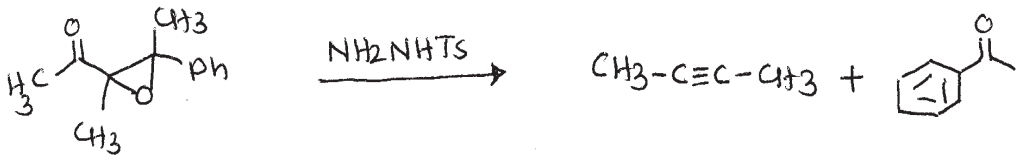
iii) Bamford - stevens reaction.

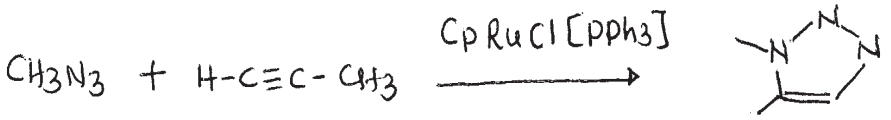
SECTION - II

Q4) Suggest the mechanism for <u>any three</u> of the following: **[9]**

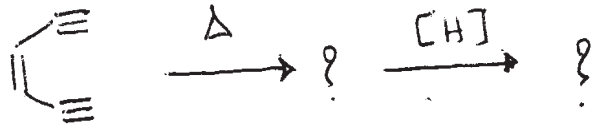
a) 

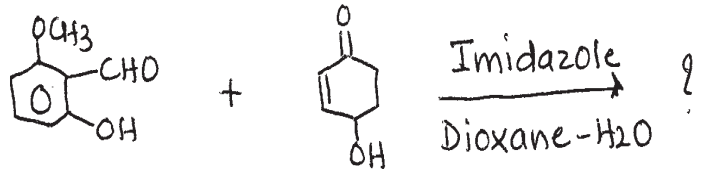
b) 

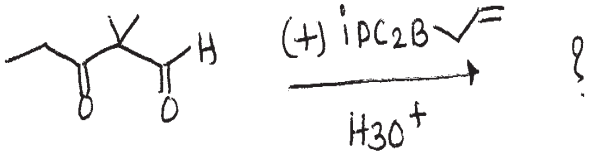
c) 

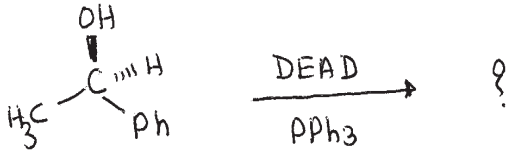
d) 

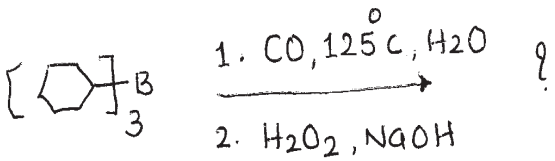
Q5) Predict the products in any four of the following: **[8]**

a) 

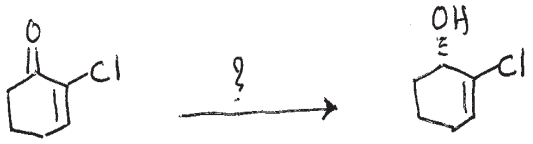
b) 

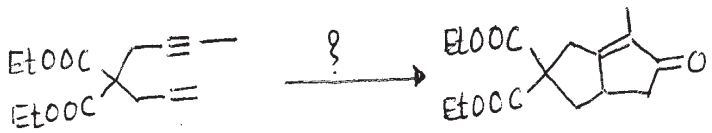
c) 

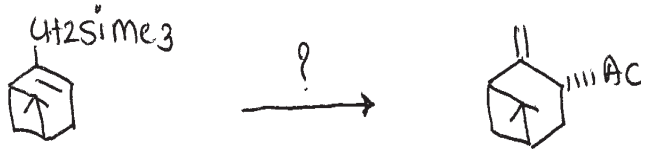
d) 

e) 

Q6) a) Complete <u>any two</u> of the following conversions using appropriate reagents. **[4]**

i) 

ii) 

iii) 

b) Write short notes on <u>any two</u> of the following: **[4]**

i) RCM and ROM.

ii) Use of Thexyl borane and disimylborane in organic synthesis.

iii) Mannich reaction.

EEE

Total No. of Questions :6]

SEAT No. :

P3011

[Total No. of Pages : 3

[4723]-4012
M.Sc.
ORGANIC CHEMISTRY
CHO - 452: Carbohydrate and Chiron Approach, Chiral Drugs and Medicinal Chemistry
(2013 Pattern) (New Course) (Semester - IV)

Time : 3 Hours] *[Max. Marks :50*

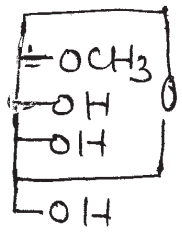
Instructions to the candidates:

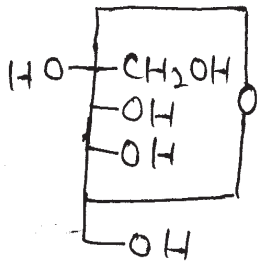
1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

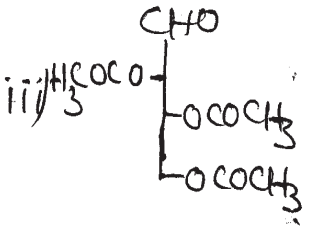
SECTION - I

Q1) Answer any three of the following: **[9]**

a) Write the names of following sugar derivatives

i) 

ii) 

iii) 

b) What is chiron approach? Explain rule of five.

c) Write the synthesis of R-Indacrinone hydrochloride.

d) Explain the mode of action of S-captopril.

Q2) a) Answer any two of the following: **[4]**

i) Write short note on anomeric effect.

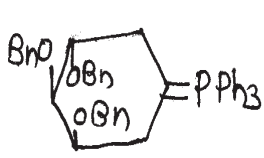
ii) Give retrosynthetic analysis of (–) – multistriatin.

iii) Define chiral drugs with suitable examples.

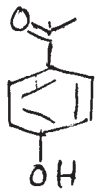
P.T.O.

b) Identify the intermediates formed in any two of following sequence of reactions and rewrite the sequence again. **[4]**

i) D-(+)-Glucose $\xrightarrow[H^+]{MeOH}$? $\xrightarrow[\text{anhydrous } ZnCl_2]{PhCHO}$?

ii) 

$\xrightarrow[ii)\ Na/Liq.NH_3]{i)\ HCHO}$? $\xrightarrow[ii)\ NaIO_4/OsO_4]{i)\ Ac_2O/Pyridine}$?

iii) 

$\xrightarrow[ii)\ H_3CONa,\ CH_3OH]{i)\ CuBr_2,\ AcOEt}$? $\xrightarrow[AcOH]{H_2,\ Pd/C}$?

Q3) Answer any two of the following: **[8]**

a) Outline the synthesis of R-epichlorohydrin.

b) Explain the term distomer. Illustrate with suitable examples distomers with

i) no side effect

ii) undesirable side effect.

c) Write complete synthesis of S-Ibuprofen and explain its pharmacological action.

SECTION - II

Q4) Attempt any three of the following: **[9]**

a) What are sulfonamides? Explain the mechanism of action of sulfonamides.

b) Cell membrane can act as drug targets". Explain with suitable examples.

c) Explain the concept of 'SAR'.

d) Draw the structure of chloramphenicol and explain its mode of action.

Q5) Answer any four of the following: **[8]**

a) What are macrolides? Explain with suitable examples.

b) Give mode of action of an antifungal agent.

c) Write a short note on antiamoebic agents.

d) What are polypeptides? Describe the important biological applications of polypeptides.

e) Write structure activity relationship in cephalosporin - C.

Q6) Answer any two of the following: **[8]**

a) Give structure activity relationship in penicillins. Why penicillin-G cannot be administered orally?

b) Describe mechanism of pharmacokinetics.

c) Give a brief account of antiviral agents with suitable examples.

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Total No. of Questions : 6]

SEAT No. :

P3012

[Total No. of Pages :5

[4723] - 4013
M.Sc. -II
ORGANIC CHEMISTRY
CHO-453: Designing Organic Synthesis and Asymmetric Synthesis
(2013 Pattern) (Semester -IV)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right side indicate full marks***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

Q1) Answer in brief any four of the following. **[8]**

a) What is reversal of polarity explain with suitable example.

b) Dihydropyran DHP cannot be used to protect chiral alcohols.

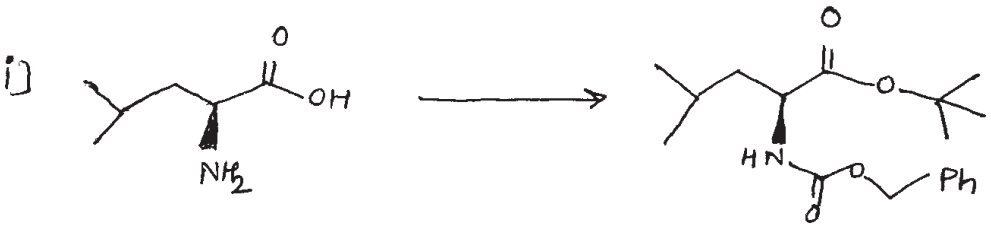
c) In Stork enamine synthesis secondary amines are exclusively used and not primary amines.

d) What are the advantages of convergent synthesis explain with suitable example.

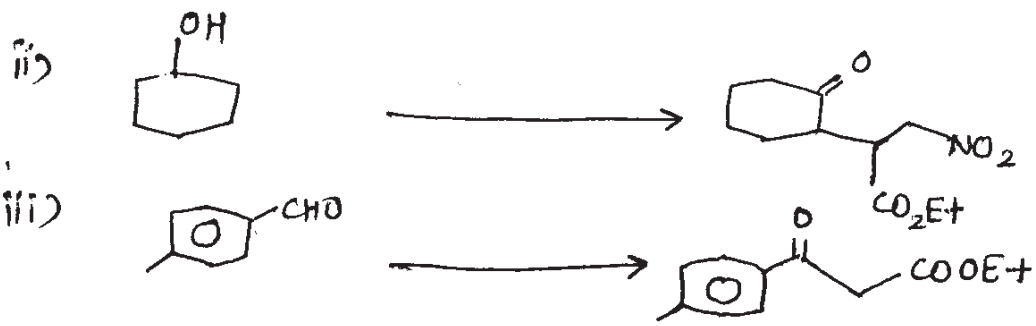
e) What are the synthetic reagents for the following synthons.

Q2) a) How will you bring about following transformations (any two). **[4]**

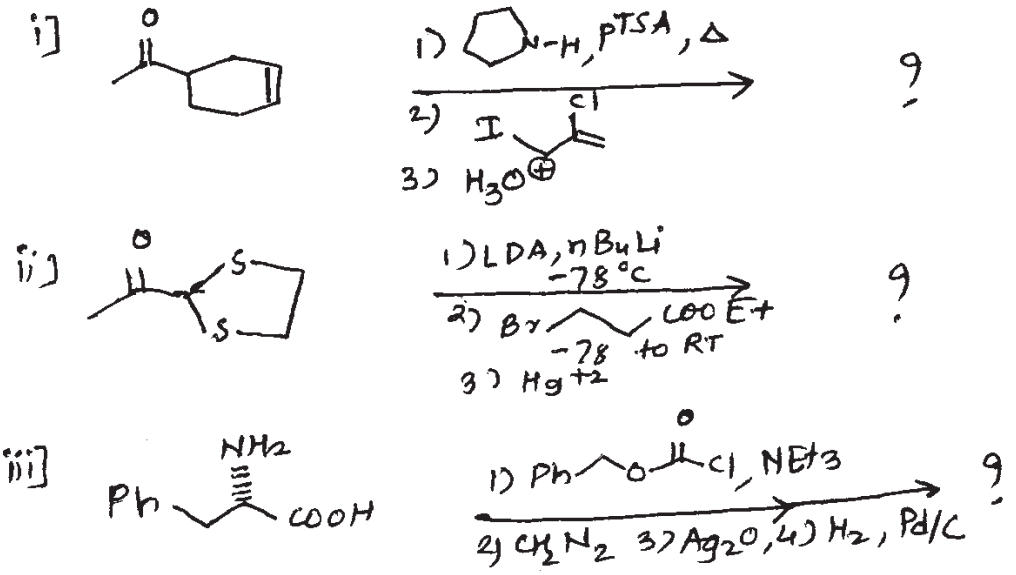
i)



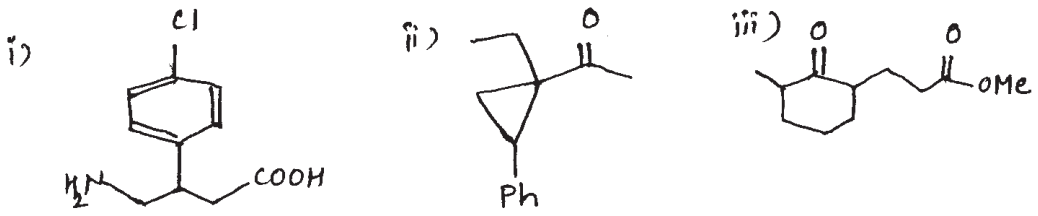
P.T.O.



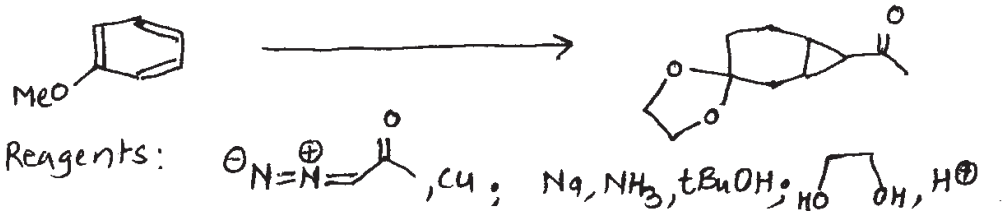
b) Predict the product/s in the follwoing (any two). **[4]**



Q3) a) Using retrosynthetic analysis, suggest suitable method to synthesize any two of the following. **[6]**



b) You are provided reagents for the following conversion. Arrange them in proper order to achieve the conversion. Write structures of the intermediate compounds. **[3]**



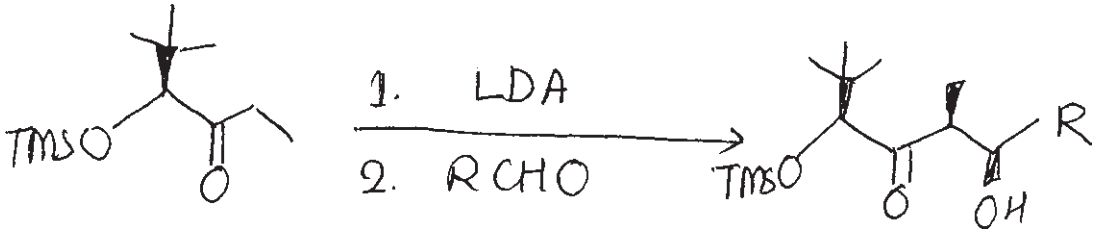
SECTION - II

Q4) Solve any four of the following. **[8]**

a) Explain an appropriate use of manganese salen complex in asymmetric synthesis.

b) Explain stereo selective epoxidation of Cis-alkene by mCPBA. With the help of Houk model.

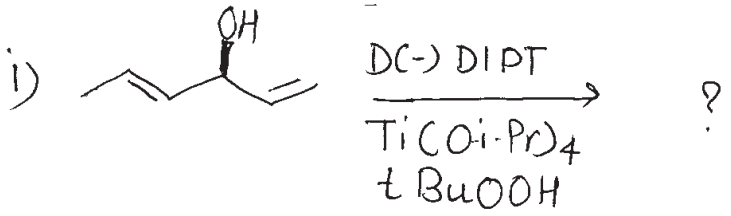
c) Explain the stereochemical control in this reaction, drawing all the intermediate.

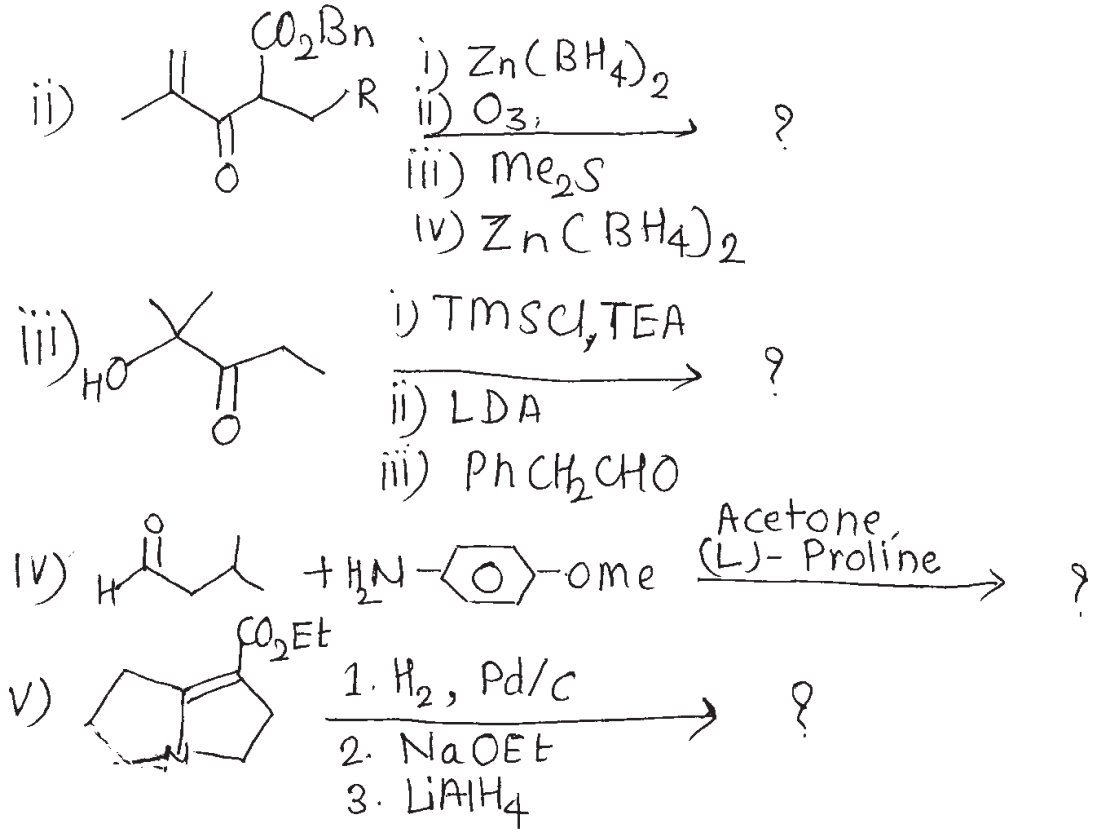


d) Why phthalazine based ligands have been used in asymmetric hydroxylation?

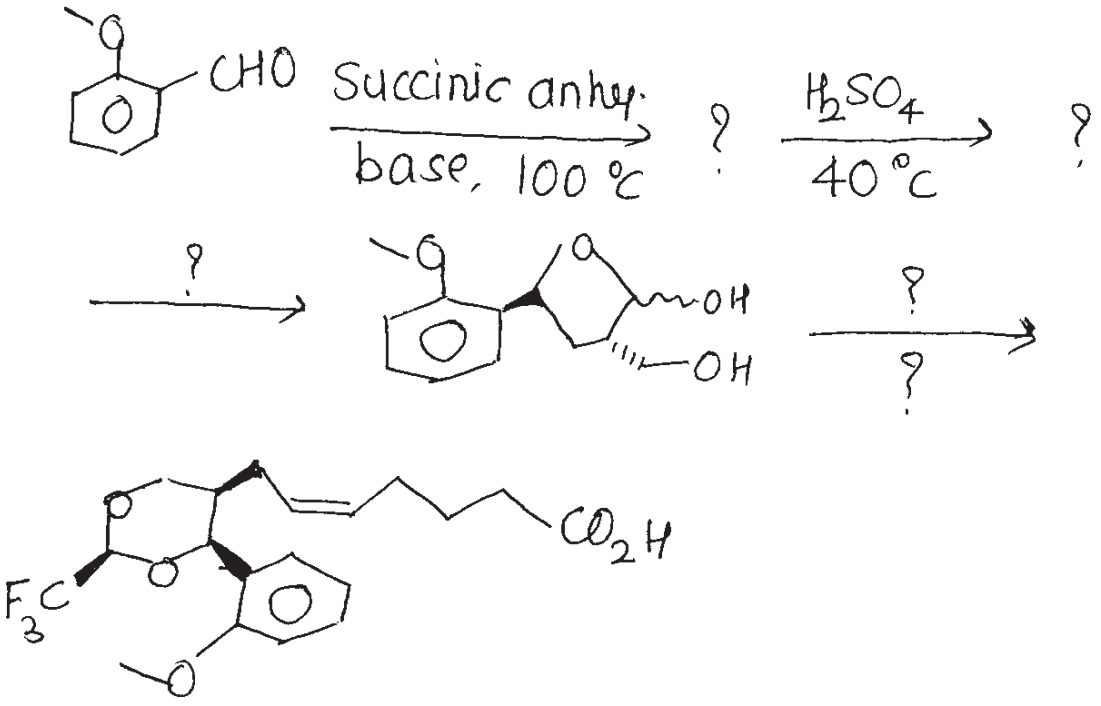
e) Comment of synthesis of CBS reagent.

Q5) Complete the following conversions & Discuss reaction mechanism and stereochemistry (Any four). **[8]**

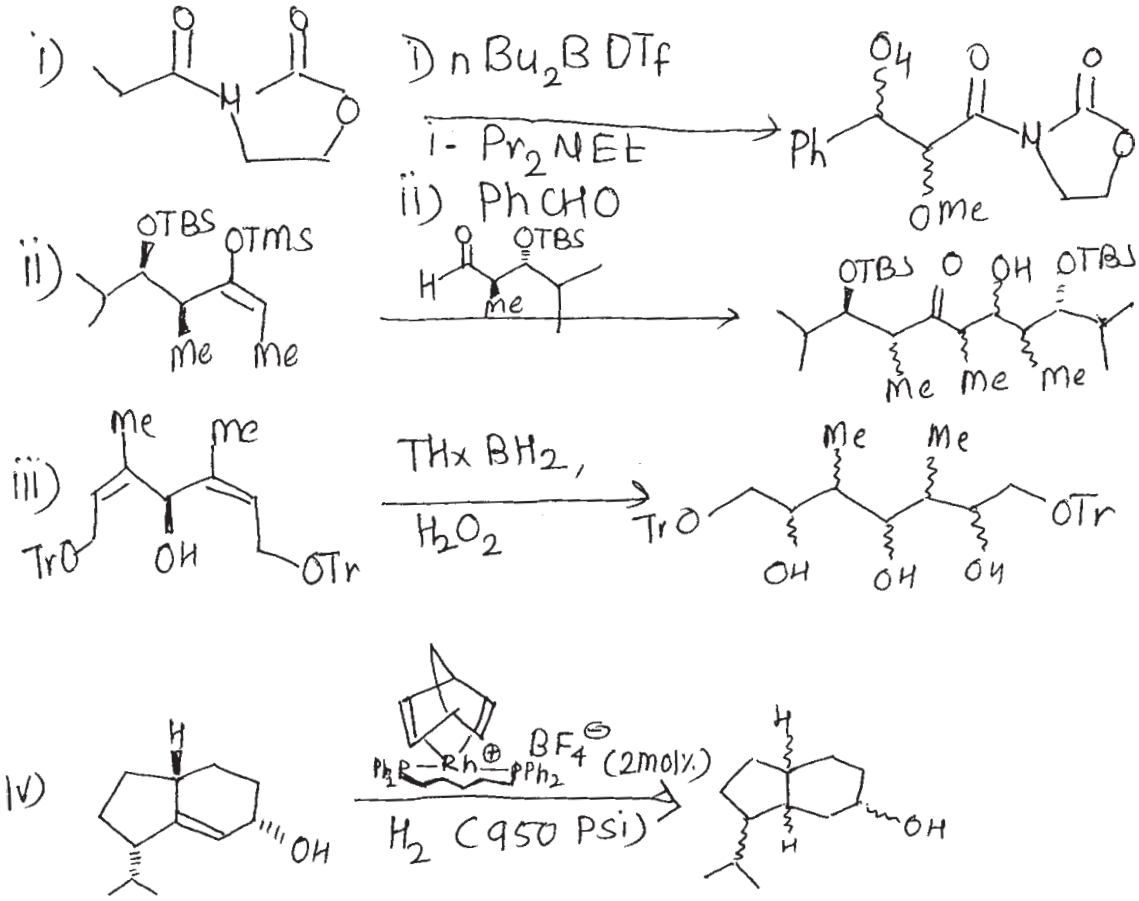




Q6) a) Complete the following reactions sequence and discuss the stereochemistry of intermediates and products. **[3]**



b) Discuss the formation & stereochemistry of intermediate/TS and assign correct stereochemistry to the product/s. (any three). **[6]**



Total No. of Questions : 6]

SEAT No. :

P3013

[Total No. of Pages :3

[4723] - 4014
M.Sc. - II
ANALYTICAL CHEMISTRY
CHA - 481 : Analytical Toxicology and Food Analysis
(2013 Pattern) (Semester - IV)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of logarithmic tables/non programmable calculator is allowed.***

SECTION - I

Q1) Answer the following: **[10]**

a) What is antidotes?

b) Give the principle of isolation and identification of Amphetamine and Metamphetamine, Type - A procedure.

c) Define the terms:

i) Addict

ii) Cannabis

d) Give the principle of isolation and identification of caffeine from urine, procedure Type - C.

e) Explain "Stimulats".

Q2) Attempt any two of the following: **[10]**

a) State the principle for determination of barbiturates by procedure A. Explain its procedure in detail.

b) Give detail procedure for absorption and elution of cocaine.

c) Explain type C procedure for isolation and determination of amphetamine for urine.

d) State principle of determination of caffeine. Discuss procedure in detail.

P.T.O.

Q3) Attempt any one of the following: **[5]**

a) Define the terms:

i) Opium.

ii) Medicinal canabis.

iii) Coca leaf.

iv) Manufactured drug

b) Sample containing drugs was analyzed by TLC. When distance traveled by solvent was 17.4cm and Barbiturate, amphetamine, metamphetamine, cocain and heroin give Rf values 0.226cm, 0.339cm, 0.673cm 0.729cm and 0.855cm. respectively. Calculate distance travelled by barbiturate, amphetamine, metamphetamine cocaine and heroin.

SECTION - II

Q4) Answer the following questions:- **[10]**

a) What are proteins?

b) What is Amylose? Give its principle.

c) Define 'peroxide value'.

d) What are food preservatives? Give any two examples.

e) How casein from milk is estimated?

Q5) Attempt any two of the following: **[10]**

a) What are carbohydrates? How are total carbohydrates are estimated by using Anthrone method?

b) Describe the Tanner method for estimation of SO_2 from food sample.

c) How methionine in food grains is estimated?

d) Explain the analytical method used for estimation of saccharin.

Q6) Solve <u>any one</u> of the following: **[5]**

a) A sample of oil weighing 4.25gm was subjected to saponification with 50ml of alcoholic KoH. It was later titrated with 0.5N HCl and it required 11.7 ml of titrant. If blank reading was 50ml, calculate saponification value of an oil.

b) Biological sample was determined for net protein utilization, digestability and biological value gives following results:-

i) Intake nitrogen (I) = 16.4mg

ii) Faecal nitrogen (F) = 7.3mg

iii) Endogenous nitrogen (F_k) = 3.7mg

iv) Urinary nitrogen (U) = 6.33 mg

v) Endogenous nitrogen (UK) = 4.15mg

Calculate NPU, D and BV.

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Total No. of Questions :6]

SEAT No. :

P3014

[Total No. of Pages : 3

[4723]-4015
M.Sc. II
ANALYTICAL CHEMISTRY
CHA - 490: Analytical Spectroscopy
(2013 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of logarithmic table/ non-programmable calculator is allowed.***

SECTION - I

Q1) Answer the following questions: **[10]**

a) State and explain the principle of XPS.

b) Why is UPS not used to study inner-shell orbitals?

c) What is absorptive edge method?

d) Explain the necessity of collimation in x-ray analysis.

e) What is SEM? Draw it's schematic diagram.

Q2) Attempt any two of the following: **[10]**

a) Enlist the detectors used for X-ray analysis. Explain the scintillation detector with schematic diagram.

b) What are analyser? Explain the retarding potential analyser with block diagram.

c) Explain the principle of Auger electron spectroscopy. How the Auger electron spectroscopy used for chemical analysis?

P.T.O.

d) 2'S' electron of sulphite ion has binding energy 160.9 eV. Estimate the kinetic energy of measured electron, iF the incident radiation is the K_α line of Al (8.28 $\mathring{A}$). The works function of electron spectrometer is 8.9 eV. [Given: PlanCks constant = 6.625×10^{-34} Js, velocity of light = 3×10^8 m/s]

Q3) Attempt <u>any one</u> of the following: **[5]**

a) Discuss with schematic diagram scanning transmission electron microscope.

b) A powdered silicon sample was exposed to copper K_α x-rays having wavelength 0.154 nm in a powder camera. The radius of camera was 57.3 mm. The distance on the exposed film between the opposite arcs of the most intense diffracted cone of radiation was 32.73 mm. Determine the spacing in silicon.

SECTION - II

Q4) Answer the following questions: **[10]**

a) Explain the principle of electro-chemiluminescence.

b) What is photo-luminescence? Enlist the factors affecting on photo luminescence.

c) State the principle of NMR. Explain the conditions for a nuclei tobe NMR active.

d) What is HETCOR and COSY?

e) Calculate the quantum efficiency for a particular reaction in which 4.9×10^{17} photons were absorbed during the excitation and 2.9×10^{17} photons were emitted during fluorescence.

Q5) Attempt any two of the following: **[10]**

a) What is a chemical shift? Explain chemical shift in ^1H -NMR and ^{13}C-NMR.

b) Describe a chemiluminescent method for the simultaneous determination of the individual concentration of NO, NO_2 and NH_3 in a gaseous mixture.

c) Explain, quantitative method of analysis of Nonluminescing compounds.

d) At 60 MHz instrument, the shift of the proton in CH_3 Br is 162 Hz from TMS, while at 100 MHz instrument, the shift is 270 Hz from TMS. Calculate the chemical shift for both data in ppm. Explain the effect of frequency of instrument on chemical shift.

Q6) Attempt any one of the following: **[5]**

a) State and explain principle of ^{13}C-NMR. Explain, ^{13}C-NMR is less sensitive than ^{1}H-NMR.

b) An excitative wavelength of 430 nm and an emissive wavelength of 495 nm, the slopes of the plots of relative fluorescence intensity as a function of concentration were 4.5×10^6 and 1.32×10^4 lit mole^{-1}, respectively for compound A and B. At an excitative wavelength of 288 nm and an emissive wavelength of 385 nm slopes were 9.00×10^6 and 1.84×10^5 lit mole^{-1} respectively for compounds A and B. The sample had a relative fluorescent intensity of 78.2 at 430/495 nm and 45.5 at 288/385 nm. Calculate the concentration of the two compounds in the sample.

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Total No. of Questions :6]

SEAT No. :

P3015

[Total No. of Pages : 3

[4723]-4016
M.Sc. -II
ANALYTICAL CHEMISTRY
CHA - 491: Analytical Methods for Analysis of Fertilizers, Detergents, Water and Polymer, Paint and Pigment
(2013 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of logarithmic tables/non-programmable calculator is allowed.***

SECTION - I

Q1) Answer the following: **[10]**

a) Define B.O.D.

b) What is citrate insoluble phosphorus?

c) Suggest a method for estimation of moisture from detergents.

d) Give any two purposes of chemical analysis.

e) What is active ingredient in detergents?

Q2) Attempt any two of the following: **[10]**

a) Give the methods used for estimation of potassium by sodium tetraphenyl borate and flame photometry.

b) How is equivalent combined SO_3 estimated from detergents?

c) Write a short note on "Industrial waste water treatment".

P.T.O.

d) 10ml of 0.01 M $ZnSO_4$ solution required 9.4 ml of EDTA solution for complete reaction. 0.340 g of sample containing calcium was dissolved in 100ml of acid. An aliquot of 10ml of same solution required 15 ml EDTA solution. Calculate percentage of calcium in the sample.

[Given :At. wt. of Ca = 40 gm]

Q3) Attempt <u>any one</u> of the following: **[5]**

a) Describe in detail methods for estimation of total hardness, chromium and lead from waste water.

b) Fertilizer containing Nitrogen weighing 0.50g was kjeldahlized and NH_3 produced was absorbed in 50 ml $^{N}/_{10}$ H_2SO_4. The excess of acid required 13 ml $^{N}/_{10}$ NaOH solution for neutralization. Find the percentage of nitrogen in the fertilizer [Given At. wt. = 14]

SECTION - II

Q4) Answer the following: **[10]**

a) How organic pigments are identified?

b) Explain transmittance and reflectance observed in plastics.

c) Define varnish and emulsion paints .

d) Define addition and condensation polymerisation.

e) What is glass transition temperature?

Q5) Answer <u>any two</u> of the following: **[10]**

a) Describe the dielectric strength and dissipation factor with respect to polymer.

b) Explain 'identification of binders' from paints.

c) Discuss 'cryoscopy' method for molecular weight determination of polymers.

d) 0.230 g of yellow chrome pigment was disintigrated and soluble chromate was extracted with sulphuric acid. The solution was used for chromate estimation iodometrically which required 13.5 ml of 0.05 N $Na_2S_2O_3$ solution for complete reaction. Calculate the percentage of chromium in sample. (At. wt. of chromium = 51.87)

Q6) Answer <u>any one</u> of the following: **[5]**

a) How 'zinc' is estimated from paints?

b) When a certain polymer sample contains

200 molecules with molecular weight 10^4,

250 molecules with molecular weight 10^5,

300 molecules with molecular weight 10^3 and

50 molecules with molecular weight 10^7,

find total $\overline{Mn}$ and $\overline{Mw}$ for the given polymer sample.

EEE

Total No. of Questions : 9]

SEAT No. :

P3016

[Total No. of Pages :3

[4723] - 4017
M.Sc. - II
ANALYTICAL CHEMISTRY
CHA-492: Method of Analysis and Applications
(2013 Course) (Semester -IV)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compuslory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of logarithmic tables/non -programmable calculator is allowed.***

SECTION - I

(Pollution Monitoring and Control)

Q1) Answer the following. **[10]**

a) Give disadvantages of chemical coagulation method for removal of heavy metals from waste water.

b) Give the principle of inertial deposition.

c) List two measures for the safety of workers analyzing particulate matter.

d) What is desulfurization of fuels?

e) Mention any two methods for analysis of particulate matter.

Q2) Attempt any two of the following: **[10]**

a) Write a short note on SO_2 control measures and it's economics.

b) Describe in detail a method for determination of Mercury in waste water.

c) Write a short note on electrostatic precipitators.

d) Suggest suitable methods for removal of fertilizers and nitrites from waste water.

P.T.O.

Q3) Attempt any one of the following:- **[5]**

a) Discuss effects of atmospheric pollution with respect to particulate matter.

b) Write a short note on "Liquid Scrubbing".

SECTION - II

(Analysis of Body Fluid)

Q4) Answer the following. **[10]**

a) How are liver function tests classified?

b) How urine is collected for analysis? What changes in urine occurs on keeping?

c) Explain various derivatives of hemoglobin.

d) What is the principle of radioimmunoassay? Give any two applications.

e) A patient has blood urea of 85mg% and urinary urea of 2500mg%. Rate of urine flow is 1ml/min. Calculate the urea clearance and comment on results.

Q5) Attempt any two of the following:- **[10]**

a) Explain glucose oxidase method for the estimation of glucose from blood serum.

b) Describe 2,6-dichloroindophend method for the vitamin -C estimation.

c) Discuss Caraway's method for uric acid determination from urine.

d) Draw the structure of bilirubin. How it is determined by direct reaction from serum?

Q6) Attempt any one of the following:- **[5]**

a) Outline the spectrophotometric method for the determination of serum tocopherol.

b) Explain the application of radioimmunoassay in insulin determination.

SECTION - III

(Carbon Nanostructures and Applications of Nanotechnology)

Q7) Answer the following. **[10]**

a) Enlist the different types of sensing modalities.

b) Discuss the phenomenon of intercalation.

c) Explain quantum dots.

d) What is the importance of material characterisation in nanobiotechnology.

e) Explain the structure of c_{60} & its crystal.

Q8) Answer any two of the following: **[10]**

a) Describe photodynamic therapy in targeted drug administration.

b) Explain the fabrication of carbon nanotubes.

c) Explain in brief DNA based nanomaterials as biosensors.

d) Describe the role of yeast in nanoparticle synthesis.

Q9) Answer any one of the following. **[5]**

a) Write a short note on

i) Superconductivity in c_{60}

ii) Vibrational properties of nanotubes.

b) Write a note on nanoparticle toxicology.

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Total No. of Questions : 6]

SEAT No. :

P2962

[Total No. of Pages : 4

[4723]-402

M.Sc.

PHYSICAL CHEMISTRY

CH-411 : Surface and Electrochemistry

(2008 Pattern) (Old) (Semester-IV)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Answers to the two sections should be written in separate answer books.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right indicate full marks.*
5) *Use of logarithmic table / calculator is allowed.*

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2)	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3)	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4)	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION-I

Q1) Answer Any Three of the following: **[15]**

a) Write Gibbs equation for adsorption on liquid surface and discuss the experimental methods for its verification.

b) Describe the volumetric method for studying adsorption of gas on solid.

c) Write the BET equation. How it is used for determining surface area of solids?

d) Derive the two dimensional ideal gas law for a film formed on a liquid surface. How is it used to determine the molecular weight of a protein?

e) What is catalyst deactivation? Discuss in brief the causes of deactivation.

Q2) Answer Any Three of the following: **[15]**

a) What are zeolites? Discuss in brief their applications.

b) What is flotation? Explain its mechanism and give its important applications.

c) What is spreading coefficient? Write the equation relating spreading coefficient with surface tension, work of adhesion and work of cohesion.

d) Describe different states of monomolecular films.

e) Discuss the adsorption of gas on porous solids.

Q3) Solve Any Two of the following: **[10]**

a) To retard the evaporation of water hexadecanol ($C_{16}H_{33}OH$) has been used to produce monomolecular film on water reservoirs. If the cross section area of alcohol in close packed layer is 0.20 nm^2, how many grams of the alcohol are required to cover 20,000 m^2 lake?

b) The mass *x* of a solute adsorbed per gram of a solid adsorbent is given by the Freundlich adsorption isotherm $x = kc^n$ where x and n are 0.16 and 0.43 respectively. Calculate the amount of acetic acid (M = 60 g/mol) that 1 kg of charcoal would adsorb from 0.85m vinegar solution.

c) The surface tension of propanol water mixture follows the equation $\gamma = 70 - 0.5C + 0.2C^2$, where C is propanol concentration in moles/lit. Calculate Γ in moles cm^{-2} for 0.5m solution at T = 25°C.

SECTION-II

Q4) Answer Any Three of the following: **[15]**

a) Write Bernal-Fowler equation for heat of soluation and explain the terms involved in it.

b) Explain the term ionic strength. How does it affect

i) Thickness of ionic atmosphere.

ii) The mean activity coefficient of any electrolyte.

c) Show that maximum value of charge on spherical cell is at $r = x^{-1}$.

d) Explain the terms:

i) Galvani potential

ii) Outer potential

iii) Surface potential

iv) Electrochemical potential.

e) Derive the equation for specific conductivity and equivalent conductivity in terms of mobility of ion.

Q5) Answer Any Three of the following: **[15]**

a) What is exchange current density? How is the concept understood using Butler-Volmer equation?

b) What is passivation of metals? Explain its general mechanism.

c) With neat diagram describe any one example of a fuel cell.

d) Give one example each in electrosynthesis

i) anodic oxidation,

ii) cathodic reduction.

e) Discuss the methods for preventing corrosion.

Q6) Solve Any Two of the following: **[10]**

a) When a dilute solution of NaOH was electrolysed using a nickel cathod, the overpotential was found to be 0.40V to maintain the current density 0.01 A/m^2 and 0.15V to maintain current density 0.0001 A cm^{-2}. Calculate the transfer coefficient and exchange current density for hydrogen / hydrogen ion equilibrium at nickel cathode in given medium at 298 K.

b) The diffusion coefficient of K^+ in 0.1M KCl at 25°C was measured with radioactive tracer Na* as $D = 1.3 \times 10^{-9}$ m^2 s^{-1}. Calculate the electric mobility of K^+ in this solution.

c) The following reaction may be made to operate in a fuel cell at 298K $CH_4 + 2\ O_2 \rightarrow CO_2(g) + 2\ H_2O(l)$ $\Delta H_{298} = -890.2$ kJ mol^{-1}, $\Delta G_{298} = -818.0$ kJ mol^{-1}.

Calculate:

i) The number of electrons transferred overall in cell reaction.

ii) Reversible emf of the cell at 298 K.

iii) The maximum efficiency of cell.

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Total No. of Questions : 5]

SEAT No. :

P2963

[Total No. of Pages :3

[4723] - 403

M.Sc.

PHYSICAL CHEMISTRY

CH - 414 : Biophysical Chemistry and Related Techniques

(2008 Pattern) (Semester - IV)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *Answers to the TWO sections should be written in SEPARATE answer books.*
2) *ALL questions are COMPULSORY.*
3) *Figures to the RIGHT SIDE indicate FULL marks.*
4) *Use of logarithmic table/calculator is ALLOWED.*
5) *Neat diagrams must be drawn WHEREVER necessary.*

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
2)	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3)	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ J s
4)	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Attempt any three of the following: **[15]**

a) Discuss the different levels of biological structure.

b) Sketch and explain the structure of the animal cell.

c) Explain the plot of the oxygen binding of haemoglobin as a function of partial pressure of oxygen.

d) Discuss the coagulation reactions of proteins.

e) Discuss why invivo and invitro behaviour of macromolecules different. Give examples.

Q2) Attempt any three of the following: **[15]**

a) Differentiate between good solvents and poor solvents in polymer solution chemistry.

b) What are heat shock proteins? Why is proline known to be an unusual amino acid?

c) Derive the Henderson-Hassalbalch equation and explain its limitations.

d) Explain the biological significance of Donnan membrane equilibrium.

e) Discuss the role of Caldesmon in smooth muscle contraction.

Q3) Solve any two of the following: **[10]**

a) Calculate R_g if R_{rms} is 71.15 nm where the terms have the usual significance in polymer chain lengths.

b) Calculate the pH of a litre solution containing $1cm^3$ of 0.5M CH_3COOH and $1cm^3$ of .1M sodium acetate. [pKa = 4.7447].

c) Determine B_{ideal} (Virial coefficient) for water as a solvent when a macromolecule having mass 10kg mol^{-1} is dissolved in it.

SECTION - II

Q4) Attempt any four of the following: **[20]**

a) Enlist five important functions of a cell membrane.

b) What is passive transport? How is it facilitated by membrane proteins?

c) Explain irreversible enzyme inhibition with examples.

d) State the principle of X-ray diffraction. How is it used to determine the molecular weight of the asymmetric macromolecule?

e) Describe the sedimentation velocity method to determine the molecular weight of biopolymers.

f) Write a note on Helix-cell transition.

Q5) Attempt any four of the following: **[20]**

a) Define the terms:

i) Neuron

ii) Resting membrane potential

iii) Voltage gated channels

iv) Action potential and

v) Nerve impulse

b) Explain the factors affecting enzyme activity.

c) What is rotational diffusion coefficient? How is it calculated?

d) Explain the terms: Gel electrophoresis and solubilizers.

e) Write a note on membrane equilibria.

f) Describe the instrumentation for measuring optical rotatory dispersion.

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Total No. of Questions : 5]

SEAT No. :

P2964

[Total No. of Pages : 3

[4723] - 404

M.Sc.

PHYSICAL CHEMISTRY

CH-415: Special Topics in Nuclear and Radiation Chemistry

(2008 Pattern) (Old) (Semester - IV)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right side indicate full marks.*
4) *Use of logarithmic table/calculator is allowed.*
5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ mol^{-1}
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			$= 1.602 \times 10^{-19}$ C
5)	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6)	Gas Constant	R	$= 8.314 \times 10^{7}$ ergK^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Attempt any three of the following: **[15]**

a) Discuss the general principles for using radio-pharmaceuticals in therapy and diagnosis.

b) Write a note on positron emission tomography, which radio nuclides are used for this purpose?

c) Describe the method of separation for boron isotopes.

d) What are the desirable nuclear properties of indicator radionuclide for diagnostic purposes?

e) State the principle for the separation of heavy hydrogen. Describe the method applied for the separation.

Q2) Attempt any three of the following: **[15]**

a) Explain the terms planck, era, GVT era. What are their characteristics?

b) Give an account of heavy element burning.

c) Discuss the problems in synthesis of Boron and Lithium

d) Explain p-p-chain reaction.

e) Describe the method for waste disposal of radioactive liquid.

Q3) Attempt any two of the following: **[10]**

a) Find the activity of 99m T_c which was extracted after 15h after loading $99M_o$ in the generator.

[Given: Initial activity off $99M_o$ = 27000 cpm, % extraction = 70, $t_{1/2}$ of 99 M_o = 66 hrs. and of 99m T_c = 6 hrs.]

b) Write the reactions in helium burning of CS-137.

c) Find out the dose due to 100 μCi source at a distance of 2.5m.

[Given: γ energy of $^{137}C_s$ is 0.67Mev].

SECTION - II

Q4) Attempt any four of the following: **[20]**

a) Give an account of radiometric titrations based on absorption of β-particles. What are its advantages?

b) Explain radiolysis of aromatic hydrocarbons.

c) Write a note on Carriers.

d) Explain molecular kinetics based on Arrhenius law.

e) State and explain the procedure for determination of beam energy.

f) Describe radiometric titration curves for the titration of a mixture of three ions in which ion precipitating first and last are labelled.

Q5) Attempt any four of the following: **[20]**

a) Explain how kinetic equation can be applied to conductometric method to measure concentration.

b) Write a note on molecular kinetics.

c) 12ml labelled NaI were titrated with 0.055M $AgNo_3$ radiometrically. Addition of 0.5ml $AgNo_3$ showed a reduction in initial activity from 18500 count for B^3 minutes to 5000 cpm. Find out the amount of NaI in the mixture if background counts are 50 for 5 minutes.

[Given: At. Wt.of Na = 23, I = 127, Ag = 108, N = 14, O = 16]

d) Draw a neat labelled experimental set up used for β back scattering titration. Give its advantages and limitations.

e) Describe the procedure for extraction radiometric titration apparatus used by Dunean and Thomas.

f) Define radical scavenging and explain it with suitable example.

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Total No. of Questions : 4]

SEAT No. :

P2965

[Total No. of Pages :3

[4723] - 405

M.Sc.

PHYSICAL CHEMISTRY

CH - 416 : Special Topics in Physical Chemistry

(Old) (2008 Pattern) (Semester - IV)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *Answers to the TWO sections should be written in SEPARATE answer books.*
2) *ALL questions are COMPULSORY.*
3) *Figures to the RIGHT SIDE indicate FULL marks.*
4) *Use of logarithmic table/calculator is ALLOWED.*
5) *Neat diagrams must be drawn WHEREVER necessary.*

Physico - Chemical Constants

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4)	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
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12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

Q1) Attempt any four of the following: **[20]**

a) Define sensors. What are the two basic types of sensors? Draw a block diagram of a sensor system and give explanation.

b) Write proton condition for H_3PO_4 and H_2Se.

c) Calculate the pH and concentration of all ionic species for 0.1M $NaHCO_3$.

[Given : $pKa_1 = 6.35$, $pKa_2 = 10.25$].

d) Write the charge balance for 0.1N NaCN and 0.2N HCN.

e) Write a note on potentiometric sensors.

f) Explain the adsorption isotherm of type I and IV.

Q2) Attempt any four of the following: **[20]**

a) Give the mechanism of the phenol-acetone condensation reaction to get bisphenol A.

b) Draw a logarithmic concentration diagram for 0.01M acetic acid.

[Given pKa = 4.75].

c) Explain the catalysis in dilute aqueous solution.

d) Define the term:

i) catalyst

ii) activity

iii) poison

iv) selectivity of catalyst

e) Why are ceramics used in sensors? What are the requirements for conducting electrodes for normal operation of sensors?

f) Derive the rate expression for Michaelis - Menten Kinetics.

SECTION - II

Q3) Attempt any four of the following: **[20]**

a) Discuss briefly mechanical properties of nanoparticles.

b) Explain active smartness with proper illustration.

c) Write a note on tunable transducers.

d) Describe the different applications of piezoelectric actuators.

e) Draw a ray diagram of the working of a compound microscope.

f) Write a note on - nano robot.

Q4) Attempt any four of the following: **[20]**

a) What is the design and working of rubber like ceramic smart materials?

b) Write a note on carbon nanotubes.

c) State the expression relating ºC to ºF. Indicate the boiling point and freezing point of water on these scales. At what temperature does ºC = ºF.

d) Explain why nano particles behave anamalously.

e) What are the various applications of aerogels and aerosols?

f) Write a note on resistance thermometer.

Total No. of Questions : 4]

SEAT No. :

P2966

[Total No. of Pages : 2

[4723]-406
M.Sc.-II
INORGANIC CHEMISTRY
CH-430 : Inorganic Polymer and Heterogeneous Catalysis
(2008 Pattern) (Semester-IV)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Draw neat diagrams wherever necessary.***

Q1) Answer Any Four of the following: **[20]**

a) Calculate Framwork electrons in the compound $[Mo_6(CO)_{16}]^{2-}$ and draw its structures.

b) Give example of polynuclear metal carbonyls. Explain the effect of pyrolysis on these carbonyls.

c) Name the important type of reactors. Used in heterogeneous catalysis and explain working of any one of them in detail.

d) Explain the basic principle of heterogeneous catalysis.

e) What are molecular sieves? Give their classification and important applications

Q2) Answer the following (Any Four): **[20]**

a) What are peroxy acid? Explain the acidic properties of these compounds.

b) Discuss the use of nanomaterials in organic synthesis.

c) What are phosphazenes? Give an account of their synthesis and draw their structure.

d) What are heterogeneous catalyst? Give their classification.

e) Draw the structures of the following.

i) $Ir_4(CO)_{12}$

ii) $[Si_4O_{12}]^{8-}$

P.T.O.

iii) S_4N_4

iv) $B_{10}H_{14}$

v) $[Pt_{15}(CO)_{30}]$

Q3) Answer Any Four of the following: **[20]**

a) Write note on P-N compounds.

b) Give an account of the surface characterization methods for supported metal catalyst.

c) Discuss the use of NMR technique to explain the structure of borane compounds.

d) Explain Fischer-Tropsch synthesis.

e) What do you understand by the term "supported metal catalysts" explain their applications.

Q4) Write note on (Any Four): **[20]**

a) ALPO and SAPO.

b) MCM-41.

c) Cyclic polymers.

d) Electrocatalysis.

e) Adsorption isotherm and catalysis.

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Total No. of Questions : 4]

SEAT No. :

P2967

[Total No. of Pages : 2

[4723]-407
M.Sc. II
INORGANIC CHEMISTRY
CH- 431:Material Science
(2008 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables & calculators is allowed.***

Q1) Attempt any four of the following: **[20]**

a) Explain the origin of valance band & conduction band on the basis of band energy level diagram.

b) What is nanomaterial? Explain in brief size dependent properties of nanomaterials.

c) Explain the crystal growth of dehydration reaction in detail and how the water are removed from solid state dehydration reactions?

d) State the different applications of Ficks law of diffusion.

e) Define coherence length. Explain the classification of superconductor with graphical representation and example.

Q2) Attempt any four of the following: **[20]**

a) Describe the Czochariskis method for manufacture of single crystal of germanium with the help of neat labeled diagram.

b) In Ge energy gap is 0.75 eV. What is wavelength of which Ge starts absorption of light.

P.T.O.

c) Find the drift velocity for an electron in silver wire of radius 1 mm and carrying a current of 2 amp. Density of silver is 10.5 gm/cc and Avogadros number = 6.023×10^{23}.

d) Derive expression for Curies law.

e) Explain different applications of biomaterials.

Q3) Attempt <u>any Four</u> of the following: **[20]**

a) What are different types of magnetism.

b) Give the different applications of superconducting materials.

c) Discuss the principles underlying the operation of thermocouples and refrigerators.

d) What is photoconductivity? Explain the photoconductivity with the help of band energy diagram.

e) What is 'Hysteresis loop'? Explain different types of Hysteresis loops.

Q4) Write short notes on (any Four): **[20]**

a) n-p-n Transistors.

b) Schottkey and Frenkel defects.

c) Portland cement.

d) Perovskite.

e) Luminescence.

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Total No. of Questions : 9]

SEAT No. :

P2968

[Total No. of Pages : 4

[4723]-408
M.Sc. -II
INORGANIC CHEMISTRY
CH- 445: Inorganic Applications in Industry, Biotechnology and Environmental Chemistry
(2008 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Attempt any TWO sections from the following.***
2) ***Both sections should be written in the same answer book.***
3) ***All questions are compulsory.***
4) ***Figures to the right indicate full marks.***
5) ***Neat diagrams must be drawn wherever necessary.***
6) ***Use of logarithmic table/calculator is allowed.***

SECTION - I

(Inorganic Applications in Industry)

Q1) Attempt any three of the following: **[15]**

a) Explain the methods for electroplating of precious metals.

b) What is the difference between a pigment and dye? Explain the use of chromium in dyeing of wool using azo dyes? Give the structure of the compounds involved.

c) A piece of wood containing moisture weigh 174.3 gm and after oven drying a constant weight is 156.5gm.What is its percentage moisture content? Justify your answer on the quality of wood.

d) Explain the basic materials and chemical composition of portland cement. Describe various types of portland cement.

P.T.O.

Q2) Attempt any three of the following: **[15]**

a) Explain how such complexes such as Prussian blue and ferrocene modify the behaviour of electrodes in electroplating.

b) What are the main types of synthetic fibers? Explain any one with production and properties.

c) How are redox centers are ligand to PVP electrode coating? Explain the effect of increasing the positive potential of the platinum electrode on electro deposition.

d) Give two examples and draw structure of

i) Metallized dye.

ii) Additional reagents.

Q3) Write notes on (any Two): **[10]**

a) Formazanns.

b) White pigment.

c) Complexes of azomethanine.

SECTION - II

(Environmental Chemistry)

Q4) Attempt any three of the following: **[15]**

a) Draw a schematic diagram that shows all the components of AAS. How is an aqueous sample introduced into AAS? The metal ion analyte has a positive charge, how does it become a neutral atom?

b) Explain, how the detergent and pesticides are responsible for water pollution.

c) What are the best option for energy source for 21^{st} century? Explain in short.

d) Describe how nitrogen can be removed from the waste water by biological treatment.

Q5) Attempt any three of the following: **[15]**

a) List the five provisions of the clean water act (CWA). Which of these are considered the most important?

b) Compare aerobic treatment process with an anaerobic treatment process.

c) What do you understand by electrodialysis? Explain its use in environmental analysis.

d) Draw a schematic diagram of a molten carbonate fuel cell (MCFC). Write the reaction that occur at the cathode and anode. Show over all reaction.

Q6) Write notes on (any Two): **[10]**

a) Industrial waste treatment.

b) Tidal power.

c) Reverse osmosis.

SECTION - III

(Biotechnology)

Q7) Answer any three: **[15]**

a) Describe one method in detail to induce variations in plants.

b) Give an account of DNA mapping.

c) "Tissue culture has a great commercial application". Justify the statement.

d) Describe a method to convert sugar to ethanol.

e) What is a bioreactor? Discuss the design criteria for these reactors.

Q8) Attempt any three: **[15]**

a) Compare and contrast the conventional waste water treatments and bio-technological processes.

b) Explain the role of microbes in oil refineries.

c) Explain the germ theory of diseases.

d) What is meant by biomass? Discuss the options for conversion of biomass to energy.

e) What is meant by immobilization of enzymes? Describe the techniques for immobilization of enzymes.

Q9) Write short notes on (any two): **[10]**

a) DNA mapping.

b) Vaccines.

c) Ethical and economical impacts of biotechnology.

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Total No. of Questions : 6]

SEAT No. :

P2969

[Total No. of Pages :4

[4723] - 409
M.Sc.
ORGANIC CHEMISTRY
CH - 450 : Chemistry of Natural Products
(2008 Pattern) (Semester - IV)

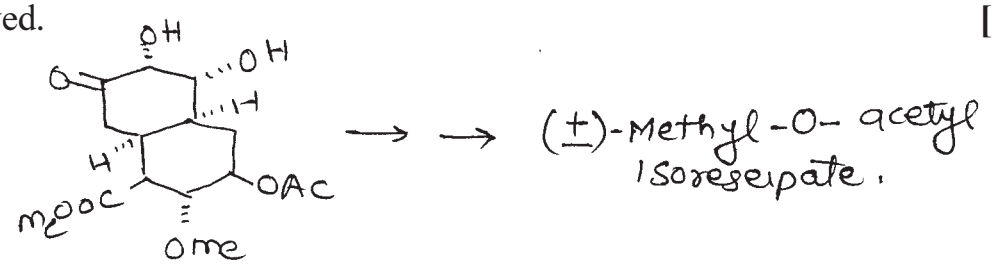
Time : 3Hours] *[Max. Marks : 80*

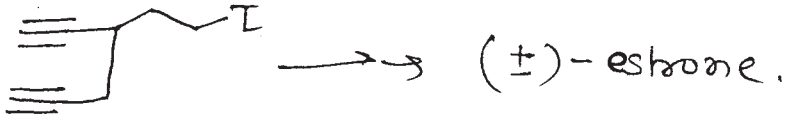
Instructions to the candidates:

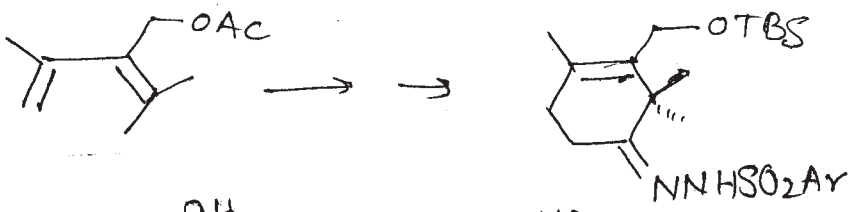
1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

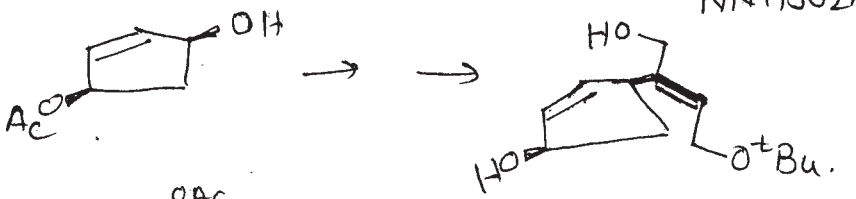
SECTION - I

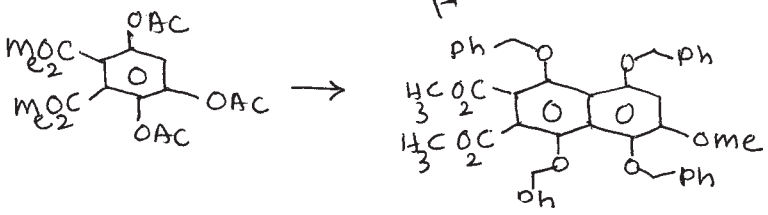
Q1) Outline the steps in any four of the following synthetic sequences. Indicate the reagents used and discuss the mechanism and stereochemistry involved. **[16]**

a) 

b) 

c) 

d) 

e) 

P.T.O.

Q2) Give evidence to prove the structural features in <u>any three</u> of the following: **[12]**

a) Presence of α,β-unsaturated carboxylic acid and β-substituted furan ring in Hardwickiic acid.

b) Presence of hydroxy group in ring A of Hydroxycamptothecin.

c) Presence of Lactone ring in podophyllotoxin.

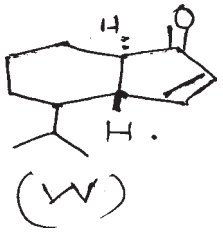
d) Presence of tertiary hydroxyl group and ethyl group in camptothecin.

Q3) a) Answer <u>any two</u> of the following: **[6]**

i) How will prove the presence of C-5 methyl and the stereochemistry at C-5 in Hardwickiic acid?

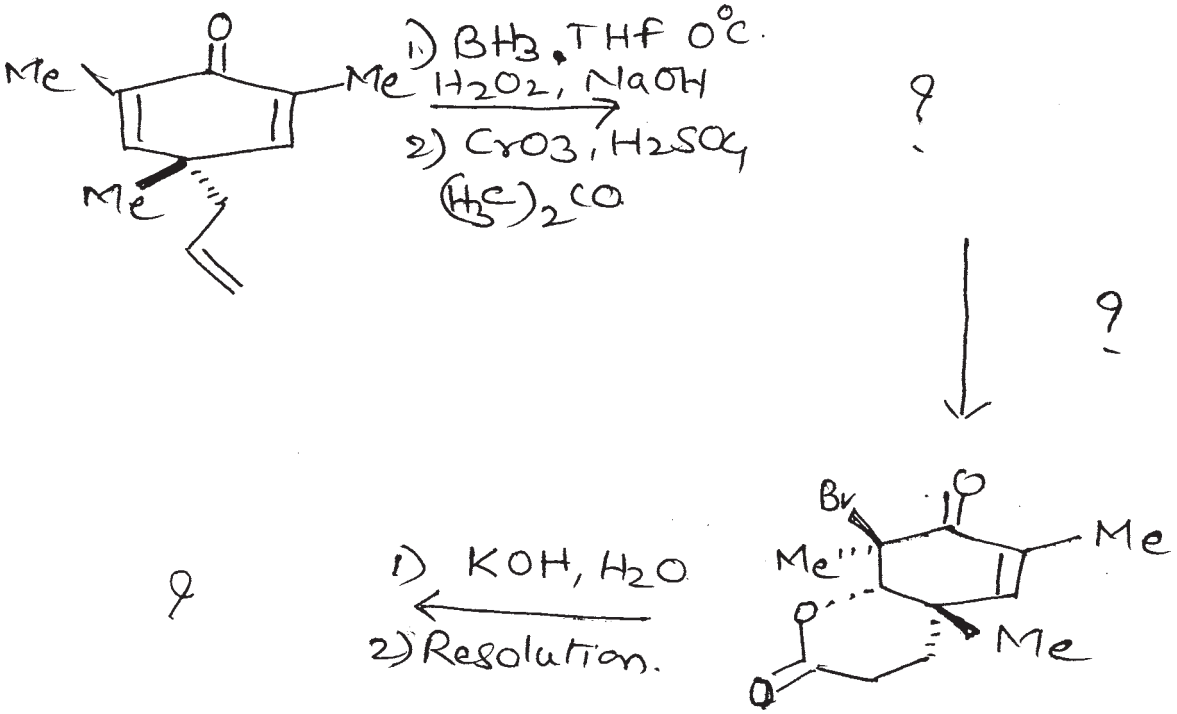
ii) What is the role of $KMnO_4$ oxidation of podophyllic acid in determination of structure of podophyllotoxin?

iii) How will you prove the presence of α,β unsaturated ketone and isopropyl group in compound (w) by spectral methods?



(W)

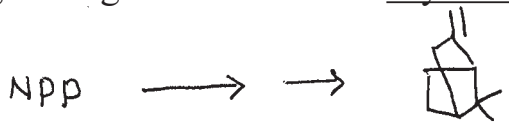
b) Complete the following synthesis. Write appropriate intermediates and reagents. **[6]**

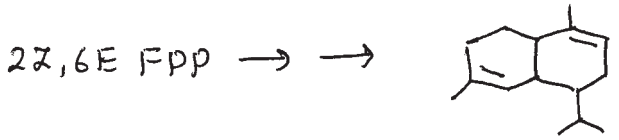


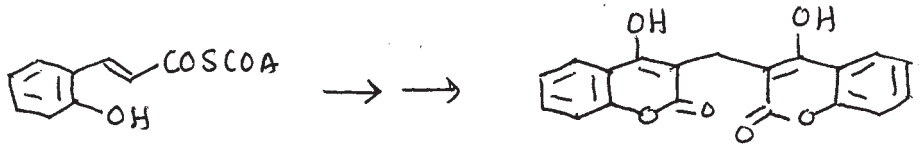
SECTION - II

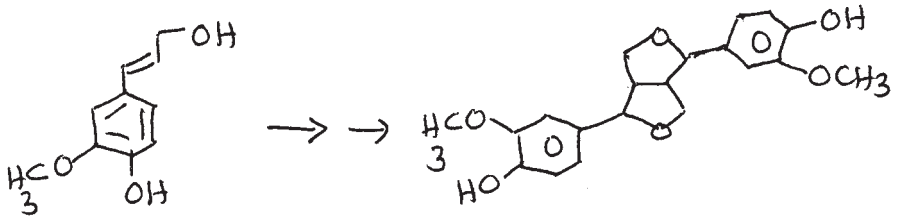
Q4) a) Explain the role of co-enzymes NAD^+ and FAD in the reactions catalysed by dehydrogenase enzymes. **[4]**

b) Suggest biogenetic scheme for <u>any three</u> of the following: **[12]**

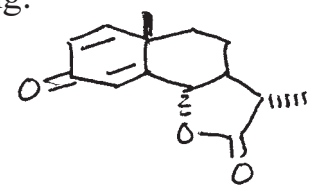
i) 

ii) 

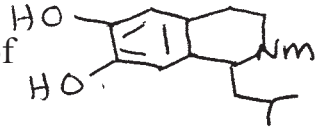
iii) 

iv) 

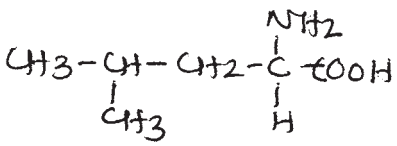
Q5) Attempt <u>any two</u> of the following: **[12]**

a) Explain the biogenesis of  from 2E, 6E FPP.

b) Suggest the biogenesis of L-Trp from Anthranilic acid.

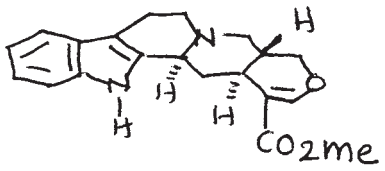
c) Outline the steps in the biogenesis of 

From L-Tyr

and 

Q6) Answer <u>any two</u> of the following: **[12]**

a) Discuss the biogenesis of ajamalicine from L-Trp



Ajamalicine

b) Give the complete biogenesis for the formation of L-phenyl alanine from PEP and erythrose 4-phosphate.

c) Ornithine [2-^{14}C] ⟶

Indicate the position of label in each step.

Total No. of Questions : 6]

SEAT No. :

P2970

[Total No. of Pages : 4

[4723]-410
M.Sc. -II
ORGANIC CHEMISTRY
CH- 451: Synthetic Methods in Organic Chemistry
(2008 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

Q1) Explain any four of the following: **[12]**

a) IPC_2 BH reagent is preferred over other hydroborating reagent for the synthesis of optically active alcohol.

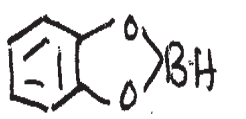
b) Atactic, isotactic and syndiotactic propen polymerisation by using Ziegler's catalyst.

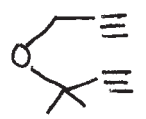
c) Synthetic applications of tetracarbonyl ferrate dianion.

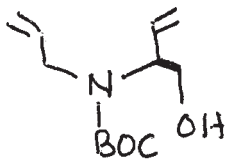
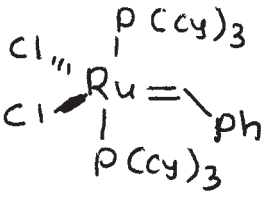
d) Use of organostannane reagent in organic synthesis.

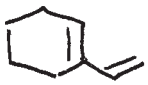
e) Advantage of FMOC as a protecting group over BOC.

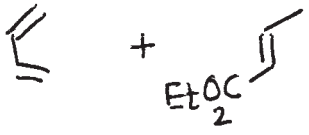
Q2) Predict the products with mechanism in any four: **[16]**

a) $R^1-C\equiv C-R^2$ +  $\xrightarrow{\Delta}$ Ar-BV ?

b)  $Co_2[CO]_8$, iso-octane, 24hr. 60°C → ?

c)  +  Ph-H, RT, 30hrs → ?

d)  1. Thexylborane 2. CO 3. H_2O_2, H_2O → ?

e)  1 Δ 2. EtmgBr, ether → ?

Q3) Write short notes on <u>any four</u> of the following: **[12]**

a) Wacker's process.

b) Solid phase peptide synthesis.

c) Convergent synthesis.

d) Nigeshi reaction.

e) Use of 9 BBN in organic synthesis.

SECTION - II

Q4) Explain <u>any four</u> of the following: **[12]**

a) Synthesis of 1, 2 dicarbonyl compounds using umpolung approach.

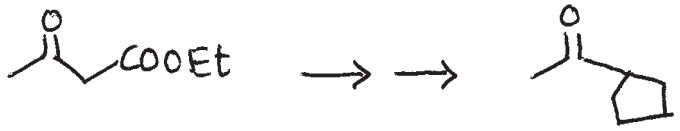
b) Acyl anion equivalent can be prepared from enol ethers.

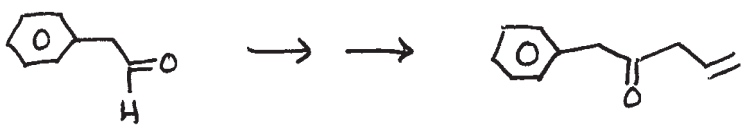
c) Hydroformylation of alkene using Wilkinson catalyst.

d) Optically active 2- hexanol can be prepared by hydroboration approach.

e) Sonogashira coupling in organic synthesis.

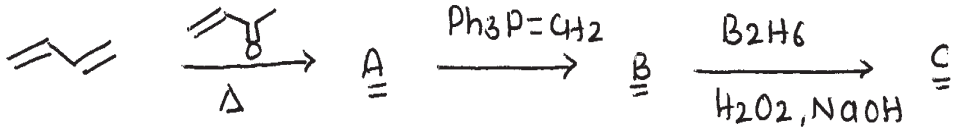
Q5) a) How will you carry out the following transformations (any two): **[6]**

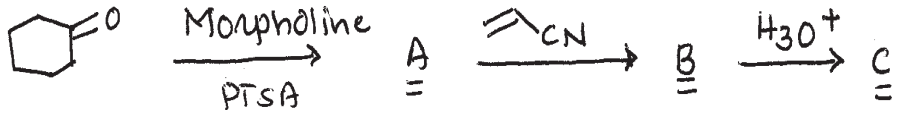
i) 

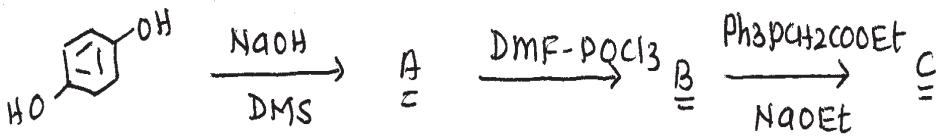
ii) 

iii) 

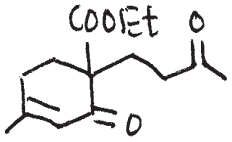
b) Identify A, B and C in the following reaction sequence (any two): **[6]**

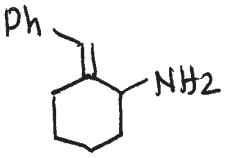
i) 

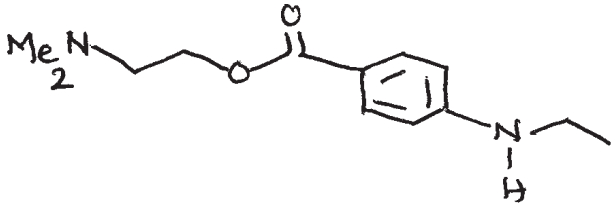
ii) 

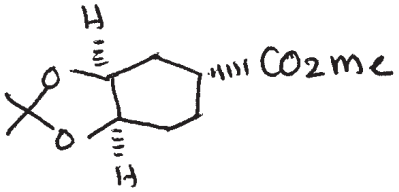
iii) 

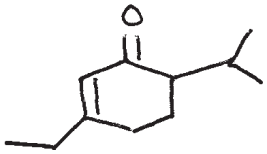
Q6) Using retrosynthetic analysis suggest a suitable method to synthesize the following (any four): **[16]**

a) 

b) 

c) 

d) 

e) 

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Total No. of Questions :6]

SEAT No. :

P2971

[Total No. of Pages :6

[4723]-411
M.Sc.
ORGANIC CHEMISTRY
CH - 452: Heterocyclic Chemistry, Chiron Approach and Medicinal Chemistry
(2008 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

Q1) a) Explain the following (any three): **[6]**

i) Traditional Friedel craft alkylation is not practicable in furan.

ii) In pyridine N - oxides, both electrophilic substitution and nucleophilic displacement of halide from C-4 go more rapidly than in pyridine.

iii) Why does pyrrole not form salt by protonation on nitrogen.

iv) Synthesis of 2-bromo, 3-bromo and 3,4-dibromo thiophenes?

b) Answer any three of the following: **[9]**

i) Suggest the structure of the major product from the interaction of resorcinol (1, 3-dihydroxybenzene) and

1) $PhCOCH_2$ COMe in AcOH/HCl

2) Methyl 2-oxocyclopentane dicarboxylate / H_2SO_4

P.T.O.

ii) What would be the products from the reactions of 5- bromo- 3 - iodo- 1-phenyl sulfonylindole with

1) Ph $B(OH)_2$ pd $(pph_3)_4$ / aq. Na_2CO_3

2) ethylacrylate / $pd(OAC)_2$ / ph_3p / Et_3N.

iii) What are the products of the following (Diels-Alder) reactions

1) 1-pyrrolidnyl cyclopentane with

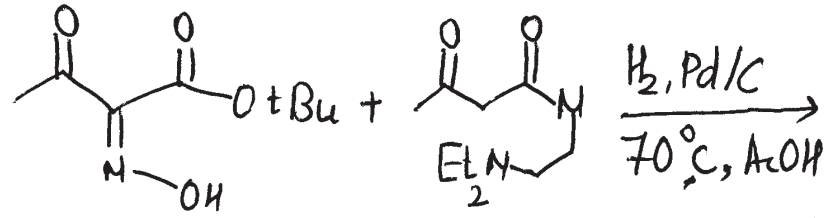
A) 1, 3, 5- triazine

B) 1, 2, 4 - triazine and

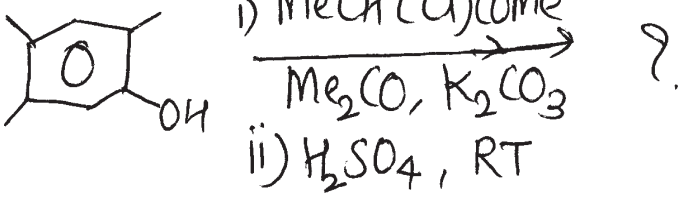
2) 3 - phenyl -1, 2, 4, 5- tetrazine with 1, 1- diethoxy ethene?

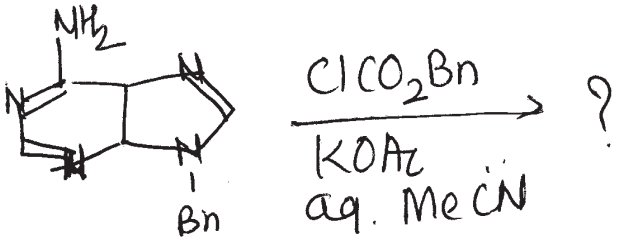
iv) Deduce the structures for bi & tetracyclic heterocycles formed in the following two steps respectively. 4 - chlorophenylthioacetic acid with PCl_3 then $AlCl_3$ ($\rightarrow C_8H_5ClOS$) then this with phenylhydrazine in hot AcOH $\rightarrow C_{14}H_8ClMS$.

Q2) a) Predict the products in any four of following reactions. **[8]**

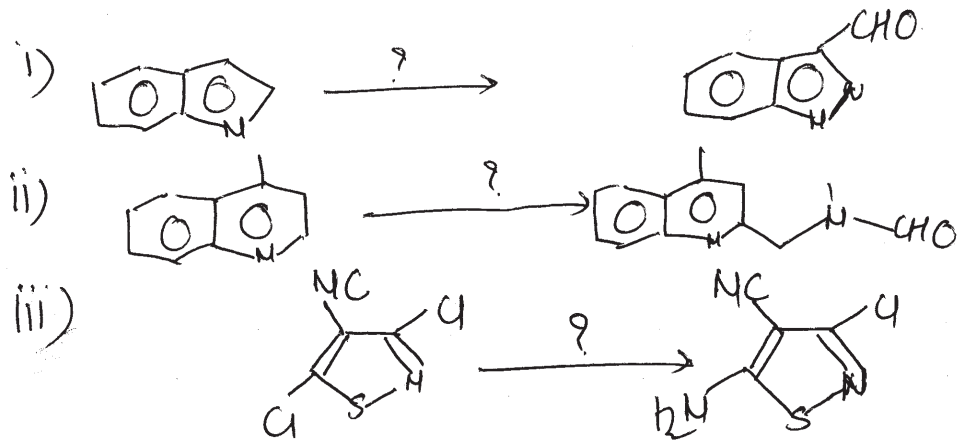
i) 

ii) Pentosan $\xrightarrow{H_2O,\ H^+}$?

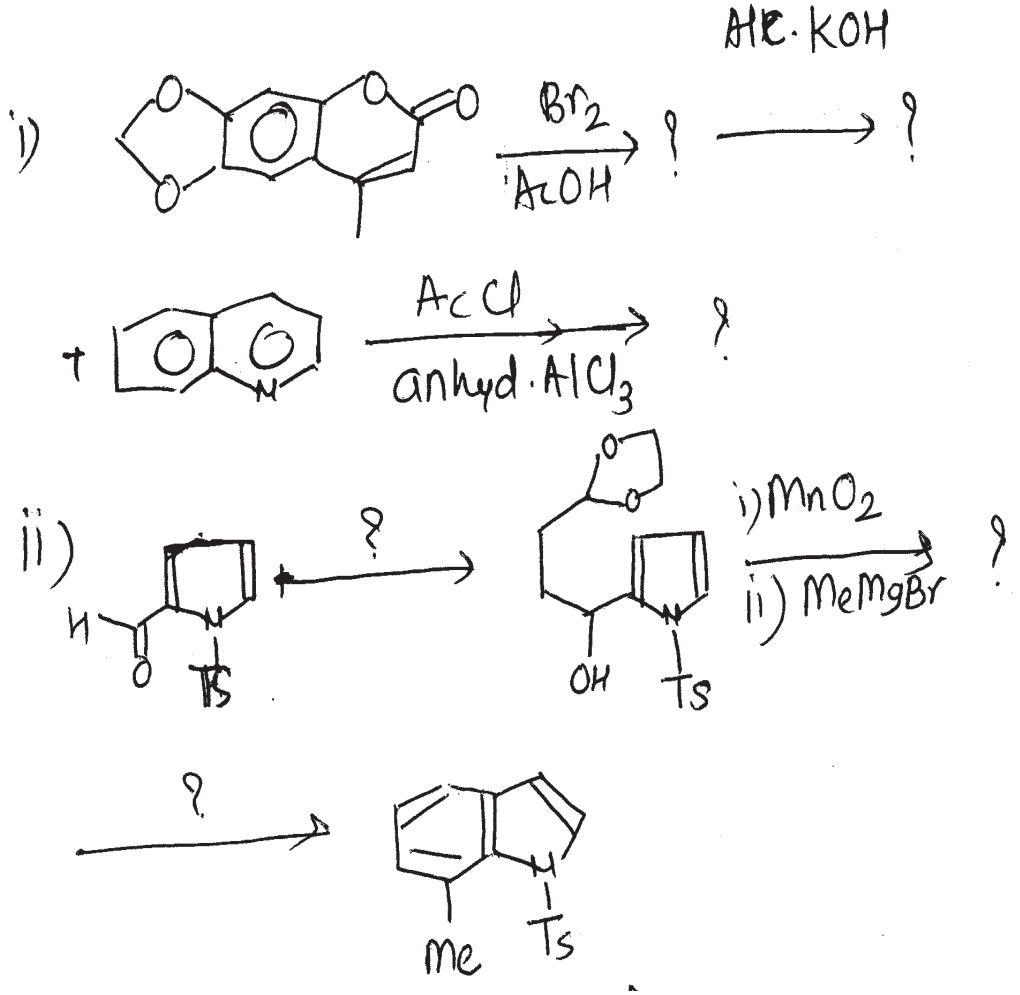
iii) 

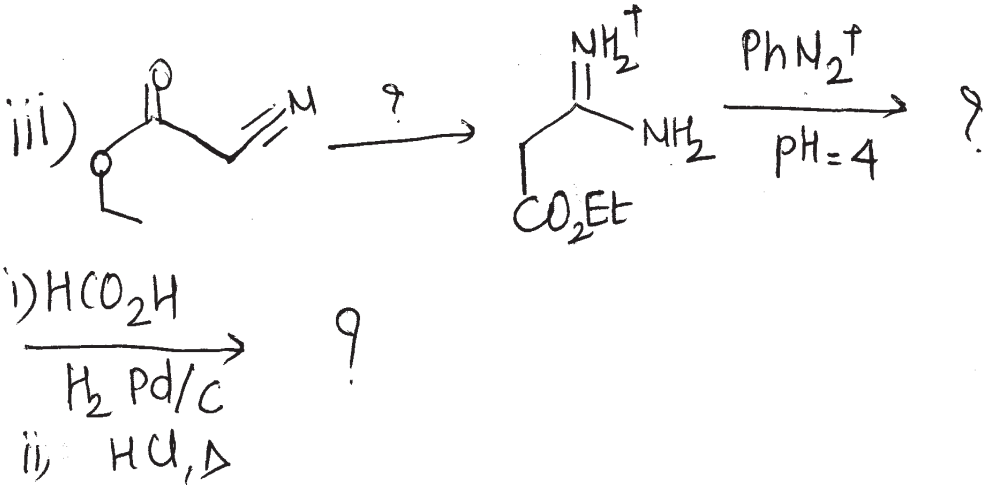
iv) 

b) Suggest the suitable reagents and reasonable mechanism for any two of the following: **[5]**



Q3) a) Complete the following sequence of reactions any two and suggest mechanism. **[6]**





b) Write notes on any two of the following: **[6]**

i) Synthesis of quinoline (skraup)

ii) Diels Alder reactions of furan

iii) Reactions of imidazole (electrophilic substitution)

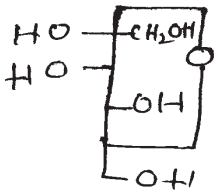
SECTION - II

Q4) a) Explain the importance of 'Ruff degradation" in carbohydrate chemistry. **[4]**

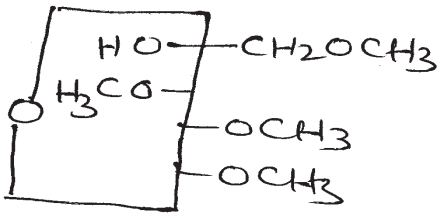
b) Explain the differences in activity of various - OH groups in D-(+) - glucose. **[4]**

c) D- (+) - glucose on reaction with Bromine water gives a carboxylic acid. Write the reaction and predict the absolute stereochemistry of each carbonatom in the acid. **[4]**

d) Write the names of the (A & B) following sugar derivatives and also draw the structure of corresponding sugars. **[4]**

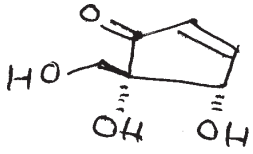


(A)



(B)

Q5) a) Give retrosynthetic analysis of (–) - pentonomycin **[4]**

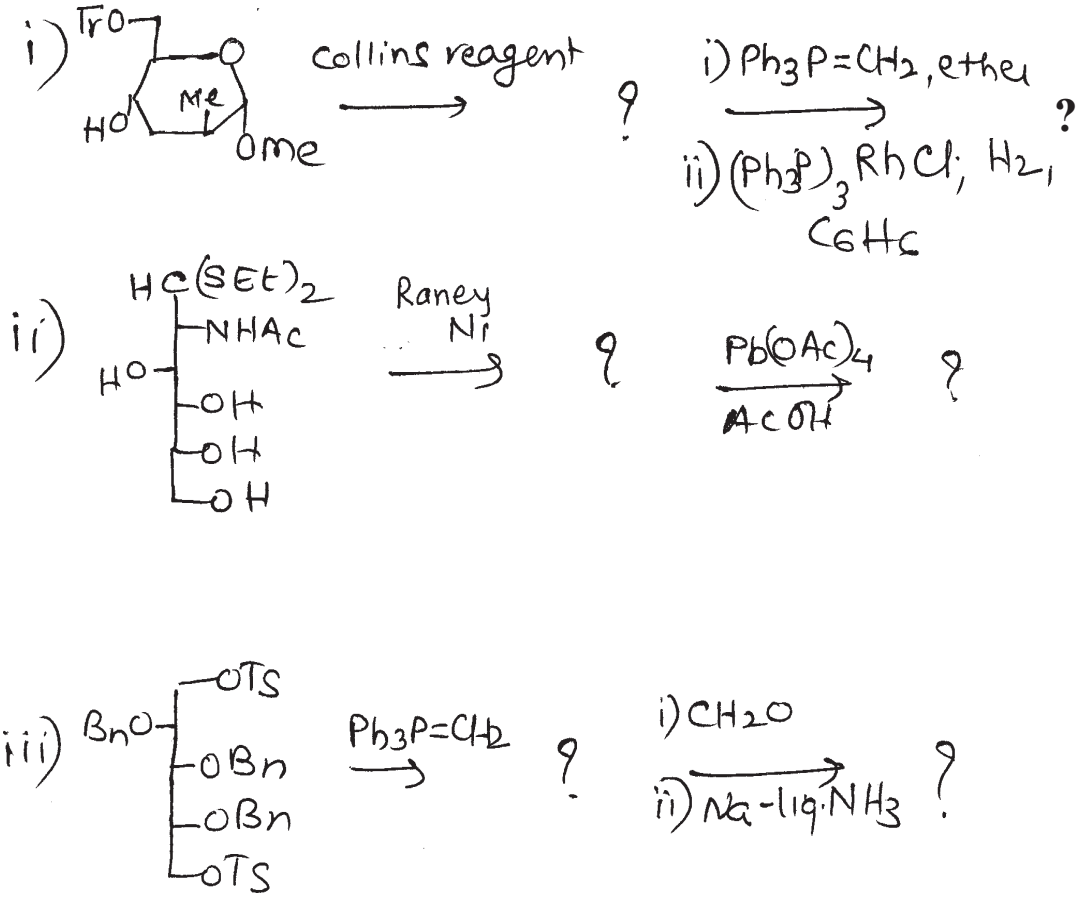


b) Write short note on any one of the following **[4]**

i) Use of Chiron approach.

ii) Apparent carbohydrate symmetry.

c) Predict the products in any two of the following: **[4]**



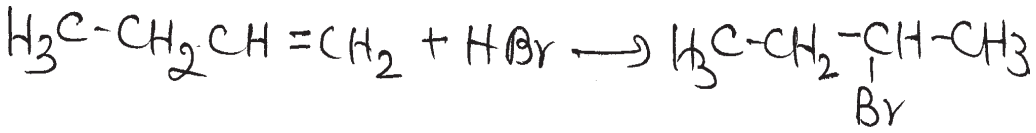
Q6) Answer any three of the following: **[12]**

a) Explain the mechanism of renal excretion.

b) Define drug? What are the steps involved in drug development?

c) What is the role of solvent in supramolecular chemistry?

d) Calculate atom economy for the following reaction.



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Total No. of Questions : 4]

SEAT No. :

P2972

[Total No. of Pages :2

[4723] - 412
M.Sc. - II
ANALYTICAL CHEMISTRY
CH- 481 : Bioanalytical and Forensic Science
(Semester - IV) (2008 Pattern)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answer to the two sections should be written in separate answer books.***
2) ***All questions are compulsory and carry equal marks.***
3) ***Neat diagram must be drawn wherever necessary.***
4) ***Use of logarithmic table/non-programmable calculator is allowed.***

SECTION - I

Q1) Answer any four of the following: **[20]**

a) What is sterilization? Discuss the test used to conform sterilization process of milk.

b) Give the method used for estimation of caffine from coffee powder.

c) How HMF content from honey is estimated? Calculate HMF content from sample of honey (100g) if absorbance of unit path length was 0.180.

d) Outline analytical method for the estimation of pectin from Jam.

e) The chicory content was estimated in coffee sample. The percentage of water extract in sample was 42%. If the average value for percentage water extract of chicory is 70% and pure coffee is 24% respectively. Calculate percentage of chicory in sample.

Q2) Attempt any four of the following: **[20]**

a) Define vitamins. Explain Wald's visual cycle and deficiency symptoms of thiamine.

b) Give the method used for estimation of amylase.

c) Give suitable analytical method for estimation of glucose.

d) How creatinine from urine sample is estimated?

e) If nitrogen retained, nitrogen absorbed and nitrogen intake from protein by rat was 2.0 mg, 1.25 mg, 9.28 mg respectively. Calculate the protein utilization, digestability and biological value.

P.T.O.

SECTION - II

Q3) Attempt any four of the following: **[20]**

a) State the principle for determination of barbiturates by procedure type A. Explain its procedure in detail.

b) State the principle and explain the technique for extraction of caffein from biological sample.

c) Explain type B procedure for isolation and determination of stimulants.

d) Outline procedure type C for isolation and identification of amphetamine from urine sample.

e) Sample containing drug was analyzed by TLC. When distance travelled by solvent front was 15.3 cm and amphetamine, metamphetamine, cocain and heroin gave Rf values 0.316cm, 0.437cm, 0.568cm and 0.877cm respectively. Calculate distance travelled by amphetamine, metamphetamine, cocain and heroin.

Q4) Attempt any four of the following: **[20]**

a) Define the terms:

i) Coca leaf

ii) Canabis (Hemp)

iii) Opium derivative

iv) Toilet preparations

b) Write note on 'bonded manufactory'.

c) Explain building arrangement required in non bounded laboratory.

d) Explain the process "movement of dutiable goods from one bonded wearhouse to another bonded wearhouse.

e) Write note on "Storage of finished products".

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Total No. of Questions : 4]

SEAT No. :

P2973

[Total No. of Pages : 3

[4723]-413
M.Sc. -II
ANALYTICAL CHEMISTRY
CH- 490: Analytical Spectroscopy
(2008 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory and carry equal marks.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of logarithmic table/ non-programmable calculator is allowed.***

SECTION - I

Q1) Attempt any four of the following: **[20]**

a) Explain the following terms used in instrumental analysis

i) Dispersive power

ii) Resolving power

iii) Period

b) Describe with neat labelled diagram the working of photomultiplier tube as a detector.

c) Explain principle and instrumentation of ESCA.

d) A 5 mg lit^{-1} solution of substance (Mol.wt = 285 g mol^{-1}) gave an absorbance of 0.395 at 420 nm in 1 cm cell. Calculate the molar concentration of solution of same substance exhibits an absorbance of 0.835.

e) Estimate the thickness of foil composed of an alloy having mass absorption coefficient 631.75 cm^2/g and density 8.012 g/cm^3. If the detector recorded 10,848 CPM of transmitted X-ray when foil was not in the path of X-ray and 1023 CPM when foil was placed in the path.

P.T.O.

Q2) Attempt <u>any four</u> of the following: **[20]**

a) What is meant by X-ray fluorescence? With schematic diagram explain energy dispersive X-ray fluorimeter.

b) With a neat diagram explain electrostatic field analyser in an electron spectroscopy.

c) What is meant by gas phase chemiluminescence? How it is used in quantitative analysis?

d) Draw schematic diagram and explain curved crystal monochromator used for X-ray analysis.

e) In ESCA electron was found to have K.E. of 1077.5eV when Mg, K_{α} source of wavelength 0.989 nm. The electron spectrometer had a work function of 17.5 eV. Calculate binding energy of electron.

(Given: h = 6.625 x 10^{-34} Js)

SECTION - II

Q3) Attempt <u>any four</u> of the following: **[20]**

a) Write a critical note on nuclear overhauser effect in NMR spectroscopy.

b) Discuss the use of solvents and shift reagents in NMR spectroscopy.

c) Distinguish between proton magnetic resonance spectra and non protomic NMR spectra.

d) Predict the splitting patterns and ratio of peak areas in each multiplet as well as between the multiplets in NMR spectrum of $CH_3CH_2O\,C\,(CH_3)_3$.

e) A proton appears as a quartet at 3.8δ, with coupling constant 8 Hz on a 90 MHz instrument. Indicates the line position in Hz of each lines. Give the relative intensities of the lines.

Q4) Attempt <u>any four</u> of the following: **[20]**

a) With neat labelled diagram describe transmission electron microscope.

b) Discuss ESR spectrum of benzene anion radical.

c) With the help of block diagram, explain the different components of EPR spectrophotometer.

d) Distinguish between NMR and ESR spectroscopy with reference to principle, sources, applied magnetic field & detectors.

e) Calculate the magnetic flux density of free electron [g = 2.0023] resonates when the esr spectrometer operated at 35 GHz.

[Given: $\beta_e = 9.275 \times 10^{-24}$ J T^{-1}, $h = 6.625 \times 10^{-34}$ Js]

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Total No. of Questions : 4]

SEAT No. :

P2974

[Total No. of Pages : 3

[4723]-414
M.Sc. -II
ANALYTICAL CHEMISTRY
CH- 491: Polymer Technology
(2008 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory and carry equal marks.***
2) ***Answers to the two sections should be written in separate answer book.***
3) ***Draw neat diagrams wherever necessary.***

SECTION - I

Q1) Attempt any four of the following: **[20]**

a) Explain the classification of polymers based on morphological behavior and tacticity. Give two examples for each.

b) Give salient features of solution condensation polymerisation.

c) Discuss the kinetics of anionic polymerisation.

d) Give method of preparation and uses of the following polymers:

i) Polyvinyl chloride

ii) Polyisoprene

e) Write a note on electrochemical polymerisation.

Q2) Attempt any four of the following: **[20]**

a) Explain 'Radiation induced polymerisation'.

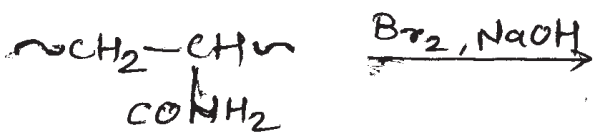
b) Discuss the various methods for generation of free radicals.

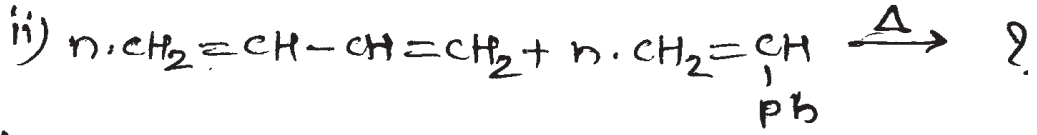
c) Write a note on 'Thermal degradation'.

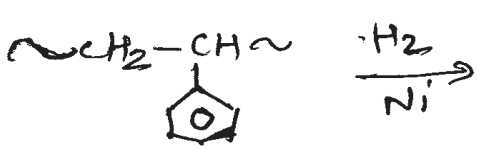
P.T.O.

d) Discuss the mechanism of cationic polymerisation.

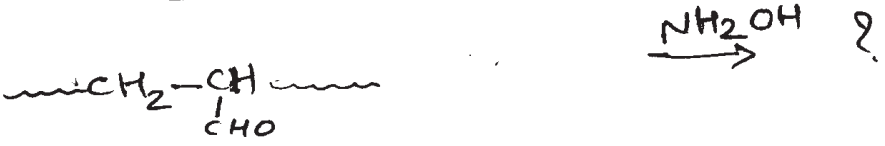
e) Complete the following reactions:

i) 

ii) 

iii) 

iv) 

v) 

SECTION - II

Q3) Attempt any <u>four</u> of the following: **[20]**

a) Explain the terms:

i) Flammability

ii) Gloss

iii) Transparency

iv) Vapour permeability

v) Resistivity

b) Explain the term sol-gel process. give brief account of aqueous chemistry of metal oxide.

c) Describe the characterization of polymers by x-ray diffraction technique.

d) Write a note on valcanization.

e) 0.936 gm of CTPB sample was dissolved in a mixture of ethyl alcohol and toluene and solution was titrated with 0.3214 N alcoholic potassium hydroxide solution. The titration reading recorded was 5.1 ml. calculate number molecular weight ($\overline{Mn}$) of the polymer. (Given - functionality of CTPB is 2)

Q4) Attempt any <u>four</u> of the following: **[20]**

a) Give an account of optical properties of polymeric materials.

b) Explain the term fibre spining. describe melt spining process for fibres.

c) Explain in brief: Extrusion moulding process for polymers.

d) Describe the dielectric strength and dissipation factor with respect to polymers.

e) Equal masses of polymer molecules with $M_1 = 10,000$ and $M_2 = 1,00,000$ are mixed. Calculate $\overline{Mn}$ and $\overline{Mw}$.

EEE

Total No. of Questions : 8]

SEAT No. :

P2889

[Total No. of Pages : 3

[4724]-1001
M.Sc.
BIOCHEMISTRY
BCH- 170: Biomolecules
(2013 Pattern) (Credit System) (Semester - I)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Question Nos. 4 and 8 are compulsory. Out of the remaining attempt 2 questions from Section I and 2 questions from Section II.***
2) ***Answers to the two sections should be written in separate answer book.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***
5) ***All questions carry equal marks.***

SECTION - I

Q1) Answer the following:

a) Write a note on deoxy sugars. Give their significance. **[3]**

b) Give any two general reactions of sugars, with a suitable example of each. **[3]**

c) Discuss the biological significance of structural carbohydrates. **[4]**

Q2) Answer the following:

a) What are amino sugars? Give an example. **[2]**

b) Differentiate between reducing and non-reducing sugars. **[3]**

c) Discuss the structure, biochemical functions and deficiency of vit Riboflavin. **[5]**

P.T.O.

Q3) Answer the following:

a) Draw the structure of triacyl-glycerol. **[2]**

b) Write a note on lipid bilayer. What is its biological significance? **[4]**

c) Enumerate the properties of water. Add a note on interaction of water with biomolecules. **[4]**

Q4) Answer any one:

a) Give the classification of lipids with suitable examples. **[5]**

b) Give the significance of carbohydrates in our body. **[5]**

SECTION - II

Q5) Answer the following:

a) write a note on the peptide bond? **[3]**

b) Write a note on rare amino acids. What is their biological significance. **[3]**

c) Differentiate between proteolysis and denaturation of proteins. give suitable examples. **[4]**

Q6) Answer the following:

a) What is Sanger's reagent? Explain its use. **[2]**

b) Describe any two supersecondary structures of proteins. **[4]**

c) Describe the Edmans reaction for protein sequence analysis. **[4]**

Q7) Answer the following:

a) An amino acid is a 3 witter ion. Explain. **[2]**

b) Write a note on primary structure of protein. **[3]**

c) Explain the principle and procedure of solid phase synthesis of oligo peptides. **[5]**

Q8) Answer any one the following:

a) Classify amino acids on the basis of their 'R' groups. **[5]**

b) Give the biological function of proteins. **[5]**

EEE

Total No. of Questions : 8]

SEAT No. :

P2890

[Total No. of Pages :2

[4724] - 1002
M.Sc.
BIOCHEMISTRY
BCH - 171 : Enzymology and Biophysical Techniques
(2013 Pattern) (Credit System) (Semester - I)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answers to both the sections should be written on separate answer sheets.***
2) ***Question no. 4 and 8 are compulsory.***
3) ***Attempt any two questions from Q.1 to Q.3 and any two from Q.5 to Q.7.***
4) ***Figures to the right indicate full marks.***

SECTION - I

(Enzymology)

Q1) Answer the following:

a) What do you understand by activation energy? **[2]**

b) Why is it important to measure pre-steady state kinetics when studying the catalytic mechanism of an enzyme? **[4]**

c) Write a note on affinity labeling. **[4]**

Q2) Attempt the following:

a) Why does the activity of enzymes vary with temperature? **[3]**

b) How the rate of degradation (Kd) of the enzyme is measured? **[3]**

c) Write a short note on zymogen activation. **[4]**

Q3) Answer the following:

a) What is the significance of enzyme turnover? **[2]**

b) Comment on catalytic power and regulation of enzyme activity. **[3]**

c) What do you understand by enzyme inhibition? Discuss irreversible inhibitors and reversible inhibitors involved in enzyme inhibition. **[5]**

P.T.O.

Q4) Attempt any one of the following:

a) Write short notes on the followings: **[5]**

i) Allosteric Enzymes.

ii) Product inhibition.

b) How substrate cycle and interconvertible enzyme cycle amplify the initial signal? Explain with suitable example. **[5]**

SECTION - II

(Biophysical Techniques)

Q5) Answer the following:

a) What is a restriction map? **[2]**

b) Describe the principle and method of ion exchange chromatography. **[4]**

c) What is the principle of 2D PAGE-gel electrophoresis? Explain its application in proteomics study? **[4]**

Q6) Answer the following:

a) Mention three unique advantages of size exclusion chromatography. **[3]**

b) Give the principle of isoelectric focusing. **[3]**

c) Why is it important to prepare a standard curve for each spectrophotometer? **[4]**

Q7) Answer the following:

a) What is the difference between an isocratic pump and a gradient pump? **[2]**

b) How are proteins eluted from affinity chromatography column? **[3]**

c) What is reverse dialysis? Give the significance of the technique. **[5]**

Q8) Attempt any one of the following:

a) Write a note on DNA cellulose chromatography. **[5]**

b) Describe the steps for the purification of enzymes. **[5]**

Total No. of Questions : 8]

SEAT No. :

P2891

[Total No. of Pages : 2

[4724] - 1003
M.Sc.
BIOCHEMISTRY
BCH - 172 : Microbiology and Cell Biology
(2013 Pattern) (Credit System) (Semester - I)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answer to both the sections should be written on separate answer sheets.***
2) ***Question No. 4 and 8 are compulsory.***
3) ***Attempt any two questions from Q-1 to Q-3 and two from Q-5 to Q-7.***
4) ***Figures to the right indicate full marks.***

SECTION - I

(Microbiology)

Q1) Answer the following:

a) Explain the principle of gram staining. **[3]**

b) What do you understand by growth curve. **[5]**

c) Why oxygen in toxio to anaerobic bacteria. **[2]**

Q2) Answer the following:

a) What is mode of action of cholera toxin. **[3]**

b) Explain nitrogen cycle. **[4]**

c) What are steps involved in the process of viral infection. **[3]**

Q3) Answer the following:

a) Write in short preservation of pure culture. **[3]**

b) Write in detail bacterial cell wall. **[3]**

c) Give the application of fluorescent Microscope. **[4]**

P.T.O.

Q4) Answer any one of the following:

a) Explain electron Microscope with reference to SEM and TEM. **[5]**

b) What are the different methods for isolation of pure culture. Explain the one which is the best for isolation. **[5]**

SECTION - II

(Cell Biology)

Q5) Answer the following:

a) Give the salient features of a plant cell. **[3]**

b) Write a note on peroxisomes. **[3]**

c) What is density gradient centrifugation? How are lysomes identified using marker enzymes? **[4]**

Q6) Answer the following:

a) Give two functions of the endoplasmic reticulum. **[2]**

b) Give the structure and function of lysosomes. **[3]**

c) Write a note on cell-cell recognition in plants. **[5]**

Q7) Answer the following:

a) Enlist the stages of the cell cycle. **[2]**

b) Give the structure and function of mitochondria. **[4]**

c) Write a note on the composition and structure of plant cell wall. **[4]**

Q8) Answer any one of the following:

a) Describe in detail the process of mitosis. **[5]**

b) Write an account of the composition and structure of the plasma membrane. **[5]**

Total No. of Questions : 6]

SEAT No. :

P2876

[Total No. of Pages :2

[4724] - 11
M.Sc. (Biochemistry)
BCH-170: BIOMOLECULES
(2010 Pattern) (Semester - I)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answer to the both sections should be written on separate answer sheets.***
2) ***All questions are compulsory.***
3) ***Figures to the right indicate full marks.***

SECTION - I

Q1) Answer any five of the following. **[15]**

a) What are anomers and epimers? Give example.

b) Give the structure of milk sugar, a steriod and a homodisaccharide.

c) What are amphiphatic lipids? How do they behave in water?

d) Differentiate between function of storage and structural polysaccharides.

e) Define acid number? What is its relation with rancidity?

f) What are lipoproteins? Give their significance.

Q2) Answer any three of the following. **[15]**

a) Explain reactions of glucose with oxidising and reducing agents and give their significance.

b) Discuss the formation of various macromolecules from their monomeric subunits.

c) Elaborate biochemical significance of various coenzymes of vitamins.

d) Give the types and significance of various lipoproteins.

P.T.O.

Q3) Write note on any two of following. **[10]**

a) Phospholipids

b) Storage and structural carbohydrates

c) Fat soluble vitamins.

SECTION - II

Q4) Answer any five of the following. **[15]**

a) List out the types of amino acids based on polarity.

b) Show the features of proteolysis and denaturation of proteins.

c) What are zwitterions? How they are formed?

d) Give the significance of factors that maintain tertiary structure of proteins.

e) Differentiate between simple and conjugated proteins.

f) What are non-standard aminoacids? Give examples.

Q5) Answer any three of the following. **[15]**

a) Explain reactions of amino acids with sanger's, Dansylchloride, Dabsyl chloride and edmann's reagent and their significance.

b) Elaborate steps involved in determination of primary structure of proteins.

c) Classify proteins based on biochemical functions.

d) Elaborate features of tertiary structure of proteins.

Q6) Write note on any two of the following. **[10]**

a) Titration curve of glycine.

b) Biochemical functions of protein

c) Ram chandran plot.

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Total No. of Questions : 6]

SEAT No. :

P2877

[Total No. of Pages :2

[4724] - 12

M.Sc. (Biochemistry)

BCH - 171 : ENZYMOLOGY AND BIOPHYSICAL TECHNIQUES

(2010 Pattern) (Semester - I)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answer to both the sections should be written on separate answer sheets.***
2) ***All questions are compulsory.***
3) ***Figures to the right indicate full marks.***

SECTION - I

(Enzymology)

Q1) Answer any three of the following: **[15]**

a) What are enzymes? Why are they called biocatalyst?

b) Write a note on Zymogens.

c) Why does the proximity effect play a role in catalysis in many enzymes.

d) Describe the kinetics of allosteric enzymes.

Q2) Answer any three of the following: **[15]**

a) Give the effect of competitive inhibitors on double reciprocal plot.

b) Explain the mechanism of action of lysozymes.

c) Write a note on turnover of enzyme.

d) What do you understand by interconvertible enzyme cycle?

Q3) Write note on any two of the following: **[10]**

a) Affinity labeling.

b) Relaxation methods.

c) Multienzymes.

P.T.O.

SECTION - II

(Biophysical Techniques)

Q4) Answer any three of the following: **[15]**

a) Illustrate gar chromatography instrument: Describe the principle components.

b) Explain how dialysis helps to purify proteins.

c) Describe any two applications of UV. spectrophotometer.

d) Explain any one separation method based on solubility for purification of proteins.

Q5) Attempt any three of the following: **[15]**

a) Explain why DNA fragments separate according to size in an electrophoresir gel.

b) Describe any two applications of gel filtration chromatography.

c) Describe a filter binding assay to measure binding between a DNA and a protein.

d) What factors allows molecules to be separated by chromatography.

Q6) Write note on any two of the following: **[10]**

a) TLC.

b) Disc electrophoresis.

c) Hydrophobic interaction chromatography.

Total No. of Questions : 6]

SEAT No. :

P2878

[Total No. of Pages : 2

[4724] - 13
M.Sc.
BIOCHEMISTRY
BCH - 172 : Microbiology and Cell Biochemistry of Eukaryotes
(2010 Pattern) (Semester - I)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answer to both the sections should be written on separate answer sheets.***
2) ***All questions are compulsory.***
3) ***Figures to the right indicate full marks.***

SECTION - I

Q1) Answer any three of the following: **[15]**

a) Write the Koch's postulates about bacterial diseases.

b) How radiation control bacterial growth?

c) What is the mode of action of ethylene oxide?

d) Distinguish between prokaryotic and eukaryotic cells.

e) Describe the methods for determination of antibiotic activity.

Q2) Explain the following (any three): **[15]**

a) Media sterilization.

b) Mechanism of gram staining.

c) Pili and Capsules.

d) Bacterial growth curve.

e) Electron microscopy and its limitations.

Q3) Write note on any two of the following: **[10]**

a) Production of alcohol.

b) Classification of animal viruses.

c) Differential staining.

P.T.O.

SECTION - II

(Cell Biochemistry of Eukaryots)

Q4) Answer any three of the following: **[15]**

a) What is cell differentiation? Explain the different events occuring during it.

b) Explain in detail the cell-cell adhesion.

c) Explain the ultrastructure of golgi apparatus and its function.

d) Elaborate on the biochemical composition and function of plasma membrane.

e) List out the marker enzymes used to identify subcellular components and give their significance.

Q5) Answer any three of the following: **[15]**

a) Differential between Xylem and phloem.

b) Explain the ultrastructure of endoplasmic reticulum and its function.

c) Classify fungi and list out its biological importance.

d) Define fertilization. Elaborate on biochemical events that occur during fertilization.

Q6) Write note on any two of the following: **[10]**

a) Cell junction.

b) Cell size and shape.

c) Ultrastructure of chloroplast.

Total No. of Questions : 8]

SEAT No. :

P2892

[Total No. of Pages : 2

[4724]-2001
M.Sc.
BIOCHEMISTRY
BCH-270 : Bioenergetics and Metabolism
(2013 Pattern) (Semester-II) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answer to both the section should be solved in different answer sheets.***
2) ***Solve any two question from Q. 1 to Q. 3 and any two from Q. 5 to Q. 7.***
3) ***Question No. 4 and 8 are compulsory.***
4) ***Figures to the right indicate full marks.***

SECTION-I

Q1) Attempt the following:

a) Give the significance of glyoxalate pathway. **[4]**

b) What is the role of glycogenin in glycogen synthesis? **[3]**

c) List out the enzymer of fatty acid synthase complex. **[3]**

Q2) Answer the following:

a) What is free energy, enthalpy and entropy? **[2]**

b) Write a note on lactose intolerance and Galactosemia. **[4]**

c) Elucidate the regulation of glycolysis and gluconeogenesis. **[4]**

Q3) Attempt the following:

a) What are the types of oxidation of fatty acids. **[2]**

b) Give the significance of pyruvate dehydrogenase complex. **[3]**

c) Explain the steps involved in pentose phosphate pathway. **[5]**

P.T.O.

Q4) Answer Any One of the following:

a) Explain the steps involved in the synthesis of ascorbic acid. **[5]**

b) Write a note on inhibitors and uncouplers of ETC. **[5]**

SECTION-II

Q5) Answer the following:

a) Write a note on Inborn errors of amino acid metabolism. **[3]**

b) Show the steps involved in formation of uric acid formed in humans. **[3]**

c) Enlist the aminoacids that can be synthesized from pyruvate. **[4]**

Q6) Attempt the following:

a) What is the significance of xanthine oxidase? **[2]**

b) Give the significance of pyridoxal phosphate in aminoacid metabolism. **[3]**

c) Explain purine biosynthesis by denovo pathway. **[5]**

Q7) Answer the following:

a) Give two examples of salvage pathway of nucleotide synthesis. **[2]**

b) Show the regulation of nucleotide synthesis. **[4]**

c) Discuss the clinical manifestations of phenylketonuria and alkaptonuria. **[4]**

Q8) Answer Any One of the following:

a) Elaborate on porphysin biosynthesis. **[5]**

b) How are branched amino acids degraded in our body? **[5]**

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Total No. of Questions : 8]

SEAT No. :

P2893

[Total No. of Pages : 2

[4724]-2002
M.Sc.
BIOCHEMISTRY
BCH-271 : Techniques in Characterization of Biomolecules
(Semester-II) (Credit System) (2013 pattern)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answers to both the sections should be written on separate answer sheets.***
2) ***Question No. 4 and 8 are compulsory.***
3) ***Attempt any two questions from Q.1 to Q.3 and any two questions from Q.5 to Q.7.***
4) ***Figures to the right indicate full marks.***

SECTION-I

Biophysical Methods

Q1) Answer the following:

a) Enlist the factors affecting sedimentation velocity. **[2]**

b) What are the different methods used for measurement of concentration distribution in an analytical centrifuge cell. **[4]**

c) What is the theory of X-ray. **[4]**

Q2) Attempt the following:

a) Explain the effect of shape on standard sedimentation coefficient. **[3]**

b) Explain stripping film method of autoradiography. **[3]**

c) Distinguish between boundary and band sedimentation. **[4]**

Q3) Answer the following:

a) Define and give the significance of sedimentation coefficient. **[2]**

b) What are the methods used for measurements of viscosity of the solution. **[3]**

c) Give application of partial specific volume. How it is measured by pycnometry? **[5]**

P.T.O.

Q4) Attempt Any One of the following:

a) Draw a neat diagram of atomic absorption spectrometer. Describe the theory of in brief. **[5]**

b) Give the principle and functions of liquid scintillation counter. **[5]**

SECTION-II

(Structure determination of Biomolecules)

Q5) Answer the following:

a) What differences might be expected between NMR spectra of water and ice? Explain. **[2]**

b) What is fluorescence depolarization? Describe the experimental arrangement for measuring the polarization of fluorescence. **[4]**

c) What are the advantages of LC-MS over GC-MS. **[4]**

Q6) Attempt the following:

a) Describe the advantages of atmospheric pressure photoionization. **[3]**

b) What are the steps required for sample preparation for MALDI-MS analysis. **[3]**

c) "Electronic response is proportional to biological response of analyte". Discuss this statement with reference to MM graph. **[4]**

Q7) Answer the following:

a) Enlist the applications of infrared spectroscopy. **[2]**

b) Explain the theory of fluorescence. **[3]**

c) What are the properties of ESR spectra? **[5]**

Q8) Attempt Any One of the following:

a) Explain any one application of ORD or CD. **[5]**

b) Describe briefly the theory of NMR spectrometry. What information can be obtained from NMR absorption peaks? **[5]**

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Total No. of Questions : 8]

SEAT No. :

P2894

[Total No. of Pages :2

[4724]-2003
M.Sc.
BIOCHEMISTRY
BCH- 273: Membrane Biochemistry and Genetics
(2013 Pattern) (Credit System) (Semester - II)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Answers to both the sections should be written on separate answer sheets.***
2) ***Question No. 4 and 8 are compulsory.***
3) ***Attempt any two questions from Q-1 or Q-3 and any two from Q-5 or Q-7.***
4) ***Figures to the right indicate full marks.***

SECTION -I

(Membrane Biochemistry)

Q1) Answer the following;

a) How protein-lipid interaction takes place. **[3]**

b) Explain sodium potassium channels. **[3]**

c) What are the different types of transport mechanism. Explain the role of protein in transport. **[4]**

Q2) Answer the following:

a) Write a note on gramicidin. **[2]**

b) Give some example of modes of penetration of antimicrobial agents. **[3]**

c) Elaborate on various modes used to explain membrane structure. **[5]**

Q3) Answer the following:

a) What is membrane asymmetry? Give example. **[2]**

b) Elucidate the various models proposed to affirm the membrane structure. **[4]**

c) Explain how temperature affects fluidity of membrane. **[4]**

P.T.O.

Q4) Answer any one of the following: **[5]**

a) What are miscells and liposomes?

b) How do membrane lipids influence the curvature of the membrane.

SECTION -II

(Genetics)

Q5) Answer the following:

a) Write a note on codominance and incomplete dominance with suitable examples. **[3]**

b) Define plasmid and enlist different types of plasmids. **[3]**

c) Diagrammatically show the steps of life cycle of Bacteriophage. **[4]**

Q6) Answer the following:

a) Write a note on tetrad analysis with example. **[3]**

b) Describe structure of Watson and crick model of DNA. **[3]**

c) Give Mendel's principle of law of independent assortment. **[4]**

Q7) Answer the following:

a) Write a note on lytic cycle of bacteriophage. **[3]**

b) Genetic code is degenerate. Explain. **[3]**

c) Write a note on genetic mutation. **[4]**

Q8) Answer any one of the following: **[5]**

a) Write a note on lac operon.

b) Explain different types of RNA.

EEE

Total No. of Questions : 8]

SEAT No. :

P2895

[Total No. of Pages :4

[4724] - 2004
M.Sc.
BIOCHEMISTRY
BCH - 272 : Biostatistics Computer and bioinformatics
(2013 Pattern) (Semester - II) (Creidt)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answers to both the sections should be written on separate answer sheets.***
2) ***Question No. 4 and 8 are compulsory.***
3) ***Attempt any two questions from Q.1 to Q.3 and any two from Q.5 to Q.7.***
4) ***Figures to the right indicate full marks.***
5) ***Supplementary will be provided for checking P-values.***
6) ***Graph papers will be provided.***

SECTION - I

Q1) Answer the following:

a) Calculate the value of median and also determine it graphically using ogive. **[3]**

Variable	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency	4	6	10	15	11	7	3

b) Calculate the geometric mean of the following data: **[3]**

Variable	6	7	8	9	10	11
Frequency	4	7	10	9	6	2

c) Calculate the standard deviation and standard error of data on waxy endospermic plants recored in maize: **[4]**

Waxy endospermic Plants	7	8	9	10	11	12
No. of Plants	13	13	18	17	15	14

P.T.O.

Q2) Answer the following:

a) For the standard normal variate z = 1.98 find the proportion (area) occupied by it as measured from zero. Represent in normal distribution curve. **[2]**

b) An average of 5 litres of milk is given by a buffalo every day. Assuming this to be a poisson distribution, what is the probability that exactly 0, 1, 2, 3 and 4 litres of milk is given per day by the buffalo? **[3]**

c) Height (inches) and weight (kgs.) are recorded for 10 students. The results are given below. Calculate the regression coefficient and test the level of significance. **[5]**

Height (inches)	62	72	78	58	65	70	66	63	60	72
Weight (Kgs)	50	65	63	50	54	60	61	55	54	65

Q3) Answer the following:

a) The following data represents the number of productive tillers per plant of a wheat variety. Calculate the mean number of tillers per plant. **[2]**

Number of productive tillers = 10, 11, 12, 9, 8, 19, 15, 14, 12

b) Find out the value of arithmatic mean and median from the following data: **[4]**

Number of angular seeded plants	12	8	17	10	11	16	18	14	6	7
Number of plants	39	33	42	40	47	42	60	50	22	25

c) Following is the data recorded on nitrate content of water (mg/l) from two lakes. Analyse the data and show whether the two lakes are significantly different. **[4]**

Samples	1	2	3	4	5	6	7	8	9	10
Lake 1	0.62	0.87	0.54	1.36	0.87	0.62	1.24	1.36	1.10	1.24
Lake 2	0.79	1.68	1.59	0.99	1.61	1.49	1.39	1.24	1.24	1.86

Q4) Answer any one of the following: **[5]**

a) Data on hair colour and the eye colour are given in the table. Calcualte the chi-square value. Determine the association between the hair colour and the eye colour.

		Fair	Brown	Black	Total
Eye colour	Blue	15	20	5	40
	Grey	20	20	10	50
	Brown	25	20	15	60
	Total	60	60	30	150

b) Draw a percentage bar diagram and a pie diagram of the following data relating to the areas under cultivation of different crops in Maharashtra in the year 1987-88.

Crops	Rice	Jowar	Bajra	Maize	Wheat
Area in thousand hectares	3123	2572	324	296	11

SECTION - II

Q5) Answer the following:

a) State the salient features of any protein 3D structure visualization software. **[3]**

b) With respect to the GenBank, explain the need of curations and annotation of databases. **[3]**

c) What is Entrez? Describe why Entrez is most powerful tool to retrieve the biological data. **[4]**

Q6) Answer the following:

a) Differentiate between Orthologous and Paralogous genes. **[2]**

b) Explain how multiple sequence alignment can be used to find the conserved regions of protein sequences. **[3]**

c) Explain how sequence data is generated for *Expressed Sequence Tags database division of NCBI.* **[5]**

Q7) Answer the following:

a) Differentiate between sequence similarity and sequence homology. **[2]**

b) Differentiate between Global and Local sequence alignment. **[4]**

c) What is progressive alignment? Explain how Clustal W uses progressive alignment for multiple sequence alignment. **[4]**

Q8) Answer any one of the following: **[5]**

a) What is Local sequence alignment? Using Smith-Waterman Algorithm determine the optimal alignment of following DNA sequences

Seq 1 : CATGCGGTAC

Seq 2 : CTAGCGCTAC

Use following parameters for obtaining the alignment. Identity: +2, Mismatch: 0, Gap: 0.

b) Explain why there is need of Heuristics approach in database sequence search. Explain any one heuristics approach in sequence similarity search.

Total No. of Questions : 4]

SEAT No. :

P2879

[Total No. of Pages :2

[4724] - 21
M.Sc.
BIOCHEMISTRY
BCH-270: Bioenergetics & Metabolism
(2008 & 2010 Pattern) (Semester - II)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***All questions carry equal marks.***
3) ***Figures to the right indicate full marks.***

Q1) Attempt any four of the following. **[20]**

a) Write a note on intracellular organisation of photosynthetic system.

b) How does fatty acid cross the inner mitochondrial membrane? Explain.

c) Give biochemical significance of Acetyl CoA.

d) Describe in detail oxidative phosphorylation.

Q2) Answer any four of the following. **[20]**

a) Write a short note on photosynthetic pigments?

b) Explain in detail degradation of glycogen.

c) Explain fate of pyruvate in anaerobic condition.

d) Write a note on Interconversion of Hexoses.

e) What are high energy compounds?

P.T.O.

Q3) Answer the following. **[20]**

a) Explain β-oxidation saturated fatty Acids.

b) Write a note on enzymes & co-enzymes involved in conversion of pyruvate to acetyl CoA.

c) Explain the regulation of fatty acid biosynthesis.

d) Write a note on ketone bodies.

Q4) Answer any 4 of the following. **[20]**

a) Give the significance of HMP.

b) Describe cyclic & non cyclic photophosphorylation.

c) Describe Glucuronic acid cycle.

d) Elaborate on entry of other carbohydrates in Glycolytic pathway.

e) Write a note on Biosynthesis of triglycerides.

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Total No. of Questions : 4]

SEAT No. :

P2880

[Total No. of Pages : 2

[4724]-22
M.Sc.
BIOCHEMISTRY
BCH-271 : Techniques for Characterization of Biomolecules
(2010 Pattern) (Semester-II)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to right indicate full marks.***

Q1) Answer Any Four of the following: **[20]**

a) What are the factors that govern the choice of emitter, emulsion & isotope? Add a note on resolution.

b) Write short account on isotope tracer technique.

c) What is meant by sensitization in autoradiography?

d) How will you prove by sedimentation that DNA is having single strand breaks?

e) Describe the application of x-ray diffraction.

Q2) Attempt Any Four of the following: **[20]**

a) What is viscosity? Write a note on Ostwald's capillary viscometer.

b) Describe any one application of ultracentrifugation with example.

c) What are the applications of atomic absorption spectroscopy? Explain any one in brief.

d) How will you measure radioactivity by Geiger - Muller counter?

e) What is sedimentation velocity? Describe the factors that affect sedimentations.

P.T.O.

Q3) Answer Any Two of the following: **[20]**

a) Describe the principle and working of MALDI-TOP-MS.

b) Explain the phenomenon & applications of fluorescence.

c) What are the basic components of biosensor? Describe their functions in detail.

Q4) Write short notes (Attempt Any Four): **[20]**

a) ESR.

b) ORD & CD.

c) Conductometric biosensors.

d) Electron spray assisted ionization.

e) Chemical shift.

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Total No. of Questions : 4]

SEAT No. :

P2881

[Total No. of Pages :2

[4724]-23
M.Sc.
BIOCHEMISTRY
BCH- 273: Membrane Biochemistry & Nucleic Acids or Genetics
(2008 & 2010 Pattern) (Semester - I)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***All questions carry equal marks.***
3) ***Draw neat labelled diagrams where necessary.***

Q1) Attempt four out of the following questions. **[20]**

a) Write a note on osmoregulation.

b) Discuss the role of Na K ATPase in the transport of sodium & potassium.

c) Explain how the antimicrobial agents reach their targets.

d) Discuss the factors affecting physical properties of membranes.

e) Describe the assembly of virus membrane receptor.

Q2) Attempt any four of the following: **[20]**

a) Give a detailed account of voltage gated channels.

b) Distinguish between active and passive transport with suitable example.

c) Discuss the biochemical chemiosmotic hupothesis of mitchell.

d) Describe the semi-conservative mechanism of DNA replication.

e) Describe the life cycle of a bacteriophage.

P.T.O.

Q3) Attempt any four of the following: **[20]**

a) Discuss the Mendelian laws of Inheritance.

b) Write a note an mutant isolation and selection.

c) Describe the structure of a biological membrane.

d) What is exocytosis? Explain its role in physiology of a cell.

e) Describe gap junctions with a neat diagram.

Q4) Attempt any four of the following: **[20]**

a) What is DNA denaturation? What factors does it depend on.

b) What is an operon? Describe with a suitable example.

c) Discuss the role of proteins in transport.

d) Describe the structure of RNA. Add a note on the types of RNA.

e) Write a note on nuclear pores.

EEE

Total No. of Questions : 6]

SEAT No. :

P2896

[Total No. of Pages : 2

[4724]-3001
M.Sc.
BIOCHEMISTRY
BCH- 370: Molecular Biology
(2013 Pattern) (Credit System) (Semester - III)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Neat diagrams must be drawn wherever necessary.***
2) ***Figures to the right side indicate full marks.***
3) ***Solve any three questions from Q1 to Q4.***
4) ***Question 5 and 6 are compulsory.***

Q1) Answer the following: (10 Marks)

a) Give any two different types of DNA damage. **[2]**

b) Why alternative splicing is required? **[3]**

c) Explain role of RNA polymerase. **[2]**

d) Explain in short features of retroviruse. **[3]**

Q2) Answer the following: (10 Marks)

a) Why are t-RNAs called as adaptor molecules? **[3]**

b) Explain base excision repair system. **[3]**

c) Explain inhibitors of protein synthesis. **[4]**

Q3) Answer the following: (10 Marks)

a) What are SINES &LINES? **[3]**

b) Enlist the types of RNA polymerase in eukaryotes. **[3]**

c) Give roles of RecA, RuvA,RuvB, RuvC involved in recombination. **[4]**

P.T.O.

Q4) Answer the following: (10 Marks)

a) What are spliceosome? **[2]**

b) What role glycosylation plays in protein targeting? **[3]**

c) Give the role of topoisomerase in DNA replication. **[2]**

d) What is RNA editing? **[3]**

Q5) Attempt any two: (10 Marks)

a) Write in brief about regulation of transcription. **[5]**

b) Explain why Ames test can be used for detecting carcinogenesis. **[5]**

c) Explain DNA replication is semiconservative. **[5]**

Q6) Attempt any two: (10 Marks)

a) Explain the steps involved in prokaryotic translation. **[5]**

b) Explain chromatin remodeling. **[5]**

c) Explain the lysosomal transportation of protein. **[5]**

EEE

Total No. of Questions : 8]

SEAT No. :

P2897

[Total No. of Pages :2

[4724] - 3002

M.Sc. (Biochemistry)

BCH - 371 : MEDICAL BIOCHEMISTRY AND IMMUNOLOGY

(Credit System) (Semester - III) (2013 Pattern)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Neat labelled diagrams must be drawn wherever necessary.***
2) ***Figures to the right indicate full marks.***
3) ***Questions 4 & 8 are Compulsory.***
4) ***Solve any two questions from Q. No. 1 to 3 and any two questions from Q. No. 5 to 7.***

SECTION - I

(Medical Biochemistry)

Q1) Answer following:

a) Define drugs and antibiotics. **[2]**

b) What is role of viruses in carcinogenesis. **[4]**

c) Give the pathaphysiology of sickle cell anemia. **[4]**

Q2) Answer following:

a) Give any two basic approaches by WHO for control of cancer. **[2]**

b) Give features of hallucinogenes. **[4]**

c) Explain biochemistry of (CHD) coronary heart diseases. **[4]**

Q3) Answer following:

a) Name any two causes of hemoglobinopathies. **[2]**

b) Explain α-thalassemias pathaphysiology. **[4]**

c) Give function structure of lysosome in animal cell. **[4]**

P.T.O.

Q4) Answer in detail:

a) Explain Molecular genetics of cancer. **[5]**

OR

b) Any one mechanism of resistance to antibiotics. **[5]**

SECTION - II

(Immunology)

Q5) Answer the following:

a) Explain graft rejection. **[2]**

b) Explain Monoclonal antibodies. **[4]**

c) Explain attenuated vaccines **[4]**

Q6) Answer the following:

a) Define isotypes, allotypes. **[2]**

b) Explain classic complement system. **[4]**

c) Explain humoral immuneresponses. **[4]**

Q7) Answer the following:

a) Explain vaccine with an example. **[2]**

b) Explain innate immunity. **[4]**

c) What is junctional flexibility? **[4]**

Q8) Explain in detail:

a) Structure of antibody in detail with labeled diagram. **[5]**

OR

b) Explain in detail western blotting? **[5]**

Total No. of Questions : 8]

SEAT No. :

P2898

[Total No. of Pages :3

[4724] - 3003

M.Sc. (BioChemistry)

BCH-372: NEUROCHEMISTRY AND BIOCHEMISTRY OF SPECIALIZED TISSUES

(2013 Pattern) (Semester - III) (Credit System)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answers to both the sections should be written in separate answer sheets.***
2) ***Question no. 4 and 8 are compulsory.***
3) ***Attempt any two questions from Q.1 to Q.3 and any two from Q.5 to Q.7.***
4) ***Figures to the right indicate full marks.***

SECTION- I

Neurochemistry

Q1) Answer the following:

a) What is the difference between brain and cerebrum? **[2]**

b) Describe the types of neuronal circuits. **[4]**

c) Explain the role of NMDA and AMPA glutamate receptors in learning and memory process. **[4]**

Q2) Attempt the following.

a) Write a note on neuropeptides. **[3]**

b) What are the components and functions of the SNS, ANS, and ENS? **[3]**

c) Describe the synthesis, storage, mode of action and uptake of acetylcholine. **[4]**

Q3) Answer the following.

a) What is the function of the myelin sheath? Do all axons present a myelin sheath? **[2]**

P.T.O.

b) Explain the role of reticular formation. **[3]**

c) Describe the components and functions of the diencephalon. **[5]**

Q4) Attempt any one the following.

a) According to the stimuli they collect how are the sensory receptors classsified? Explain the functions of each sensory receptor. **[5]**

b) What is circadian rhythm? Explain the role on biomolecules involved in circadian rhythm. **[5]**

SECTION - II

(Biochemistry of Specialized Tissues)

Q5) Answer the following.

a) What is the relationship between ATP and creatine phosphate in the production of energy used for skeletal muscle contractions? **[2]**

b) Write a short note on taste buds. **[4]**

c) How does synaptic transmission between neurons take place? **[4]**

Q6) Attempt the following.

a) Discuss the role of Ca^{2+} in the regulation of muscle contraction. **[3]**

b) How does the motion of the hair bundle create a change in membrane potential? **[3]**

c) Write a note on cytoskeleton. **[4]**

Q7) Answer the following.

a) What is graded potential? **[2]**

b) Discuss the role of cGMP, phosphodiesterase and transducine in visual excitation. **[3]**

c) What are the differences between taste and olfaction receptors? **[5]**

Q8) Attempt any one of the following.

a) How many different kinds of photosensitive pigments are found in the human retina? How they produce electrical responses in the retina and their relation to colour vision? **[5]**

b) Describe and give the functions of the three kinds of proteins found in muscle tissue. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P2899

[Total No. of Pages :2

[4724] - 3004
M.Sc.
BIOCHEMISTRY
BCH-373: Toxicology and Plant Biochemistry
(2013 Pattern) (Semester - III) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answers to both the sections should be written on separate answer sheets.***
2) ***Question no. 4 and 8 are compulsory.***
3) ***Attempt any two questions from Q.1 to Q.3 and any two from Q.5 to Q.7.***
4) ***Figures to the right side indicate full marks.***

SECTION - I

(Toxicology)

Q1) Answer the following.

a) Explain the Dose-Response relationship. **[2]**

b) What is the fate of heavy metal lead in human body? **[4]**

c) What are the different areas of toxicology? Explain their roles. **[4]**

Q2) Attempt the following.

a) Give the composition of snake venom. **[3]**

b) Distinguish between venomous and poisonous animals. **[3]**

c) What is response curve? Give the significance of LD_{50} and MLD. **[4]**

Q3) Answer the following.

a) What do you understand the terms acute toxicity and chronic toxicity? **[2]**

b) Give the forensic applications of toxicology. **[3]**

c) Comment on membrane as a major barrier for the entry of toxicants. **[5]**

P.T.O.

Q4) Attempt any one of the following.

a) What is bioactivation? Explain with suitable example. **[5]**

b) Discuss in brief the phase-I metabolism of xenobiotic detoxification. **[5]**

SECTION - II

(Plant Biochemistry)

Q5) a) List out the micro and macro element required for plant growth. **[2]**

b) Comment on cyclic and non cyclic electron flow in photo synthetic system. **[3]**

c) Discuss the role of nitrogenase system and nitrate reductase in plant. **[5]**

Q6) a) What are plant hormones? Give their role in plant development. **[5]**

b) Explain the role of secondary metabolites with reference to flavonoids, Gum pectin, terpenoids and lignins. **[5]**

Q7) a) Give the biochemical changes occurring during seed germination. **[4]**

b) Write a short note on plant diseases. **[3]**

c) Explain the deficiency disorders caused due to iron and manganese. **[3]**

Q8) Answer any one.

a) Explain seed germination and storage protein. **[5]**

b) What is plant breeding? Give application of plant breeding in crop improvement with suitable example. **[5]**

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Total No. of Questions : 4]

SEAT No. :

P2882

[Total No. of Pages :2

[4724]-31
M.Sc.
BIOCHEMISTRY
BCH- 370: Molecular Biology
(2008 & 2010 Pattern) (Semester - III)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***

Q1) Answer any four of the following: **[20]**

a) Expalin the importance of shine and Dalgarno sequence . What are its role.

b) Justify why eukaryotic mRNA molecules are capped by r-methylguanosine?

c) Give importance of EF-TU in E.coli during translation.

d) Why methylation of DNA bases is important for survival of E.coli.

e) Explain the importance of amino acyl t-RNA - synthatase in translation in E.coli.

Q2) Attempt any two of the following: **[20]**

a) Write note on replication fork.

b) Explain in detail the excision repair mechanism for restoration of damaged DNA.

c) What is RNA editing? Explain with suitable example how does it changes a protein encoded by mRNA.

P.T.O.

Q3) Answer any four of the following: **[20]**

a) Design an experiment to prove that there are nicks in DNA.

b) Why mechanism of splicing is essential? Explain a general mechanism of splicing.

c) Differentiate between DNA polymerase I, II and III with respect to their catalytic activity and subunit structure.

d) What are mutations? How they are good and bad for bacteria.

e) What is spliceosome? Describe its role.

Q4) Write short notes on (any four): **[20]**

a) Clover leaf structure of t-RNA.

b) E.coli RNA polymerase.

c) Histone protein.

d) SOS.

e) Okazaki fragment.

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Total No. of Questions : 6]

SEAT No. :

P2883

[Total No. of Pages :2

[4724] - 32
M.Sc.
BIOCHEMISTRY
BCH - 371 : Medical Biochemistry and Immunology
(2010 Pattern) (Semester - III)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answers to both the sections should be written on separate answer sheets.***
2) ***All questions are compulsory.***
3) ***Figures to the right indicate full marks.***

SECTION - I

(Medical Biochemistry)

Q1) Answer any three of the following: **[15]**

a) How bacteria develop resistance to antibiotics.

b) Give the composition of cerebrospinal fluid and their biochemical significance.

c) Write short account on antimetabolites and their applications.

d) What are analgesics? Give example. Discuss the mechanism of their action.

Q2) Answer any three of the following: **[15]**

a) What are lysosomes? Give their physiological role.

b) Explain the process of programmed cell death.

c) Elaborate on the mechanism of fibrin formation.

d) Elaborate on the cause and treatment of Artheriosclerosis.

Q3) Write note on any two of the following: **[10]**

a) Etiology of cancer.

b) Sickle cell anemia.

c) Teratogenesis.

P.T.O.

SECTION - II

(Immunology)

Q4) Answer any three of the following: **[15]**

a) Explain the principle, procedure and application of ELISA.

b) Write note on class I and class II MHC moleculs with their fucntion.

c) Write a note on Antigen and Antibody reaction.

d) What are monoclonal and polyclonal antibodies? How are they prepared?

Q5) Answer any three of the following: **[15]**

a) Differentiate between cell mediated and humoral immunity.

b) Differentiate between T and B lymphocyts.

c) Explain the mechanism of complement fixation.

d) Classify Immonoglobulins and give their features.

Q6) Write note on any two of the following: **[10]**

a) Interferons.

b) Vaccins.

c) Anaphylaxis.

Total No. of Questions : 4]

SEAT No. :

P2884

[Total No. of Pages : 2

[4724] - 33
M.Sc. (Biochemistry)
BCH-372: NEUROCHEMISTRY
(2010 Pattern) (Semester - III)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Draw neat labelled diagram where necessary.***

Q1) Answer any four of the following. **[20]**

a) Write a note on cytology of a neuron.

b) Neuropeptides.

c) Explain the term dipolarisation, Repolarisation and hyperpolarisation of a membrane in signal transmission.

d) GABA receptor.

e) Explain the factors that affect development of CNS.

Q2) Attempt any two of the following. **[20]**

a) Explain the synthetic pathways and in activation mechanism of catecolamines and acetylcholine.

b) Explain the mechanism proposed for short term and long-term memory storage.

c) Describe the local factors affecting brain blood flow. Compare their effectiveness with autonomous regulation of cerebral blood flow.

P.T.O.

Q3) Answer any two of the following. **[20]**

a) Explain the generation and conduction of action potentials.

b) Explain the mode of action of hair cells involved in the generation of sound.

c) Describe the overall function of the basal ganglia.

Q4) Answer any four of the following. **[20]**

a) Write a short note on Rod and cone cells.

b) Write a note on olfactory receptors.

c) Calcium signalling.

d) Write a note on limbic signalling.

e) Synaptic plasticity.

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Total No. of Questions : 4]

SEAT No. :

P2885

[Total No. of Pages : 2

[4724] - 34
M.Sc.
BIOCHEMISTRY
BCH - 373 : Biochemical Toxicology
(2010 Pattern) (Semester - III)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures in bracket on the right hand side indicate full marks.***

Q1) Answer Any four of the following: **[20]**

a) What are the aims & objectives of the experimental toxicology studies? How acute toxicity of toxicant is determined?

b) What are teratogenic effects?

c) Give the significance of occupational toxicology.

d) What are chemical applications of toxicology.

e) Explain the carbonate insecticides & mechanism of their action.

f) Explain the dose response relationship.

Q2) Attempt any four of the following: **[20]**

a) What are toxic effect of ethenol?

b) Explain the various enzymatic reactions involved in detoxication of organophosphorus insecticides.

c) Explain the vascular effect on brain & lung.

d) What is the site & mechanism of action of DDT.

e) Explain the biotransformation pathway of benzene leading to toxic effects.

f) Give the fate of cadmium in human body.

P.T.O.

Q3) Answer any four of the following: **[20]**

a) Enumerate the amphibian toxins & their toxic effects.

b) How oxidative type of air pollution is generated?

c) What are the cellular & carcinogenic effects of arsenic?

d) Explain the endogenous and exogenous factors influence the metal toxicity.

e) Give chemical compositing no of snake venom.

f) Give the fate of mercury in human body.

Q4) Give the pathogenesis & clinical manifestation of any four of the following:**[20]**

a) Encephalopathy due to head.

b) Shock & hypotension by snake venom.

c) Cholestasis due to various chemical agents.

d) Silicosis and asbestosis.

e) Photoxicity by plant toxins.

f) Oncogenesis of lungs.

Total No. of Questions : 8]

SEAT No. :

P2900

[Total No. of Pages : 2

[4724]-4001
M.Sc.
BIOCHEMISTRY
BCH-470 : Physiological Biochemistry and Endocrinology
(2013 Pattern) (Semester-IV) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answer to both the section should be solved in different answer sheets.***
2) ***Solve any two question from Q. 1 to Q. 3 and any two from Q. 5 to Q. 7.***
3) ***Question No. 4 and 8 are compulsory.***
4) ***Figures to the right indicate full marks.***

SECTION-I

(Physiological Biochemistry)

Q1) Answer the following:

a) Write the anatomy of liver. **[3]**

b) Explain the physiological function of kidney. **[3]**

c) Give the absorption of carbohydrate protein, lipids minerals and vitamin. **[4]**

Q2) Attempt the following:

a) Give the list of clotting factors. **[2]**

b) Write in detail the abnormalities associated with acid-have balance. **[4]**

c) Write a note on water and mineral metabolism. **[4]**

Q3) Answer the following:

a) Write the principles of gaseous exchange during respiration. **[3]**

b) What are different kidney disorders? **[3]**

c) Write a note on Jaundice and its types. **[4]**

P.T.O.

Q4) Answer Any One of the following:

a) Explain intrinsic and extrinsic pathway. **[5]**

b) What are the different types of buffer and explain its function? **[5]**

SECTION-II

(Endocrinology)

Q5) Answer the following:

a) What is PTH? Explain its role in brief. **[2]**

b) Describe the general regulation of secretion of growth hormone. **[3]**

c) What are the intracellular changes that occur after androgen binds its receptor. **[5]**

Q6) Attempt the following:

a) What is glucagon? What are its target cells? **[3]**

b) What are catecholamines? Describe the physiological functions of catecholamines. **[3]**

c) How does the endocrine system work with other body system, such as the nervous system & the circulatory system. **[4]**

Q7) Answer the following:

a) What are thyroxine? Describe the function of thyroxine in brief. **[2]**

b) What is the significance of altering kinase activity in target cells. **[4]**

c) Describe the function of each of the following harmones TSH, GnRH, LH and PRL. **[4]**

Q8) Attempt Any One of the following:

a) What are the major biochemical effects of insulin? **[5]**

b) Describe the mechanism to control secretion of insulin. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P2901

[Total No. of Pages : 2

[4724]-4002
M.Sc.
BIOCHEMISTRY
BCH-471 : Fermentation Technology and Tissue Culture
(2013 Pattern) (Semester-IV) (Credit System)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answer to both the sections should be written on separate answer sheets.***
2) ***Question No. 4 and 8 are compulsory.***
3) ***Attempt any two questions from Q.1 to Q.3 and any two questions from Q.5 to Q.7.***
4) ***Figures to the right indicate full marks.***

SECTION-I

(Fermentation Technology)

Q1) Answer the following:

a) What are different criteria for isolation of industrially important micro-organism? **[3]**

b) Discuss various factors that affect downstream processing of biotech products. **[4]**

c) How will you proceed for isolation of resistant mutant? **[3]**

Q2) Attempt the following:

a) Explain the role of agitation and aeration in fermentation. **[4]**

b) Discuss the various methods for effluent treatment. **[4]**

c) Explain any one method used for product recovery. **[2]**

Q3) Answer the following:

a) Discuss in brief the range of fermentation process. **[3]**

b) Describe in detail the manufacture of beer by fermentative process. **[4]**

c) Fermentation technology is widely applied in many fields. Justify this statement. **[3]**

P.T.O.

Q4) Attempt Any One of the following:

a) Explain the effect of inducer and precursor in fermentation. **[5]**

b) Explain the strain improvement using auxotrophic mutants. **[5]**

SECTION-II

(Tissue Culture)

Q5) Answer the following:

a) Write a note on somaclonal variation. **[3]**

b) Explain primary and secondary cell culture. **[3]**

c) Describe in detail Hanging drop, suspension and monolayer culture. **[4]**

Q6) Attempt the following:

a) Give the importance of serum in media preparation. **[3]**

b) Explain the technique of Agrobacterium mediated hair root culture. **[3]**

c) Describe in detail different cell culture methods. **[4]**

Q7) Answer the following:

a) Explain the technique of protoplast fusion. **[3]**

b) What are primary and established cell lines? **[3]**

c) Explain the characteristics of transformed cell. **[4]**

Q8) Answer Any One of the following:

a) Discuss the techniques of micropropagation in detail. **[5]**

b) What do you mean by Haploid culture and embryo culture? **[5]**

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Total No. of Questions : 8]

SEAT No. :

P2902

[Total No. of Pages :2

[4724]-4003
M.Sc.
BIOCHEMISTRY
BCH- 472: Genetic Engineering
(2013 Pattern) (Credit System) (Semester - IV)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Answers to both sections should be written on separate answer sheets.***
2) ***Question No. 4 and 8 are compulsory.***
3) ***Attempt any two from Q 1 to Q 3 and any two from Q 5 to Q 7.***
4) ***Figures to the right side indicate full marks.***

SECTION -I

Q1) Answer the following:

a) What are ligases? **[2]**

b) Draw and explain T-DNA in Ti - plasmid. **[4]**

c) Discuss features of a good vector? Explain one plasmid and one phage. **[4]**

Q2) Attempt the following:

a) Write note on foot printing using DNase I. **[3]**

b) Explain any one method used for transformation. **[3]**

c) Explain herbicide resistance with example. **[4]**

Q3) Answer the following:

a) Define plasmid and cosmid. **[2]**

b) Write note on cloning vectors for insects explain any one in detail. **[3]**

c) Explain role of restriction endonucleases in genetic engineering. **[5]**

P.T.O.

Q4) Answer the following:

a) Write note on types of yeast vectors. Also explain SV40 vector in detail. **[5]**

OR

b) Explain the difference between cDNA and genomic library. **[5]**

SECTION -II

Q5) Answer the following:

a) Name any two recombinant proteins. **[2]**

b) Write note on Invitro mutagenesis. **[4]**

c) Explain principle of RFLP. **[4]**

Q6) Attempt the following:

a) Explain the agrobacterium mediated gene transfer in plants. **[3]**

b) Explain method for producing recombinant factor VIII. **[4]**

c) Give application of PCR. **[3]**

Q7) Answer the following:

a) Briefly describe mi RNA and si RNA. **[2]**

b) Give importance of protein engineering technology. **[3]**

c) Explain process of site directed mutagenesis. **[5]**

Q8) Attempt following:

a) Write note on Antisense RNA and its application in plants. **[5]**

OR

b) Write note on particle gun method and lepofection techniques. **[5]**

EEE

Total No. of Questions : 8]

SEAT No. :

P2903

[Total No. of Pages :2

[4724] - 4004

M.Sc.

BIOCHEMISTRY

BCH - 473 : Clinical Nutrition & Food Technology

(2013 Pattern) (Semester - IV) (Credit System) (Optional Course)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answer to both the section should be written on separate answer sheet.***
2) ***Question No. 4 & 8 are compulsory.***
3) ***Attempt any two questions from Q.1 to Q.3 and two questions from Q.5 to 7.***
4) ***Figures to the right indicate full marks.***

SECTION - I

Q1) Answer the following:

a) Explain the effect of cooking on nutritional quality of food. **[2]**

b) Which toxic chemicals are present in tea? Explain the effect in brief. **[4]**

c) Describe the interrelationship between dietary lipids and cholesterol metabolism. **[4]**

Q2) Attempt the following:

a) What are acidic foods? Explain any one example in detail. **[3]**

b) Describe the effect of food quality on mental development. **[3]**

c) Write a note on tobacco. **[4]**

Q3) Answer the following:

a) What is the effect of fermentation on nutritional quality of food. **[2]**

b) Enlist the organs affected by alcohol consumption. Describe the effect of alcohol on each organ in brief. **[3]**

c) Describe the factors affecting on absorption of food. **[5]**

Q4) Attempt any one of the following:

a) Explain the effect of exercise on metabolic adaptation. **[5]**

b) What are the inborn errors of metabolism? Explain the management of any two inborn errors. **[5]**

P.T.O.

SECTION - II

Q5) Answer the following:

a) Differentiate the features of foods obtained from plant and animal origin. **[3]**

b) What do you mean by primary feed stock. **[3]**

c) Explain the principle of food preservation. **[4]**

Q6) Attempt the following:

a) Write a note on single cell protein. **[3]**

b) Describe the different enzymes used for food processing. **[4]**

c) Explain different food additin. **[3]**

Q7) Answer the following:

a) Explain natural and synthetic sweetness. **[4]**

b) Write a note on neat Tenderisation. **[3]**

c) Explain starch production. **[3]**

Q8) Answer any one of the following:

a) How are genetically modified food is prepared. **[5]**

b) Explain food additives, flavoring agents color and sweetness. **[5]**

Total No. of Questions : 8]

SEAT No. :

P2886

[Total No. of Pages : 3

[4724]-41
M.Sc.
BIOCHEMISTRY
BCH-470 : Biochemical Endocrinology and Tissue Culture
(2008 Pattern)
BCH-470 : Biochemical Endocrinology and Plant Biochemistry
(2010 Pattern) (Semester-IV)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answer to both the sections should be written on separate answer sheets.***
2) ***Attempt any two questions from Section-I.***
3) ***Draw figures wherever necessary.***
4) ***Figures to the right indicate full marks.***

SECTION-I

(Biochemical Endocrinology)

Q1) Answer the following: **[20]**

a) What are the hormones secreted by adrinal modulla? What are their respective functions.

b) How is calcium homeostasis maintained in our body?

c) Describe the function of ADH.

d) Describe how the level of thyroxine is controlled in the bloodstream.

Q2) Attempt the following: **[20]**

a) Explain the target cell concept.

b) Classify hormones based on biochemical nature & their mechanism of action.

c) Describe the function of each of the following hormones in the uterine & ovarian cycles: GnRH, FSH, LH, estrogens, progesterone and inhibin.

d) What is the renin-angiotensin system? Explain role of their system in endocrine function.

P.T.O.

Q3) Answer the following: **[20]**

a) What are the structural difference between proinsulin and insulin?

b) What are gastro-intestinal harmone? Explain the function of any five harmones in brief.

c) What are some disorders of the endocrine system? How do doctors treat them?

d) Explain the effect of cholera toxin on adenylate cyclase system.

SECTION-II

(Tissue Culture (Old / 2008))

Q4) Answer Any Three of the following: **[15]**

a) What is media? Give importance of micronutrients.

b) Describe the various ways of sterilization.

c) Give the process and importance of Agrobacterium mediated having root culture.

d) Define phytochemical. Give their importance.

e) Explain the process of hardening in PTC.

Q5) Explain the following (Any Three): **[15]**

a) Explain the term organ culture. Describe the various methods involved in organ culture.

b) What is cell repository? Give its maintenance and importance.

c) Describe the process of callus culture and give its significance.

d) Explain the production of somatic hybrids.

e) Techniques for maintenance of fibroblast culture.

Q6) Short note on Any Two: **[10]**

a) Anther culture.

b) Contact inhibition.

c) Embryo culture.

SECTION-II

(Plant Biochemistry) (2010 Pattern)

Q4) Answer the following (Any Three): **[15]**

a) Hill reaction.

b) Photophosphorylation.

c) CO_2 fixatron.

d) Biosynthesis of sucrose.

e) Role of sulfur in plant growth.

Q5) Explain the following (Any Three): **[15]**

a) Function of indole acetic acid.

b) Role of calcium in plant growth.

c) Protoplast function technique.

d) Plant Tissue culture media.

e) Seed germination and storage proteins.

Q6) Write short notes on (Any Two): **[10]**

a) Nitrate reductase.

b) Circardian rhythm.

c) Regeneration of plant from callus.

●●●●●

Total No. of Questions : 6]

SEAT No. :

P2887

[Total No. of Pages : 2

[4724]-42
M.Sc.
BIOCHEMISTRY
BCH-471 : Fermentation Technology and Food Technology
(2010 Pattern) (Semester-IV)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answer to both the section should be written on separate answer sheets.***
2) ***All questions are compulsory.***
3) ***Figures to right indicate full marks.***

SECTION-I

(Fermentation Technology)

Q1) Answer Any Three questions from the following: **[15]**

a) What are different criteria for isolation of industrially important micro-organism?

b) What do you understand from hatch culture?

c) How microorganisms are isolated by enrichment culture technique?

d) Give the different methods for strain improvement.

e) Discuss biological method of effluent treatment.

Q2) Attempt any three questions: **[15]**

a) What are various methods of feedback control?

b) What are the different methods of preservation of industrially important micro-organism?

c) What are the basic requirement for expression of foreign DNA in micro-organism?

d) How will you proceed for isolation of resistant mutants?

e) How filtration is used in product recovery?

P.T.O.

Q3) Attempt Any Two questions: **[10]**

a) Write a note on instrumentation and control system in fermentation.

b) Explain physical and chemical methods of effluent treatment.

c) What is meant by media formulation?

SECTION-II

(Food Technology)

Q4) Answer Any Three of the following: **[15]**

a) Differentiate the features of foods obtained from plant and animal origin.

b) How will you monitor food quality?

c) What do you mean by primary feed stock?

d) Write a note on single cell protein.

e) Explain the manufacturing of natural and synthetic syrups.

Q5) Attempt Any Three of the following: **[15]**

a) Write a note on different food additives.

b) Write the principle of food preservation.

c) Explain the different chemical changes occuring in food spoilage.

d) How will you proceed for starch production?

e) What are flavoring agents? Explain.

Q6) Answer Any One of the following: **[10]**

a) Explain how food is modified genetically.

b) What is the role of different enzymes in food processing?

c) How will you analyse food for its quality?

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Total No. of Questions : 4]

SEAT No. :

P2888

[Total No. of Pages :2

[4724]-43
M.Sc.
BIOCHEMISTRY
BCH- 472: Genetic Engineering
(2008 & 2010 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Answer any four of the following: **[20]**

a) What are restriction endonucleases? Give its types with example.

b) What is vector? Explain pBR322.

c) Explain the technique of replica plating and give its importance.

d) Explain the term transgenic plants?

e) Write a note on microarray.

Q2) Answer any four of the following: **[20]**

a) Explain in detail methods for selection of recombinant clones.

b) Explain the structure of Ti plasmid. Give its importance.

c) Describe the methods for screening of rDNA clones.

d) Discuss the application of genetic engineering in medicine.

e) What is RNAi technology? Give its various applications.

P.T.O.

Q3) Answer any four of the following: **[20]**

a) Explain insecticide resistant plant.

b) Explain the term Epigenetics.

c) Give the methods involved in protein engineering.

d) How recombinant factor VIII is genetically engineered?

e) Define cosmid. Give its importance in cloning.

Q4) Write a note on any four of the following. **[20]**

a) Reverse transcriptase.

b) Colony hybridization.

c) RFLP.

d) M13 Phage.

e) Methods of transfection.

EEE

Total No. of Questions : 6]

SEAT No. :

P2929

[Total No. of Pages : 4

[4725]-3001
M.Sc.
DRUG CHEMISTRY
CHD- 361: Chemistry of Heterocycles and Drug Synthesis
(2013 Pattern) (Credit System) (Semester - III)

Time : 3 Hours] *[Max. Marks :50*

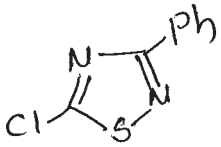
Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer book.***

SECTION - I

Q1) Explain any four of the following: **[8]**

a) The relative rates of reaction with piperidine in ethanol are



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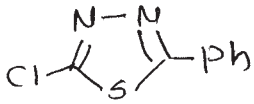

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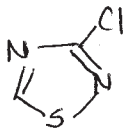


1

b) Coumarins can serve as dienophiles in Diels-Alder reaction.

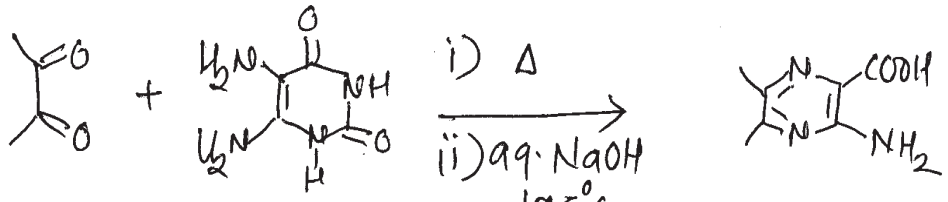
c) Hydrolysis of 4-chloro-3-nitropyridine can be achieved under mild conditions as compared to 2-chloronitrobenzene.

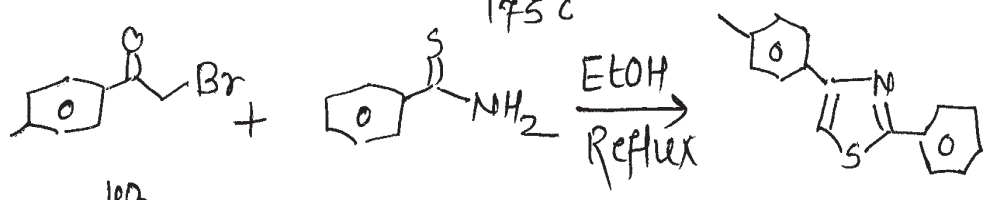
d) Indole on reaction with chloroform, KOH in ethanol give 3-chloroquinoline as one of the product.

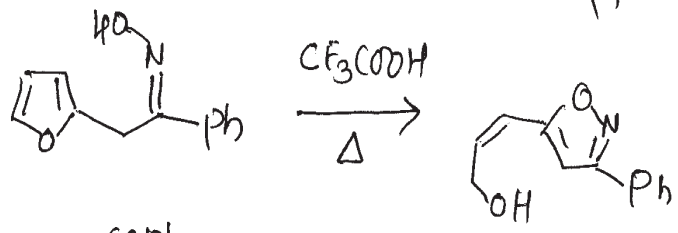
e) Thiophene is more stable to strongly acidic conditions than furan and pyrrole.

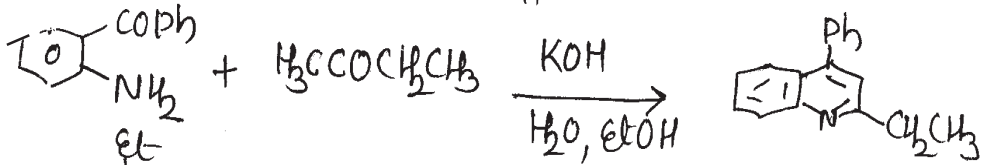
P.T.O.

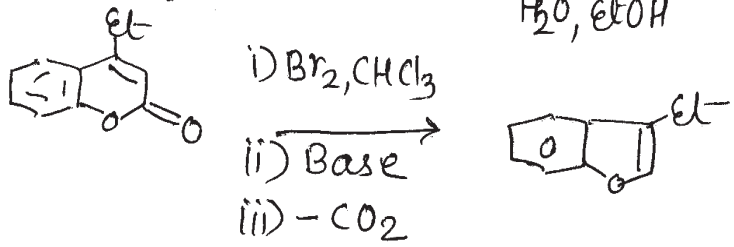
Q2) Suggest the suitable mechanism for any four of the following conversions. **[8]**

a) 

b) 

c) 

d) 

e) 

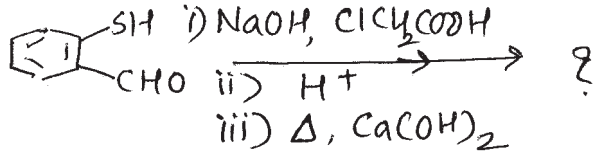
Q3) a) Write short notes on any two of the following: **[4]**

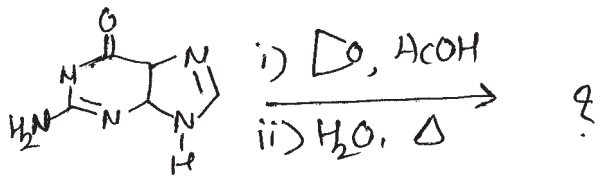
i) Baker-Venkatraman Reaction.

ii) Pictet-spengler synthesis of isoquinolines.

iii) Hinsberg thiophene synthesis.

b) Predict the products for any two of the following: **[5]**

i) 

ii) 

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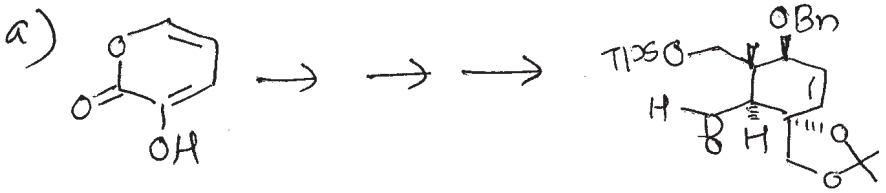
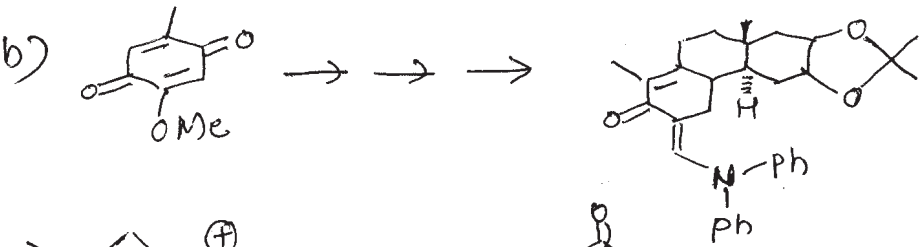
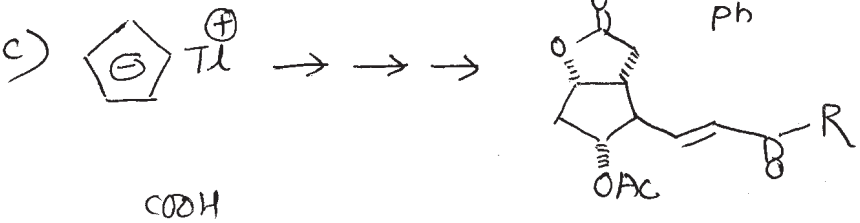
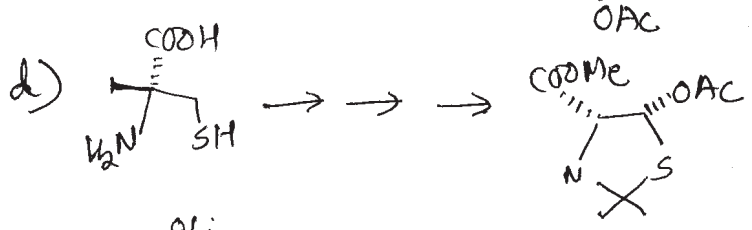
SECTION - II

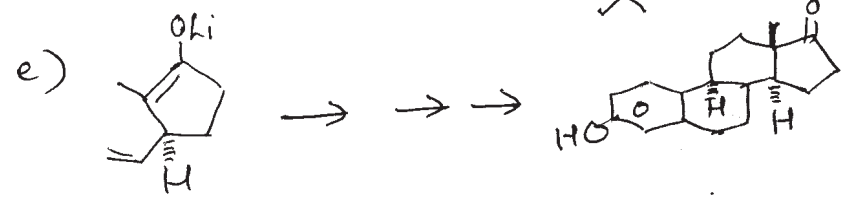
Q4) Discuss the steps involved in the following transformations. Comment on the steps indicating mechanism and reagent used (any three) **[12]**

a) 

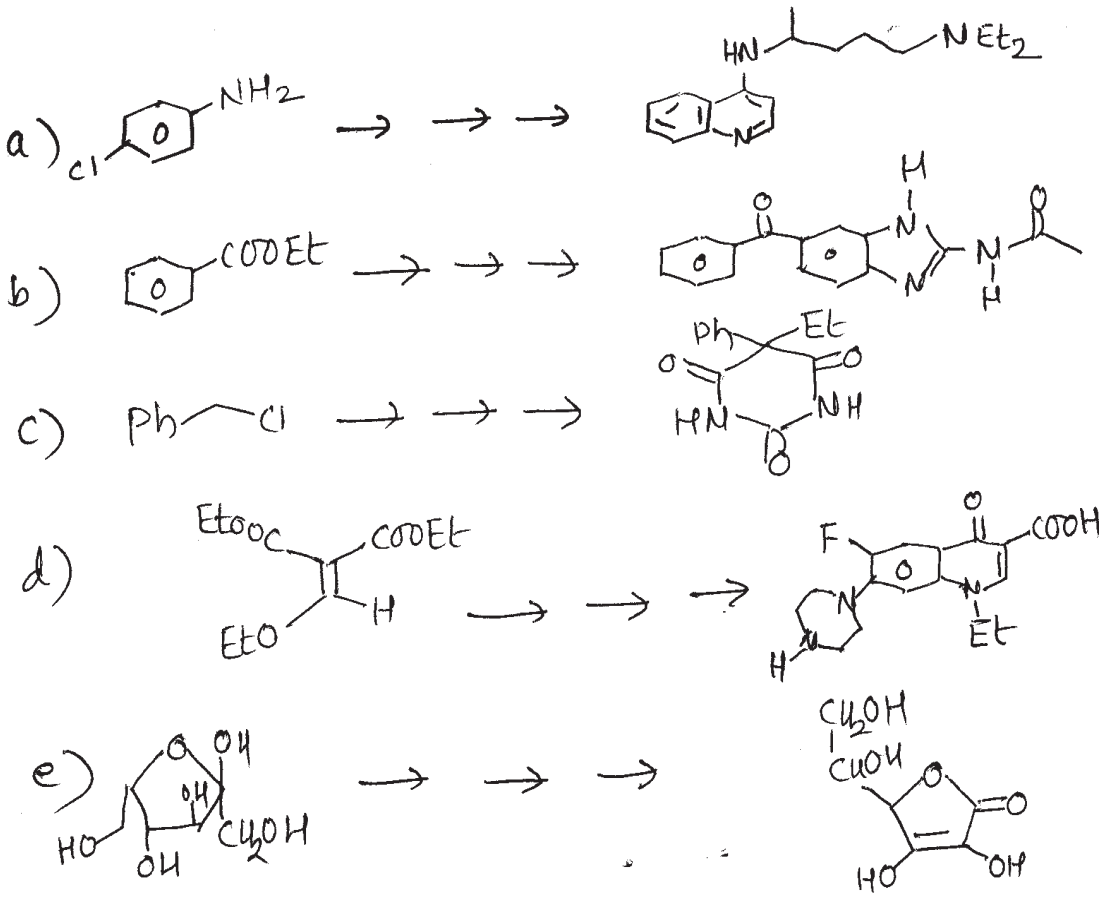
b) 

c) 

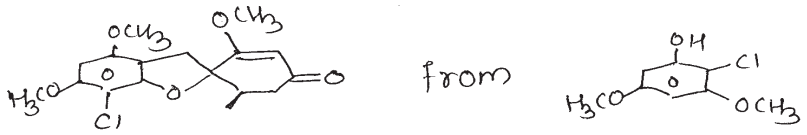
d) 

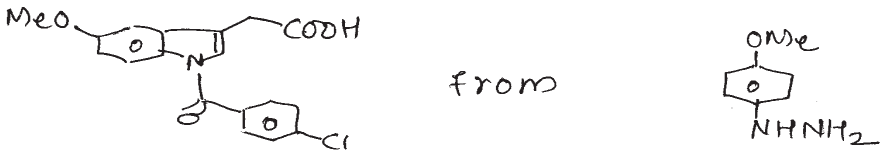
e) 

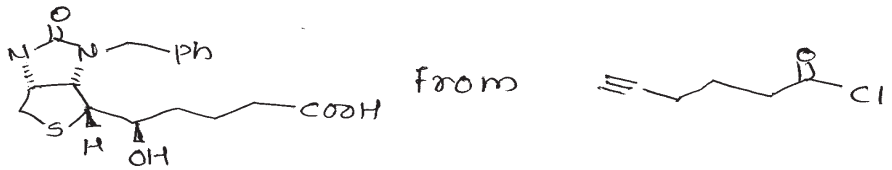
Q5) Discuss the steps involved in the synthesis of following drug molecules. Explain the mechanism involved (any three): **[9]**



Q6) Devise a synthetic pathway for any two of the following from the starting compound shown: **[4]**

a) 

b) 

c) 

EEE

Total No. of Questions : 6]

SEAT No. :

P2930

[Total No. of Pages : 6

[4725]-3002
M.Sc.
DRUG CHEMISTRY
CHD-362 : Advanced Analytical Methods
(2013 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Figures to the right side indicate full marks.***

SECTION-I

Q1) A) Answer Any Three of the following: **[6]**

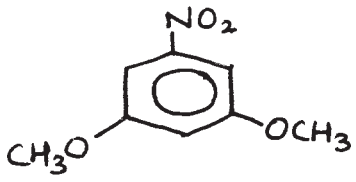
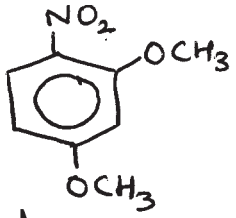
a) Explain the significance of metastable ions in MS.

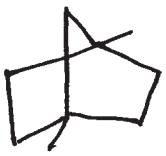
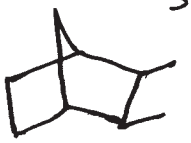
b) In PMR of nitrobenzene the orthoprotons are deshielded while in CMR the ortho carbons are sheilded. Explain.

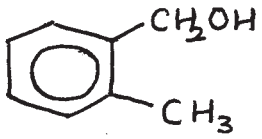
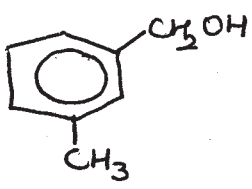
c) The vicinal coupling constants J_{12} and J_{23} in naphthalene are not same. Explain.

d) The ^1H NMR spectrum of monofluoro acetone shows a doublet for methyl protons with J = 4.3Hz, explain.

B) Distinguish between the following pairs by using the indicated spectral methods (Any Two): **[3]**

a)  and  PMR

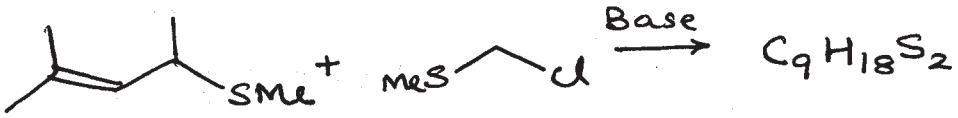
b)  and  CMR

c)  and  Mass

P.T.O.

Q2) Answer <u>Any Four</u> of the following: **[10]**

a) Complete the following sequence of reaction. Deduce the structure of the product on the basis of the PMR data



^{1}HNMR: 1.28(s, 6H) 1.63(d, 4.5Hz, 3H)
2.45(s, 6H) 4.22(s, 1H) 5.41(d, 15Hz, 1H)
5.63(dq, 15 & 4.5Hz, 1H)

b) Deduce the structure

M.F. : $C_6H_6O_2$
IR : 1600, 1500, 1705 cm^{-1}
PMR : 2.3(s, 3H) 5.85(d, 2Hz, 1H) 6.2(dd, 1.5 & 2Hz, 1H) 7.2(d, 1.5Hz, 1H)
CMR : 198, 156, 145, 130, 125, 23
DEPT 135 : 145, 130, 125, 23 up
198, 156 absent

c) Predict the structure

M.F. : $C_9H_{16}O$
IR : 1680, 1635 cm^{-1}
PMR : 0.9(d, 7Hz, 6H) 1.0(t, 7Hz, 3H) 1.77(m, 1H)
2.09(t, 7Hz, 2H) 2.49(q, 7Hz, 2H) 5.1(d, 16Hz, 1H)
6.71(dt, 16 & 7 Hz, 1H)
CMR : 8.15(q) 22.5(q. str) 28.3(d) 33.1(t) 42.0(t) 131.8(d)
144.9(d) 191.6(s)

d) Deduce the structure

M.F. : $C_7H_7O_3N$
UV(λ_{max}) : 265nm (ϵ = 15,000)
IR : 3600, 1600, 1530, 1495, 1360 cm^{-1}
PMR : 2.9(s, 6mm, exch.) 5.0(s, 12mm)
7.6(m, 18mm) 8.15(dd, 2 & 7Hz, 6mm)

e) On a 60 MHz instruments, the AB quartet show δ_A = 112Hz, δ_B = 120Hz and J_{AB} = 15Hz. Calculate the line positions of the four lines in Hertz. Clearly write all the calculations.

Q3) Write short note on Any Three of the following: **[6]**

a) Various analyzers used in spectrometry.

b) Homo and Hetero nuclear correlated spectroscopy.

c) Factors affecting vicinal coupling constants in PMR.

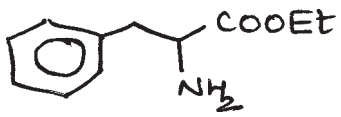
d) Contact-Shift reagents.

SECTION-II

Q4) A) Write the genesis of the ions indicated below (Any Three): **[6]**

a) Hexanenitrile 97, 82, 68, 41

b) 2, 6-Dimethyl heptan-4-ol 126, 111, 87, 68

c) 

193, 120, 102, 91

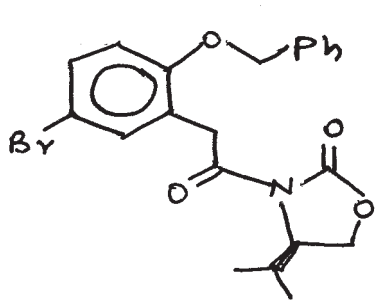
d) Ethyl isopropyl thioether 104, 89, 61, 47

B) The two isomers of C_6H_{14} show following mass spectral data. Assign the structures to each isomer. The m/e(%) are as follows: **[2]**

I : 86(15.5) 57(100) 43(81) 42(41) 41(70) 29(61)

II : 86(0.1) 57(98) 56(32) 43(100) 41(56) 29(48)

Q5) a) Assign the signals given below to the various protons in compound X. Justify your answer: **[4]**



X

7.35-7.28(m, 7H) 6.79(d, 8.7Hz, 1H)

5.05(d, 11.7Hz, 1H) 5.0(d, 11.7Hz, 1H)

4.21(d, 17.5Hz, 1H) 4.31(m, 1H)

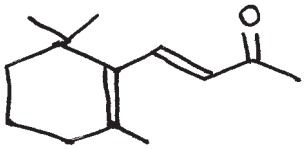
4.18(d, 17.5Hz, 1H) 4.14(dd, 9.1 & 3Hz, 1H)

4.07(t, 9Hz, 1H) 2.29(m, 1H)

0.85(d, 7.1Hz, 3H) 0.77(d, 7Hz, 3H)

Decoupling Expt:	Change at
irradiate at	i) 2.29(m) → septet
4.31δ	ii) 4.14(dd) → d(J = 9.1Hz)
	iii) 4.07(t) → d(J = 9.1Hz)

b) Assign the signals to different carbons in the following structure and justify your answer: **[3]**



17.5(t) 19.7(q) 25.2(q)

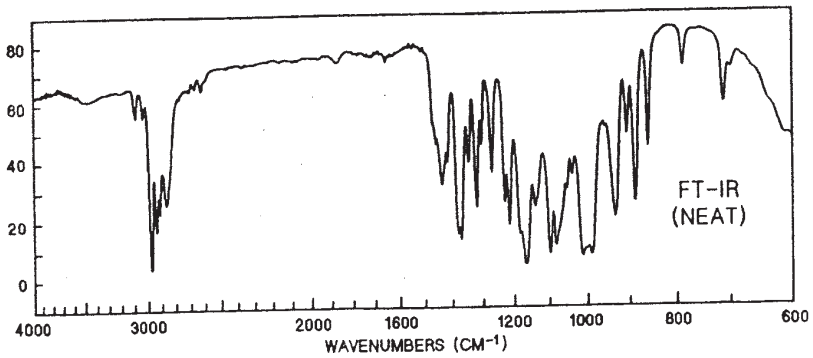
27.0(q, str.) 31.8(t) 32.6(s, weak)

38.4(t) 130.7(d) 133.4(s, weak)

134.7(s, weak) 140.7(d) 195.5(s, weak)

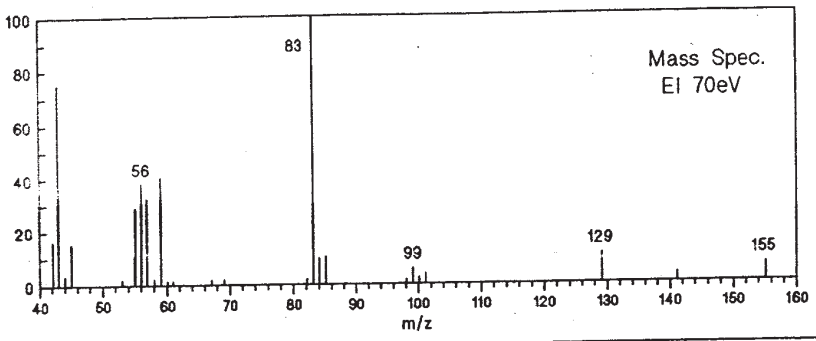
c) Assign the number of esr signals in methyl radical. **[2]**

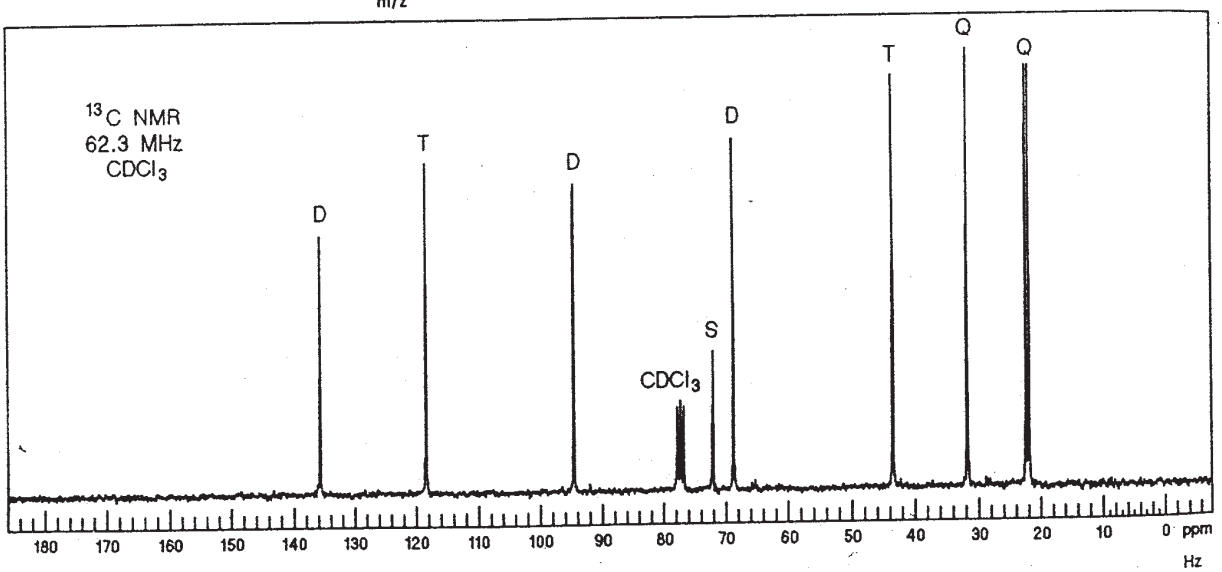
Q6) A compound exhibits following spectral data shown on the attached sheet. Suggest the structure and explain the observed spectral data. **[8]**

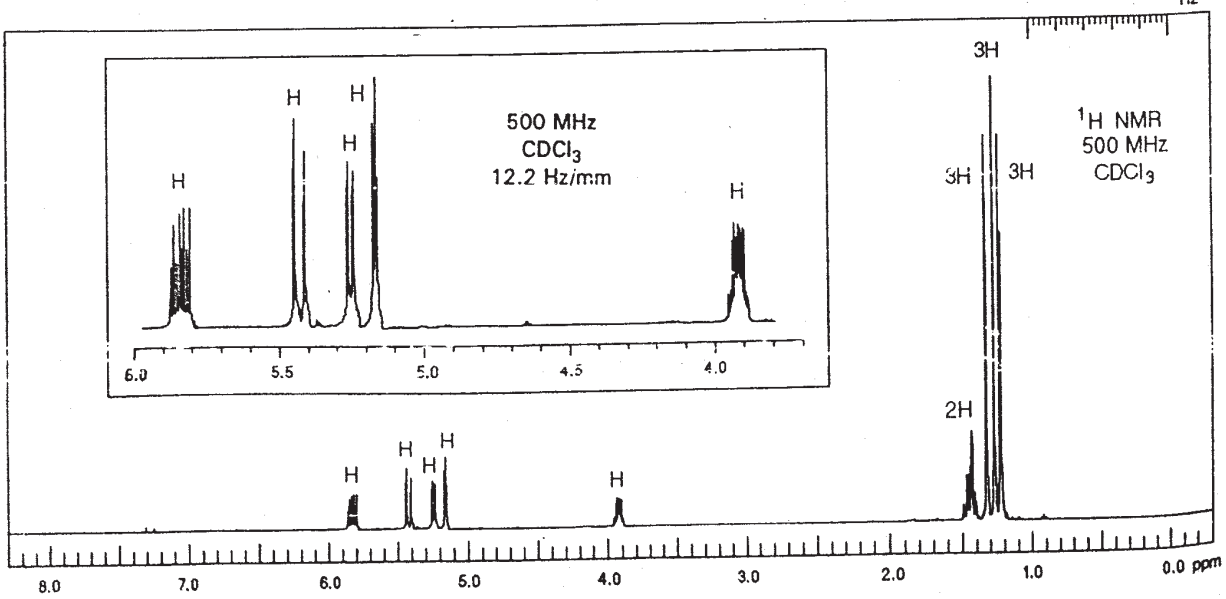


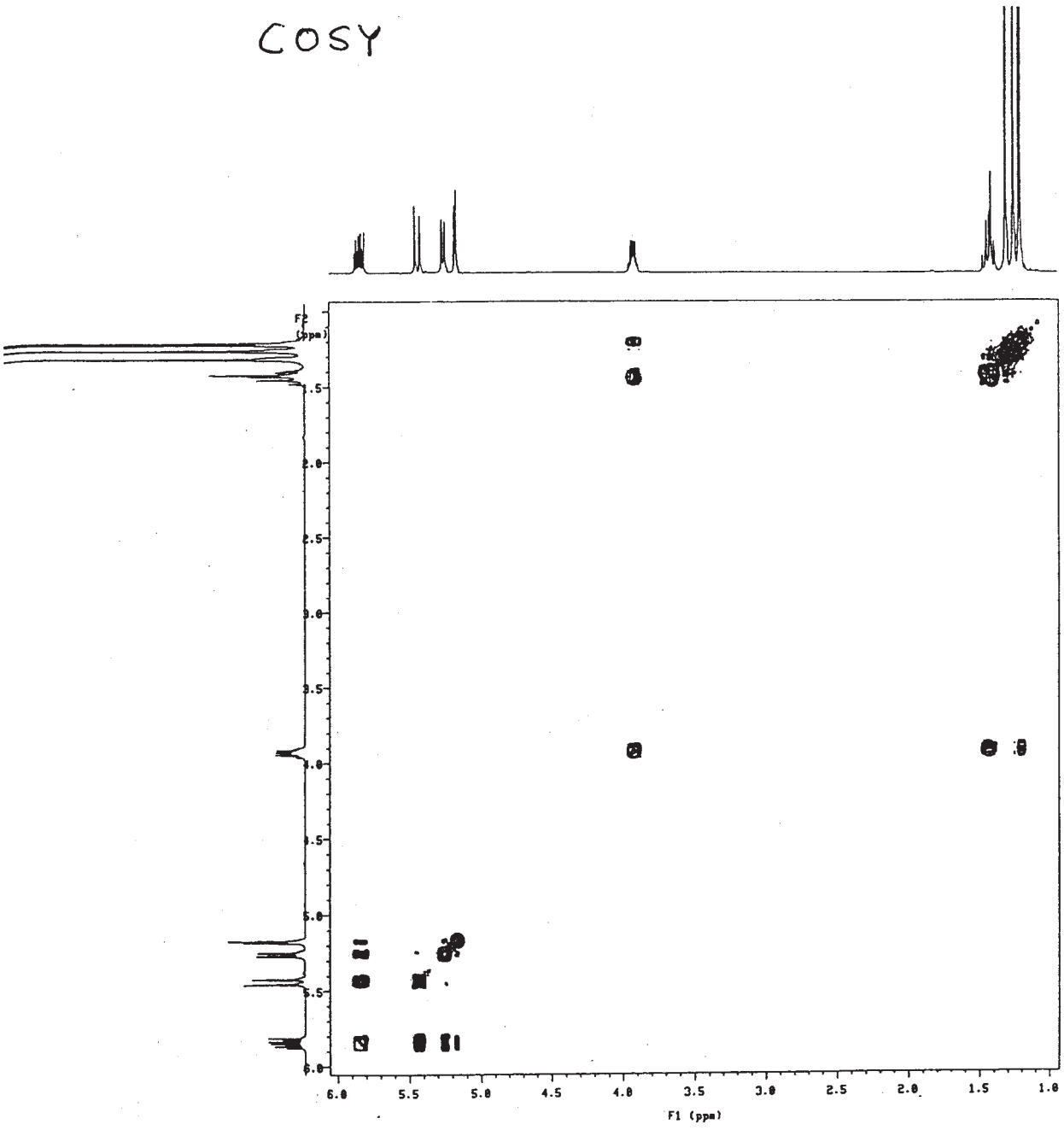
Exact M.S. (EI) = 156.1150

UVλ_{max} = BLANK








COSY
F2 (ppm)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
F1 (ppm)

●●●●●

Total No. of Questions : 6]

SEAT No. :

P2931

[Total No. of Pages :3

[4725] - 3003

M.Sc. (Drug Chemistry)

CHD-363: MICROBIOLOGY, IMMUNOLOGY & DRUG DISCOVERY AND DEVELOPMENT

(2013 Pattern) (Semester - III) (Credit System)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate maximum marks.***
3) ***Draw neat labelled diagrams wherever necessary.***
4) ***Answers to the two sections to be written in separate answer books.***

SECTION- I

Q1) Attempt any three of the following: **[12]**

a) What classification system is used for bacteria? Explain giving a broad outline of different groups of bacteria.

b) What are the principles of bacterial strain improvement?

c) With the help of a suitable diagram, explain different phases of bacterial growth.

d) List different nutrient media used for microbial growth. Give the components and explain role of the components in any one medium.

e) Explain principles of microbial effluent treatment processes.

Q2) Attempt any two of the following: **[8]**

a) Explain activation of antibody mediated immune response.

b) Describe the mechanism and symptoms of Type -II hyper sensitivity.

c) List drugs used to suppress immune reactions. Explain mechanism of any one in detail.

d) Explain precipitation reactions to visualize antigen-antibody complexes in vitro.

P.T.O.

Q3) Explain any five of the following terms: **[5]**

a) Receptors

b) Therapeutic Ratio

c) SAR

d) Drug target

e) Pharmacodynamics

f) First pass effect

SECTION - II

Q4) Answer any three of the following. **[12]**

a) How do drugs exhibit biological activity? Explain. What is meant by potency and efficacy of a drug?

b) Give brief account of testing drugs in vivo and in vitro. Discuss the benifits of each.

c) Give a brief account of scale up and process development carried out in a pharmaceutical industry.

d) What properties of a drug are responsible for its dosage forms. Why are some drugs taken by IV only? What will be the best dosage form for skin Infection and eye infection.

e) Give a brief overview of drug discovery techniques. How will you approach to discover a new drug. Justify your approach.

Q5) Answer any two of the following. **[8]**

a) Explain

i) Patent

ii) Patentable Inventions

iii) Infringement

iv) Provisional specifications

b) Discuss the role of following in pharma industry.

i) QA and QC

ii) R &D

c) Discuss

i) Observations made in phase II & III of clinical trials

ii) Need of phase I clinical trials.

Q6) Explain any two of the following. **[5]**

a) Need of various dosage forms.

b) Chronic toxicity studies carried out on an NCE.

c) Lead development methods.

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Total No. of Questions : 6]

SEAT No. :

P2932

[Total No. of Pages : 5

[4725]-3004
M.Sc.
DRUG CHEMISTRY
CHD- 364: Stereochemistry Asymmetric Synthesis and Pericyclic Reactions
(2013 Pattern) (New) (Semester - III)

Time : 3 Hours] *[Max. Marks :50*

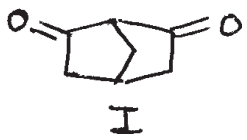
Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right side indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

Q1) Answer any five of the following: **[10]**

a) Compound I do not show acidic property.



I

b) Cis - 4 hydroxy cyclohexane carboxylic acid Lactorize, while the trans isomer does not.

c) Draw the stereostructures for cis-anti-trans and cis-anti-cis isomers of perhydrophenanthrene and compare their stabilities. Comment on their optical activity.

d) Chair - boat interconversion is more facile in cyclohexanone than in cyclohexane.

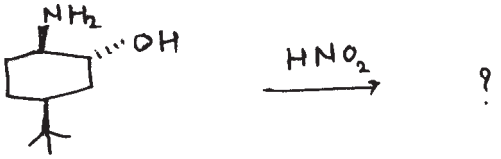
e) Trans hydrindane is more stable than cis isomer below 466^{o}K while above 466^{o}K the cis isomer predominates at equilibrium.

f) Van Auwer's skita rule does not apply to explain the boiling points of alkyl cyclohexanols.

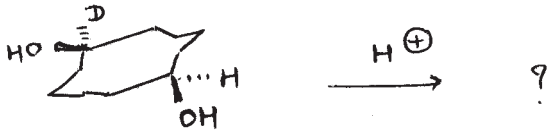
P.T.O.

Q2) Predict the product/(S). Explain the mechanism & stereochemical principles involved (any Two): **[10]**

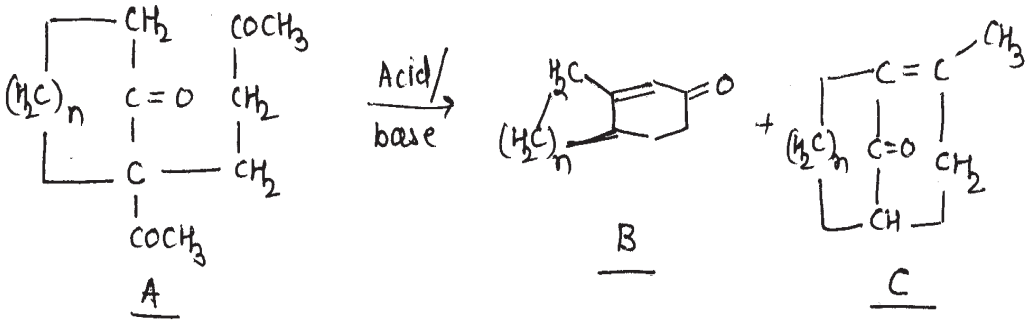
a) i)



ii)



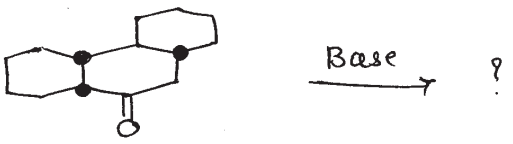
b) Compound A with acid or base furnish either fused ring B or bridge ring system C or both depending upon the ring size. Explain.



	A	B
n = 4	65%	-
n = 5	32%	14%
n = 6	-	76%

c) i)

ii)



Q3) Write notes of the following: **[5]**

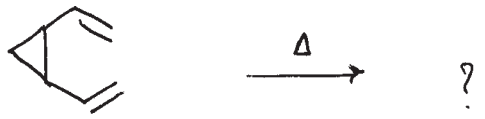
a) Stability & stereochemistry of bicyclo [3, 3, 1] nonane & adamentane.

b) Pyrolysis of cycloalkyl trimethylammonium hydroxides with 6 to 10 membered rings.

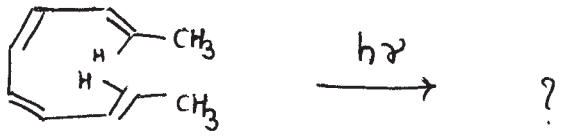
SECTION - II

Q4) Predict the product/s & write the stereochemistry. Justify your answer (any five): **[10]**

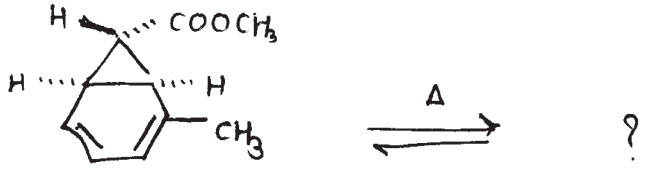
a)



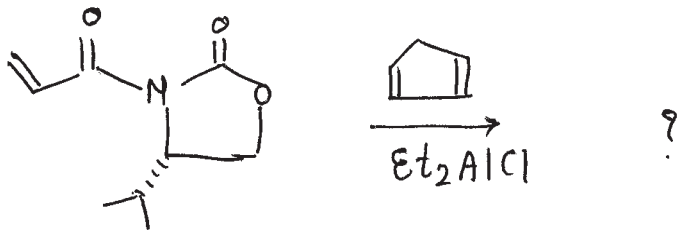
b)



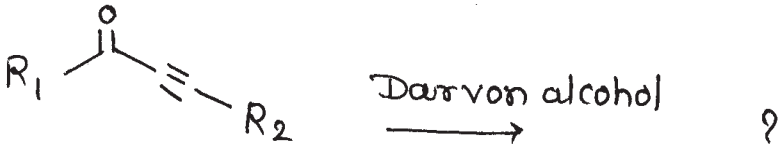
c)



d)



e)



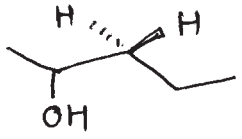
f)

Q5) Answer <u>any Two</u> of the following: **[10]**

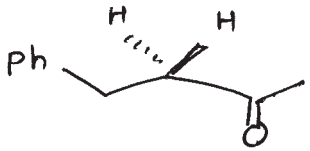
a) i) Write a note on Chiral Auxiliaries.

ii) Write a note on Crams rule.

b) i) Identify Pro R & Pro S hydrogen atoms in the following compounds.

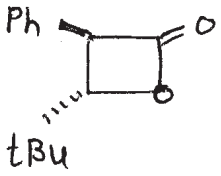


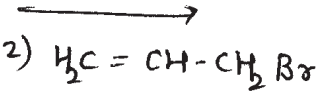
(a)



(b)

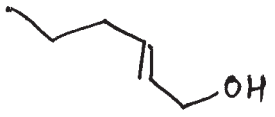
ii)

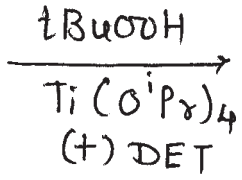




?

c) i)





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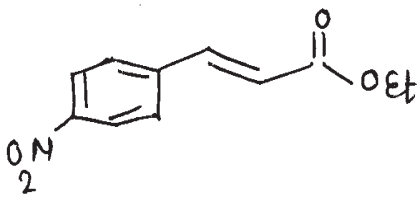
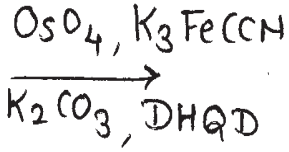
ii)





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Q6) Answer the following: **[5]**

a) Predict the stereochemistry of the product in the following sigmatropic reaction why no [1, 3] or [1,5] sigmatropic hydrogen migration observed if the reaction is carried out thermally.

b) Using ATS concept predict whether conrotatory & disrotatory conversion of 1, 3, 5 hexatriene to 1, 3 cyclohexadiene is allowed thermally or photochemically.

ℰ ℰ ℰ

Total No. of Questions : 6]

SEAT No. :

P2922

[Total No. of Pages : 4

[4725]-301
M.Sc.
DRUG CHEMISTRY
CH - 361: Chemistry of Heterocycles and Biologically Active Compounds
(2008 Pattern) (Semester - III)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

Q1) Explain any four of the following: **[12]**

a) Pyrroles do not undergo cycloaddition reactions but furan does.

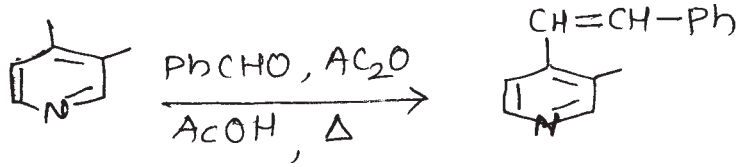
b) 2-ethyl pyridine reacts with aq. formaldehyde in weak basic conditions while pyridine does not.

c) Thiophene undergoes nitration at 2-position while nitration of benzothiophene mainly occurs at 3-position.

d) In Doebner-Von-Miller synthesis aldehydes R_1CH_2CHO and R_2CH_2CHO give four products.

e) Thiamine could be used as catalyst in aldol condensation.

Q2) Suggest the suitable mechanism for any four of the following conversions. **[12]**

a) 

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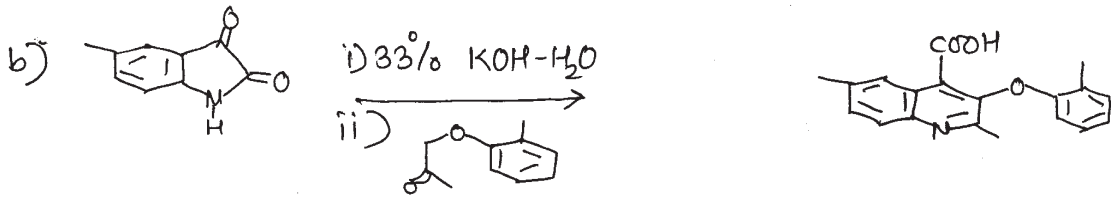
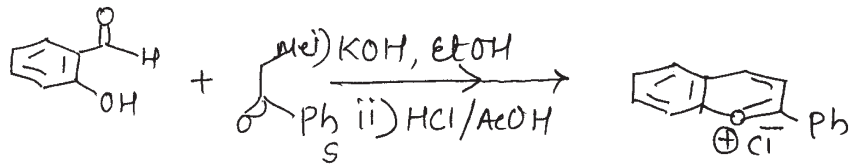
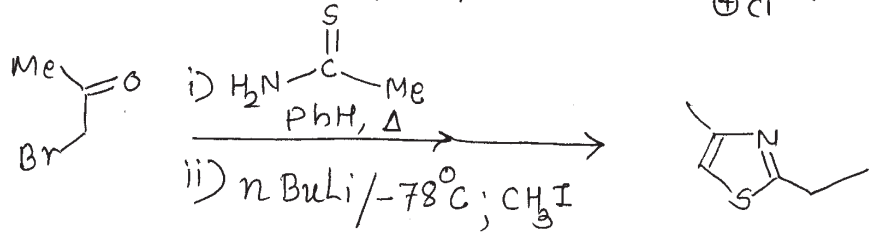
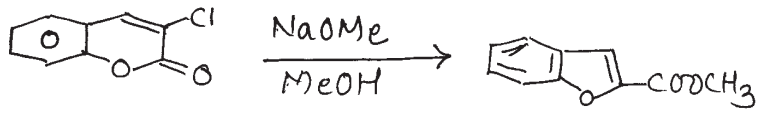
b) 

c) 

d) 

e) 

Q3) a) Write short notes on any three of the following: **[9]**

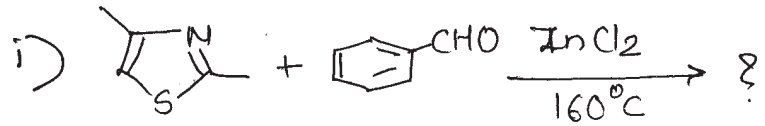
i) Bischler-Napieralski synthesis.

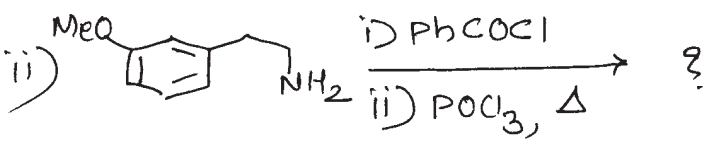
ii) Pechmann synthesis of coumarin.

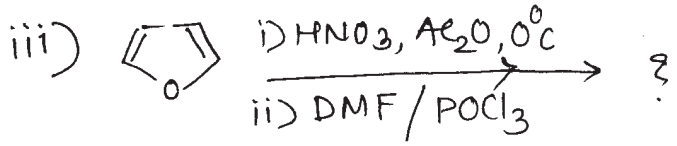
iii) Knorr-pyrrole synthesis.

iv) Madelung synthesis.

b) Predict the products with mechanism (any two): **[7]**

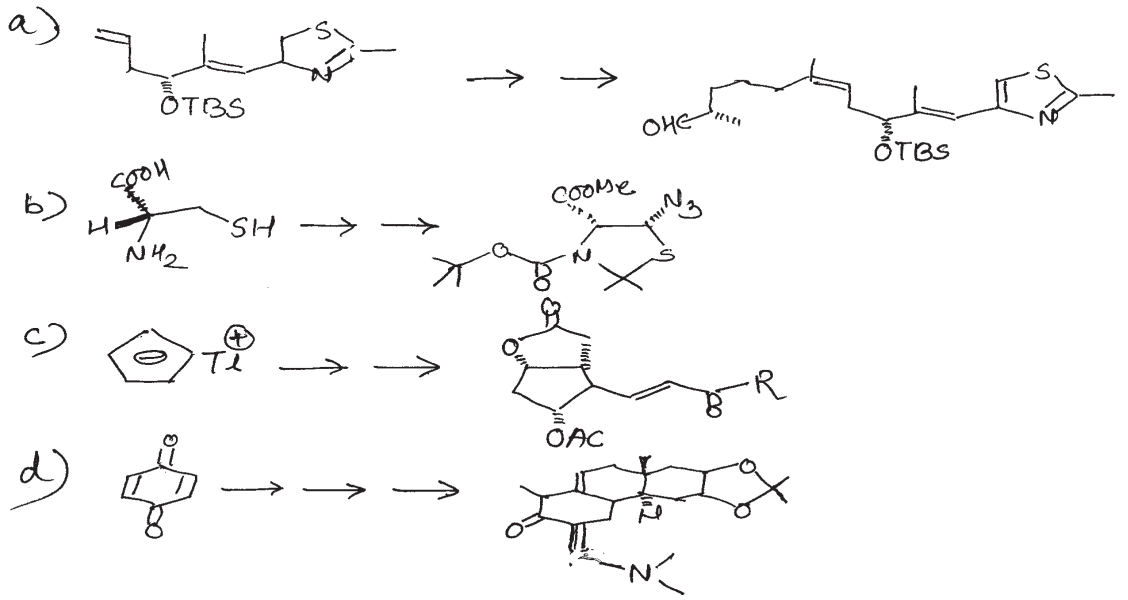
i) 

ii) 

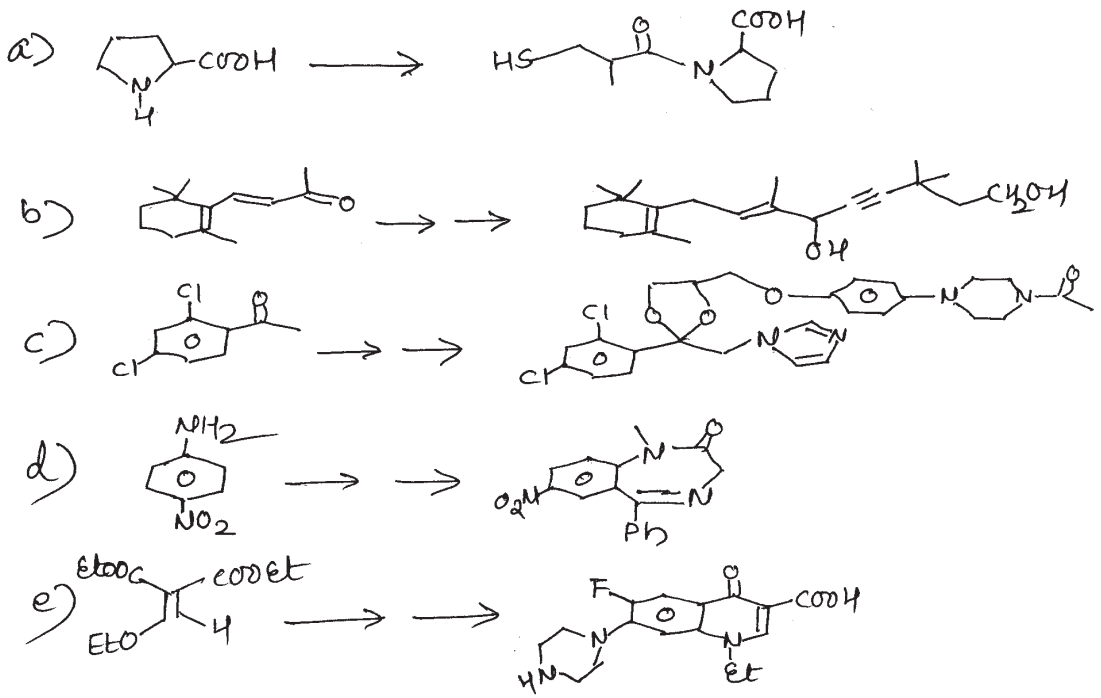
iii) 

SECTION - II

Q4) Discuss the steps involved in the synthesis of following naturally occuring drug molecules or intermediates. Explain the mechanism (any three): **[15]**

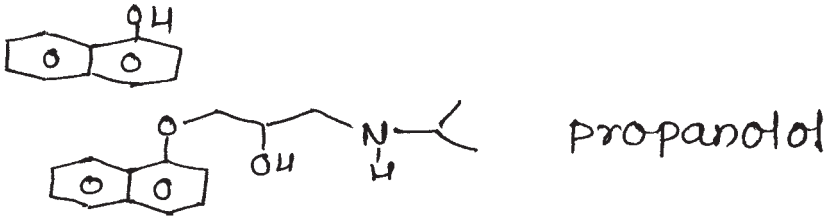


Q5) Discuss the steps involved in the synthesis of the following drug molecules from the precursors shown (any four): **[16]**

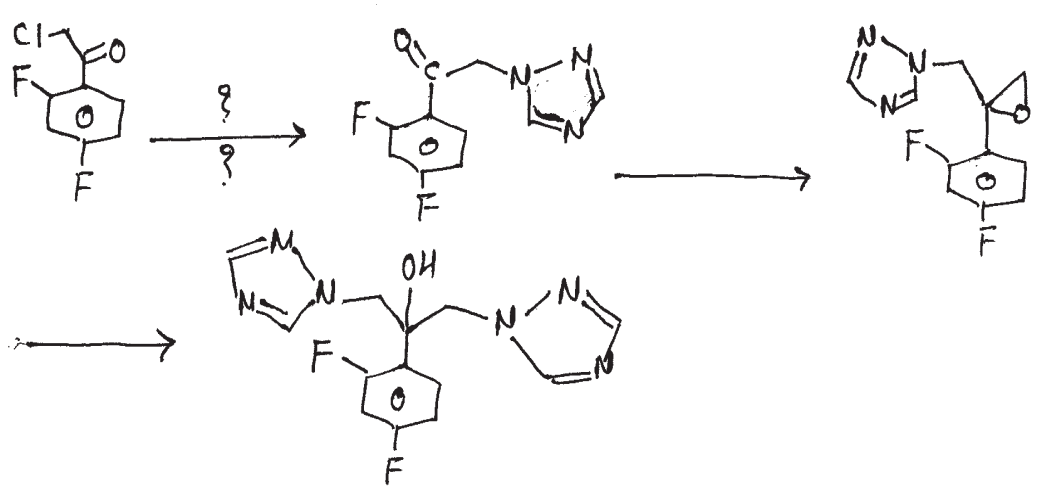


Q6) Answer any three of the following: **[9]**

a) Do a reterosynthetic analysis of propanolol. Give a synthetic pathway for its synthesis starting with



b) Identify the missing reagents and explain the following transformation.



c) Explain the role of protecting groups in drug synthesis.

d) Discuss:

i) McMurry coupling

ii) Bayer Villiger oxidation

EEE

Total No. of Questions : 6]

SEAT No. :

P2923

[Total No. of Pages : 6

[4725]-302
M.Sc.
DRUG CHEMISTRY
CH-362 : Advanced Analytical Methods
(2008 Pattern) (Semester-III)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Figures to the right side indicate full marks.***

SECTION-I

Q1) Explain Any Four of the following: **[12]**

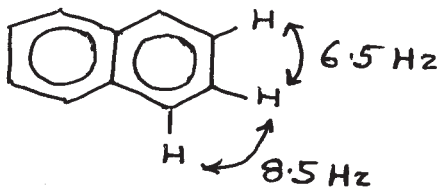
a) For equal number of nucleii- ^{13}C NMR peaks are much weaker than ^{1}H NMR peaks.

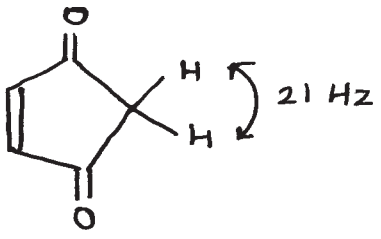
b) Acetylenic protons appear at 2-3δ while olefinic protons at 4.6-5.8δ in ^{1}H NMR spectrum. Explain.

c) Molecular ion intensity decreases in the order cyclic > Acyclic > branched.

d) MALDI is used for biomolecules and high molecular weight compounds.

e) The compling constants for the following compounds are as shown below.





Q2) Answer Any Four of the following: **[16]**

a) Deduce the structure from the spectral data

Mol formula: $C_9H_{12}O_3S$

PMR: 7.45(d, 8Hz, 2H) 8.8(d, 8Hz, 2H)

4.1(q, 6Hz, 2H) 2.45(S, 3H), 1.3(t, 6Hz, 3H)

Mass: m/e(%): 200(40) 170(20) 155(60) 107(10) 91(100) 65(30)

P.T.O.

b) Assign the structure from the spectral data

M.F.: $C_8H_{12}O$

CMR: 23.5(t), 25.6(t)* 40.1(t)* 68.7(s)

72.8(d), 88.4(s) *Equally strong

Mass: 124(M^+), 123, 109, 95, 81, 68, 53, 39

c) Deduce the structure

M.F.: $C_9H_8O_3$

CMR: 115.4, 115.9, 125.4, 130.0, 144.2, 159.9, 168.1

DEPT 135: 115.4, 115.9, 130.0, 144.2 up

125.4, 159.9, 168.1 absent

DEPT 90: 115.4, 115.9, 130.0, 144.2 up

d) Predict the structure

M.F.: $C_6H_{10}O_2$

^{1}H NMR: 6.1(d, 1.5Hz, 1H) 5.5(d, 1.5Hz, 1H)

4.2(q, 7Hz, 2H) 1.95(s, 3H) 1.2(t, 7Hz, 3H)

e) An acid $C_5H_{10}O_3$ shows 1.2(d, 7Hz, 3H) signal in its ^{1}H NMR. On treatment with conc. H_2SO_4 gives compound A having following spectral data. Deduce its structure.

M.F.: $C_5H_8O_2$

IR: 1780, 1170 cm^{-1}

^{1}H NMR: 1.35(d, 6Hz, 9mm) 1.5-1.6(n, 12mm)

4.55(distorted sexlet, 6Hz, 3mm)

Mass: 100(4.2) 85(55) 56(100) 43(33)

Q3) Write short notes on Any Three of the following: **[12]**

a) Spin-spin decoupling.

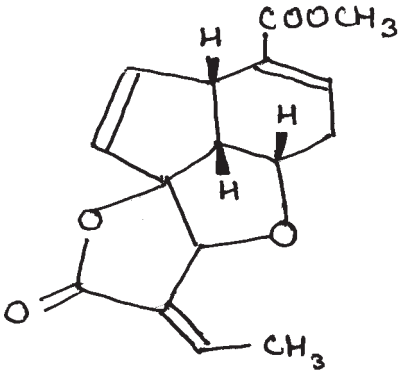
b) Karplus equations for predicting J values.

c) Correlated spectroscopy.

d) Soft ionization techniques in MS.

SECTION-II

Q4) A) Assign the following PMR signals to different protons of compound X with proper justification. **[6]**



X

2.11(d, 7Hz, 3H) 3.46(dd, 6, 9Hz, 1H)

3.79(s, 3H) 4.0(dd, 9, 2.5Hz, 1H)

5.59(d, 6Hz, 1H) 5.67(d, 6Hz, 1H)

6.08(dd, 6, 2.5Hz, 1H) 5.1(bs, 1H)

7.19(dq, 7, 1.5Hz, 1H) 7.46(s, 1H)

Spin decoupling expt:

i) Irradiation of signal at 3.46 changes the signal at 5.59 into a singlet and a signal at 4.0 into a doublet (J = 2.5Hz).

ii) Irradiation at 7.19 changes the signal at 2.11 into a singlet and the signal at 5.1 becomes sharp.

B) Answer Any Two of the following: **[6]**

a) Explain various detectors used in HPLC.

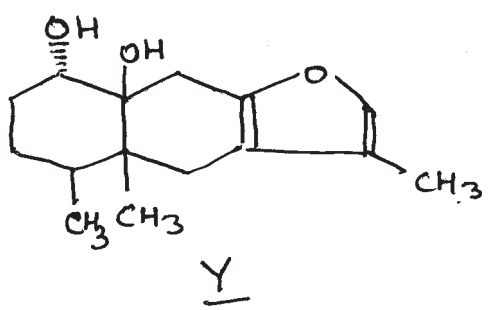
b) Explain

i) Reverse phase column.

ii) Chiral column.

c) Draw schematic diagram of GCMS and explain the factors responsible in resolution.

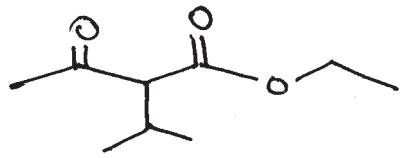
C) Assign the CMR signals given below to different carbons in the following compound Y. Justify your answer. **[4]**

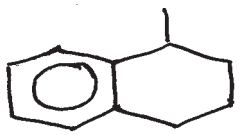


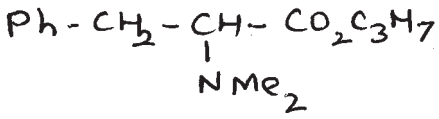
Y

8.0(q)	17.0(q)	20.0(q)
28(t)	29.0(t)	34.01(t)
35.0(t)	49.0(s)	72.0(d)
82.0(d)	85.0(s)	125.0(s)
128.0(s)	135.0(d)	148.0(s)

Q5) A) Explain the genesis of the ions for <u>Any Three</u> of the following: **[9]**

a)  172, 130, 115, 87, 43

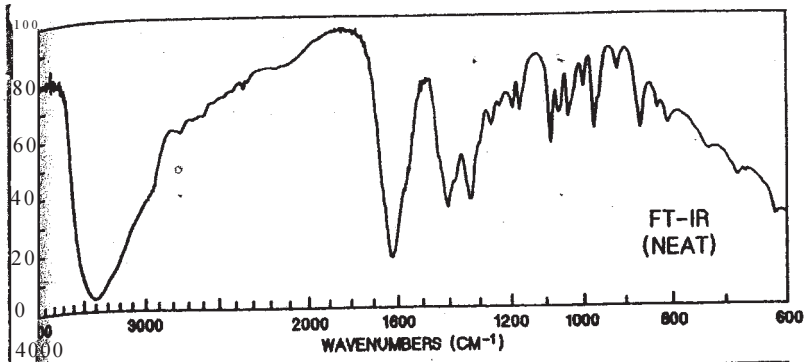
b)  131, 118

c)  148, 144, 102, 91

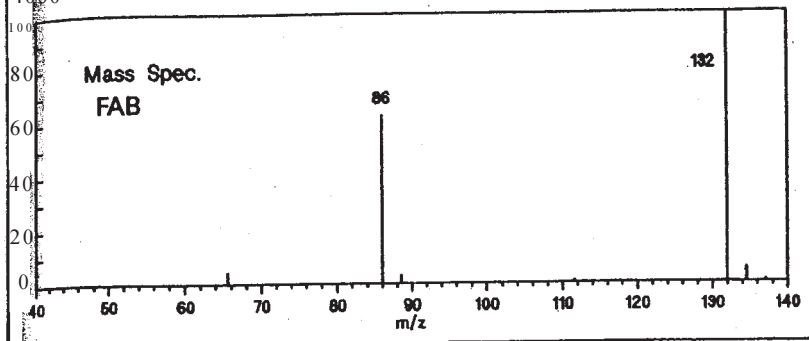
d)  136, 134, 56, 54, 39,27

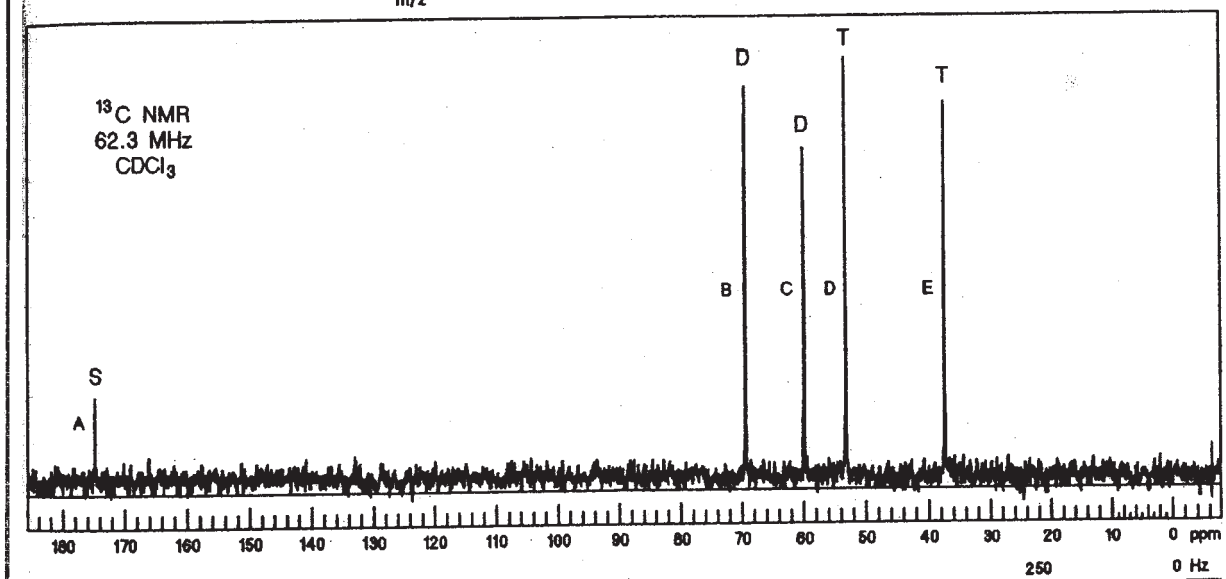
B) An unknown substance shows M^+ = 170(100) M + 1 = 171(13.2) and M + 2 = 172(1.0). Deduce the molecular formula of the unknown compound. **[3]**

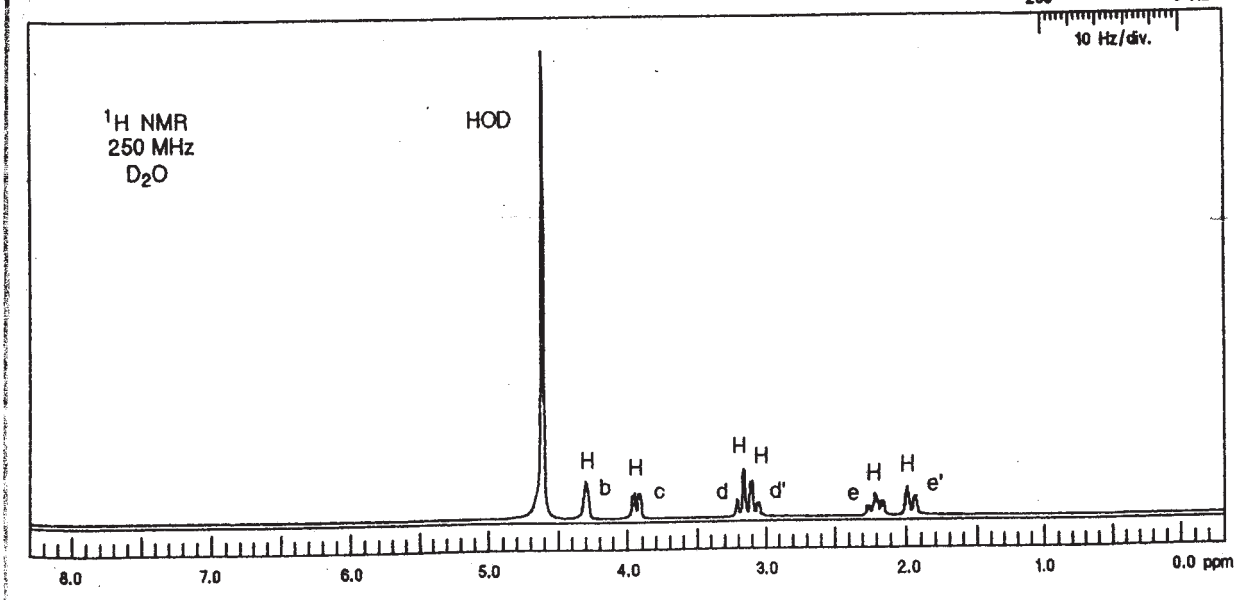
Q6) A compound with molecular formula $C_5H_{13}NO_2$ shows spectral information provided on the next page. Deduce the structure and justify your answer. **[12]**

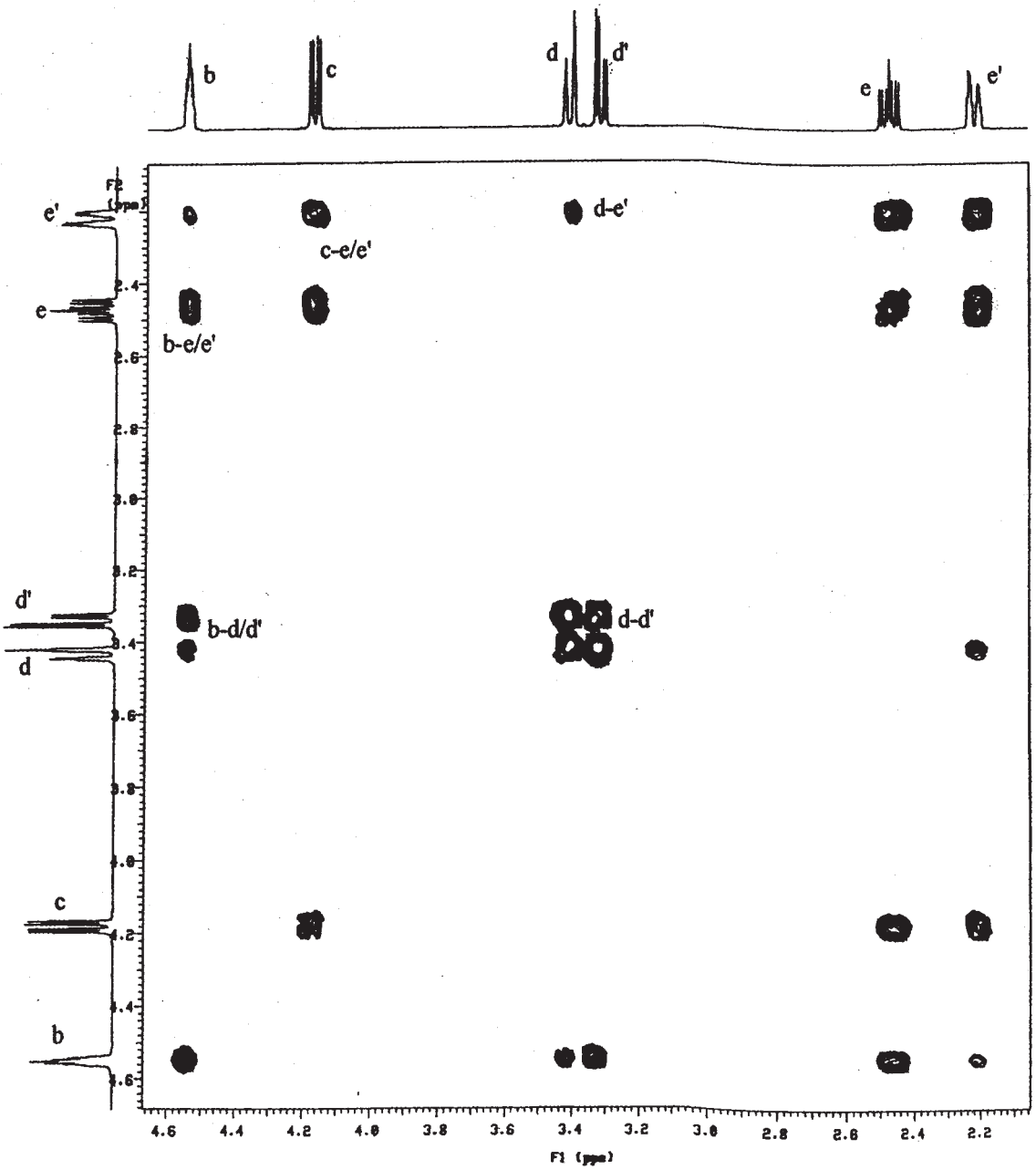

FT-IR
(NEAT)
WAVENUMBERS (CM⁻¹)

M.F. $C_5H_9NO_3$


Mass Spec.
FAB
86
132
m/z


^{13}C NMR
62.3 MHz
$CDCl_3$
S
A
B
C
D
D
T
T
E
ppm


^{1}H NMR
250 MHz
D_2O
HOD
H b
H c
H H d d'
H e
H e'
ppm


b
c
d
d'
e
e'
F2 (ppm)
e'
e
d'
d
c
b
c-e/e'
d-e'
b-e/e'
b-d/d'
d-d'
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
F1 (ppm)

●●●●●

Total No. of Questions : 6]

SEAT No. :

P2924

[Total No. of Pages :3

[4725] - 303
M.Sc. (Drug Chemistry)
CH-363: DRUG DEVELOPMENT
Immunology and Micro Biology
(2008 Pattern) (Semester - III)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate maximum marks.***
3) ***Answers to the two sections to be written in separate answer books.***

SECTION- I

Q1) Answer any three of the following: **[15]**

a) Describe screening methods for isolation of actinomycetes producing antibiotic.

b) What are the strategies for designing fermentation media for large scale production of antifungal compounds.

c) What are steps in strain improvement of industrially important antibiotic producer?

d) Explain turbidometric assays for antibacterial antibiotics.

e) Compare and contrast-microbial and chemical processes for treatment of drug industry effluent.

Q2) Attempt any three of the following: **[15]**

a) Explain innate immunity, giving suitable examples.

b) Giving structural features of immunoglobulin molecule, explain it's function.

c) Describe -

i) Immunodeficiency and

ii) Immunostimulation

P.T.O.

d) What is immunization? Explain use of vaccines.

e) Describe agglutination technique for detection of antigen-antibody interaction.

Q3) Answer any two of the following. **[10]**

a) What is meant by 'drug'? Give the characteristics expected of a goal drug? What are the sources of drugs?

b) How are SAR studies carried out? How do the SAR studies help in identifying the functional groups important for a molecule its exhibit activity? Explain Bioisosterism.

c) Explain the following terms.

i) Pharmacophore

ii) ED_{50}

iii) Therapeutic index

iv) Placebo

v) Quality assurance

SECTION - II

Q4) Answer any three of the following. **[18]**

a) How do the physical, chemical & biological properties of a drug molecule decide its dosage form & route of administration? Explain with examples.

b) What is the need for toxicological evaluation of an NCE? How are LD_{50}, reproductive toxicity & mutagenicity tests performed.

c) Explain in brief the strategies adopted in lead discovery? Why is rational drug discovery more popular than random drug discovery? Discuss.

d) Discuss in brief pharmacokinetics of drug action. Explain how rates of absorption, distribution, metabolism & excretion affects a drugs bioavailiability.

Q5) Answer any two of the following. **[12]**

a) What are intellectual property rights? What are the requirements for the grant of a patent? Discuss the components of a provisional specifications.

b) Discuss in details how clinical trials are conducted on an NCE. What are the motives of phase I, Phase II & Phase III? When is a trial suspended?

c) If a new compound is isolated or synthesised, how is it subjected to biological evaluation? Explain at least one of the pharmacological/ biochemical test performed on this compound.

Q6) Answer any two of the folloiwng. **[10]**

a) Discuss the strategies adopted in R &D and process development departments in a pharma industry.

b) Describe in brief the various ways adopted to improve the lead compound.

c) Discuss

i) Lipinski's rule of 5

ii) Phase IV clinical trials.

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Total No. of Questions : 6]

SEAT No. :

P2925

[Total No. of Pages : 5

[4725]-304
M.Sc.
DRUG CHEMISTRY
CH- 364: Stereochemical Principles & Applications
(Old 2008Pattern) (Semester - III)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer books.***

SECTION - I

Q1) Answer any four of the following: **[16]**

a) Reduction of cyclobutanone by $NaBH_4$ is much easy than reduction of cyclo octonone. Explain.

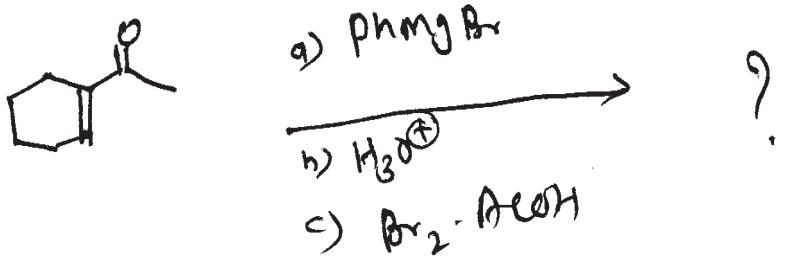
b) Equatorial cyclohexylamine with HNO_2 yield equatorial alcohol.

c) Trans 4-t-butyl cyclohexane carboxylic acid is stronger than the corresponding cis isomer.

d) 1, 2, 2, 6, 6- penta-4-hydroxy-4-phenyl piperidine is more stable in boat conformation. Explain.

e) Equatorial 2-chloro cyclohexanone show higher IR streching frequency than axial isomer.

Q2) Predict the product(s). Explain the mechanism & Stereochemical principles involved (Any four): **[12]**

a) 

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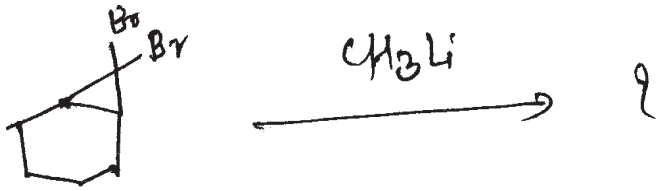
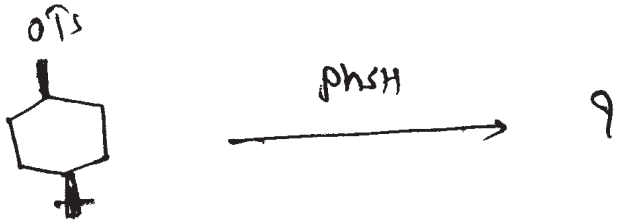
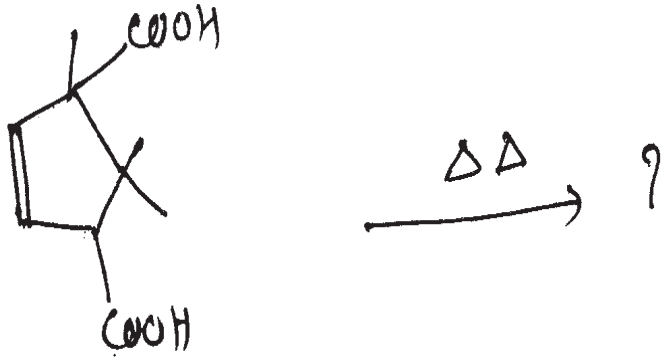
b) 

c) 

d) 

e) 

Q3) Write short note on any three of the following: **[12]**

a) Von -auwer's skita rule & its limitations.

b) Transannular interactions.

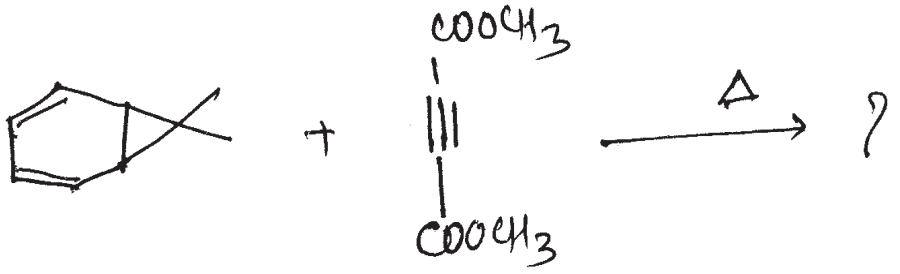
c) Stereochemistry of NGP reactions.

d) 2- Alkyl ketone effect.

SECTION - II

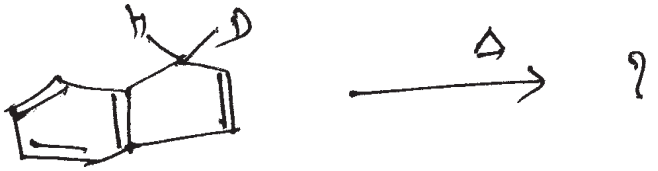
Q4) a) Explain CON rotatory ring opening of 1,2- cyclohexadiene to 1,3,5-hexatriene with the help of co-relation diagram. **[4]**

b) Predict the product & explain stereochemistry (Any three): **[6]**

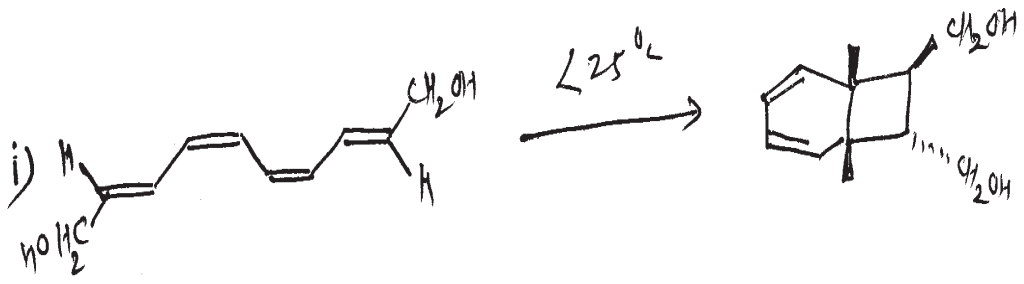
i) 

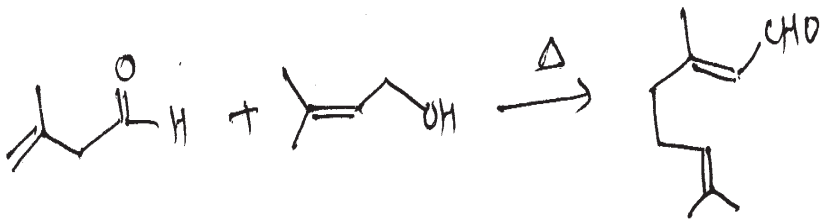
ii) 

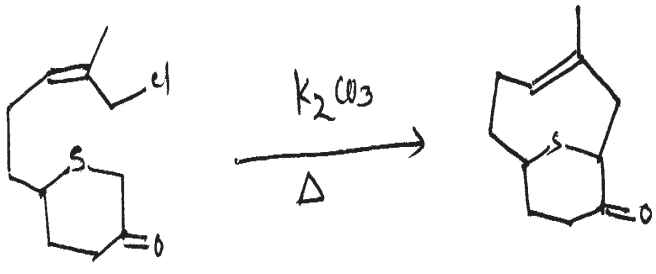
iii) 

iv) 

c) Suggest stereochemical mode of reaction with proper mechanism (Any two): **[6]**



ii) 

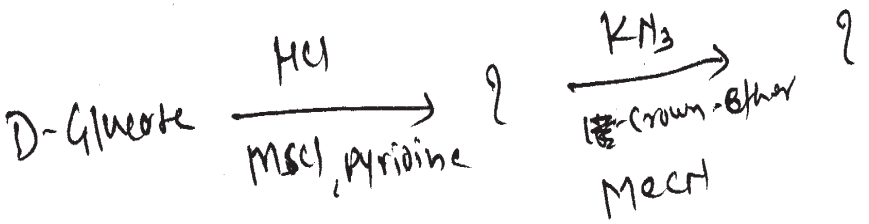
iii) 

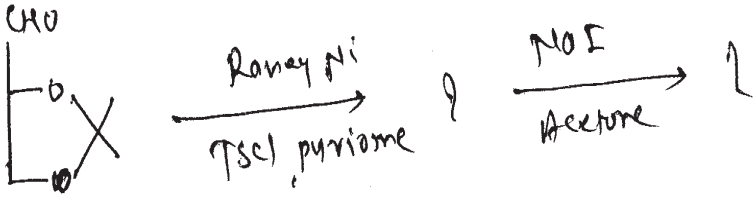
Q5) Answer the following:

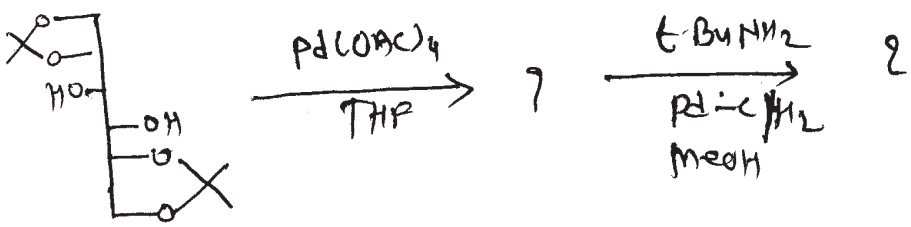
a) Write the reaction sequence for the conversion of manitol to R-epichlorohydrine. **[3]**

b) Write short note on 'Cram's rule & its modification'. **[3]**

c) Complete the following reactions (Any two): **[6]**

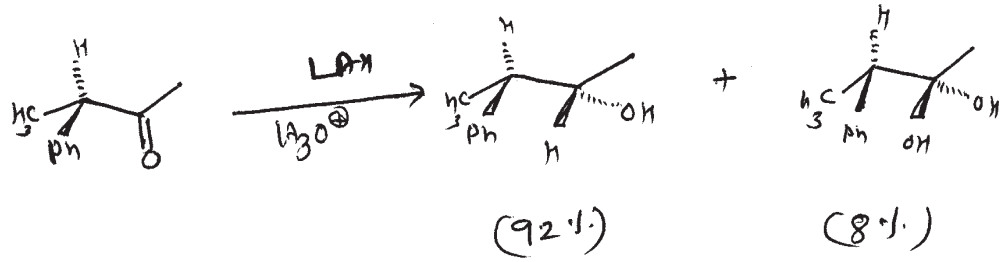
i) 

ii) 

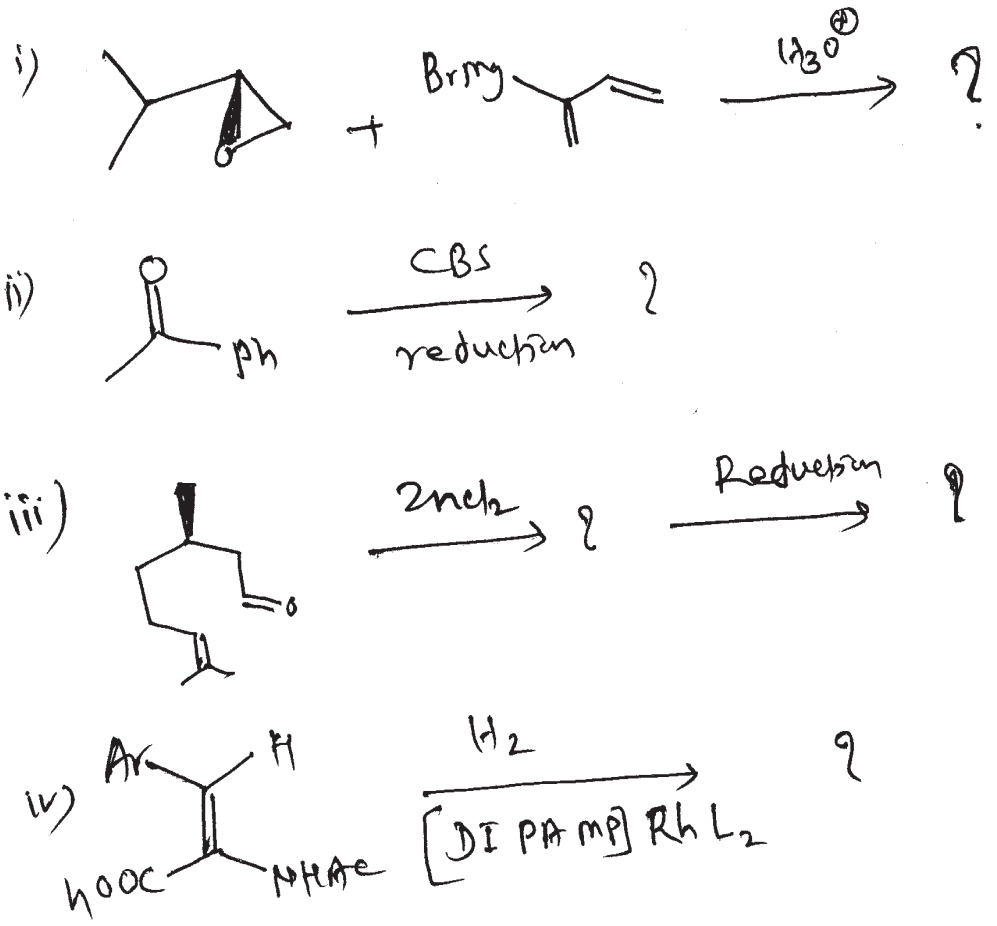
iii) 

Q6) Answer the following quesions:

a) Explain diastereomeric excess (de). Calculate the de of the following reactions: **[3]**



b) Solve any three of the following: **[6]**



c) Give the comparison between chiral auxillary & catalyst. Give the synthesis of David Evan's auxillary. **[3]**

EEE

Total No. of Questions : 6]

SEAT No. :

P2933

[Total No. of Pages :5

[4725] - 4001

M.Sc.

DRUG CHEMISTRY

CHD - 461 : Advanced Organic Synthesis, Principles and Strategies (2013 Pattern) (Semester - IV)

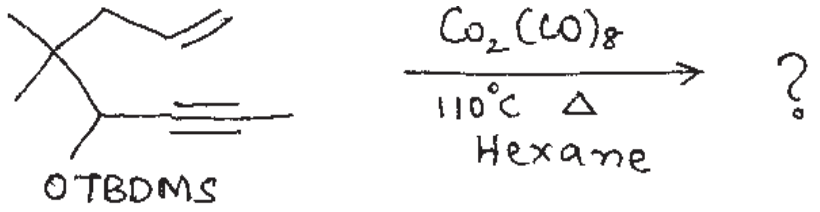
Time : 3Hours] *[Max. Marks : 50*

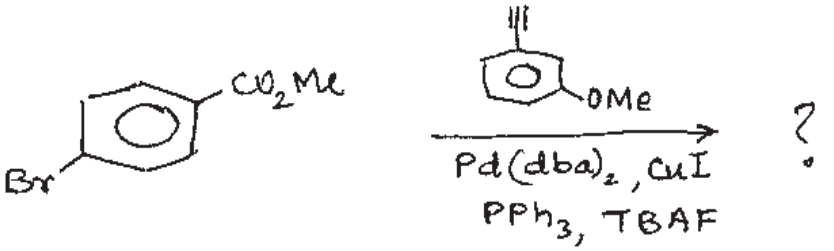
Instructions to the candidates:

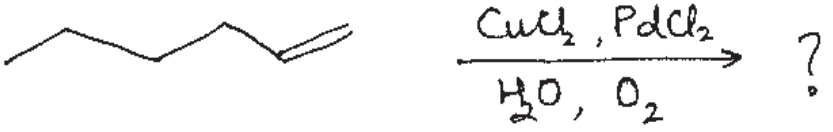
1) ***All questions are compulsory.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Figures to the right indicate full marks.***

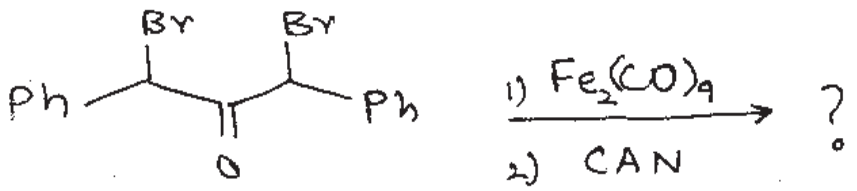
SECTION - I

Q1) a) Predict the products for the following sequence of reaction (any three) and explain the role of transition metal complex. **[6]**

i) 

ii) 

iii) 

iv) 

P.T.O.

b) Explain <u>any two</u> of the following: **[3]**

i) Non-terminal alkenes can be converted to terminal alkenes by use of hydroboration reaction.

ii) Azide-alkyne cycloaddition using $C_p^* RuCl(PPh_3)_2$ gives, 1, 5-disubstituted triazole.

iii) Diisopinocamphylborane shows higher enantioselectivity for Cis - alkenes.

Q2) a) Carry out the following transformations using organoborane chemistry (any two): **[4]**

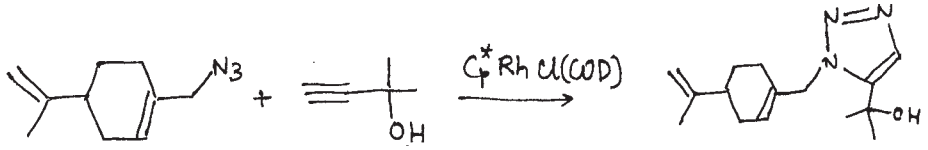
i)

ii)

iii)

b) Suggest the mechanism for the formation of the product (any two): **[4]**

i)



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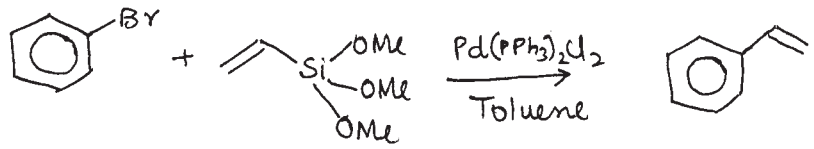

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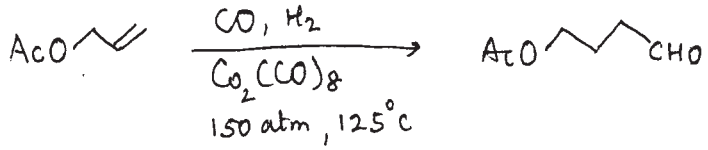
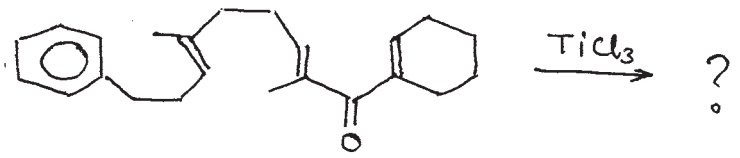


Q3) a) Write the product with suitable mechanism (Any Two): **[4]**

i)



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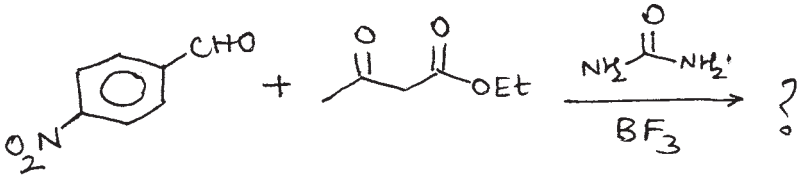

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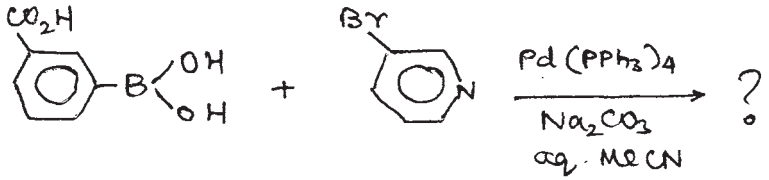


b) Write short note on <u>any two</u> of the following: **[4]**

i) Bergman cyclization.

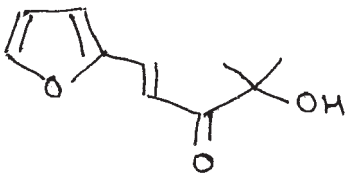
ii) Fukuyama reaction.

iii) Buchwald - Hartwig reaction.

SECTION - II

Q4) Using retrosynthetic analysis, suggest the suitable method to synthesize <u>any three</u> of the following components. **[9]**

a)



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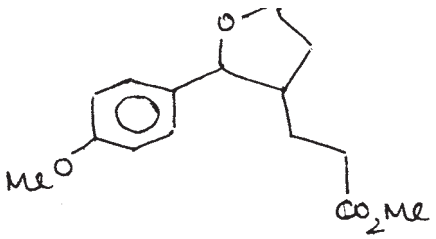
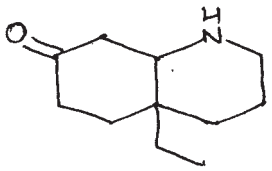
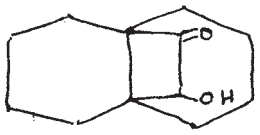
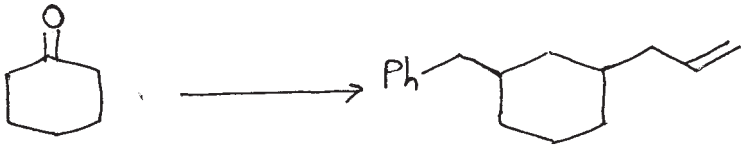


c) 

d) 

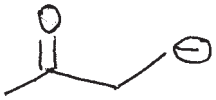
Q5) a) Answer <u>any two</u> of the following: **[4]**

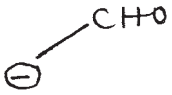
i) Carryout the following transformation by examine approach.



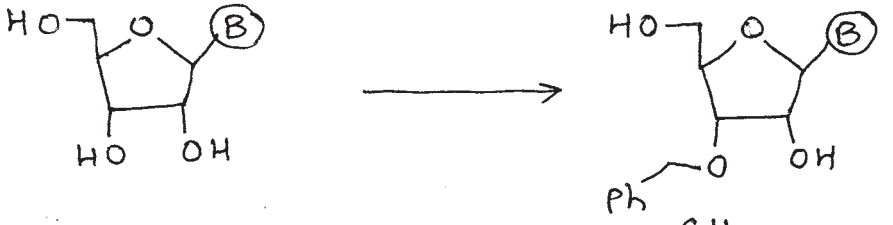
ii) Complete the sequence using organoborane.

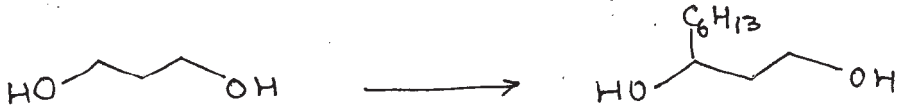
iii) Give one reaction with a reagent for each synthon given below:

1) 

2) 

b) Complete <u>any two</u> of the following transformations: **[4]**

i) 

ii) 

$\Delta HP/H^+$; $C_6H_{13}MgBr$; $MeOH/H^+$; $PCC/NaOAc$; H_3O^+

(arrange the reagents in proper order)

iii) 

Q6) a) Answer <u>any two</u> of the following: **[4]**

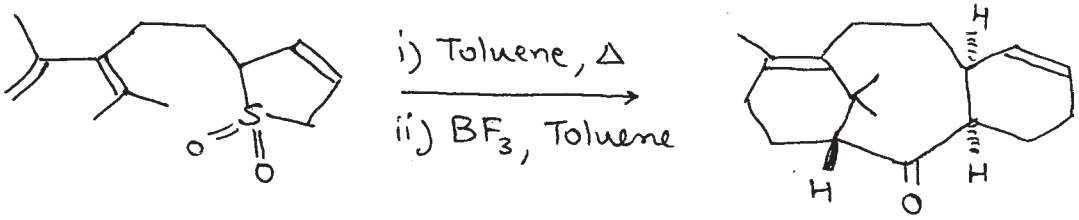
i) Discuss the steps involved in the synthesis of Phe-Ala dipeptide.

ii) Benzyloxycarbonyl group is preferred protection than benzyl group for amino protection during peptide synthesis. Explain.

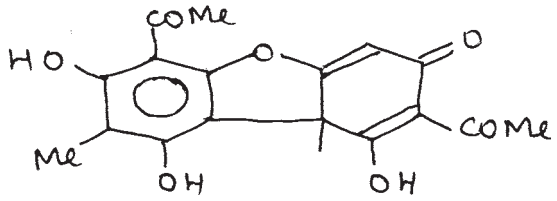
iii) Explain that umpolung method is employed to obtain 1, 2-dicarbonyl compounds.

b) Answer <u>any two</u> of the following: **[4]**

i) Explain the advantage of Cascade reaction. Write the steps involved in the following reaction.



ii) Explain the biomimetic approach to the retrosynthesis of the following:



iii) Discuss the principles of Green Chemistry.

Total No. of Questions :6]

SEAT No. :

P2934

[Total No. of Pages : 3

[4725]-4002
M.Sc.
DRUG CHEMISTRY
CHD - 462: ADVANCED MEDICINAL CHEMISTRY
(2013 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Figures to the right indicate full marks.***

SECTION - I

Q1) Answer any three of the following questions: **[9]**

a) Give an brief overview of second and third generation cephalosporins.

b) Discuss in brief the following classes of antibiotics

i) Tetracyclines.

ii) Aminoglycosides.

c) Give a brief commentory on development of following penicillins.

i) Ampicillin

ii) Amoxycillin

iii) Carbenicillin

iv) Fludoxacillin

d) What is the importance of folate pathway? How do sulphonamides and trimethoprim exhibit selectively toxic antibacterial activity.

P.T.O.

Q2) Answer any two of the following: **[10]**

a) What are common fungal diseases. Discuss in brief polyene membrane disruptors and ergosterol biosynthesis inhibitors as antifungal agents.

b) Draw a neat diagram of neuron and explain the steps involved in neurotransmission. Explain how this process is affected in convulsions? Give the strategies to overcome this problem.

c) Explain in brief the following with respect to cancers (any three).

i) Cell cycle

ii) Alkylating agents

iii) Antimitotics

iv) Antimetabolites

Q3) Discuss in brief any three of the following: **[6]**

a) Topoisomerase Inhibitors.

b) Analgesics.

c) MAO Inhibitors.

d) Drug resistance.

SECTION - II

Q4) Answer any three of the following: **[9]**

a) Discuss in brief inflammation. How do non-steroidal anti-inflammatory drugs exhibit their activity.

b) Give a brief account of agents interfering with viral nucleic acid replication.

c) What are common GIT disorders. Discuss in brief emesis and its treatment.

d) Give a brief account of any two of the following:

i) NIDDM

ii) Malaria

iii) Leprosy

Q5) Answer any two of the following: **[10]**

a) Give a brief account of following CVS disorders (any three)

i) Angina

ii) Myocardial Infarction

iii) Hypertension

iv) Congestive heart failure

b) How are following group of drugs capable of rectifying a deseased state. (any three):

i) Organic nitrates

ii) Proton pump inhibitors

iii) Ca^{2+} channel blockers

iv) Corticosteroids

c) Explain the feed back mechanism of hormone release. Discuss the function of hypothalamus and adrenal cortex.

Q6) Give the mode of action and used of the following drugs (any three) **[6]**

a) Clavulanic acid.

b) Ciprofloxacin

c) Streptomycin

d) Phenobarbitone

e) Roxithromycin

EEE

Total No. of Questions : 6]

SEAT No. :

P2935

[Total No. of Pages : 2

[4725]-4003
M.Sc. (Chemistry)
DRUG CHEMISTRY
CHD- 463: Principles & Applications in Drug Design
(2013 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answers to the two sections are to be written in separate answer books.***
3) ***Figures to the right indicate full marks.***

SECTION - I

Q1) Attempt any three of the following: **[9]**

a) Define the terms-

i) Proteomics

ii) Metabolomics

iii) Pharmacogenomics

b) Explain the steps in preparation of monoclonal antibodies.

c) Give applications of gene therapy in treatment of inherited disorders.

d) Explain use of restriction endonucleases in rDNA technology.

Q2) Attempt any three of the following: **[12]**

a) What are the various drug-receptor interactions involved in drug action. How are they converted to physico-chemical descriptors?

b) Explain in brief how a QSAR is performed on a series of compounds using the Hansch method.

c) What are the benifits of Topliss over Hansch? Explain with an example.

d) Give a case-study of design of antimalarials or antidepressants.

P.T.O.

Q3) Answer any two of the following: **[4]**

a) Application of virtual screening.

b) High throughput screening.

c) Craig's plot.

SECTION - II

Q4) Answer any three of the following: **[12]**

a) Explain the steps involved in signal transmission θ by GPCR technique.

b) How is prodrug design is utilized to improve the pharmacokinetics of drugs? Explain with proper examples.

c) Explain the use of bioinformatics in drug designing.

d) What are the functions of cell membrane? Give a commentory on membrane bound receptor.

Q5) Answer any three of the following: **[9]**

a) How has computer aided drug design helped in getting novel pharmaceuticals?

b) Explain

i) Quantum mechanics

ii) Molecular mechanics

c) Explain the steps involved in designing molecules when the structure of target is known and unknown.

d) How is 3D-QSAR is performed? Explain in brief.

Q6) Discuss any two of the following: **[4]**

a) Combinatorial chemistry.

b) Drug target optimization.

c) Docking.

EEE

Total No. of Questions : 9]

SEAT No. :

P2936

[Total No. of Pages :5

[4725] - 4004
M.Sc.
DRUG CHEMISTRY
CHD-464A: Bioinformatics, Chemoinformatics & Biostatistics in Drug Discovery and Design
CHD-464B: Current trends in Org. Chemistry: Supra-molecular, Green Chemistry, Photochemical & Free Radical Reactions
CHD-464C: Entrepreneurship Development and Project Management
(2013 Pattern) (Semester - IV)

Time : 3Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any two of 464A, 464B, 464C sections only.***
2) ***Each section is for 25 marks.***
3) ***All questions are compulsory.***
4) ***Answers to the two sections should be written in separate answer books.***
5) ***Figures to the right indicate full marks.***

CHD-464A: Bioinformatics, Chemoinformatics & Biostatistics in Drug Discovery and Design.

Q1) Answer any three of the following: **[12]**

a) What is the significance of arithmatic mean and standard deviation in dealing with a data set? Compute the same for the below given data of No. of hours of sleep recorded by 10 infants in a day:

12.5,13.2,12.8,11.2,10.9,12.3,14.2,14.8,13.1,12.9

b) In a desert region on an average 10 people fall sick every year by eating a certain plant. Using poisson distribution find the probability that

i) Exactly 9 fall sick

ii) No one fall sick in a given year.

P.T.O.

c) Obtain the median for the following data.

Class	10-15	15-20	20-25	25-30	30-35
Frequency	7	13	17	22	04

d) Explain the following.

i) Standard deviation

ii) Multivariate analysis

iii) Sample and population

iv) Cumulative frequency.

Q2) Answer any two of the following. **[8]**

a) Discuss the concept of bioinformatics. How the structural bioinformatics is used in drug discovery?

b) What are biological databases? Explain with proper examples primary databases.

c) Explain:

i) Genome

ii) Proteome

iii) Metabolome

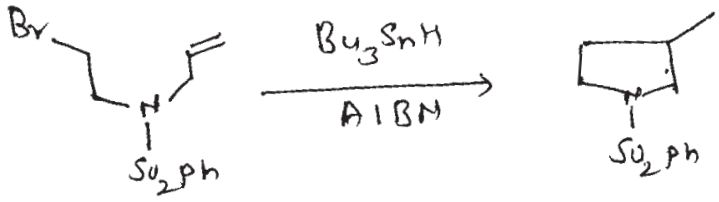
Q3) Answer any two of the following. **[5]**

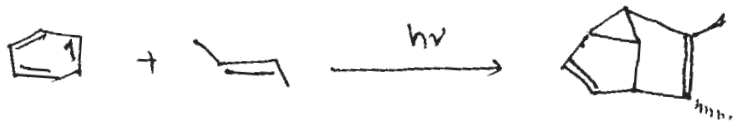
a) Disucss structure based drug discovery in brief.

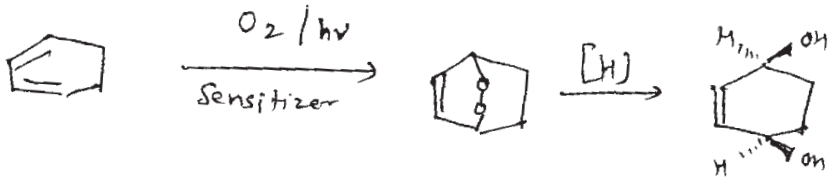
b) Structural comparison of biomolecules using bioinformatic sources.

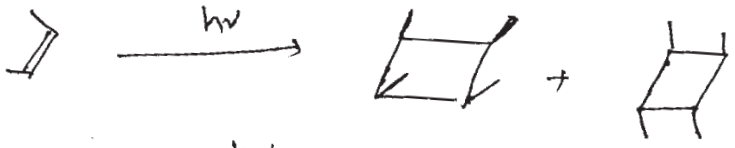
c) Toxicogenomics.

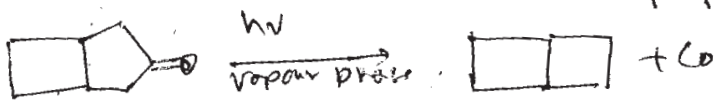
Q4) Suggest the mechanism & Explain (any five). **[10]**

a) 

b) 

c) 

d) 

e) 

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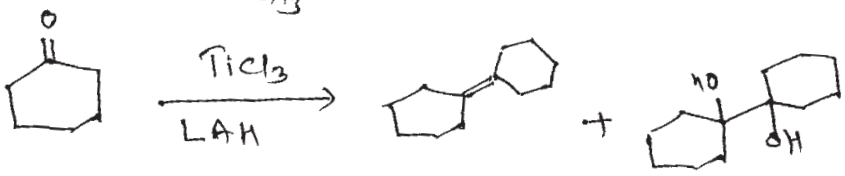
g) 

Q5) Answer the following (Any three). **[9]**

a) Explain generation and stability of free radical with suitable examples.

b) Explain photosensitive Molecular receptors with suitable example.

c) Explain supramolecular ditopic co-receptor with suitable example.

d) Explain how protecting groups reduce the atom economy of the reaction.

Q6) Write short note on any two of the following. **[6]**

a) Applications of ionic liquids in Organic synthesis.

b) Free radical substitution reactions.

c) Photo rearrangement reactions.

CHD-464C: Entrepreneurship Development & Project Management

Q7) Answer any six of the following MCQ's. **[6]**

a) The term entrepreneur was first applied to business in _____.

i) 16^{th} Century ii) 17^{th} Century

iii) 18^{th} Century iv) 19^{th} Century

b) Which of the following is not a characteristic of an Entrepreneurship?

i) Enterprise creation ii) Vision

iii) Idea generation iv) Organization

c) Intrapreneur is one who _____.

i) does entrepreneurial activities for his employer

ii) manages his own organisation

iii) Employs others

iv) takes all managerial decisions

d) Which of the following is not a reason to become an entrepreneur?

i) to determine location

ii) to automate income

iii) to work on their own schedule

iv) to please one self

e) Entrepreneur plays the following role

i) Economic growth & prosperity

ii) Balanced regional development

iii) Innovator

iv) All of above

f) "Entrepreneurs are innovators who use a process of shattering the status quo of existing products & services, to set up new products, new services".

i) J B Say
ii) Peter Drvoker
iii) Schumpter
iv) Albert Shapero

g) Which of the following is not economic factors affecting entrepreneurial growth.

i) Capital
ii) Labour
iii) Raw material
iv) Custom

h) Entrepreneurship is _____.

i) Habit
ii) Practice
iii) Process
iv) Action

Q8) Answer any three of the following. **[9]**

a) Differentiate between a manager & entrepreneur.

b) "Entrepreneurs are born & not made" comment on the statement.

c) What are the three needs identified by McCelland?

d) State Danhof's classification of entrepreneurship.

e) Explain the evolution of the term 'Entrepreneur".

Q9) Answer any two of the following. **[10]**

a) What are the contents of a business plan? Explain in details.

b) Write in brief about "conducting feasibility studies".

c) Discuss about entrepreneurial search & identification.

☼ ☼ ☼

Total No. of Questions : 6]

SEAT No. :

P2926

[Total No. of Pages :5

[4725] - 401
M.Sc.
DRUG CHEMISTRY
CH- 461 : Synthetic Methods in Organic Chemistry
(2008 Pattern) (Semester - IV)

Time : 3Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Figures to the right side indicate full marks.***

SECTION - I

Q1) a) Explain any three of the following with an example. **[9]**

i) Enamines are usually preferred from secondary amines rather than primary amines.

ii) Longifolylborane can be used to prepare optically active alcohols.

iii) Role of $CO_2(CO)_8$ in hydrofarmylation of olefine.

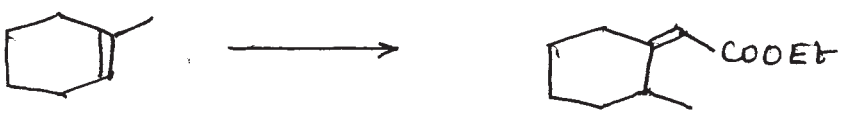
iv) Organo sulphur compounds can be used for umpolung reactions.

b) Complete the following transformation and justify your answer. (any two). **[6]**

i)

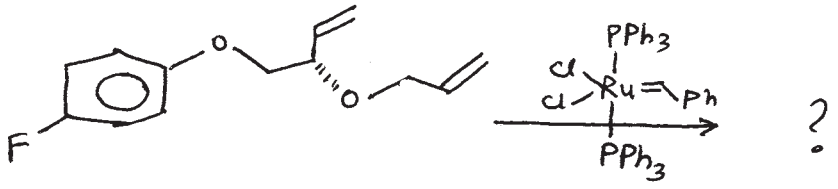
ii)

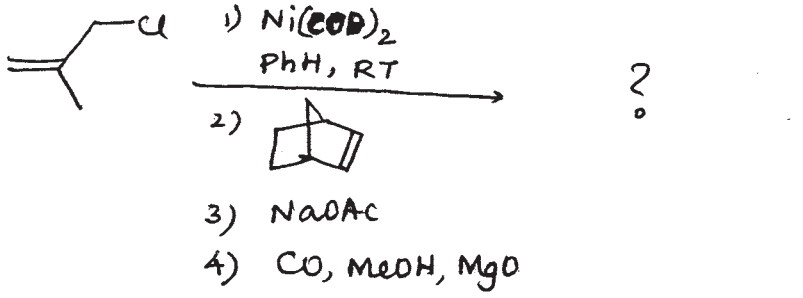
iii)

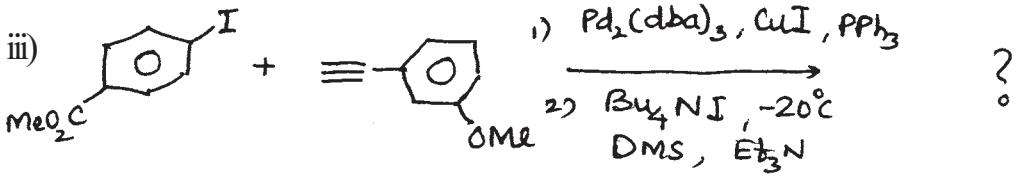


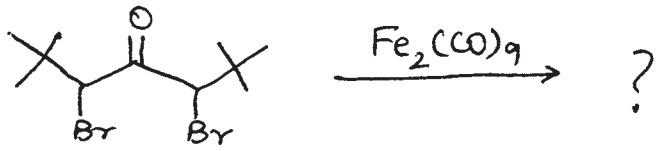
P.T.O.

Q2) a) Predict the product explaining the role of transition metal complex (any three): **[9]**

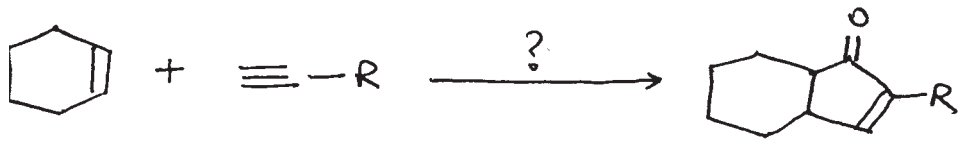
i) 

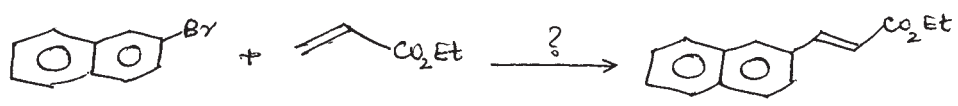
ii) 

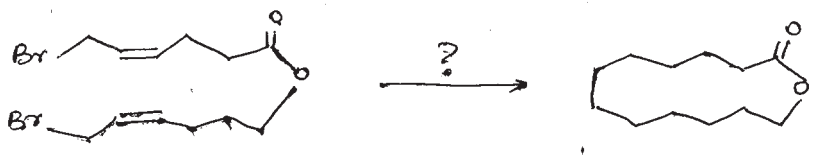
iii) 

iv) 

b) Predict the reagent in the following conversions (any two): **[6]**

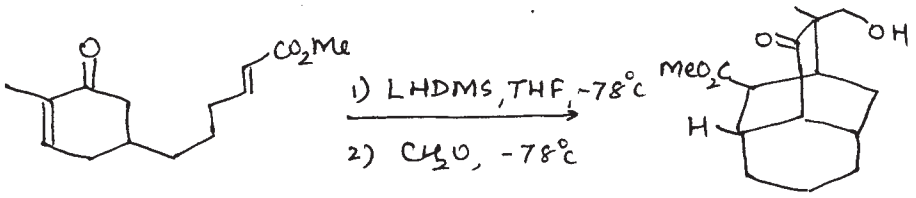
i) 

ii) 

iii) 

Q3) a) What is Domino reaction? Explain the steps involved in <u>any one</u> of the following reaction. **[5]**

i)



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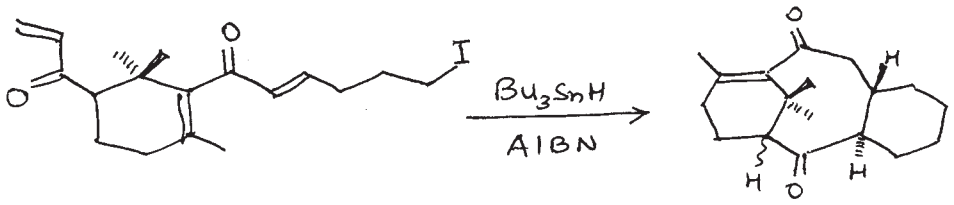
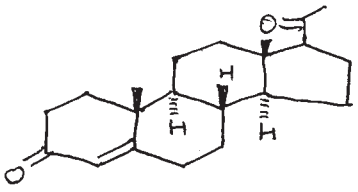
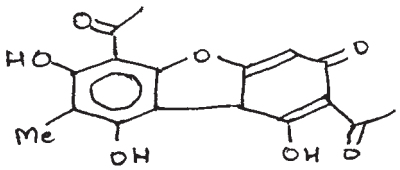


b) What is biomimetic reaction? Explain how this is used to synthesize following (any one): **[5]**

i)



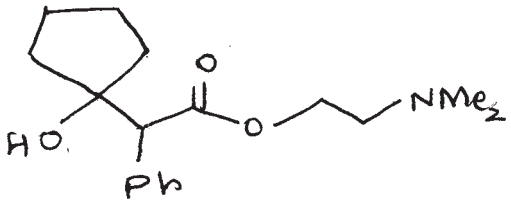
ii)



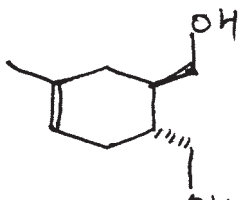
SECTION - II

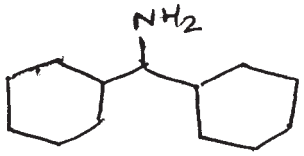
Q4) Using retrosynthetic analysis, suggest a suitable method to synthesize <u>any three</u> of the following compounds. **[12]**

a)



b)

c) 

d) 

Q5) a) Give one reaction with reagent for each synthon given below: **[6]**

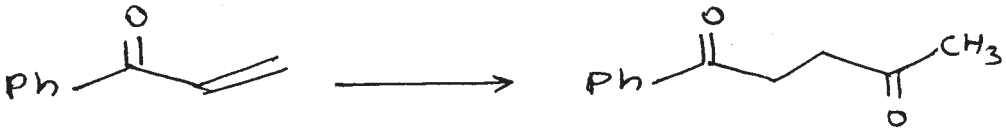
i) $ph\overset{\ominus}{C} = 0$

ii) $\overset{\oplus}{C}OOH$

iii) $\overset{\oplus}{C}H_2COOH$

b) Using the method of umpolung carry out conversion of <u>any two</u> of the following: **[6]**

i) 

ii) 

iii) 

Q6) a) Answer <u>any one</u> of the following: **[4]**

i) Explain the use of super-critical fluids in the extraction process in organic synthesis.

ii) Discuss various methods used in Green synthesis.

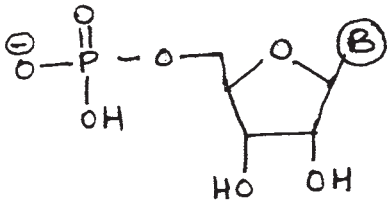
b) Answer <u>any four</u> of the following: **[12]**

i) Give two methods for the synthesis of the following:

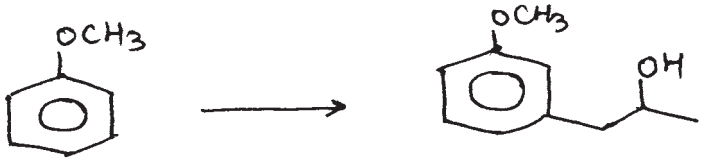
ii) Arrange the reagents given to achieve the following conversion

$(COOH)_2$, Steam dist.; ^nBuLi, THF, –78°C; $NaBH_4$, THF, EtOH; ^nBuBr, THF.

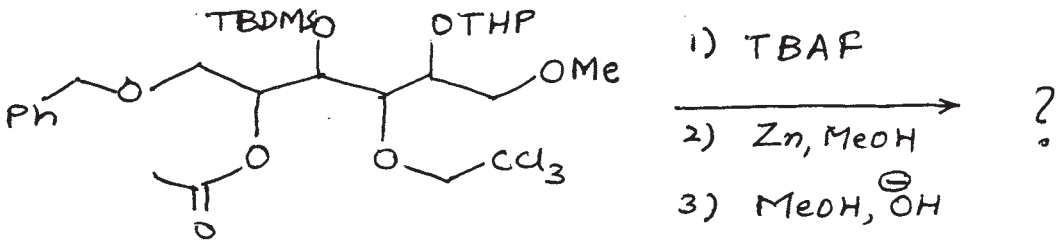
iii) Discuss the steps involved in the synthesis of the following ribonucleotide.



iv) How the following conversion can be achieved?



v) Write the product.



Total No. of Questions : 6]

SEAT No. :

P2927

[Total No. of Pages : 4

[4725]-402
M.Sc.
DRUG CHEMISTRY
CH- 462: Chemotherapy
(2008 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Answers to the two sections should be written in separate answer book.***

SECTION - I

Q1) Answer any three of the following: **[18]**

a) Explain the mechanism of action of β- lactam antibiotics & sulfonamides. Why are these drugs selectively toxic to bacteria?

b) Discuss the development of Quinolone antibacterials. Why have they achieved the distinction of "Most commonly used antibacterials."

c) Describe viral life cycle & discuss atleast three drugs acting on the different phases of life cycle? What will be the best strategy to stop viral infection.

d) Discuss the steps involved in protein synthesis (translation) & the drugs acting as inhibitors of protein synthesis & their uses.

e) Give a brief overview of drug resistance? Explain the mechanism of drug resistance & strategies of combat resistance.

Q2) Answer any two of the following: **[10]**

a) Give a brief account of the development of alkylating agents used in cancer chemotherapy - clearly indicate the benefits achived in the process.

b) Give a brief account of antimetabolites used as drugs.

c) Comment on drugs of choice for Malaria & Tuberculosis.

P.T.O.

Q3) Describe the mode of action & uses of <u>any 4</u> of the following drugs: **[12]**

a) Vinblastine sulfate

b) Nystatin

c) AZT

d) Diazepam

e) Aspirin

f) Duanomycin

SECTION - II

Q4) Answer <u>any two</u> of the following: **[16]**

a) What is hypertension? What are the factors responsible for hypertension? Discuss the drugs used to manage hypertension.

b) Discuss the function of the following hormones (any 4). Explain what happens if they are oversecreted or undersecreted.

i) Calcitonin

ii) Aldosterone

iii) Estrogen

iv) Thyroxin

v) Somatotropin

c) What is Diabetis? Explain its various types? What are the current strategies adopted to manage diabetis? Discuss how the drugs central the BSL.

Q5) Answer <u>any two</u> of the following: **[12]**

a) Discuss convulsions or Depression? How does the drug intervention help in rectifying the disorder - explain mechanism of atleast one drug types? Why the therapy is long term?

b) What is Acute Myocardial infraction? What are the factors responsible for AMI? How is AMI managed with drugs?

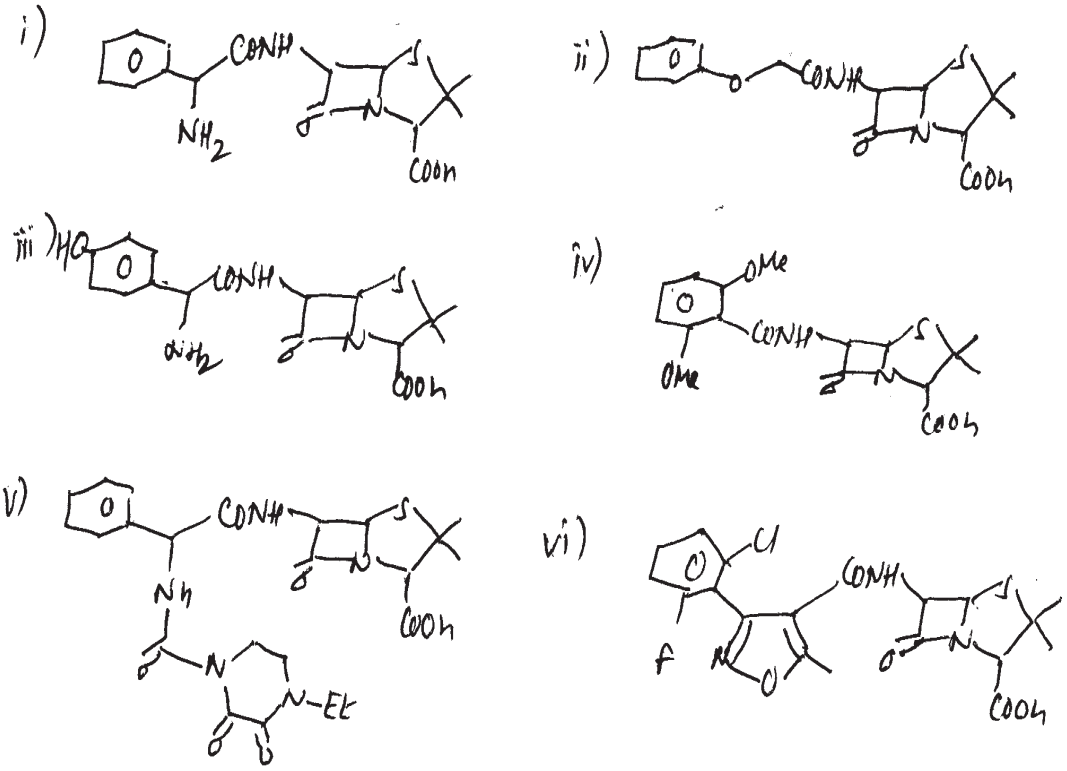
c) Discuss the following in brief (any two):

i) Cortico steroids

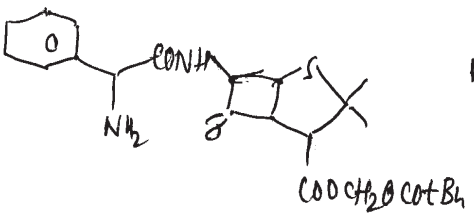
ii) Diuretics

iii) Inflammation.

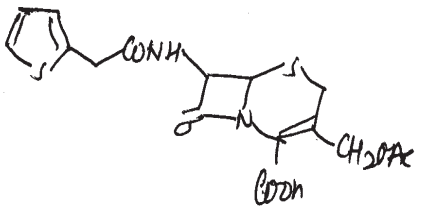
Q6) The following drugs are deliberate modification of the original/natural drug molecules. Name the individual compound shown & discuss what benefits it has over its congener & its application. **[12]**



vii)



viii)



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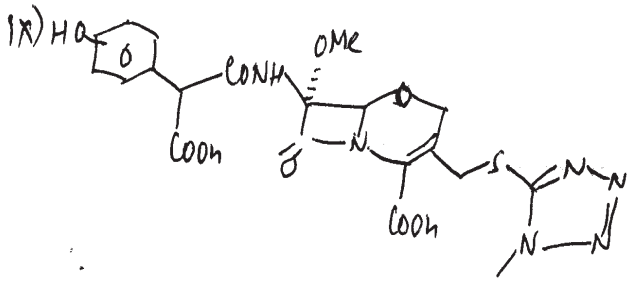
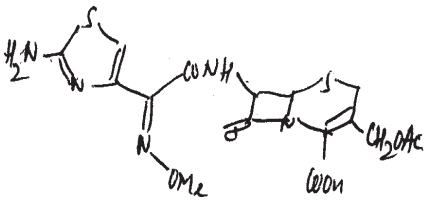


x)



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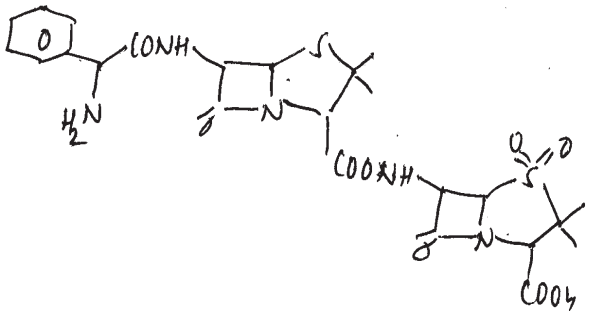

EEE

Total No. of Questions : 6]

SEAT No. :

P2928

[Total No. of Pages : 3

[4725]-403
M.Sc.
DRUG CHEMISTRY
CH- 463: Drug Design
(2008 Pattern) (Semester - IV)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer book.***
2) ***Figures to the right indicate full marks.***
3) ***All questions are compulsory.***

SECTION - I

Q1) Answer any two of the following: **[14]**

a) Discuss briefly

i) Use of transgenic animals in pharming.

ii) Problems encountered in production of human proteins in bacteria.

b) Define following

i) Genome

ii) Metabolome

iii) Transcriptome

c) Answer any two

i) Edible vaccines.

ii) PCR amplification

iii) Cytotoxic antibodies

P.T.O.

Q2) Answer any two of the following: **[12]**

a) What is standard deviation, why it is used? Compute standard deviation for following data of hight (in inches) of 10 plants.

4.8, 5.4, 5.3, 5.5, 4.9, 4.7, 5.00, 5.3, 4.8, 5.2

b) Define correlation between two variables. compute the same for the following data of production in quintals and price is Rupees for 6 different years.

Production -	(x)	940,	861,	840,	815,	791,	725
Price Rs.Thousands	(y)	1.7	1.8	2.0	2.1	2.3	2.4

c) Define probability of an event. Two person A & B solve a particular problem independently have probabilities 0.6 and 0.4 respectively. Find the probability that

i) Only one solve the problem

ii) The problem is solved.

Q3) Attempt <u>any two</u> of the following: **[14]**

a) What is a receptor? Discuss in brief receptor theories & receptor models to explain drug action.

b) Give a brief account of the stages involved in the interaction of 7 TM receptor-ligand complex with G-protein & the signal transduction using secondary messengers.

c) Give an account of prodrugs designed to

i) Increased absorption

ii) Crossing the blood brain barrier

iii) Decreased rate of metabolism

SECTION - II

Q4) Answer any three of the following: **[18]**

a) What are the aims & procedures involved in combinational chemistry. Explain with examples.

b) What is QSAR? What benefits it has over SAR? How QSAR studies are carried out using Hansch approach - discuss.

c) Explain the following term

i) Systematic search

ii) Density functional theory

iii) Energy minimization

d) What are the components of a standard force field? Describe them & give their significance.

Q5) Answer any two of the following: **[12]**

a) Discuss how are the following calculated

i) log P

ii) E_s

iii) π

b) How would you approach to design a drug molecule when the structure of the target is unknown & when it is known - explain & justify your approach

c) Discuss in brief

i) Topliss manual approach

ii) Free Wilson approach.

Q6) Explain in brief the following (any two): **[10]**

a) Lipinski's rule of five.

b) Bioinformatics in dry discovery.

c) High thoroughput screening.

EEE

Total No. of Questions : 6] **SEAT No. :**

P3103 **[Total No. of Pages : 2**

[4729] - 1001
M.Sc. (Semester - I)
ZOOLOGY
ZY101 - T : Biochemistry - I
(2013 Pattern) (3 Credits)

Time : 2½ Hours] ***[Maximum Marks : 38***

Instructions to the candidates:

1) ***Attempt any three questions from Q.No. 1 to Q.No. 5.***
2) ***Q.No. 6 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***

Q1) a) What are monosacharides? Classify them with suitable examples. **[4]**

b) Explain Allostric enzymes with suitable example. **[4]**

c) What are the sources of Vitamin B_{12}? **[2]**

Q2) a) Explain the non - covalent bonds responsible for maintaining the protein structure . **[5]**

b) Explain sources and functions of Vitamin A. **[3]**

c) What is cofactor? **[2]**

Q3) a) What are steroids? Explain their biological significance. **[3]**

b) Water is universal solvent, Explain. **[3]**

c) Explain the PITC reaction and give its importance. **[4]**

Q4) a) How does substrate concentration affect enzyme activity. **[4]**

b) Explain enzyme specificity with suitable examples. **[4]**

c) What is buffer? Name two biological buffers. **[2]**

P.T.O.

Q5) a) What are Isozymes? Explain with suitable example **[5]**

b) Explain the source and functions of Vitamin - E. **[5]**

Q6) Attempt any two of the following : **[8]**

a) Draw the structure of following polypeptide.

Pro – Met – Gly

b) Proteins are most important biomolecules, Explain.

c) What are triglycerols? Explain the saponification reaction and give its significane?

♦♦♦♦

Total No. of Questions : 6] SEAT No. :

P3105 [Total No. of Pages : 2

[4729] - 1002
M. Sc. (Semester - I)
ZOOLOGY
Z Y-102-T : Cell biology
(3 Credits)
(2013 Pattern)

Time : 2½ Hours] *[Max. Marks : 38*

Instructions to the candidates:

1) ***Attempt any three questions from Q. No. 1 to Q. No. 5.***
2) ***Q. No. 6 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***

Q1) a) Explain the organization of nuclear pore complex and give its significance. **[4]**

b) Explain the variousion channels in plasma memrane. **[4]**

c) Compare the cellular organization of prokaryotic and eukaryotic cell. **[2]**

Q2) a) Explain the organization and functions of receptor protein tyrosine-kinases. **[5]**

b) Explain the gap junction and give its importance. **[3]**

c) Enumerate the lipid components of plasma membrane. **[2]**

Q3) a) Write a note on Lysosomal acid hydrolases. **[3]**

b) Explain the functions of peroxisomes in brief. **[3]**

c) Explain the various membrane proteins and give their significance. **[4]**

Q4) a) Explain the functions of Golgi body. **[4]**

b) Explain the functions of smooth endoplasmic reticulum. **[4]**

c) Explain in brief the S-phase of cell cycle. **[2]**

P.T.O.

Q5) a) Explain the regulation of CDK cyclin activity. **[5]**

b) Describe the ultrastructure of mitochondria and add a note on oxidative phosphorylation. **[5]**

Q6) Attempt any two of the following : **[8]**

a) Write a note on passive transport.

b) Explain the structure and organization of actin filaments.

c) Explain the regulation of cell cycle by extracellular signals.

d) Write a note on nucleolus.

Total No. of Questions : 4] SEAT No. :

P3106 [Total No. of Pages : 2

[4729] - 1003
M.Sc. - I (Semester - I)
ZOOLOGY
ZY - 103 T : Genetics
(2013 Pattern) (2 Credits)

Time : 1½ Hours] *[Max. Marks : 25*

Instructions to the candidates:

1) ***Attempt any two questions from Q.No. 1 to Q. No. 3.***
2) ***Question no.4 is compulsory.***
3) ***Figures to the right indicate full marks.***

Q1) a) Explain with suitable example, the influence of genes and environment on quantitative inheritance. **[4]**

b) Explain ABO blood group system in humans as an example of multiple allelism. **[4]**

c) What is test cross? State its applications. **[2]**

Q2) a) Define operon. Explain the organization of Lac operon. **[5]**

b) Explain in brief the classical concept of a gene. **[3]**

c) Define : **[2]**

i) epistasis

ii) linkage

Q3) a) Explain 'Hybridoma technique' in brief. State its applications. **[4]**

b) Explain the genetic basis of any two 'In - born' metabolic disorders. **[3]**

c) If the frequency of 't' allele is 0.56. Find out the number of heterozygous tasters in a population of 1000 persons. **[3]**

Q4) A hybrid F_1 females +++/hfz eg were test crossed with recessive males h fz eg/hfz eg. **[5]**

Following progeny was obtained from the cross.

+++ = 393 ++ eg = 28

h fz eg = 409 h fz + = 30

+ fz eg = 58 + fz + = 1

h++ = 80 h + eg = 1

P.T.O.

Determine the sequence of genes on the chromosomes & the distance between them. Construct a gene map for the three loci.

OR

Among 1500 people, the following blood types were obtained:

A = 40% B = 25% AB = 10% O = 25%.

Calculate the number of heterozygote “A” persons.

Total No. of Questions : 4]

SEAT No. :

P3107

[Total No. of Pages :2

[4729] - 1004

M.Sc. (Semester - I)

ZOOLOGY

ZY 104 : (T) : BIOSTATISTICS

(2013 Pattern) (Credit system)

Time :1.30 . Hour] *[Max. Marks :25*

Instructions to the candidates:-

1) ***Attempt any TWO questions from Q1,Q2 and Q3.***
2) ***Question 4 is compulsory.***
3) ***Figures to the right indicate full marks.***
4) ***Use of calculator and statistical tables is allowed.***

Q1) a) Define the terms: Sample , Class limits, cumulative frequency, median. **[4]**

b) Describe in brief the method of drawing histogram. **[3]**

c) Define the term dispersion , absolute and relative measure of dispersion. **[3]**

Q2) a) The table below gives frequency distribution. Compute 17^{th} Percentile. **[4]**

Class	Frequency
00 - 20	12
20 - 40	19
40 - 60	26
60 - 80	32
80 - 100	17
100 - 120	11

b) State the formula for quartile deviation, variance and coefficient of variation. **[3]**

c) Explain the concept of regression .State the equations of two regression lines. **[3]**

P.T.O.

Q3) a) What are different types of experiments? Give one example of each. **[4]**

b) State the probability distribution of binomial distribution.Also state its properties. **[3]**

c) Define:Acceptance region , Type I error, Level of significance. **[3]**

Q4) Write short note on any one. **[5]**

a) F-test for equality of two population variance.

b) Mathematical and Classical definition of Probability.

Total No. of Questions : 4] **SEAT No. :**

P3108 **[Total No. of Pages : 2**

[4729]-1005

M. Sc. (Part - I) (Semester - I)

ZOOLOGY

ZY - 105 T : Skills In Scientific Communication & Writing

(2013 Pattern) (Credit System)

)Time : 1.30 Hours] *[Max. Marks : 25*

Instructions to the candidates:

1) ***Attempt any two questions from Q. No. 1, 2 & 3.***
2) ***Q. No. 4 is compulsory.***
3) ***Figures to the right indicate full marks.***
4) ***Draw neat labelled diagrams wherever necessary.***

Q1) a) How to write "Discussion" section in a scientific paper **[4]**

b) How to write legends for illustrations? Describe. **[4]**

c) What is jorgans **[2]**

Q2) a) Explain Genetic code as a simple language **[5]**

b) What are the qualities of a good "Title" for a scientific paper? Explain with suitable example **[3]**

c) Explain the importance of english in Scientific communication [2]

Q3) a) Explain the method of Proof correction with appropriate symbols. **[3]**

b) Explain the style of writing "Introduction" **[3]**

c) Describe features of precis writing **[4]**

P.T.O.

Q4) a) Describe how to prepare "Power point" slides for oral presentation. [5]

OR

b) Discuss Language as a communication tool for reading, writing, hearing and speaking. [5]

Total No. of Questions : 4] **SEAT No. :**

P3109 **[Total No. of Pages : 1**

[4729] - 1006
M.Sc. - I (Semester - I)
ZOOLOGY
ZY 106 T : Freshwater Zoology
(2013 Pattern) (2 Credits)

Time : 1½ Hours] ***[Maximum Marks : 25***

Instructions to the candidates:

1) ***Attempt any two questions from Q.No. 1 to Q.No. 3.***
2) ***Question no. 4 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***

Q1) a) Describe protective adaptations in freshwater protozoa. **[4]**

b) Give importance of dissolved oxygen in aquatic life. **[3]**

c) Discuss role of temperature in fresh water. **[3]**

Q2) a) Give an economic importance of molluscs. **[5]**

b) Describe ephimeral water bodies. **[3]**

c) Describe oligotrophic lake. **[2]**

Q3) a) Give diagnostic features of fairy shrimps. **[4]**

b) Describe biological changes in rivers due to sewage pollution. **[3]**

c) Give adaptations of turtles. **[3]**

Q4) Write short notes on (any one) **[5]**

a) Importance of tadpole in life cycle at frog.

b) Lentic habitat.

♦♦♦♦

Total No. of Questions : 8] **SEAT No. :**

P3091 **[Total No. of Pages : 2**

[4729] - 101
M.Sc. - I (Semester - I)
ZOOLOGY
ZY - 101 : Biochemistry
(2008 Pattern)

Time : 3 Hours] ***[Maximum Marks : 80***

Instructions to the candidates:

1) ***Attempt any four questions.***
2) ***All questions carry equal marks.***
3) ***Draw neat diagrams wherever necessary.***

Q1) Answer the following : **[20]**

a) Define Wax. Give its significance with suitable example.

b) Explain the term peptide bond? Give structure of following Gly - Try - Ser - Lys.

c) Explain in brief ETC.

d) Describe the term polysaccharide. Explain Structural polysaccharide.

Q2) a) Explain the structure and function of pyruvate dehydrogenase complex. **[10]**

b) What are lipids? Explain its outline classification and biological importance. **[10]**

Q3) a) Explain the reactions catalyzed by glutamate dehydrogenase. **[10]**

b) Explain the process of gluconeogenesis. **[10]**

Q4) Write short note on. **[20]**

a) Reaction of polypeptide with trypsin.

b) Edman's degredation.

c) Reaction of polypeptide with Cynogen bromide.

d) Dansyl chloride reaction.

Q5) a) Write a note on ketone bodies. **[10]**

b) Explain the chemiosmotic theory. **[10]**

P.T.O.

Q6) a) Explain the classes of restriction enzymes with their cleavage sites. **[10]**

b) Describe the process of glycogen synthesis and give the role of branching. enzyme. **[10]**

Q7) Explain the purine biosynthesis in detail. **[20]**

Q8) Write short note on. **[20]**

a) Regulatory enzymes.

b) Urea cycle.

c) Transamination.

d) Role of Acetyl CoA in Metabolism.

♦♦♦♦

Total No. of Questions : 8] SEAT No. :

P3092 [Total No. of Pages : 2

[4729] - 102
M. Sc. - I (Semester - I)
ZOOLOGY
Z Y - 102 (A) : Genetics
(B) : English for Scientists
(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Attempt any two questions from each section.***
3) ***All questions carry equal marks.***
4) ***Use of calculator is allowed.***

SECTION - I

(A) Genetics

Q1) Discuss the mechanism of gene regulation citing suitable example. **[20]**

Q2) a) Derive Hardy-Weinberg's equation to show that gene frequencies remains constant in absence of evolutionary forces with any suitable data.

b) Give the types of crossing over and the factors influencing them.

[20]

Q3) a) Explain gene manipulation technique with suitable example.

b) Explain the organization of Arabinose operon.

[20]

Q4) Answer any two of the following : **[20]**

a) DNA sequencing methods.

b) Concept of a gene.

c) Sources of genetic variation and their impact on population.

P.T.O.

SECTION - II

ZY 102 b : English for Scientists

Q5) What is scientific research paper? Explain the format of research article and comment on writing abstract and key words. **[20]**

Q6) How to write the result and discussion section of an research article? Explain the methods of data representation. **[20]**

Q7) a) Explain the importance of review of literature in an scientific paper. **[10]**

b) Explain with suitable examples the various styles of writing the references in the bibliography part of an article. **[10]**

Q8) Attempt any four of the following : **[20]**

a) Title of a research paper and its importance.

b) Genetic code as simple language.

c) Hypothesis and its importance.

d) Tautology.

e) Proof reading and its importance.

Total No. of Questions : 8] SEAT No. :

P3093 [Total No. of Pages : 3

[4729] - 104
M.Sc. - I (Semester - I)
ZOOLOGY
ZY - 103 : A) Fresh Water Zoology
B) Statistical Methods
(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Answer any two questions from each section.***
2) ***Answers to the two sections should be written in separate answer book.***
3) ***Draw neat labelled diagrams wherever necessary.***
4) ***Figures to the right indicate full marks.***

SECTION - I

A) Freshwater Zoology

Q1) Give an account of protective adaptations of freshwater animals. **[20]**

Q2) Comment upon the general organization and life cycle of crustaceans. **[20]**

Q3) Explain the diagnostic feature of fairy shrimp and tadpole shrimp. **[20]**

Q4) Write short notes on (any four) **[20]**

a) Thermal stratification

b) Importance of chemical conditions to aquatic life

c) Adaptations in reptiles

d) Locomotory adaptations in insects

e) Significance of frog tadpole

P.T.O.

SECTION - II

B) Statistical Methods

Q5) a) Define the following terms: **[6]**

i) Class-Limits,

ii) Class-Mark,

iii) Class-Width.

b) The following data gives blood sugar level (mg/dl) observed in 100 patients: **[10]**

Blood Sugar Level	80-100	100-120	120-140	140-160	160-180
No. of Patients	25	30	20	15	10

Obtain coefficient of variation (C.V.) of the above data.

c) Define mode, Describe the procedure how it is obtained for individual observations & discrete frequency distribution. **[4]**

Q6) a) Define p.m.f. of Binomial distribution & Poisson distribution. **[6]**

b) In an experiment on pea breeding, a scientist obtained the following frequencies of seeds; 316 round and yellow, 102 wrinkled and yellow, 109 round and green and 33 wrinkled and green. Theory predicts that the frequency of seeds should be in the proportion 9:3:3:1 respectively. Does experiment supports theory. Use 5% level of significance. **[10]**

c) Define correlation and interpret the values of correlation coefficient r = 0.-1. +1. **[4]**

Q7) a) Explain the test procedure for testing two population means. **[10]**

b) The following table gives weights (in grams) of 8 albino rats in 2 different batches. **[10]**

Wt.in 1st batch	105	95	85	102	108	103	95	87	100
Wt.in 2nd batch	110	101	90	110	112	107	98	91	100

Test whether the two population from which the two batches were selected have equal variability with regards to the weights of rats. Use 10 % level of significance.

Q8) a) Explain the chi-square test of goodness of fit. **[10]**

b) From the following data of height of brother and sisters, calculate the coefficient of Correlation and comment on the result. **[10]**

Height of brothers (cm) X	65	66	67	68	69	70	71
Height of sisters (cm) Y	67	68	66	69	72	72	69

Hence obtain regression line of Y on X.

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Total No. of Questions : 6] SEAT No. :

P3110 [Total No. of Pages : 2

[4729] - 2001

M.Sc. (Semester - II)

ZOOLOGY

ZY - 201 T : Biochemistry - II

(2013 Pattern) (3 Credits)

Time : 2½ Hour] *[Max. Marks : 38*

Instructions to the candidates:

1) ***Attempt any three questions from Q.No. 1 to Q.No. 5.***
2) ***Q.No. 6 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***

Q1) a) Explain the structure and function of pyruvate dehydrogenase complex. **[4]**

b) Explain the Chemiosmotic theory. **[4]**

c) Define Enthalpy. **[2]**

Q2) a) Explain the reactions in which glucose is formed from noncarbohydrate source. **[5]**

b) Explain the reaction of methyl malonate pathway. **[3]**

c) Explain the role of Coenzyme in metabolic pathway with a example. **[2]**

Q3) a) Explain the reaction of the decarboxylation of pyruvic acid. **[3]**

b) Explain the conversion of α ketoglutarate to glutamate. **[3]**

c) Explain the β- oxidation of fatty acid. **[4]**

Q4) a) Explain the role of branching enzyme in glycogen synthesis. **[4]**

b) Explain the mechanism of transamination. **[4]**

c) Define 1^{st} law of thermodynamics. **[2]**

Q5) a) Explain the synthesis of AMP starting from IMP. **[5]**

b) Explain the degradation of pyrimidine nucleotide. **[5]**

Q6) Attempt any two of the following : **[8]**

a) Explain the role of Acetyl Co-A in metabolic pathways.

b) Explain in brief ETC.

c) Explain the conversion of succinate to fumarate

d) Explain the conversion of malate to citrate

Total No. of Questions : 6]

SEAT No. :

P3111

[Total No. of Pages : 2

[4729] - 2002

M.Sc. (Semester - II)

ZOOLOGY

ZY202T : Molecular Biology

(2013 Pattern) (3 Credits)

Time : 2½ Hours] *[Max. Marks : 38*

Instructions to the candidates:

1) ***Attempt any three questions from Q. No. 1 to Q. No. 5.***
2) ***Q. No. 6 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***

Q1) a) Explain the initiation of DNA replication in prokaryotes. **[4]**

b) Explain elongation and proofreading of DNA strand during replication. **[4]**

c) State the function of DNA ligase in replication of eukaryotes. **[2]**

Q2) a) What are nucleosomes? Explain higher order chromatin structure. **[5]**

b) Explain the structure and function of tRNA. **[3]**

c) What is satellite DNA? **[2]**

Q3) a) What are transposons? **[3]**

b) Explain the structure of Eukaryotic ribosome and give its function. **[3]**

c) Explain Base excision repair. **[4]**

Q4) a) Explain the structure and function of DNA polymerase in prokaryotes. **[4]**

b) Explain the mechanism of DNA damage by UV rays. **[4]**

c) Define nucleotide. **[2]**

P.T.O.

Q5) a) Explain the mechanism of modification of mRNA at 5'end. **[5]**

b) Explain the mechanism of elongation of protein synthesis. **[5]**

Q6) Write notes on any two of the following: **[8]**

a) Protein folding.

b) DNA topology.

c) Promoter sequences.

d) Cot ½ and its importance.

Total No. of Questions : 8] SEAT No. :

P3094 [Total No. of Pages : 2

[4729] - 201

M.Sc. - I (Semester - II)

ZOOLOGY

ZY - 201 : A) Developmental Biology

B) Comparative Animal Physiology

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any two questions from each section.***
2) ***Answers to the two sections should be written in seperate answer-books.***
3) ***All questions carry equal marks.***
4) ***Draw neat labelled diagrams wherever necessary.***

SECTION - I

A) Developmental Biology

Q1) Explain the process of oogenesis and comment on synthesis and storage of maternal transcripts. **[20]**

Q2) Explain in detail the process of mesoderm induction in Xenopus. **[20]**

Q3) Describe fate maps in chick embryo using radioactive cell tracking. **[20]**

Q4) Write notes on any two of the following : **[20]**

a) Tail fibre complex.

b) Organizers in frog

c) Cell ageing.

d) Acrosome reaction.

P.T.O.

SECTION - II

B) Comparative Animal Physiology

Q5) Explain the ultra structure of sketletal muscle. Add a note on mechanism of muscle contraction and role of calcium ion in contraction. **[20]**

Q6) Explain the mechanism of hormonal action. Add a note on the chemistry of vertebrate hormones. **[20]**

Q7) a) Explain the process of urine formation. **[10]**

b) Describe the respiratory pigments in animals. **[10]**

Q8) Write notes on the following : **[20]**

a) Poikilotherms and Homiotherms

b) Dietary requirements in mammals.

c) Oxygen dissociation curve

d) Cardiac output.

Total No. of Questions : 8] SEAT No. :

P3095 [Total No. of Pages : 2

[4729] - 202
M.Sc. (Semester - II)
ZOOLOGY
Zy - 202 : A) MOLECULAR BIOLOGY
B) CELL BIOLOGY
(2008 Pattern)

Time :3. Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *Attempt any two sections.*
2) *Answer any two questions from each section.*
3) *Answer to the two sections should be written in separate answer books.*
4) *All questions carry equal marks.*
5) *Neat diagrams must be drawn wherever necessary.*

SECTION - I

MOLECULAR BIOLOGY

Q1) Explain the various post-transcriptional modifications in prokaryotes. **[20]**

Q2) a) Enlist and explain in brief the different forms of DNA. **[10]**

b) Explain in brief the structure nucleosome. **[10]**

Q3) Explain the Eukaryotic DNA replication process. **[20]**

Q4) Write notes on the following. **[20]**

a) Base Excision Repair

b) Initiation of translation.

c) Temperature melting.

d) Properties of genetic code.

P.T.O.

SECTION - II

CELL BIOLOGY

Q5) Explain the structure and function of endoplasmic reticulum. **[20]**

Q6) Explain the role of cytoskeleton in cell architecture and cell motility. **[20]**

Q7) Give the ultrastructure of nucleus. Explain nuclear pore complex. **[20]**

Q8) Write notes on: **[20]**

a) Ribosomes.

b) Cell cycle.

c) Cell adhesion molecules.

d) Protein import in mitochondria.

Total No. of Questions : 8] **SEAT No. :**

P3116 **[Total No. of Pages : 4**

[4729] - 3001
M.Sc. (Part - II) (Semester - III)
ZOOLOGY
ZY - 301 T : Animal Physiology - I
(2013 Pattern) (Special Paper - 4 Credits)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***
3) ***Draw neat diagrams wherever necessary.***

Q1) a) What is bioluminescence? Explain the structure of luminescent organ. **[5]**
b) Explain the salient features of aqueous environment. **[3]**
c) Define homeostatis. **[2]**

Q2) a) What are electro - receptors? Explain their significance. **[4]**
b) What is Biological clock? Explain the lunar rhythm. **[4]**
c) What is swim bladder? **[2]**

Q3) a) "Biological membrane is semi - permeable". Explain. **[3]**
b) What is the role of $Na^+ - K^+$ pump? **[3]**
c) Explain action potential in detail? **[4]**

Q4) a) Explain the effect of high altitude on metabolism. **[5]**
b) Write a note on deep sea hydrothermal vent. **[3]**
c) Define Anaerobic respiration. **[2]**

Q5) a) Define : Current; Conductance. **[3]**
b) Explain ureotelism with suitable examples. **[3]**
c) How is metabolic rate related to body size? Explain with a suitable example. **[4]**

Q6) a) Explain osmoregulation in marine fish. **[4]**
b) Explain the regulation of water and electrolyte balance in terrestrial vertebrates. **[4]**
c) Define osmotic pressure. **[2]**

Q7) a) Explain the renal regulation of acid - base balance. **[5]**
b) "Ammonia formed in the body is toxic". Explain. **[5]**

Q8) a) Write a note on gas floats. **[5]**
b) "Glycogen is energy storage molecule'. Explain. **[5]**

P.T.O.

Total No. of Questions : 8]

P3116

[4729] - 3001
M.Sc. (Semester - III)
ZOOLOGY
ZY - 301T : Entomology - I
(2013 Pattern) (Special Paper - 4 Credits)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Explain in brief the origin and evolution in insects. **[4]**
b) Explain the structure of Pectinate antenna. **[3]**
c) Explain Hemelytra. **[3]**

Q2) a) Give the distinguishing characters of order Protura with two examples. **[5]**
b) Explain the characters of Odonata with two examples. **[3]**
c) Define Moulting. **[2]**

Q3) a) Sketch and label head sutures of a generalized insect. **[4]**
b) Explain wing venation. **[4]**
c) Give the function of Maxilla. **[2]**

Q4) a) Mention the distinguishing characters of Diptera with two examples. **[4]**
b) Explain - chewing and lapping type of mouthparts. **[3]**
c) Sketch & label - Corbiculate leg of honeybee worker. **[3]**

Q5) a) Explain Telotrophic ovariole. **[5]**
b) Explain wax gland. **[3]**
c) Give function of regenerative cells. **[2]**

Q6) a) Explain structure and function of salivary gland of typical insects. **[4]**
b) Explain Accessory pulsatory organs. **[4]**
c) Give the meaning of Hemipneustic tracheal system. **[2]**

Q7) a) What is excretion? Explain the structure and function of Malpighian tubules. **[5]**
b) Explain the any endocrine glands of insects. **[5]**

Q8) a) Explain structure function of ommatidium of an insect. **[5]**
b) Explain morphology of male reproductive system of generalized insects. **[5]**

Total No. of Questions : 8]

P3116

[4729] - 3001
M.Sc. (Part - II) (Semester - III)
ZOOLOGY
ZY - 301 T : Genetics - I
(2013 Pattern) (Special Paper - 4 Credits)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Neat labelled diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***

Q1) a) "Evolutionary forces operating on a population change the allelic frequencies". Justify the statement with the help of any one evolutionary force. **[4]**

b) What is narrow sense heritability? How does it differ from Broad sense heritability? **[3]**

c) "It is advantageous the use Nucleic acid information in determining molecular phylogeny". Explain. **[3]**

Q2) a) Explain the partitioning of environmental variance (V_E). **[4]**

b) A complete recessive allele 'g' is lethal in homozygous condition. If 'G' mutates to 'g' at a rate of 10^{-6}per generation, what is the expected frequency of the lethal homozygous when the population reaches mutation selection equilibrium. **[4]**

c) What are paralogous & orthologus genes? **[2]**

Q3) a) Explain the nucleic acid phylogeny based on DNA - DNA hybridization. **[4]**

b) Write the characteristics of 'r' strategists. How do they differ from 'K' strategists? **[3]**

c) State the applications of Reverse genetics. **[3]**

Q4) a) What are chromosomal probes? Explain the types of probes. **[5]**

b) Explain 'Heterozygote superiority' with suitable example. **[3]**

c) What is 'effective population size'? Calculate effective population size with 76 females and 4 males. **[2]**

Q5) a) Explain the role of gene duplication in evolution. **[4]**

b) Define Allopatric & Sympatric speciations. Explain how speciations differ from one another. **[4]**

c) A Study of quantitative variation for abdominal bristle number in female Drosophila yielded estimates of : $V_g = 3.17$, $V_p = 6.08$, $V_e = 2.91$. What is the broad sense heritability for this trait. **[2]**

Q6) a) Explain molecular phylogeny using Amino acid sequencing . **[5]**

b) Distinguish between : "Ex - vivo and in - vivo methods" of gene therapy. **[5]**

Q7) a) Explain the life cycle of Neurospora. How it is useful in genetic studies. **[5]**

b) A, B and C are Inbreed strains of mice assumed to be completely homozygous. A is mated to B and B to C, then A × B hybrids are mated with C and their offsprings to B × C. What is the inbreeding coefficient of the offsprings of this last mating? **[5]**

Q8) a) Explain the method of measurement of heritability from parents to offsprings. **[5]**

b) What is inbreeding? Explain genetic effects of inbreeding. **[5]**

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Total No. of Questions : 4] SEAT No. :

P3117 [Total No. of Pages : 2

[4729] - 3002
M. Sc. (Part - II) (Semester - III)
ZOOLOGY
Z Y : 302 - T : Immunology (2 Credits)
(2013 Pattern)

Time : 1½ Hours] *[Max. Marks : 25*

Instructions to the candidates:

1) ***Attempt any two questions from Q. No. 1 to Q. No. 3.***
2) ***Question No. 4 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***

Q1) a) Explain in brief the molecular basis of generation of antibody diversity. **[5]**

b) Explain Hashimoto's thyroiditis? **[3]**

c) Give the location and function of Payer's patches. **[2]**

Q2) a) Explain the structure and function of T-cell receptor. **[4]**

b) Explain the process of inflammation. **[4]**

c) Define epitope. **[2]**

Q3) a) What are interferons? Explain their functions. **[4]**

b) Explain the process of phagocytosis and give its significance. **[3]**

c) What is Immunological memory? **[3]**

Q4) Attempt any one of the following : **[5]**

a) Explain the principle and applications of ELISA.

b) Explain the alternative pathway of complement system.

P.T.O.

Total No. of Questions : 4]

P3117

[4729] - 3002
M. Sc. (Part - II) (Semester - III)
ZOOLOGY
Z Y : 302 - T : Environmental Biology (2 Credits)
(2013 Pattern)

Time : 1½ Hours] ***[Max. Marks : 25***

Instructions to the candidates:

1) ***Attempt any two questions from Q. No. 1 to Q. No. 3.***
2) ***Question No. 4 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***

Q1) a) Discuss carbon cycle in brief. **[5]**

b) What is Red data book? **[3]**

c) What is ecosystem? **[2]**

Q2) a) Describe applications of microbiology in environmental science. **[4]**

b) What is nutritional flux? **[3]**

c) Discuss distribution of semi-arid habitats of India. **[3]**

Q3) a) Describe faunal diversity of India. **[4]**

b) Discuss role of local community in wildlife management. **[4]**

c) What is niche? **[2]**

Q4) Write short note on <u>any one</u> of the following : **[5]**

a) Food chain.

b) Various causes for extinction of species.

Total No. of Questions : 4] **SEAT No. :**

P3118 **[Total No. of Pages : 2**

[4729] - 3003
M.Sc. (Part - II) (Semester - III)
ZOOLOGY
ZY : 303 – T : Genetic Toxicology (2 Credits)
(2013 Pattern)

Time : 1½ Hours] ***[Max. Marks : 25***

Instructions to the candidates:

1) ***Attempt any two questions from Q. No. 1 to Q. No. 3***
2) ***Question No. 4 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***

Q1) a) What are genotoxic carcinogens? Classify them and add a note on their action. **[5]**

b) What is frame shift mutation? **[3]**

c) Define Toxinology. **[2]**

Q2) a) Explain Ame's test and give its significance. **[4]**

b) Explain the Structural changes in chromosomes. **[4]**

c) Define base analogs. **[2]**

Q3) a) What are alkylating agents? Illustrate their potential to cause mutations. **[4]**

b) Write a note on risk assessment. **[3]**

c) Explain anuploidy with suitable example. **[3]**

Q4) Attempt any one of the following: **[5]**

a) Explain a method to study mutation in *Drosoplila.*

b) Write a note on molecular methods to detect mutation.

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P.T.O.

Total No. of Questions : 4]

P3118

[4729] - 3003
M.Sc. (Part - II) (Semester - III)
ZOOLOGY
ZY : 303 – T : Aquaculture
(2013 Pattern) (Credit System)

Time : 1½ Hours] ***[Max. Marks : 25***

Instructions to the candidates:

1) ***Attempt any two questions from Q. No. 1,2 &3.***
2) ***Question No. 4 is compulsory.***
3) ***Figures to the right indicate full marks.***
4) ***Draw neat labelled diagrams wherever necessary.***

Q1) a) Explain in brief fresh water prawn culture. **[4]**

b) Give the use of Geographic Information System (GIS) technology in fisheries development. **[4]**

c) Explain fresh water equaculture systems. **[2]**

Q2) a) Give in brief harvesting techniques of fish. **[5]**

b) What is Mariculture? **[3]**

c) Describe culture of Eels. **[2]**

Q3) a) Write a note on collection and rearing of oysters. **[3]**

b) Explain what is insertion of nucleus in pearl culture. **[3]**

c) Explain various worm diseases in fishes. **[4]**

Q4) Write short note on any one of the following : **[5]**

a) Natural breeding in fishes.

b) Preparation and Management of stocking ponds.

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Total No. of Questions : 4] **SEAT No. :**

P3119 **[Total No. of Pages : 1**

[4729] - 3004

M.Sc. (Part - II) (Semester - III)

ZOOLOGY

ZY 304 T : Insect Physiology & Biochemistry

(2 credit) (2013 Pattern)

Time : 1½ Hours] ***[Max. Marks : 25***

Instructions to the candidates:

1) ***Attempt any two questions from Q. No. 1 to Q. No. 3.***
2) ***Question No. 4 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***

Q1) a) Describe the structure of insect epicuticle. **[4]**

b) Explain physico-chemical properties of insect plasma. **[3]**

c) Give the functions of insect integument. **[3]**

Q2) a) Describe the structure of haemocytes. **[5]**

b) Explain the role of harmones in insect moulting. **[3]**

c) Enlist the functions of haemocytes. **[2]**

Q3) a) Explain the carbohydrate digestion & absorption in insects. **[4]**

b) Describe the structure of flight muscle. **[3]**

c) Explain steroid harmones. **[3]**

Q4) Describe role of microsomal enzymes in insecticides degradation & detoxification. **[5]**

OR

Describe the structure and function of malpighian tubules in insects.

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Total No. of Questions : 4] **SEAT No. :**

P3120 **[Total No. of Pages : 2**

[4729]-3005

M. Sc. (Part - II) (Semester - III)

ZOOLOGY

ZY - 305 T : Research Methodology

(2013 Pattern) (2 Credits)

Time : 1.30 Hours] *[Max. Marks : 25*

Instructions to the candidates:

1) ***Attempt any two questions from Q. No. 1 to Q. No. 3***
2) ***Question No. 4 is compulsory.***
3) ***Neat labelled diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***

Q1) a) State the Beer-lambert's law. Discuss working of a spectrophotometer. **[4]**

b) State the principle, working & advantages of electrophoresis **[4]**

c) Define ultra centrifugation **[2]**

Q2) a) Discuss the PCR technique & its importance **[5]**

b) State applications of bioinformatics. [3]

c) Explain significance of Atomic force microscopy [2]

Q3) a) How literature review is important to define a research problem? Explain **[3]**

b) Enlist the biostatistical methods for analysis of biological data **[3]**

c) Define Data Explain any two methods of analysis & interpreptation of data **[4]**

P.T.O.

Q4) a) Give significance of purification & characterization of biomolecules [5]

OR

b) Explain the importance of computer in biological research. [5]

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Total No. of Questions : 4] **SEAT No. :**

P3121 **[Total No. of Pages : 1**

[4729] - 3006
M.Sc. - II (Semester - III)
ZOOLOGY
ZY 306 T : Parasitology
(2013 Pattern) (Credit System))

Time : 1½ Hours] ***[Maximum Marks : 25***

Instructions to the candidates:

1) ***Attempt any two questions from question no. 1, 2, & 3.***
2) ***Question no. 4 is compulsory.***
3) ***Figures to the right indicate full marks.***
4) ***Draw neat and labeled diagrams wherever necessary.***

Q1) a) Describe life cycle and pathogenicity of Schistosoma. **[4]**

b) Discuss the parasitic effects benefiting the host. **[4]**

c) Describe sexual stage of Trypanosoma. **[2]**

Q2) a) Explain VSG gene expression in Trypanosoma. **[5]**

b) Describe chromatin dimination in Ascaris. **[3]**

c) What is genetic prophylaxis? **[2]**

Q3) a) Describe Radio immuno assay. **[3]**

b) Explain Altruism with suitable example. **[3]**

c) Discuss the social behaviour of host with example. **[4]**

Q4) Describe morphology, transmission, pathogenicity and treatment of Dracunculus. **[5]**

OR

Explain sex linked inheritance in Schistosomes.

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Total No. of Questions : 4] SEAT No. :

P3122 [Total No. of Pages : 1

[4729] - 3007
M.Sc. - II (Semester - III)
ZOOLOGY
ZY. - 307 : - T Fundamentals of Systematics
(2013 Pattern) (2 Credits)

Time : 1½ Hour] *[Max. Marks : 25*

Instructions to the candidates:

1) ***Attempt any two questions from Q. No. 1 to Q. No. 3.***
2) ***Question No. 4 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***

Q1) a) What characteristics of an organism should be considered for taxonomic study? **[5]**

b) Differentiate between race and Species. **[3]**

c) What is Binomial Nomenclature. **[2]**

Q2) a) Describe the process of preserving Insects. **[4]**

b) What is curation explain its significance? **[4]**

c) Define Phylogeography. **[2]**

Q3) a) What are SNP? Why are they useful in Taxonomy? **[4]**

b) Explain the characteristics of kingdom Monera. **[3]**

c) What is numerical taxonomy? Explain with an example. **[3]**

Q4) Attempt any one of the following : **[5]**

a) What is ICZN? Describe in brief it's purpose.

b) What is DNA fingerprinting? Explain its importance in taxonomy.

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Total No. of Questions : 4] **SEAT No. :**

P3123 **[Total No. of Pages : 1**

[4729] - 3008

M.Sc. (Part - II) (Semester - III)

ZOOLOGY

ZY - 308 T : Insect Ecology

(2013 Pattern) (2 Credits)

Time : 1½ Hours] ***[Max. Marks : 25***

Instructions to the candidates:

1) ***Attempt any two questions from Q. No. 1 to Q. No. 3.***
2) ***Question No. 4 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***

Q1) a) Explain how climatic factors control insect life. **[5]**

b) Describe feeding strategies of herbivorous insects. **[3]**

c) What is niche? **[2]**

Q2) a) Describe how natural enemies affects on insect population. **[4]**

b) Describe history of insect ecology. **[3]**

c) Discuss importance of insects in cycling of nutrients. **[3]**

Q3) a) Discuss how insects compete with each other. **[4]**

b) Describe leaf shredding insects. **[3]**

c) Describe various measures for insect conservation. **[3]**

Q4) Write short note on <u>any one</u> of the following : **[5]**

a) Structure of plant community.

b) Threats to insect life.

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Total No. of Questions : 4]

SEAT No. : ____

P3124

[Total No. of Pages : 1

[4729] - 3009

M.Sc. (Part - II) (Semester - III)

ZOOLOGY

ZY - 309 T : Toxicology I

(2013 Pattern) (2 Credits)

Time : 1½ Hour] ***[Max. Marks : 25***

Instructions to the candidates:

1) ***Attempt any two questions from Q. No. 1 to Q. No. 3.***
2) ***Question No. 4 is compulsory.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***

Q1) a) What are toxicants? Explain in detail their mode of action. **[5]**

b) Classify the pesticides based on the chemical structure. **[3]**

c) Differentiate between LD 50 and LC 50. **[2]**

Q2) a) Describe in detail the sources, mode of action and toxic effect of heavy metal arsenic. **[4]**

b) Explain mode of action of DDT. **[4]**

c) What is acute toxicity? **[2]**

Q3) a) Explain biomagnification of pesticides. **[4]**

b) What are metalloproteins? **[3]**

c) Discuss occupational diseases with examples. **[3]**

Q4) Write short note on <u>any one</u> of the following : **[5]**

a) Storage depots of toxicants

b) Lead toxicity

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Total No. of Questions : 8]

SEAT No. :

P3097

[Total No. of Pages : 3

[4729] - 301
M.Sc. (Part - II) (Semester - III)
ZOOLOGY
ZY - 311 : Entomology - I
(2008 Pattern)

Time : 3 Hours] ***[Maximum Marks : 80***

Instructions to the candidates:

1) ***Attempt any four questions.***
2) ***Draw neat labelled diagram wherever necessary.***
3) ***All questions carry equal marks.***

Q1) Describe the origin and evolution of Insects.

Q2) Describe the structure of thorax of a generalized Insect.

Q3) Describe the generalized wing vennation. Add a note on wing coupling in insects.

Q4) Write distinguishing characters of following insect orders with atleast two examples from two families.

a) Protura
b) Collembola
c) Hymenoptera
d) Diptera

Q5) Describe the structure of respiratory system in insects.

Q6) Describe the morphology of female reproductive system of a generalized insect. Add a note on polytrophic ovariole.

Q7) Describe the structure of heart in insects and add a note on types of haemocytes.

Q8) Write notes on (any two)

a) Fat bodies
b) Endocrine glands
c) Structure of ommatidium
d) Structure of alimentary canal of typical insect.

P.T.O.

Total No. of Questions : 8]

P3097

[4729] - 301
M.Sc. (Part - II) (Semester - III)
ZOOLOGY
ZY 312 : Genetics - I
(2008 Pattern)

Time : 3 Hours] ***[Maximum Marks : 80***

Instructions to the candidates:

1) ***Attempt any four questions.***
2) ***All questions carry equal marks.***
3) ***Draw well labelled diagrams wherever necessary.***

Q1) Describe Hardy - Weinberg law for distribution of alleles and distribution of genotype in a population and show how these two are related.

Q2) What properties make mitochondrial gene particularly useful in the study of evolutionary changes in the population.

Q3) Enlist various applications of following techniques :

a) PCR
b) DNA microarrays
c) FISH
d) Flow sorting

Q4) Give an overview of the current status of gene therapy.

Q5) Describe different methods of locating genes on a chromosome.

Q6) a) Explain genetic polymorphism with suitable examples.
b) Differentiate between 'r' and 'k' selection.

Q7) Write short notes on :

a) Applications of Reverse Genetics.
b) RFLP

Q8) Explain the Directional, Disruptive and stabilizing modes of selection. Add a note on its effects with suitable examples.

Total No. of Questions : 8]

P3097

[4729] - 301
M.Sc. (Part - II) (Semester - III)
ZOOLOGY
ZY - 313 : Animal Physiology - I
(2008 Pattern)

Time : 3 Hours] ***[Maximum Marks : 80***

Instructions to the candidates:

1) ***Attempt any four questions.***
2) ***All questions carry equal marks.***
3) ***Draw neat diagrams wherever necessary.***

Q1) Explain the diversity of excretory organs in animal kingdom.

Q2) a) Describe the problems of deep sea diving.
b) Explain the strategies of density reduction in aquatic organisms.

Q3) What is B.M.R.? Explain the effect of body size on the metabolic rate.

Q4) What is resting membrane potential? Add a note on Goldman - Hodkin - Katz potential.

Q5) What is biological rhythm? Explain circadium and lunar rhythms with suitable examples.

Q6) Describe the modes of energy storage in animals. Add a note on anaerobic metabolism.

Q7) Discuss the physiological change due to fluctuations of external environment in animals.

Q8) Write Notes on :

a) Extracellular environment.
b) Renal regulation of acid base balance.
c) Photoperiodism
d) Miscellianeous end products of nitrogen metabolism.

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Total No. of Questions : 20] SEAT No. :

P3098 [Total No. of Pages : 3

[4729] - 302
M. Sc. II (Semester - III)
ZOOLOGY
Z Y - 321 : Immunology
Z Y - 322 : Environmental Biology
Z Y - 323 : Fundamentals of Systematics
Z Y - 324 : Aquaculture
Z Y - 325 : Insect Ecology
(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any two sections ZY - 321 to ZY - 325.***
2) ***Answer any two courses should be written in separate answer books.***
3) ***Answer any two questions from each optional course.***
4) ***Neat diagrams must be drawn wherever necessary.***
5) ***All questions carry equal marks.***

SECTION - I

ZY – 321 : Immunology

Q1) Explain antigen processing. Add a note on role of MHC in immune system.

Q2) Explain molecular basis of generation of antibody diversity.

Q3) What is Immune response? Explain the types of immune responses.

Q4) Write notes on (any two) :

a) Active and Passive immmunization.

b) Principle and application of ELISA.

c) Allergy.

P.T.O.

SECTION - II

ZY – 322 : Environmental Biology

Q5) What is productivity? Describe productivity of biogeochemical cycles. of Marine ecosystem. **[20]**

Q6) Give an account of air pollution in detail. **[20]**

Q7) Discuss how sustainable development helps in environmental conservation. **[20]**

Q8) Write short notes on <u>any two</u> of the following : **[20]**

a) Grassland ecosystem

b) Human impact on animals

c) Aquatic ecosystem

d) Global warming

SECTION - III

ZY – 323 : Fundamentals of Systematic

Q9) Explain the importance of systematics and add a note on molecular phylogeny.

Q10) Explain the role of cytotaxanomy and chemotaxanomy in systematics.

Q11) Explain in detail the concept of Race, Species and Taxa.

Q12) Write short notes on any two :

a) Preservation and its role in taxonomic process.

b) Zoological nomenclature.

c) Whittaker's system.

SECTION - IV

ZY – 324 : Aquaculture

Q13) Describe the types of prawns and culturing of freshwater prawns.

Q14) Explain various techniques of preservation and processing of fishes.

Q15) What is fishery science? Write an essay on inland fisheries.

Q16) Write short notes on :

a) Induced breeding.

b) Preparation and maintenance of Nursery ponds.

c) Marine fisheries.

d) Rearing of Oysters.

SECTION - V

ZY – 325 : Insect Ecology

Q17) Describe impact of Physical factors on insect population.

Q18) Explain how insects are related with vascular plants.

Q19) Write an essay on entomophagous insects.

Q20) Write notes on (any four) :

a) Aquatic insects.

b) Insect Scavengers.

c) Insect parasites of vertebrates.

d) Insectivorous vertebrates.

e) Soil insects.

Total No. of Questions : 12] SEAT No. :

P3099 [Total No. of Pages : 2

[4729] - 303
M.Sc. (Part - II) (Semester - III)
ZOOLOGY
ZY-331 : Parasitology
ZY-332 : Insect Physiology and Biochemistry
ZY-334 : Genetic Toxicology
(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) ***Attempt any two Sections***
2) ***Attempt any two questions from each section.***
3) ***All questions carry equal marks.***
4) ***Draw neat labelled diagrams wherever necessary.***
5) ***Answers to the two sections should be written in separate answer book.***

SECTION - I

ZY-331 : Parasitology

Q1) Describe the life cycle, pathogenicity, treatment and control measures of Schistosoma sp. and Dracunculus sp. **[20]**

Q2) Describe various serological methods used in parasitology. **[20]**

Q3) Describe interspecific and strain variations in *Plasmodium and Echinococcus.* **[20]**

Q4) Write notes on any two: **[20]**

a) *Leishmania* sp.

b) Host behaviour.

c) Variable gene expression (VSG).

d) Resistance of malaria to drugs.

P.T.O.

SECTION - II

ZY-332 : Insect Physiology and Biochemistry

Q5) Describe the physiology of digestion and absorption of proteins, carbohydrates and lipids in insects. **[20]**

Q6) Describe the physico-chemical properties of insect plasma. **[20]**

Q7) Write short notes on any two of the following. **[20]**

a) Role of endocrine glands in insect moulting.

b) Structure of insect integument.

c) Structure and physiology of flight muscle.

Q8) Describe the microsomal enzymes involved in insecticide degradation and detoxification. **[20]**

SECTION - III

ZY-334 : Genetic Toxicology

Q9) What is Mutation? Explain the various types of mutation. **[20]**

Q10) Explain the assessment of genotoxicological potential of a test compound in bacteria. **[20]**

Q11) Explain the scope and various divisions of toxicology. Add a note on applications of genetic toxicology. **[20]**

Q12) Write note on : **[20]**

a) Micronucleus test.

b) Oncogenes.

Total No. of Questions : 8] SEAT No. :

P3125 [Total No. of Pages : 6

[4729] - 4001
M.Sc. (Semester - IV)
ZOOLOGY
ZY - 401 T : Entomology - II
(2013 Pattern) (4 Credits)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicates full marks.***
3) ***Draw neat labelled diagram wherever necessary.***

Q1) a) Describe the process of oogenesis in insects. **[5]**

b) Describe structure of spermatozoa. **[3]**

c) Define spermiogenesis. **[2]**

Q2) a) Describe the sex determination in insects. **[4]**

b) Sketch & label polytrophic ovariole. **[4]**

c) Describe Hemicephalous larva. **[2]**

Q3) a) Explain mechanism of oviposition in insects. **[3]**

b) Describe oligopod larva. **[3]**

c) Explain vitellogenesis in insects. **[4]**

Q4) a) Describe the development of nervous system in insects. **[5]**

b) Describe Hatching stimuli. **[3]**

c) Define Energids. **[2]**

Q5) a) Explain ageing in insects. **[3]**

b) Explain aquatic nymphs. **[3]**

c) Describe exarate pupa. **[4]**

P.T.O.

Q6) a) Describe development up to germ band formation in insects. **[4]**

b) Enlist theories of gastrulation. **[4]**

c) Describe Hemimetabolous development. **[2]**

Q7) a) What is gastrulation? Explain the process of gastrulation in insects. **[5]**

b) Describe development of reproductive system in insects. **[5]**

Q8) a) Describe the blastokinesis in insects. **[5]**

b) Give an account of types of pupae in insects. **[5]**

Total No. of Questions : 8]

P3125

[4729] - 4001
M.Sc. - II (Semester - IV)
ZOOLOGY
ZY - 401 T : Animal Physiology - II
(2013 Pattern)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicates full marks.***
3) ***Draw neat labelled diagrams wherever necessary.***

Q1) a) Write a note on Electrocardiogram. **[5]**

b) Explain the types and functions of leucocytes. **[3]**

c) What is Calorimetry? **[2]**

Q2) a) Write a note on lung volume and capacities. **[4]**

b) Write a note on haematopoiesis. **[4]**

c) Explain the role of acetylcholine esterase in synaptic transmission. **[2]**

Q3) a) Explain the process of CO_2 transport. **[4]**

b) What is peristalsis? Give its importance in digestion. **[3]**

c) What is arterial blood pressure? How is it maintained? **[3]**

Q4) a) Describe the components of digestive system. **[5]**

b) Write a note on pace makers. **[5]**

Q5) a) Explain simple muscle twitch. **[5]**

b) Explain the structure and function of neuron. **[3]**

c) What is external respiration? **[2]**

Q6) a) Explain the impact of drugs on synaptic transmission. **[5]**

b) Explain the sliding filament theory of muscle contraction. **[5]**

Q7) a) Describe the structure of eye. **[3]**

b) Explain the role of bile in digestion. **[3]**

c) Explain the physiology of hearing. **[4]**

Q8) a) Explain the role of various ion channels in nerve excitation. **[5]**

b) Describe the internal structure of heart. **[5]**

Total No. of Questions : 8]

P3125

[4729] - 4001
M.Sc. - II (Semester - IV)
ZOOLOGY
ZY - 401 T : Genetics - II
(2013 Pattern) (4 Credits)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figures to the right indicates full marks.***
3) ***Draw neat labelled diagrams wherever necessary.***

Q1) a) Explain how inbred strains are used to investigate animal behaviour. **[4]**

b) What is genomic imprinting? Give evidences for the same from Uniparentaldisomy. **[4]**

c) What is SKY? **[2]**

Q2) a) Write a note on HLA and disease association. **[4]**

b) Explain Gene mapping by FISH Technique. **[4]**

c) Define Pleiotrophy. **[2]**

Q3) a) What is genetic heterogeneity? Explain the concept of Locus and Alleleic heterogeneity with suitable examples. **[4]**

b) Explain cell hybrids and its applications. **[3]**

c) Explain hereditary cancers with suitable examples. **[3]**

Q4) a) Explain maternal serum screen (Triple screen) a method of pre-natal diagnosis. **[5]**

b) Write a note on FACS analysis. **[3]**

c) Give the characteristic features of autosomal recessive inheritance. **[2]**

Q5) a) Explain Molecular basis of simple β-thalassemia. **[5]**

b) What are fragile sites? Give their clinical significance with reference to X-chromosome. **[3]**

c) Explain congenic strains with suitable examples. **[2]**

Q6) a) Explain the mechanism of X-inactivation in humans. Which genes escape inactivation? **[5]**

b) Explain role of hox genes in body-axis determination of Drosophila. **[5]**

Q7) a) Describe sex determination mechanism in Drosophila. **[5]**

b) Write a note on genetic basis of Alzheimer's disease. **[5]**

Q8) a) Explain "Twin and adoption studies". **[5]**

b) Explain G banding and its applications. **[5]**

Total No. of Questions : 4] SEAT No. :

P3126 [Total No. of Pages : 2

[4729] - 4002
M.Sc. - II (Semester - IV)
ZOOLOGY
Zy - 402 T : Economic Zoology
(2013 Pattern)

Time :1½ Hours] *[Max. Marks : 25*

Instructions to the candidates:

1) ***Attempt any two questions from Q.No.1 to Q.No.3.***
2) ***Question No.4 is compulsory.***
3) ***Figures to the right indicate full marks.***
4) ***Draw neat labeled diagrams wherever necessary.***

Q1) a) What are parasitic protozoa? Describe the role of any two protozoans in human welfare. **[5]**

b) What is sponge? Give its general characters. **[3]**

c) Name any four model animals used in pharmaceutical industry. **[2]**

Q2) a) What is helminth? Describe the role of any two helminthes in human life. **[4]**

b) What is coral reef? How it is formed? **[3]**

c) Write a note on economic importance of amphibians. **[3]**

Q3) a) What is nematoda? Describe the role of any two nematodes in human health. **[4]**

b) Write a note on Milk and Milk Products. **[4]**

c) Name any four stored grain pests. **[2]**

Q4) Attempt any one of the following:

a) Give a detailed layout of an sericulture Unit. **[5]**

b) Describe the life cycle of Honey Bee. **[5]**

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P.T.O.

Total No. of Questions : 4]

P3126

[4729] - 4002

M.Sc. (Semester - IV)

ZOOLOGY

Zy - 402 T : Bacteria & Phage Genetics

(2013 Pattern) (2 Credits)

Time : 1½ Hours] ***[Max. Marks : 25***

Instructions to the candidates:

1) ***Attempt any two questions from Q.No.1 to Q.No.3.***
2) ***Question No.4 is compulsory.***
3) ***Figures to the right indicate full marks.***

Q1) a) Describe any one mechanism of gene transfer in bacteria. **[5]**

b) What is temperate phage? Give an example. **[3]**

c) Define missense mutation. **[2]**

Q2) a) Distinguish between T even and T odd phages. **[4]**

b) What is complementation? Give its groups. **[3]**

c) Give morphology of T4 phage. **[3]**

Q3) a) Give general properties of bacteriophages. **[4]**

b) Explain about salient features of T7 phages. **[4]**

c) What are overlapping genes. **[2]**

Q4) Give an account of lysogenic cycle of lambda phage. **[5]**

OR

Write a note on “Trasposable elements”. **[5]**

Total No. of Questions : 8] **SEAT No. :**

P3100 **[Total No. of Pages : 4**

[4729] - 401
M.Sc. - II (Semester - IV)
ZOOLOGY
ZY - 411 : Entomology - II
(2008 Pattern)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates:

1) ***Attempt any four questions.***
2) ***All questions carry equal marks.***
3) ***Neat and labelled diagrams must be drawn wherever necessary.***

Q1) Describe the process of spermatogenesis in insects. Add a note on spermatozoa.

Q2) Describe the development of insect egg upto blastoderm formation.

Q3) Describe the phenomenon of blastokinesis. Add a note on theories of blastokinesis in insects.

Q4) What is metamorphosis? Explain different types of metamorphosis in insects.

Q5) Write short notes on (any two) :

a) Gastrulation in insects

b) Hadorn experiments.

c) Dyar's law

d) Types of larvae

Q6) Define pest. Explain the different types of insecticides on the mode of action.

P.T.O.

Q7) Write an essay on biological control.

Q8) Write short notes on (any two) :

a) Male sterile techniques.

b) Pheromonal control of pest.

c) Pesticide hazards.

d) Vitellogenesis.

Total No. of Questions : 8]

P3100

[4729] - 401
M.Sc. - II (Semester - IV)
ZOOLOGY
ZY - 412 : Genetics - II
(2008 Pattern)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates:

1) ***Attempt any four questions.***
2) ***All questions carry equal marks.***
3) ***Draw neat labelled diagrams wherever necessary.***

Q1) What are Hox genes? Explain their genetic regulations with respect to Boundary elements and enhancers.

Q2) Explain the mechanism of X-inactivation in humans Which genes escape inactivation?

Q3) Explain the importance of pedgree in identifying and analyzing genetic diseases.

Q4) a) Describe Rothen Bulers experiment on genetics of bee behaviour.

b) Explain the genetic basis of antibody diversity.

Q5) "LOD score analysis" a statistical tool in human genetics; Explain.

Q6) Explain 'Triplet Repeats' lead to disorders.

Q7) Explain in brief :

a) Importance of twin studies in nature and nature experiments.

b) Differentiate between parametric and non-parametric analysis.

Q8) What is Genomic imprinting? Explain the genetic basis of genomic imprinting with respect to Prader Willi and Angelman-syndrome.

Total No. of Questions : 8]

P3100

[4729] - 401
M.Sc. - II (Semester - IV)
ZOOLOGY
ZY - 413 : Physiology - II
(2008 Pattern)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates:

1) ***Attempt any four questions.***
2) ***All questions carry equal marks.***
3) ***Draw neat diagrams wherever necessary.***

Q1) Explain the structure and function of newrons and add a note on saltatory conduction.

Q2) What is digestion? Explain the physiology of digestion in intestine. Add a note on gastrointestinal harmones.

Q3) Explain the structure of eye and give the details of Physiology of vision.

Q4) What is respiration? Explain the transport of oxygen and add a note on oxygen dissociation curve.

Q5) Explain the functions and compositions of blood and add a note on haematopoiesis.

Q6) Explain the mechanical events of cardiac cycle. Add a note on ECG.

Q7) Explain the structure of skeletal muscle. Add a note on molecular basis of its contraction.

Q8) Write notes on :

a) Chemotransduction
b) Muscle twitch
c) Physiology of hearing
d) Venous return

Total No. of Questions : 20] SEAT No. :

P3101 [Total No. of Pages : 3

[4729] - 402
M.Sc. (Semester - IV)
ZOOLOGY
Zy-421: ANIMAL TISSUE CULTURE
ZY-422 : Pollution Biology
ZY-423 : Marine Biology
ZY-424 : Bacterial and Phage Genetics.
ZY-425 : Medical Entomology
(2008 Pattern)

Time :3. Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *Attempt any two sections.*
2) *Attempt any two questions from each section.*
3) *All questions carry equal marks.*
4) *Answer to the two sections should be written in separate answer books.*

SECTION - I

ZY 421: Animal Tissue Culture

Q1) What is Animal tissue culture? Explain the sterilization techniques in Animal Tissue Culture. **[20]**

Q2) Explain the principle, working and applications of CO_2 Incubator. **[20]**

Q3) What is cell bank and Primary cell culture? Give their importance in Animal Tissue Culture. **[20]**

Q4) Write short notes on: **[20]**

a) Serum and its importance.

b) Lymphocyte culture.

c) Inverted Microscope.

d) Organ culture.

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SECTION - II

ZY - 422 : Pollution Biology

Q5) Describe in detail the various components of Biosphere.

Q6) Describe the sources and effects of sound pollution.

Q7) Describe the causes and effects of degradation of land with suitable examples.

Q8) Write short notes on:

a) Algal bloom.

b) Eutrophication.

c) Global warming.

d) Pathway of pesticide pollution.

SECTION - III

ZY - 423 : Marine Biology

Q9) Give a detailed account of marine environment with suitable examples.

Q10) What are marine resources? Describe algal and marine resources.

Q11) Describe the profile and sediment of sea floor in marine environment.

Q12) Write notes on:

a) Benthic and pelagic zones.

b) Estuarine food web.

c) Control measures of boring animals.

d) Typical Indian-estuary.

SECTION - IV

ZY - 424 : Bacterial and Phage Genetics

Q13) Explain in detail the mechanisms of transduction in bacteria. **[20]**

Q14) Explain the morphology nucleic acid structure and life cycle of T even phages. **[20]**

Q15) Explain in brief:

a) Bacterial transformation. **[10]**

b) RNA phages. **[10]**

Q16) Write short notes on: **[20]**

a) Bacteriophage Mu.

b) Transposable elements.

c) Two point crosses.

d) Conjugation and Chromosome mapping.

SECTION - V

ZY - 425 : Medical Entomology

Q17) What is vector? Discuss the role of vectors from family culicidae and pulicidae in the transmission of diseases.

Q18) What are house hold pests? Describe the importance of cockroaches, ants, wasps and silver fishes from human health point of view.

Q19) Describe the causative agent, pathogenecity and control measures of carrion disease and relapsing fever.

Q20) Write short notes on:

a) Trypanosomiasis.

b) *Pediculus humanus.*

c) Veterinary entomology.

d) Bubonic plague.