Total No. of Questions :8]

SEAT No. :

P1305

[Total No. of Pages :3

[5442] - 101
M.Sc. (IMCA)
MATHEMATICS
MIM - 101 : Real Analysis
(2013 Pattern) (Semester - I)

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

Instructions to the candidates:

1) *Attempt any five questions.*
2) *Figures to the right indicate full marks.*
3) *Unless specified, $\mathbb{R}^n$ is assumed to have usual metric for all $n \geq 1$.*

Q1) a) Prove that a set E is open if and only if its complement is closed. **[4]**

b) If X is a metric space and $E \subset X$ then prove that $\overline{E}$ is closed. **[3]**

c) Give an example of an infinite collection of open sets whose intersection need not be open. **[3]**

Q2) a) If E is an infinite subset of a compact set K, then prove that E has a limit point in K. **[4]**

b) Prove that if p > 0 then $\lim_{n\to\infty} \sqrt[n]{p} = 1$. **[3]**

c) Find radius of convergence of $\sum_{n=1}^{\infty} n^n z^n$. **[3]**

Q3) a) Show that $\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e$. **[4]**

b) Suppose f is a continuous mapping of a compact metric space X in to a metric space Y. Then prove that $f(x)$ is compact. **[3]**

c) Let f be defined on $[a, b]$. If f is differentiable at a point $x \in [a, b]$ then prove that f is continuous at x. **[3]**

P.T.O.

Q4) a) Suppose f is a real differentiable function on $[a,b]$ and suppose $f'(a) < \lambda < f'(b)$. Prove that there exists a point $x \in (a,b)$ such that $f'(x) = \lambda$. **[4]**

b) Suppose f' is continuous on $[a, b]$ and $\in > 0$. Prove that there exists $\delta > 0$ such that $\left|\frac{f(t)-f(x)}{t-x} - f'(x)\right| < \in$, whenever $0 < |t-x| < \delta$ **[3]**

c) Let f be defined for all real x, and suppose that $|f(x)-f(y)| \le (x-y)^2 \forall x, y \in \mathbb{R}$. Prove that f is constant. **[3]**

Q5) a) Prove that $\underline{\int_{a}^{b}} f d\alpha \le \overline{\int_{a}^{b}} f d\alpha.$ **[4]**

b) If $f \in \mathbb{R}(\alpha)$ on $[a,b]$ then prove that $|f| \in \mathbb{R}(\alpha)$ and $\left|\int_a^b f d\alpha\right| \le \int_a^b |f| d\alpha.$

[3]

c) If $f(x) = x^2$ and $\alpha(x) = x + 5$, then evaluate $\int_0^1 f d\alpha.$ **[3]**

Q6) a) Suppose $\lim\limits_{n\to\infty} f_n(x) = f(x), (x \in E)$ Put $M_n = \sup\limits_{x \in E} |f_n(x) - f(x)|$.

Then prove that $f_n \longrightarrow f$ uniformly on E if and only if $M_n \longrightarrow 0$ as $n \to \infty$.

[4]

b) Prove that $\left\{f_n^1(x)\right\}_{n=1}^{\infty}$ does not converge to f', where $f_n(x) = \frac{\sin nx}{\sqrt{n}}, x \in \mathbb{R}, n \in \mathbb{N}.$ **[3]**

c) If $\sum_{n=1}^{\infty} a_n$ converges then prove that $\lim\limits_{n\to\infty} a_n = 0.$ **[3]**

Q7) a) Prove that every compact subset of a metric space is closed. **[5]**

b) If f and g are continuous real functions on $[a, b]$ which are differentiable on (a,b) then prove that there exists a point $x \in (a,b)$ at which $[f(b)-f(a)]g'(x)=[g(b)-g(a)]f'(x)$. **[5]**

Q8) a) Prove that $f \in \mathbb{R}(\alpha)$ on $[a,b]$ if and only if for every $\in > 0$ there exists a partition P such that $U(p, f, \alpha) - L(p, f, \alpha) < \in$. **[5]**

b) Let $f_n(x) = n^2x(1 - x^2)^n$, $(0 \le x \le 1, n = 1, 2, 3, ...)$

i) Prove that $\lim\limits_{n\to\infty} f_n(x) = 0$.

ii) Prove that $\lim\limits_{n\to\infty} \int_0^1 f_n(x)dx \neq \int_0^1 \left[\lim\limits_{x\to\infty} f_n(x)\right]dx$. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1306

[Total No. of Pages : 3

[5442]-102
M.Sc. (IMCA)
MATHEMATICS
MIM - 102 : Linear Algebra and Computational Geometry
(2013 Pattern) (Semester - I)

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

Instructions to the candidates:

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

Q1) Attempt each of the following:

a) Give an example of a vector space of dimension 3 over $\mathbb{R}$. **[2]**

b) Prove that a nonempty set W of a vector space V is a subspace of V if and only if $\alpha w_1 + \beta w_2 \in W, \forall \alpha, \beta \in \mathbb{R}$ and $w_1, w_2 \in W$. **[4]**

c) Does the set S = {(1, 1, 2), (1, 2, 5), (5, 3, 4)} form a basis for $\mathbb{R}^3$? Justify. **[4]**

Q2) Attempt each of the following:

a) Define an inner product space V. **[2]**

b) Let V be a n-dimensional vector space ($n \geq 1$). Prove that any linearly independent subset of V with n elements is a basis of V. **[4]**

c) Show that for the vectors $u = (u_1, u_2)$ and $v = (v_1, v_2)$ in $\mathbb{R}^2$,

$\langle u, v \rangle = 5\, u_1 v_1 - u_1 v_2 - u_2 v_1 + 10\, u_2 v_2$ defines an inner product on $\mathbb{R}^2$. **[4]**

P.T.O.

Q3) Attempt each of the following:

a) State Cayley Hamilton Theorem for matrices. **[2]**

b) Let u = (cos t, sin t, 0), v = (–sin t, cos t, 0), w = (0, 0, 1) in $\mathbb{R}^3$. Show that the set of vectors B = {u, v, w} is orthonormal basis for Euclidean inner product space $\mathbb{R}^3$ for any real *t*. **[4]**

c) Let transformation T : $\mathbb{R}^2 \to \mathbb{R}^3$ be defined as

$T(x, y) = (2x, x + y, x - y)$. Show that T is a linear transformation. **[4]**

Q4) Attempt each of the following:

a) Let T : $\mathbb{R}^2 \to \mathbb{R}^3$ be a linear transformation defined by $T(x_1, x_2) = (x_2, -5x_1 + 13x_2, -7x_1 + 16x_2)$. Find the matrix $[T]_B^{B'}$, where B = {u_1, u_2} and B′ = {v_1, v_2, v_3} are bases of $\mathbb{R}^2$ and $\mathbb{R}^3$ respectively where $u_1 = (3, 1)$, $u_2 = (5, 2)$, $v_1 = (1, 0, -1)$, $v_2 = (-1, 2, 2)$ and $v_3 = (0, 1, 2)$. **[5]**

b) State and prove Cauchy Schwarz Inequality. **[5]**

Q5) Attempt each of the following:

a) Write a short note on orthographic projection. **[5]**

b) Write an algorithm to generate uniformly spaced n points on an arc of the standard ellipse in the first quadrant. **[5]**

Q6) Attempt each of the following:

a) The circle with radius 2 units is transformed by using transformation matrix $[T] = \begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix}$. Obtain the area of transformed figure. **[2]**

b) Show that the transformation matrix for rotation about the origin through an angle ‘θ’ is $[T] = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$. **[4]**

c) Reflect the line segment between the points A $\begin{bmatrix} -3 & 3 \end{bmatrix}$ and B $\begin{bmatrix} 1 & 4 \end{bmatrix}$ through the line $x - 4y + 8 = 0$. Write the concatenated transformation matrix. **[4]**

Q7) Attempt each of the following:

a) State any two properties of Bezier curve. **[2]**

b) Find the transformation matrix obtained by reflecting the pyramid OABC with O [0, 0, 0], A [1, 0, 0], B [0, 1, 0], C [0, 0, 1] in the plane z = –5. **[4]**

c) Obtain the transformation matrix for the trimetric projection formed by rotation about the y-axis through 30°, followed by rotation about the x-axis through 35°, followed by orthographic projection on z = 0 plane. Determine the principal foreshortening factors. **[4]**

Q8) Attempt each of the following:

a) State any two properties of an affine transformation. **[2]**

b) Find the parametric equation of the Bezier curve for the control points B_0 [2, 1], B_1 [4, 4], B_2 [5, 3] and B_3 [5, 1]. Find the position vector of the point on the curve corresponding to parameter value t = 0.5. **[4]**

c) Generate uniformly spaced 8 points on the circle $(x-3)^2 + (y+1)^2 = 16$. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P1307

[Total No. of Pages : 3

[5442] - 103

M.Sc. (IMCA)

MATHEMATICS

MIM 103 : Discrete Mathematics

(2013 Pattern) (Semester - I)

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 scientific calculator is not allowed.***

Q1) a) Give the converse, inverse and contrapositive of " The home team wins whenever it is raining ". **[3]**

b) How many strings of three decimal digits **[3]**

i) do not contain the same digit three times ?

ii) begin with an odd digit ?

iii) have exactly two digits that are 4's ?

c) Show that if n is a nonnegative integer, then **[4]**

i) $^{2n}C_n = \sum_{k=0}^{n} \left({}^{n}C_k \right)^2$

ii) $\sum_{k=0}^{n} (-1)^k \; {}^{n}C_k = 0$

Q2) a) Give a proof by contradiction of the theorem, " If (3n + 2) is odd then n is odd ". **[4]**

b) Show that if five integers are selected from the first 8 positive integers, there must be a pair of these integers, with a sum equal to 9. **[3]**

c) How many functions are there from the set {1, 2, ... n}, where n is a positive integer to the set {0, 1} ? **[3]**

Q3) a) Prove that K_5 is not a planar graph. **[5]**

b) Draw the arborescence of the following expression and write it in polish notation : **[5]**

$$\frac{(2a-3b)^2}{c\left(3d+e^4\right)}$$

P.T.O.

Q4) a) Prove that every tree with n vertices has $(n-1)$ edges. **[5]**

b) Determine the smallest positive integer n so that the complete graph K_n has at least 55 edges. **[3]**

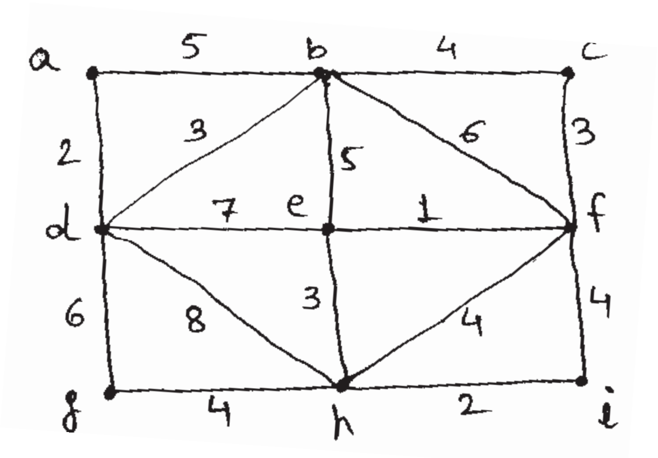
c) State the following rules of inference : **[2]**

i) Modus ponens

ii) Law of syllogism.

Q5) a) Let G be a connected graph and S a cut-set of G. Prove that S contains at least one branch of every spanning tree of G. **[3]**

b) Use Kruskal's algorithm to find a minimum spanning tree for the weighted graph. **[4]**



c) Let T be a binary tree with n vertices. Show that T has $\frac{n+1}{2}$ pendant vertices. **[3]**

Q6) a) Define the following terms : **[4]**

i) Bipartite graph

ii) Regular graph

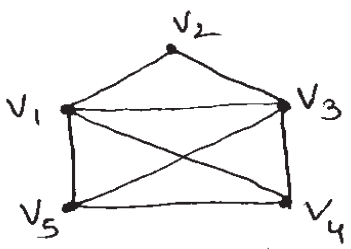
iii) Center of a tree

iv) Diameter of a tree

b) Prove that in a graph G, there are always an even number of vertices of odd degree. **[3]**

c) Draw all possible non-isomorphic trees on 6 vertices. **[3]**

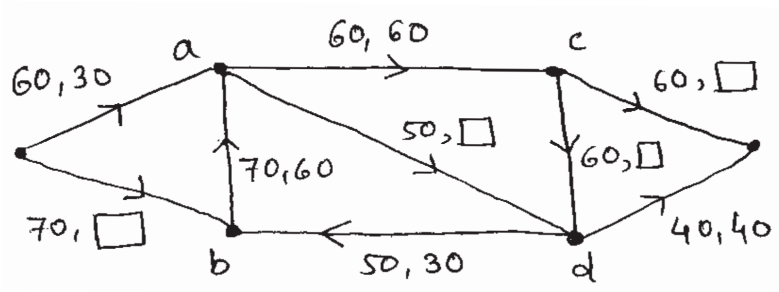
Q7) a) Find the adjacency matrix and incidence matrix for the graph. **[2]**



b) Prove that the number of vertices in a self-complementary graph is of the form 4k or 4k + 1 where k is a positive integer. **[4]**

c) Find the minimum height and maximum height of a binary tree with n =15 vertices. Draw such trees. **[4]**

Q8) a)



In the above network , fill the block with suitable numbers so that the second set of numbers determine a flow in the network. **[4]**

b) Draw a suitable digraph with 5 vertices in which each vertex has out degree 2. **[2]**

c) Let T be a tree with n vertices, $n \geq 2$. Show that T has at least 2 pendant vertices. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P1308

[Total No. of Pages : 3

[5442]-104

M.Sc.

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 104 : C Programming

(2013 Pattern) (Semester - I)

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

Instructions to the candidates:

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

Q1) Attempt each of the following.

a) Explain do-while loop with example. **[4]**

b) Explain the use of getchar() getch() and getche() with suitable example. **[4]**

c) Write the different features of 'C' language. **[2]**

Q2) Attempt each of the following:

a) Explain ftell (), rewind () and fseek () functions with example. **[4]**

b) Write a program to find the factorial value of any number entered through the keyboard. **[4]**

c) What will be the output of the following program. **[2]**

```
main ()
{
   intx = 1;
   while (x==1)
   {
        x = x – 1;
        Print f ("\n%d",x);
   }
}
```

P.T.O.

Q3) Attempt each of the following.

a) What is pointer? What are the different operations that can be performed on pointer? **[4]**

b) Explain the different data types used in C language with example. **[4]**

c) Define the following terms with example. **[2]**

i) Keyword

ii) Variable

Q4) Attempt each of the following:-

a) Explain switch control statement with example. **[4]**

b) Explain the difference between structure and union. **[4]**

c) Find out the output of the following C code. **[2]**

```
main()
{
   int k, num = 30;
   k = (num > 5? (num < = 10? 100:200) : 500);
   Print f (“\n % d”, num);
}
```

Q5) Attempt each of the following.

a) Write a note on bitwise operators. **[4]**

b) What is an Array? Explain two dimensional array in detail. **[4]**

c) Write the output of following C code. **[2]**

```
Main ()
{
      int i = 4, z = 12;
      if (i = 5 && z > 5)
            Print f (“\n C Language”);
      else
            print f (“\n any other language”);
}
```

Q6) Attempt each of the following.

a) Write the different file opening modes in detail. **[4]**

b) Explain 'for' loop in detail with example. **[4]**

c) Write the output of following C code. **[2]**

```
Main ()
{
    int x = 4, y, z;
    y = – –x ;
    z = x – –;
    Print f("\n%d%d%d",x,y,z);
```

Q7) Attempt each of the following:-

a) Write a short note on dynamic memory allocation. **[5]**

b) Write down the different advantages of functions. **[5]**

Q8) Attempt each of the following:-

a) Write a 'C' program to check for the leap year using conditional operators. **[5]**

b) Write a 'C' program to create a function power (a,b), to calculate the value of a raised to b. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1309

[Total No. of Pages : 2

[5442]-105
M.Sc.
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 105 : Elements of Information Technology
(2013 Pattern) (Semester - I)

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) What is the need of cache memory in CPU? **[2]**

b) What is unicode? What are the advantages of use of unicode? **[4]**

c) Explain the difference between PROM and EPROM. **[4]**

Q2) a) Solve $(110\ 110)_2 = (?)_{10}$. **[2]**

b) Explain the different characteristics of computer. **[4]**

c) Write a note on EBCDIC code. **[4]**

Q3) a) Solve $(AC2)_{16} = (?)_8$. **[2]**

b) Explain the working of CDROM. **[4]**

c) Write a note on Central Processing Unit (CPU). **[4]**

Q4) a) List the different types of number systems. **[2]**

b) Explain the working of RISC processor. **[4]**

c) Write a note on OCR input method. **[4]**

Q5) a) List the different addressing modes available in instruction set. **[2]**

b) Write a note on Plotter. **[4]**

c) Write a note on VDU. **[4]**

P.T.O.

Q6) a) What is a flash memory? Write any two advantages of flash memory. **[2]**

b) Explain the working of magnetic hard disk. **[4]**

c) Write a note on 'Instruction set'. **[4]**

Q7) a) Write a note on memory organization. **[5]**

b) Write a note on serial Access memory. **[5]**

Q8) a) Explain the use of any four registers used in CPU. **[5]**

b) Write a note on 'Printers'. **[5]**

Total No. of Questions : 8]

SEAT No. :

P1310

[Total No. of Pages : 2

[5442]-201
M.Sc. (IMCA)
MATHEMATICS
MIM - 201 : Complex Analysis
(2013 Pattern) (Semester - II)

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 $f'(z)=0$ everywhere in a domain D then show that $f(z)$ must be constant throughout D. **[5]**

b) Find all the roots of $(-16)^{1/4}$ in rectangular coordinates. Also point out which is the principal root. **[3]**

c) Sketch the closure of the set: **[2]**

$|\operatorname{Re} z| < |z|$.

Q2) a) Prove that a composition of continuous functions is itself continuous. **[5]**

b) Determine where $f'(z)$ exists and find its value when $f(z) = x^2 + iy^2$. **[3]**

c) Show that $\left|\exp\left(z^2\right)\right| \leq \exp\left(|z|^2\right)$. **[2]**

Q3) a) Suppose that $f(z)=u(x,y)+iv(x,y)$, where $z = x+iy$ and $z_0 = x_0 + iy_0$, $w_0 = u_0 + iv_0$. Prove that $\lim\limits_{z\to z_0} f(z) w_0$ if and only if $\lim\limits_{(x,y)\to(x_0,y_0)} u(x,y) = u_0$ and $\lim\limits_{(x,y)\to(x_0,y_0)} v(x,y) = v_0$. **[5]**

b) Show that the set of values of $\log\left(i^2\right)$ is not the same as the set of values of 2 log *i*. **[3]**

c) Show that $\lim\limits_{z\to 0}\left(\dfrac{z}{\bar{z}}\right)$ does not exist. **[2]**

Q4) a) State and prove Cauchy's residue theorem. **[5]**

b) Prove that $\sin z = 0$ if and only if $z = n\pi\left(n = 0, \pm 1, \pm 2, ...\right)$. **[3]**

c) Evaluate $\int_1^2 \left(\frac{1}{t} - i\right)^2 dt$. **[2]**

Q5) a) Let C_R denote the upper half of the circle $|z| = R\left(R > 2\right)$, taken in the counter clockwise direction. Show that **[5]**

$$\left|\int_{C_R} \frac{2z^2 - 1}{z^4 + 5z^2 + 4} dz\right| \leq \frac{\pi R\left(2R^2 + 1\right)}{\left(R^2 - 1\right)\left(R^2 - 4\right)}$$

b) Derive the Taylor's series representation **[3]**

$$\frac{1}{1 - z} = \sum_{n=0}^{\infty} \frac{\left(z - i\right)^n}{\left(1 - i\right)^{n+1}} \quad \left(|z - i| < \sqrt{2}\right)$$

c) Define an essential singular point. Also give a suitable example of essential singular point of a function. **[2]**

Q6) a) Let f be analytic everywhere inside and on a simple closed contour C, taken in the positive sense. If z_0 is any point interior to C, then prove that

$$f\left(z_0\right) = \frac{1}{2\pi i} \int_c \frac{f\left(z\right) dz}{z - z_0}.$$ **[5]**

b) Evaluate $\int_C \frac{dz}{z\left(z - 2\right)^4}$, where C is the positively oriented circle $|z - 2| = 1$. **[3]**

c) State Cauchy-Goursat theorem. **[2]**

Q7) a) Evaluate $\int_0^{\infty} \frac{x^2}{x^6 + 1} dx$. **[5]**

b) State and prove the fundamental theorem of algebra. **[5]**

Q8) a) State and prove Taylor's theorem. **[5]**

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

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Total No. of Questions : 8]

SEAT No. :

P1311

[Total No. of Pages : 2

[5442]-202
M.Sc.(IMCA)
MATHEMATICS
MIM - 202 : Algebra - I
(2013 Pattern) (Semester - II)

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 set G={5, 15, 25, 35} is a group under multiplication modulo 40. What is the identity element of this group? **[4]**

b) Prove that every subgroup of a cyclic group is cyclic. **[4]**

c) Show that a group G is abelian iff $(a\ b)^{-1} = a^{-1}\ b^{-1}$, $\forall a, b \in G$. **[2]**

Q2) a) Let G be a group and let 'a' be an element of G of order n. For each integer k between 1 and n, show that $O(a^k) = O(a^{n-k})$. **[2]**

b) Find all subgroups of the group of quaternious Q_8. How many of these are normal subgroups of Q_8? **[4]**

c) Let $\phi : (\mathbb{Z}\ +) \rightarrow (\mathbb{Z}_n, t_n)$ be defined by $\phi(a) = \overline{a}$, $\forall a \in \mathbb{Z}$. Show that ϕ is a homomorphism. Find ker ϕ. **[4]**

Q3) a) Write the following permutation on S_8 as a product of disjoint cycles :

$\sigma = (1\ 3)\ (4\ 6\ 7)\ (3\ 1)\ (2\ 7\ 1\ 5\ 8)$. **[2]**

b) Let G be a group. Let H, K be normal subgroups of G such that $H \cap K = \{e\}$; e, the identify element of G. Show that $h\ k = k\ h$, $\forall h \in H$, $\forall k \in K$. **[4]**

c) Let G be a group. Let $\mathbb{Z}$ (G) be the centre of G. Show that if $\frac{G}{Z(G)}$ is cyclic then G is abelian. **[4]**

P.T.O.

Q4) a) If $O(G) = p^2$, where p is a prime, prove that G is an abelian group. **[4]**

b) Let G= <a> be a cyclic group of order 10. Find all left cosets of H is G where H is the subgroup of G generated by a^2. **[2]**

c) Prove that a group of order 42 cannot be simple. **[4]**

Q5) a) State and prove Lagrange's theorem. **[4]**

b) Show, in usual notation, that A_n is a normal subgroup of S_n. **[4]**

c) Let R be a ring such that $a^2 = a$ for all a in R. Show that R is a commutative ring. **[2]**

Q6) a) Show that $(\mathbb{Z}_p, +_p, \times_p)$ is a field if and only if p is a prime number. **[4]**

b) Is the element $7-5\sqrt{2}$ a unit in the ring $\mathbb{Z}\left[\sqrt{2}\right] = \left\{a + b\sqrt{2} \mid a, b \in \mathbb{Z}\right\}$? Justify your answer. **[4]**

c) If an ideal I of a ring R with unity contains a unit of the ring R, prove that I=R. **[2]**

Q7) a) Let R be a commutative ring with unity. Let I be an ideal of R. Prove that R/I is an integral domain if and only if I is a prime ideal in R. **[4]**

b) Prove or disprove : $\dfrac{\mathbb{Z}_3[x]}{\langle x^2+1\rangle}$ is a field; where $\langle x^2+1\rangle$ is the ideal generated by the polynomial x^2+1 over $\mathbb{Z}_3$. **[2]**

c) Show that the product of two primitive polynomials is a primitive polynomial. **[4]**

Q8) a) Define : class equation. Obtain the conjugate classes of S_3. Verify the class equation for S_3. **[4]**

b) State and prove the first Isomorphism theorem for rings. **[4]**

c) Let $\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 3 & 1 & 5 & 4 & 6 \end{pmatrix}$

$$J = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 6 & 1 & 2 & 4 & 3 & 5 \end{pmatrix}$$

Find σJ^{-1}; $\sigma J \sigma^{-1}$. **[2]**

Total No. of Questions :8]

SEAT No. :

P1312

[Total No. of Pages : 3

[5442]-203

M.Sc. (IMCA)

MATHEMATICS

MIM 203: Numerical Analysis

(2013 Pattern) (Semester-II)

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 scientific calculator is allowed.*

Q1) a) Use $f(x) = \ln(1+x)$ and $x_0=0$ and show that the Taylor Polynomial of degree N is , **[5]**

$$P_N(x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \ldots + \frac{(-1)^{N-1} x^N}{N}.$$

b) Assume that $f \in C[a,b]$ and that there exists a number $r \in [a,b]$ such that $f(r)=0$. If $f(a)$ and $f(b)$ have opposite signs and $\{c_n\}_{n=0}^{\infty}$ represents the sequence of mid points generated by the Bisection process then prove that $|r - c_n| \le \frac{b-a}{2^{n+1}}$ for n=0,1,2,... and $\lim_{n \to \infty} c_n = r$ **[5]**

Q2) a) Consider $P(x) = -0.02x^3 + 0.1x^2 - 0.2x + 1.66$ which passes through the four points (1,1.54), (2,1.5), (3,1.42) and (5,0.66). Find $p(4)$. **[4]**

b) Determine the degree of precision of Simpson's $\frac{3^{\text{th}}}{8}$ rule. **[4]**

c) Define i) Dominant eigenvector **[2]**

ii) Order of Root

P.T.O.

Q3) a) Given the centers $x_0=1$, $x_1=3$, $x_2=4$, $x_3=4.5$ and the coefficients $a_0=4$, $a_1=-1$, $a_2=0.4$, $a_3=0.01$ $a_4=-0.002$ find Newton Polynomials $p_1(x)$, $p_2(x)$, $p_3(x)$ and $p_4(x)$. Also evaluate $p_k(2.5)$ for $k=1,2,3,4$. **[4]**

b) Obtain Newton -Raphson formula to find r^{th} root of a given number. **[4]**

c) Find the Jacobian matrix $J(x,y,z)$ at point (1,3,2) for functions, **[2]**

$$f_1(x,y,z) = x^3 - y^2 + y - z^4 + z^2$$

$$f_2(x,y,z) = xy + yz + xz$$

$$f_3(x,y,z) = \frac{y}{xz}$$

Q4) a) If $p_n = \frac{1}{2^n}$ then using Aitken Δ^2 process show that $q_n=0$ $\forall n$. **[4]**

b) Start with $p_0=-2.6$ and $p_1=-2.4$ and use the secant method to find the root $p=-2$ of the polynomial function $f(x)=x^3-3x+2$. Perform 3 iterations. **[4]**

c) Define:

i) Global discretization error

ii) Local discretization error **[2]**

Q5) a) Find characteristic polynomial and eigenpairs for the matrix, **[5]**

$$A = \begin{pmatrix} -2 & 1 & 1 \\ -6 & 1 & 3 \\ -12 & -2 & 8 \end{pmatrix}$$

b) Find inverse of the matrix, $A = \begin{pmatrix} 1 & -2 & 3 \\ -2 & 4 & -5 \\ 1 & -5 & 3 \end{pmatrix}$ **[5]**

Q6) a) Consider the following system, **[5]**

$5x - y + z = 0$

$2x + 8y - z = 11$

$-x + y + 4z = 3$

Start with $p_0 = 0$ and use Gauss - Seidel iteration to find p_k (k=1,2,3).

b) Use the Runge - Kutta method of order 4 to find the value of y when x=1. Given that $\frac{dy}{dx} = \frac{y-x}{y+x}, y(0) = 1$ (take h=1) **[5]**

Q7) a) Let $f(x)$ =sin$x$. Calculate approximations to $f'(0.8)$ with h=0.1, h=0.01, h=0.001. Also compare with the value $f'(0.8) = \cos(0.8)$. **[5]**

b) Consider $f(x)$=2+ sin $(2\sqrt{x})$. Use the composite trapezoidal rule with 11 sample points to compute an approximation to the integral of $f(x)$ taken over [1,6]. **[5]**

Q8) a) Assume that $g \in$ c [a,b]. If the range of the mapping y=$g(x)$ Satisfies $a \le y \le b \ \forall \ a \le x \le b$ then prove that g has a fixed point in [a,b], also suppose that $g'(x)$ is defined oxer (a,b) and that a positive constant k<1 exists with $|g'(x)| \le k < 1 \forall x \in (a,b)$ then prove that g has a unique fixed point P in [a,b]. **[5]**

b) Derive the formula $f''(x_0) \approx \frac{2f_o - 5f_1 + 4f_2 - f_3}{h^2}$ using Lagrange interpolation polynomial $f(t)$ based on the four points x_0,x_1, x_2 and x_3. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1313

[Total No. of Pages : 2

[5442]-204
M.Sc.Tech. - (I.M.C.A)
MIM - 204 : OBJECT ORIENTED PROGRAMMING WITH C + +
(2013 Pattern) (Semester - II)

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

Instructions to the candidates:

1) ***Attempt any 5 questions.***
2) ***Figures to the right indicate full marks.***
3) ***Assume suitable data if necessary.***

Q1) Attempt the following :

a) Differentiate friend function and normal function. **[4]**

b) Explain the static class members with suitable examples. **[4]**

c) Define : Class, Object. **[2]**

Q2) Attempt the following :

a) What is constructor ? Explain different types of constructors in brief. **[4]**

b) Explain how pre increment and post increment operators are overloaded. **[4]**

c) List the operators that can not be overloaded with friend function. **[2]**

Q3) Attempt the following :

a) How an exception is handled in C++ . **[4]**

b) Explain the ‘new’ and ‘delete’ operator in C++ . **[4]**

c) What is late binding ? **[2]**

Q4) Attempt the following :

a) What is reference variable ? Explain the use of reference variable with example. **[4]**

b) Explain the concept of public and private inheritance. **[4]**

c) Give any four applications of C++ . **[2]**

P.T.O.

Q5) Attempt the following :

a) What is a virtual base class ? Explain with suitable example. **[4]**

b) What are the different unformatted I/O operations ? Explain any two. **[4]**

c) When do we use multiple catch handlers ? **[2]**

Q6) Attempt the following :

a) What do you mean by manipulator ? Explain the following output manipulators : setw(), and setfill(). **[5]**

b) Explain the file operation functions in C++ to manipulate the position of file pointers in a random access file. **[5]**

Q7) Attempt the following :

a) Explain the overloading of function template with suitable example. **[5]**

b) Write a C++ program to create a class called STRING and Implement the following operations. Display the result after every operation by overloading the operator <<.

i) STRING S1 = 'VTU'

ii) STRING S2 = 'BELGAUM'

iii) STRING S3 = S1 + S2 (Use copy constructor). **[5]**

Q8) Attempt the following :

a) Explain the concept of inheritance in detail. Also specify the types of inheritance with proper syntax. **[5]**

b) Write a program in C++ that reads a file and convert every character of the file into upper case letter. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1314

[Total No. of Pages : 2

[5442]-205

M.Sc.

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM-205 : Data Structure Using 'C'

(2013 Credit Pattern) (Semester-II)

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

Instructions to the candidates:

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

Q1) Attempt the following:

a) Explain linear and non-linear data structure with suitable example. **[4]**

b) Write a short note on FCFS CPU schedulling technique. **[4]**

c) Define : Big-on (O) notation **[2]**
Omega (Ω) notation

Q2) Attempt the following:

a) Write an algorithm to Evaluate prefix expression. **[4]**

b) Write a 'C' program to create a doubly Linked list and delete an Element from doubly Linked List. **[4]**

c) Define Dequeue. List an possible operation performed on Dequeue. **[2]**

Q3) Attempt the following:

a) What do you mean by traversal? Explain the different types of Binary tree traversal. **[4]**

b) Sort the following Elements using Quick Sort. Show all the intermediate steps. **[4]**
55, 7, 48, 32, 18, 23, 82, 62.

c) Define Graph and Explain its types. **[2]**

Q4) Attempt the following:

a) Write a 'C' program to sort 'n' Elements in descending order using bubble sort. **[4]**

b) Write an algorithm to implement non-recursive DFS. **[4]**

c) Define the node structure for doubly linked list. **[2]**

Q5) Attempt the following.

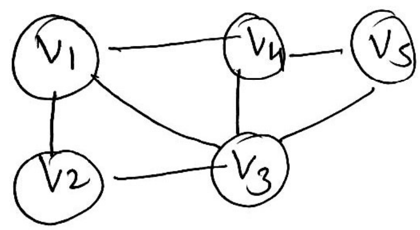
a) Write Insert and delete functions in 'C' to implement Linear queue (use dynamic representation) **[4]**

b) Discuss the various possibilites while deleting a node from Binary Search Tree. **[4]**

c) Define ADT. **[2]**

Q6) Attempt the following:

a) Convert the following graph into adjacency list and adjacency matrix. **[4]**



b) Evaluate the following Prefix expression using stack. Also give the Content of stack. **[4]**

Prefix String : *+ AB–CD

Where A=5 B=4 C=6 D=2

c) Define i) Space Complexity **[2]**

ii) Time Complexity

Q7) Attempt the following:

a) Write an algorithm to add two polynomial representations as a singly linked list. **[5]**

b) Write a short note on Merge sort. **[5]**

Q8) Attempt the following:

a) Write a 'C' function to Calculate the height of a Binary tree. **[5]**

b) Write a function for adding and deleting elements from a Circular Queue. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1315

[Total No. of Pages : 2

[5442]-301

M.Sc. (IMCA)

MATHEMATICS

MIM - 301 : Topology

(2013 Pattern) (Semester - III)

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 $f: X \rightarrow Y$ be a function from a non-empty set X into a topological space (Y, $\mho$). Let $\tau = \{f^{-1}(G) \mid G \in \mho\}$. Show that τ is a topology on X. **[4]**

b) Let $\mathcal{B}$ and $\mathcal{B}'$ be bases for the topologie, τ and τ' respectively on a set X. Then prove that τ' is finer than τ iff and only if for each $x \in X$ and each basis element $B \in \mathcal{B}$ containing 'x', there exist $B' \in \mathcal{B}'$ such that $x \in B^1 \subseteq B$. **[4]**

c) Let X = {a, b, c, d} and $\mathcal{S}$ = {{a, b}, {c, d}}. Show that $\mathcal{S}$ is a sub basis for a topology on X and find the topology generated by $\mathcal{S}$. **[2]**

Q2) a) Let X be a non-empty set. Describe all closed sets in X with respect to finite complement topology on X. **[4]**

b) Let X be a topological space. Show that a subset A of X is closed if and only if boundary of A is contained in A. **[4]**

c) Find the interior of the set A = (0, 1) in $\mathbb{R}$ with respect to k-topology. **[2]**

Q3) a) Let X be a topological space and A, B $\subseteq$ X. Show that $\overline{A \times B} = \overline{A} \times \overline{B}$ in the space XXX. **[4]**

b) Show that $f: \mathbb{R}^1 \rightarrow \mathbb{R}_l$ defined as $f(x) = x$ is not continuous function. (Here $\mathbb{R}_l$ is $\mathbb{R}$ with respect to lower limit topology). **[4]**

c) State pasting lemma. **[2]**

Q4) a) Show that every regular space is Hausdorff. **[4]**

b) Let X be a T_1-space and A $\subseteq$ X. Prove that a point $x \in X$ is a limit point of A if and only if every neighborhood of 'x' contains infinitely many points of A. **[4]**

c) Give an example of a continuous, closed map but not open. **[2]**

P.T.O.

Q5) a) Show that every second countable space is first countable. **[4]**

b) Let X be a first countable space. Prove that a point $x \in \overline{A}$ if and only if there exists a sequence of points $<x_n>$ of A such that $x_n \to x$. **[4]**

c) Define separable space. **[2]**

Q6) a) Prove that every second countable space is Lindelöf. **[4]**

b) Show that closed subspace of a normal space is normal. **[4]**

c) Define completely regular space. **[2]**

Q7) a) If Y is a compact subspace of the Hausdorff sapce X and x_o is not in Y, then show that there exists disjoint open sets U and V containing x_0 and Y respectively. **[5]**

b) Prove that union of a collection of connected subspaces of X that have a common point is connected. **[5]**

Q8) a) Let f : A $\to$ XXY be given by $f(a) = (f_1(a), f_2(a))$, where f_1 : A $\to$ X and f_2 : A $\to$ X. Prove that f is continuous if and only if f_1 and f_2 are continuous. **[5]**

b) Prove that product of two regular spaces is regular. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1316

[Total No. of Pages : 3

[5442]-302

M.Sc. - (IMCA)

MATHEMATICS

MIM - 302 : Design and Analysis of Algorithms

(2013 Pattern) (Semester - III)

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

Instructions to the candidates:

1) ***Answer any five questions out of eight questions.***
2) ***Figures to the right indicate full marks.***

Q1) a) Construct the recurrence tree of the recurrence relation

$$T(n) = 2T\left(\left\lfloor \frac{n}{2} \right\rfloor\right) + 4n$$ and hence find a good asymptotic bound on T(n). **[5]**

b) Write definition of Θ -notation and show that $n^2 - 3n$ is of order $\Theta(n^2)$. **[5]**

Q2) a) Illustrate the operation of the COUNTING - SORT on the array

A = <3, 4, 1, 4, 0, 4, 1>. **[5]**

b) Write the algorithm PARTITION in QUICKSORT and explain it. **[5]**

Q3) a) Consider the matrix-chain multiplication problem with the sequence of dimensions (5, 4, 6, 2, 7). Compute m [2, 4]. **[5]**

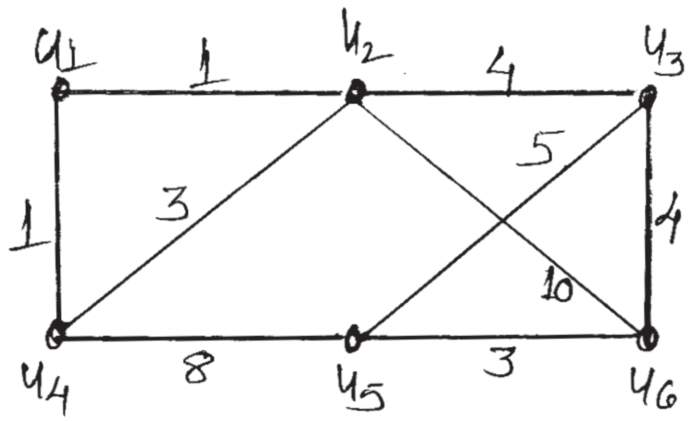
b) Explain : greedy algorithm and also explain the steps through which the greedy algorithm is developed. **[5]**

Q4) a) Find the Huffman code for the following data :

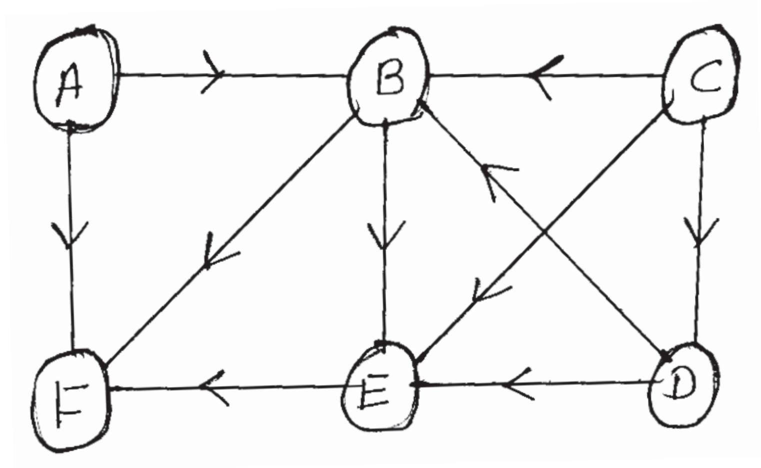
Character	a	b	c	d	e	f
Frequency (In thousands)	35	22	45	15	29	20

[5]

b) Use Kruskal's algorithm to find minimum spanning tree of the following graph. **[5]**



Q5) a) Apply DFS on the following graph and hence find it's DFS tree. (start with the vertex A). **[5]**



b) Illustrate the operation of BUCKET-SORT on the following array.
<0.59, 0.14, 0.89, 0.17, 0.51, 0.74, 0.39, 0.79, 0.85> **[3]**

c) Write at least two characteristics of an algorithm. **[2]**

Q6) a) Apply Floyd warshall algorithm to find lengths of shortest paths from vertex *u* to every other vertex of a graph G, where the adjacency matrix of G is

$$W = \begin{array}{c c} & \begin{array}{ccc} u & v & w \end{array} \\ \begin{array}{c} u \\ v \\ w \end{array} & \begin{bmatrix} 0 & 4 & 11 \\ 6 & 0 & 2 \\ 3 & \infty & 0 \end{bmatrix} \end{array}$$ **[5]**

b) Explain polynomial-time reduction algorithm. **[3]**

c) When is it said that a problem exhibits optimal substructure property? **[2]**

Q7) a) Determine longest common subsequence of the sequences

$X = \langle 0,1,1,0,1,0 \rangle$ and $Y = \langle 1,0,0,1,0 \rangle$. **[5]**

b) Illustrate the operation of MERGE - SORT on the array $A = \langle 5,9,2,8,4,7 \rangle$. **[3]**

c) Use master theorem to solve the recurrence

$$T(n) = 4T\left(\frac{n}{2}\right) + n$$ **[2]**

Q8) a) Illustrate the operation of BUILD-MAX-HEAP on the array

$A = \langle 14, 25, 8, 20, 12, 30, 2, 10, 18 \rangle$. **[5]**

b) Illustrate the operation of RADIX-SORT on the following list : CAT, TAR, BIG, COW, BAR. **[3]**

c) Determine if the following array is a min-heap.

$A = \langle 10, 24, 19, 29, 32, 22, 30, 31, 28, 35, 36 \rangle$ Justify your answer. **[2]**

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Total No. of Questions : 8]

SEAT No. :

P1317

[Total No. of Pages : 2

[5442] - 303

M.Sc.

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATION

MIM 303 : Object Oriented Software Engineering

(2013 Credit Pattern) (Semester - III)

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

Instructions to the candidates:

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

Q1) Attempt the following :

a) Explain the factors in distributed object architecture. **[4]**

b) Draw a DFD diagram of employee payroll system. **[4]**

c) What are UI design principles. **[2]**

Q2) Attempt the following :

a) Explain functional and nonfunctional requirement in software engineering requirement process. **[4]**

b) What is the goal of Test case design process ?. Give the various approaches. **[4]**

c) Define extreme programming. **[2]**

Q3) Attempt the following :

a) Write a short note on emergent system property. **[4]**

b) Explain briefly the four main phases of requirement engineering process. **[4]**

c) What are critical systems and also give its types. **[2]**

Q4) Attempt the following :

a) Explain the process activity of waterfall model. **[4]**

b) Explain the stages involved in static analysis of verification and validation model. **[4]**

c) Define fat-client and thin-client model. **[2]**

P.T.O.

Q5) Attempt the following :

a) Write a short note on tools that are included in RAD environment. **[4]**

b) Explain socio-technical system. **[4]**

c) Give any two differences between Software Engineering and System Engineering. **[2]**

Q6) Attempt the following :

a) Write a note on Agile method. **[4]**

b) Explain the key challenges facing Software Engineering. **[4]**

c) Define : **[2]**

i) Test case

ii) Test design.

Q7) Attempt the following :

a) Draw a state machine diagram of simple microwave oven. **[5]**

b) Explain the importance of feasibility study in software engineering along with their types. **[5]**

Q8) Attempt the following :

a) Draw a class diagram of college management system. **[5]**

b) Define system dependability ? Explain dimension of system dependability. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1318

[Total No. of Pages : 3

[5442]-304
M.Sc. (IMCA)
COMPUTER SCIENCE
MIM : 304 - Operating Systems
(2013 Pattern) (Semester - III)

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

Instructions to the candidates:

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

Q1) Attempt the following .

a) Explain contiguous memory allocation. **[4]**

b) Explain dining philosopher's problem. **[4]**

c) List the two operations of operating system. **[2]**

Q2) Attempt the following.

a) Explain four necessary conditions for a deadlock to occur. **[4]**

b) Explain virtual memory management. **[4]**

c) Give any two differences between user level thread & kernel level thread. **[2]**

Q3) Attempt the following.

a) Write a note on process state diagram. **[4]**

b) What is a file? Discuss several pieces of information associated with an open file. **[4]**

c) What is the dispatcher latency time? **[2]**

Q4) a) Write a note on working of following disk scheduling algorithm. **[4]**

i) FCFS ii) SCAN

b) Explain the types of schedulers. **[4]**

c) List any four file attributes. **[2]**

P.T.O.

Q5) Attempt the following.

a) Explain any four file operations. **[4]**

b) What is the wait for graph? How is resource allocation graph converted into wait for graph? Give example. **[4]**

c) What is spooling. **[2]**

Q6) Attempt the following.

a) Explain the following: **[4]**

i) Read time embedded systems.

ii) Multimedia systems.

b) Explain the following terms in brief: **[4]**

i) Waiting time

ii) Response time

iii) Turnaround time

iv) Throughput

c) Define the term-swapping. **[2]**

Q7) Attempt the following.

a) Consider the following snapshot of system. **[5]**

Process	Allocation			Max		
	A	B	C	A	B	C
P_0	2	3	2	9	7	5
P_1	4	0	0	5	2	2
P_2	5	0	4	11	0	4
P_3	4	3	3	4	4	4
P_4	2	2	4	6	5	5

Total Resources

A	B	C
3	3	2

Answer the following:

i) What are the contents of need matrix?

ii) Is the system in a safe state? If yes, give the safe sequence.

b) Explain usage and implementation of binary semaphore. **[5]**

Q8) Attempt the following.

a) Explain any five kernel I/O system. **[5]**

b) Consider the following snapshot of a system. **[5]**

Process	Burst time	Arrival Time
P_1	5	1
P_2	3	0
P_3	2	2
P_4	4	3
P_5	2	13

Calculate the average turnaround time and average waiting time using SJF (non-preemptive) and Round Robin (Time quantum=2) CPU scheduling algorithm.

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Total No. of Questions : 8]

SEAT No. :

P1319

[Total No. of Pages : 3

[5442]-305
M.Sc. (IMCA)
MATHEMATICS
MIM - 305 : Database Fundamentals
(2013 Pattern) (Credit System) (Semester - III)

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

Instructions to the candidates:

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

Q1) Attempt the following:

a) Explain any four significant differences between file-processing system and a DBMS. **[4]**

b) What is data abstraction? Explain the various levels of data abstraction. **[4]**

c) Define instance and schema. **[2]**

Q2) Attempt the following:

a) Write a short note on any two physical storage devices. **[4]**

b) Explain the difference between fixed length and variable length records. **[4]**

c) What is a descriptive attribute? Give an example. **[2]**

Q3) Attempt the following:

a) Explain the following Relational Algebra operations with example.

i) The select operation.

ii) The project operation. **[4]**

b) Write a short note on mapping cardinalities. **[4]**

c) Give any two notations used to draw an E-R diagram. **[2]**

Q4) Attempt the following:

a) What is Normalization? Explain 2NF and 3NF form of normalization with example. **[4]**

b) What are the various types of anomalies that might arise if we have redundant data? **[4]**

c) List the types of attributes associated with an entity set. **[2]**

P.T.O.

Q5) Attempt the following.

a) Write a short note on conflict serializability. **[4]**

b) Explain the states of a transaction with help of a state diagram. **[4]**

c) What is a transaction? List the ACID properties of a transaction. **[2]**

Q6) Attempt the following:

a) Explain the different modes of locks. **[4]**

b) Explain the following SQL operations with example. **[4]**

i) Union operation

ii) Intersect operation

c) Give the basic structure of a SQL query. **[2]**

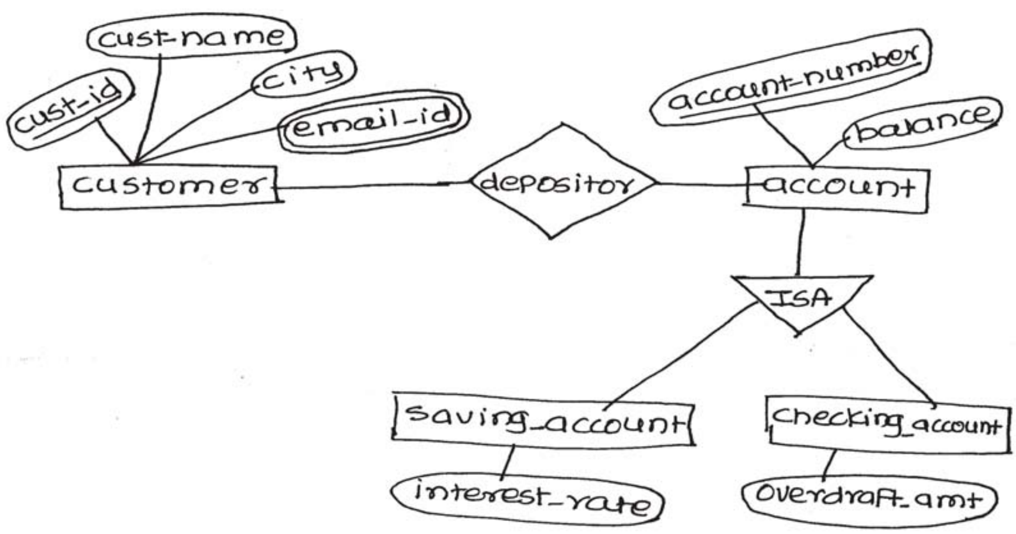
Q7) Attempt the following:

a) Consider the relation schema R = (A, B, C, D, E, F) and the set of functional dependencies defined on R as

$F = \{ A \rightarrow C, C \rightarrow BE, E \rightarrow F, CD \rightarrow F, E \rightarrow D\}$

Compute closure of F, i.e. F^+ **[5]**

b) Convert the following E-R model to corresponding relational model. **[5]**



Q8) Attempt the following:

a) Consider the following database

employee (<u>empno</u>, empname, salary, designation)

department (<u>deptno</u>, dept_name, city)

employee and department are related with many-to-one relationship. Give expression in SQL query for **[5]**

i) List the department names located at ‘Pune’ city.

ii) Update salary of every employee by 10%.

iii) Display the names and salaries of all the managers.

iv) List the department name with highest sum of salaries.

b) Consider the database from Q.8. a) and give expression in relational algebra for **[5]**

i) List the names of all the departments.

ii) List the names of employees getting salary between 30000 and 50000.

iii) Display the details of all the managers.

iv) Display the name and designation of employees working in ‘HR’ department and getting salary less than 50000.

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Total No. of Questions :8]

SEAT No. :

P1320

[Total No. of Pages : 3

[5442]-401
M.Sc. (IMCA)
MATHEMATICS
MIM 401: Ordinary Differential Equations
(2013 Pattern) (Semester-IV)

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 scientific calculator is not allowed.*

Q1) a) Find the recurrence relation and the general solution of the differential equation $y'' + xy = 0$ by using power series method around $x = 0$. **[4]**

b) Find a particular solution of $y'' + y = \sin x$ using the method of Undetermined coefficients. **[4]**

c) Solve $\frac{d^3y}{dx^3} - 2\frac{d^2y}{dx^2} - 3\frac{dy}{dx} = 0.$ **[2]**

Q2) a) Using Picard's method of successive Approximations solve the initial value problem $y' = y + x, y(0) = 1$ **[4]**

b) Show that the origin is a stable critical point of the equation of motion. **[4]**

c) Find general solution of the differential equation $y' = e^{3x} - x$ **[2]**

Q3) a) Find the general solution of the following system. **[4]**

$$\frac{dx}{dt} = 4x - 3y$$
$$\frac{dy}{dt} = 8x - 6y$$

b) State and prove Sturm Seperation Theorem. **[4]**

c) Determine whether $x = 0$ is an ordinary point of the differential equation $y'' - xy^1 + 2y = 0$ **[2]**

P.T.O.

Q4) a) Obtain Binomial series expansion by solving $(1+x)y' = py,\ y(0)=1$ where 'P' is any arbitrary constant by using power series. **[4]**

b) For the following nonlinear system. **[4]**

i) find the critical point

ii) find the differential equation of the path

iii) solve this equation to find the path

iv) sketch a few of the paths

$$\frac{dx}{dt} = y(x^2+1)$$
$$\frac{dy}{dt} = -x(x^2+1)$$

c) Find the Wronskian of the set $\{x, x^2\}$ on $(-\infty,\infty)$ **[2]**

Q5) a) Determine the nature and stability properties of the critical point (0,0) for the following linear autonomous system. **[4]**

$$\frac{dx}{dt} = 2x$$
$$\frac{dy}{dt} = 3y$$

b) Explain the method of variation of parameters to solve a second order differential equation $y'' + P(x)y' + Q(x)y = R(x)$ where $P(x), Q(x)$ and $R(x)$ are functions of x. **[4]**

c) State Volterra's Prey-Predator equations. **[2]**

Q6) a) If two solutions $x = x_1(t)$, $y = y_1(t)$ and $x = x_2(t)$, $y = y_2(t)$ of the homogeneous system.

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

are linearly independent on $[a,b]$, then show that,
$x = c_1 x_1(t) + c_2 x_2(t)$,
$y = c_1 y_1(t) + c_2 y_2(t)$
is the general solutions of the above homogeneous system on $[a, b]$. **[4]**

b) If $y_1(x)$ and $y_2(x)$ are any two solutions of the equation $y'' + P(x)y' + Q(x)y = 0$ on $[a, b]$, then prove that their Wronskian is either identically zero or never zero on $[a, b]$. **[4]**

c) Two solutions of $y'' - 2y' + y = 0$ are e^{-x} and $5e^{-x}$. Is $y = c_1 e^{-x} + c_2 5e^{-x}$ a general solution of the given differential equation? **[2]**

Q7) a) Solve $2y'' + 3y' + y = e^{-3x}$. **[5]**

b) Let $y(x)$ and $z(x)$ be two nontrivial solutions of $y'' + q(x)y = 0$ and $z'' + r(x)z = 0$ respectively, where $q(x)$ and $r(x)$ are positive functions such that $q(x) > r(x)$. Prove that $y(x)$ vanishes at least once between any two successive zeros of $z(x)$. **[5]**

Q8) a) Find two independent Frobenius series solutions of $2x^2y'' + x(2x+1)y' - y = 0$. **[5]**

b) Let $u(x)$ be any nontrivial 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 the positive x-axis. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1321

[Total No. of Pages : 3

[5442]-402

M.Sc. (IMCA)

MATHEMATICS

MIM - 402 : Coding Theory

(2013 Pattern) (Semester - IV)

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 : q-ary symmetric channel. Suppose that codewords from the binary code {000, 100, 111} are being sent over a binary symmetric channel with crossover probability P=0.03. Use maximum likelihood decoding rule to decode the word received as : 010. **[4]**

b) For a binary symmetric channel with crossover probability $P < \frac{1}{2}$, show that the maximum likelihood decoding rule is the same as the nearest neighbour decoding rule. **[4]**

c) Find two polynomials $u(x)$, $v(x)$ in $\mathbb{Z}_2[x]$ such that deg $u(x) < 4$, deg $v(x) < 3$ and $u(x)\cdot(1 + x^2 + x^3) + v(x)(1 + x + x^2 + x^3 + x^4) = 1$. **[2]**

Q2) a) Let α be a root of the polynomial $2 + x + x^2 \in \mathbb{F}_3[x]$. Find the minimal polynomial of α and of α^2. **[3]**

b) In the vector space $\mathbb{F}_2^3$, let S = {101, 111, 010}. Find <S> and $S^{\perp}$, in usual notation. **[3]**

c) Let C = {0000, 1010, 0101, 1111} be a linear code over $\mathbb{F}_2$: Find dim(C). Verify that $\dim(C) + \dim(C^{\perp}) = 4$; and show that $\left(C^{\perp}\right)^{\perp} = C$. **[4]**

Q3) a) Let C be a linear code over $\mathbb{F}_q$. Show that the Hamming weight of C is the same as the distance of the code, d(C). **[4]**

P.T.O.

b) Let q = 3. Let $S \neq \phi$, $S \subseteq \mathbb{F}_q^n$ and let C be the linear code C=<S>. Let A be the martrix whose rows are words in S and let the row reduced echelon form of A be given by $A \rightarrow \begin{pmatrix} G \\ 0 \end{pmatrix}$ where 0 is the zero matrix and

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

Find a basis for $C^{\perp}$. How many code-words are there in C? **[4]**

c) Let C be the binary [5, 3] - linear code over $\mathbb{F}_2$ with the generator matrix

$$G=\begin{bmatrix} 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 \end{bmatrix}.$$

Encode the message $\overline{u}$ = 101. **[2]**

Q4) a) Let $H = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 \end{bmatrix}$ be the parity check matrix for the binary linear code C={0000, 1011, 0101, 1110}. Prepare a syndrome look-up table for C. Decode the received word $\overline{w}$ = 1111. **[4]**

b) For an integer $q > 1$, and integers n,d such that $1 \leq d \leq n$, prove in usual notation that $A_q(n,d) \leq \dfrac{q^n}{\sum_{i=0}^{e} \binom{n}{i} (q-1)^i}$ where $e = \left\lfloor \dfrac{d-1}{2} \right\rfloor$ **[4]**

c) Find a generator matrix for the binary [7,4] - cyclic code with generator polynomial $g(x)=1+x^2+x^3$. **[2]**

Q5) a) Define binary Hamming code of length $n = 2^r - 1$. **[2]**

b) Find the generator matrix and parity check matrix for the 7-ary Reed Solomon code of length 6 with generator polynomial $g(x)=(x-3(x-3^2)(x-3^3)$. **[4]**

c) Find the dimension of the narrow sense binary BCH code of length 31 with designed distance δ=11. What is a lower bound for the dimension? **[4]**

Q6) a) Let C be a$[n, k, d]$ linear code and H a parity check matrix for C. Let $\overline{u}, \overline{v}$ be elements of $\mathbb{F}_q^n$. Prove that **[4]**

i) $S(\overline{u}+\overline{v}) = S(\overline{u}) + S(\overline{v})$, where $S(\overline{w})$ denotes the syndrome of the word $\overline{w}$; and

ii) $S(\overline{u}) = \overline{0}$ iff $\overline{u}$ is a code word of C.

b) Let C be a linear code over $\mathbb{F}_q$. Define the extended code of C. If C is the binary linear code {000, 111, 011, 100} find the extended code $\overline{C}$ of C. **[4]**

c) Define binary simplex code. **[2]**

Q7) a) Show that 3 is a primitive element of the finite field $\mathbb{F}_7$. List the quadratic residues modulo 7 and also the quadratic non-residues modulo 7. **[4]**

b) Let p be an odd prime. Show that the product of two quadratic residues modulo p is a quadratic residue modulo p. **[2]**

c) Let C and D be linear codes of the same length, over $\mathbb{F}_q$. Define

$$C + D = \left\{\overline{c}+\overline{d} \mid \overline{c} \in C, \overline{d} \in D\right\}$$

Show that C+D is a linear code and that $(C+D)^{\perp}=C^{\perp}\cap D^{\perp}$. **[4]**

Q8) a) Find a complete set of representatives of cyclotomic cosets of 2 modulo 15. **[4]**

b) Obtain the Slepian (standard) array of the binary linear code C= {0000, 1011, 0101, 1110}

Hence decode the received word $\overline{w}$=1001. **[2]**

c) Let I be a non-zero ideal in $\dfrac{\mathbb{F}_q[x]}{\langle x^n - 1\rangle}$ and $g(x)$ be a non-zero monic polynomial of least degree in I. Show that $g(x)$ is a generator of I and that $g(x)$ divides $(x^n - 1)$. **[4]**

Total No. of Questions :8]

SEAT No. :

P1322

[Total No. of Pages : 2

[5442]-403
M.Sc. (IMCA)
MIM- 403: COMPUTER NETWORKS
(2013 Pattern) (Semester-IV)

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

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Figure to right indicates full marks.***
3) ***Assume suitable data if necessary.***

Q1) Attempt the following:

a) Compare OSI reference model with TCP/IP. **[4]**

b) Define the following terms: **[4]**

i) Phase

ii) Bandwidth

iii) Wavelength

iv) Frequency

c) What is a flow control? Why it is needed? **[2]**

Q2) Attempt the following:

a) What is pipelining? Discuss the Go Back n Protocol. **[4]**

b) Explain 1, n, p persistent protocol. **[4]**

c) Show Manchester and differential Manchester encoding pattern for the bit stream 11101101. **[2]**

Q3) Attempt the following:

a) What is congestion? Explain the closed loop solution for congestion control. **[4]**

b) If the frame is 110101011 and generator is $X^4 + X + 1$. What would be the transmitted frame? **[4]**

c) Find the class id, Net id, Host id and sub net id for the IP address 212.60.54.27/16 **[2]**

Q4) Attempt the following:

a) List the goals of gigabit Ethernet. **[4]**

b) How CSMA/CD works? How it is better than CSMA? **[4]**

c) Consider the following code with only 4 valid code words 0000000000,0000011111, 1111100000,1111111111. How many errors can be corrected? **[2]**

Q5) Attempt the following:

a) Differentiate between logical, physical and port address. **[4]**

b) What is Shannon capacity formula? Find out the maximum number of bits/ second transmitted for a channel of 6 kHz bandwidth and the signal to noise ratio is 50 db. **[4]**

c) What is optimality principal? **[2]**

Q6) Attempt the following:

a) What is the need of network address translation? How NAT router maintains translation table. **[4]**

b) Write a note on firewalls. **[4]**

c) Define star and mesh topology. **[2]**

Q7) Attempt the following:

a) Explain the IPv4 datagram format. **[5]**

b) Explain the following fields of IEEE802.3 Mac Frame: **[3]**

   i) Preamble

   ii) SFD

   iii) CRC

c) What is tunnelling? **[2]**

Q8) Attempt the following:

a) Explain architecture of IEEE 802.11 with BSS and ESS. **[5]**

b) Compare virtual circuit with datagram. **[3]**

c) What is steganography? **[2]**

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Total No. of Questions : 8]

SEAT No. :

P1323

[Total No. of Pages : 2

[5442]-404
M.Sc.
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 404 : Programming in PHP
(2013 Pattern) (Semester - IV)

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

Instructions to the candidates:

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

Q1) Attempt all of the following :

a) State the difference between GET & POST methods. **[4]**

b) Explain various techniques used to maintain state in PHP. **[4]**

c) State compound data types in PHP. **[2]**

Q2) Attempt all of the following :

a) What is associative array ? Explain with suitable example, how it is different from indexed array. **[4]**

b) Explain PHP functions that convert between arrays and variables. **[4]**

c) Explain heredoc statement in PHP. **[2]**

Q3) Attempt all of the following :

a) Write a short note on introspection. **[5]**

b) How to define variable in PHP ? Explain in detail scope of variables. **[5]**

Q4) Attempt all of the following :

a) Explain advantages and disadvantages of XML. **[5]**

b) Write a short note on cookies. **[5]**

Q5) Attempt all of the following :

a) Write a PHP script to accept two strings and count the occurrences of first string in second string. **[5]**

b) Write a function to count no. of times given element occurs in array ?**[5]**

Q6) Attempt all of the following :

a) Write a PHP script to read directory name from user and display all files with their sizes in tabular format. **[5]**

b) Explain the environment variables in PHP. **[5]**

Q7) Attempt all of the following :

a) Explain following functions with syntax and example. **[5]**

i) range ( )

ii) list ( )

iii) array_pad ( )

iv) strpos ( )

v) strrchr ( )

b) What are the different kinds of Parsers used in XML ? **[5]**

Q8) Attempt all of the following :

a) What is sticky form ? Explain sticky form with suitable example. **[5]**

b) What is inheritance ? Explain with suitable example. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1324

[Total No. of Pages : 2

[5442]-405

M.Sc.

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM-405 : Java Programming

(2013 Pattern) (Semester-IV)

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

Instructions to the candidates:

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

Q1) a) Explain the various access specifiers used in Java. **[4]**

b) Explain the exception types in java. **[4]**

c) How are command line arguments used in java? **[2]**

Q2) a) Explain the concept of interfaces in java. Explain the use of any one predefined interface. **[4]**

b) Explain inheritance. Are private members and private method inherited by a subclass? Explain. **[4]**

c) Explain the terms: implements and import. **[2]**

Q3) a) Write a note on Byte stream and character streams in java. **[4]**

b) Explain the types of JDBC drivers. **[4]**

c) What is the difference between finally and finalize ( ) in java? **[2]**

Q4) a) Explain wrapper classes with an example. **[4]**

b) Differentiate between AWT and Swing. **[4]**

c) What is JVM and what is its role so that java becomes platform independent? **[2]**

Q5) a) Write a program to copy contents of one file to another. The filenames are passed as command line arguments. **[4]**

b) Write a program to define an exception called "Invalid Amount" that is thrown when withdrawal amount is entered is more than the available amount. **[4]**

c) List the different Resultset types in JDBC. **[2]**

Q6) a) What is Layout Manager? Explain Flow Layout and Grid Layout. **[4]**

b) Write a program to store 'n' names in an ArrayList and traverse the collection using an iterator. **[4]**

c) What is the difference between Method overriding and method overloading? **[2]**

Q7) a) Write a program using jdbc to read student data(rno, name, percentage) and perform the following operations: **[5]**

i) Search by name.

ii) Find student with highest percentage.

b) What is ragged array? Explain with appropriate diagram. How to initialize 2-D array in java? **[5]**

Q8) a) Write a program to create the following class hierarchy: Item(id, name, price)-> SaleItem(discount). Accept details of 'n' SaleItem objects and display the item details having the highest discount. **[5]**

b) Explain any five swing components. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1325

[Total No. of Pages : 2

[5442]-501

M.Sc.

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 501 : Digital Image Processing

(2013 Pattern) (Semester - V) (Credit System) (New)

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.*
3) *Use of non-scientific/non-programmable calculator is allowed.*

Q1) Attempt the following:

a) Explain sampling and quantization of digital image. **[4]**

b) Write a short note on Digital image water marking. **[3]**

c) Define the following: **[3]**

i) Pepper noise

ii) Salt noise

iii) White noise

Q2) a) Consider image segment as shown below. Compute length of the shortest-4, shortest-8 and shortest-m paths between pixels p & q where V = {1, 2}.**[4]**

4	2	3	2q
3	3	1	3
2	3	2	2
p2	1	2	3

b) Explain 'contrast stretching'. **[3]**

c) What is threshold? Explain how to obtain the threshold for image segmentation. **[3]**

Q3) a) Justify the statement: Laplacian is better than gradient for detection of edges. **[4]**

b) Explain 'Aliasing'. **[3]**

c) Explain image negatives with its applications. **[3]**

P.T.O.

Q4) a) Discuss the RGB model for color image processing. **[4]**

b) Show that Erosion and dilation are duals of each other. **[3]**

c) Explain coding redundancy. **[3]**

Q5) a) Consider a 3-bit image (L = 8) of size 64 × 64, which has intensity distribution shown below: **[4]**

r_k : intensity	n_k : no. of pixels
$r_0 = 0$	790
$r_1 = 1$	1023
$r_2 = 2$	850
$r_3 = 3$	656
$r_4 = 4$	329
$r_5 = 5$	245
$r_6 = 6$	122
$r_7 = 7$	81

Draw :

i) Histogram for 3-bit image

ii) Equalized histogram

b) If all the pixels in an image are shuffled, will there be any change in histogram? **[3]**

c) Explain with suitable example the spatial filter operation for smoothing and image. **[3]**

Q6) a) Explain the neccessity of image processing with suitable example. **[4]**

b) Write a note on image enhancement techniques. **[3]**

c) Explain: **[3]**

i) Unit impulse

ii) Perimeter of region

Q7) a) How do you filter an image in the frequency domain? Give its flow-chart. **[5]**

b) Explain various components of a general purpose image processing system. **[5]**

Q8) a) Explain basic principles of detecting following in the images with suitable example. **[5]**

i) Points

ii) Lines

b) Explain Morphological operation 'Opening' with suitable example. **[5]**

Total No. of Questions : 8]

SEAT No. :

P1326

[Total No. of Pages : 2

[5442]-502

M.Sc.

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 502 : Dot Net Technologies

(2013 Pattern) (Credit System) (Semester - V)

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

Instructions to the candidates:

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

Q1) Attempt the following:

a) What are the HTML server controls in ASP.NET? **[4]**

b) What are namespaces, and how are they used? **[4]**

c) Define MVC. **[2]**

Q2) Attempt the following:

a) Write a short note on CLR. **[4]**

b) Explain the use of virtual, sealed, override, and abstract. **[4]**

c) What is the difference between ASP.NET WebForms and ASP.NET MVC? **[2]**

Q3) Attempt the following:

a) Explain the advantages of ASP.NET. **[4]**

b) What are the features of C#? **[4]**

c) What is an internal modifier? **[2]**

Q4) Attempt the following:

a) Explain Exception handling in C#.Net. **[4]**

b) Describe Connection object in ADO.NET. **[4]**

c) What is the difference between an event and a delegate? **[2]**

Q5) Attempt the following:

a) What are advantages of using Master Page in ASP.NET. **[4]**

b) Differentiate between DataSet and DataReader. **[4]**

c) What is the difference between const and readonly in C#.NET? **[2]**

Q6) Attempt the following:

a) Differentiate between compile time polymorphism and runtime polymorphism. **[4]**

b) Define garbage collection in C#. How many types of generations are there in a garbage collector? **[4]**

c) How to add a ReadOnly property in C#.NET. Give a code as an example. **[2]**

Q7) Attempt the following:

a) Write a C# program to demonstrate the use of single level inheritance. **[5]**

b) Write a C# program to create multicast delegate to hold the reference of add() and mul() methods whose return type is void and takes two parameters of integer types. **[5]**

Q8) Attempt the following:

a) Write a ASP.NET program to demonstrate the use of server control Radio Button. Create a group of two radio buttons and labeled it with Male and Female. Handle appropriate event to display which element has selected. **[5]**

b) Write a short note on advantages and disadvantages of using Session State in ASP.Net. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1327

[Total No. of Pages : 1

[5442]- 503

M.Sc. -Tech.

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM- 503 : UNIX

(2013 Pattern) (Semester - V)

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) Explain xalloc( ) system in detail. **[5]**

b) What is signal ? How signal handling is done in UNIX. **[5]**

Q2) a) What is zombie state of process ? Explain exit( ) system call. **[5]**

b) Write and explain fork system call. **[5]**

Q3) a) Write a note on structure of buffer pool. **[3]**

b) Explain different services of UNIX operating system. **[3]**

c) Explain high-level architecture of UNIX system. **[4]**

Q4) a) Explain Block diagram of UNIX system kernel. **[5]**

b) What are the characteristics of UNIX file system ? **[3]**

c) When processes go into sleep state and how wakeup used ? **[2]**

Q5) a) Write a Note on Race Condition. **[5]**

b) Explain Block Read Ahead algorithm. **[5]**

Q6) a) What is inode ? Explain fields of Disk inode. **[4]**

b) What is in-core inode? What are additional fields it contains over the Disk inode ? **[4]**

c) Define : i) Process ii) Kernel **[2]**

Q7) a) Explain exec ( ) system call. **[5]**

b) Write a note on pipes. **[5]**

Q8) a) Explain DUP system call. **[4]**

b) What is use if link and Unlink system call and what are input parameters for this system call. **[3]**

c) Write a note on file system layout. **[3]**

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Total No. of Questions : 8]

SEAT No. :

P1328

[Total No. of Pages : 2

[5442]-504

M.Sc. (IMCA)

MATHEMATICS

MIM : 504 - Statistical Methods

(2013 Pattern) (Semester - V)

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

Instructions to the candidates:

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

Q1) a) A hospital switchboard receives an average of 4 emergency calls in a 10 minute interval. What is the probability that there are exactly 3 emergency calls in a 10 - minute interval? **[4]**

b) The distribution function of a random variable X is given by,

$$F(x)=\begin{cases} 0 & \text{if} \quad x<0 \\ 2x^2 & \text{if} \quad 0\le x\le ½ \\ 4x-2x^2-1 & \text{if} \quad ½\le x\le 1 \\ 1 & \text{if} \quad x>1 \end{cases}.$$

find p.d.f. of X. **[4]**

c) Write any four properties of regression coefficient. **[2]**

Q2) a) Derive an expression for mean of Poisson Distribution. **[4]**

b) If p.d.f. of random variable X is given by,

f (x) = kx^3, $0\le x<1$

0 =, otherwise

then find mean and variance of X. **[4]**

c) Define 'Mutually Exclusive Event'. **[2]**

Q3) a) State and prove 'Lack of Memory Property'. **[4]**

b) In a shooting competition, the probability of a man hitting a target is $\frac{1}{5}$. If he hits the target for 5 times then what is the probability of hitting the target only two times.? **[4]**

c) If b_{xy}= 0.2 and b_{yx} = 0.3 find the value of correlation coefficient. **[2]**

P.T.O.

Q4) a) Obtain the expected value of number of heads when three fair coins are tossed simultaneously. **[4]**

b) Obtain mean and variance of Binomial Distribution. **[4]**

c) If $P(A) = 0.6$, $P(B) = 0.5$, $P(A \cap B) = 0.3$ then find $P(A' \cap B)$. **[2]**

Q5) a) The letters of the word 'Seminar' are arranged at random. Find the probability that the vowels occupy the even places. **[4]**

b) Write definition and properties of normal distribution. **[4]**

c) If a pair of unbiased coins is tossed then find the probability of occurrence of single head. **[2]**

Q6) a) Consider the following pmf of random variable X

X	0	1	2	3	4
$P(X=x)$	k	3k	5k	2k	k

Find i) The value of k

ii) $P(X<3)$ **[4]**

b) Obtain the formula for mean and variance of Exponential Distribution. **[4]**

c) Suppose A and B are two events defined on Ω. If $P(A) = 0.8$, $P(A \cup B) = 0.9$ & $P(B) = x$ then find value of x if A and B are mutually exclusive. **[2]**

Q7) a) The mean of a normal Distribution is 60 and 6% of the values are greater than 70. Find the standard deviation. **[5]**

b) Let $X \sim U(a,b)$. Derive the formula for mean, variance and standard deviation of X. **[5]**

Q8) a) Explain chi-square test for goodness of fit. **[5]**

b) Explain the method of test for independence of Attribute. **[5]**

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Total No. of Questions : 8]

SEAT No. :

P1329

[Total No. of Pages : 3

[5442]-505
M.Sc. - III
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 505 : Cryptography
(2013 Pattern) (Semester - V)

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

Instructions to the candidates:

1) *Attempt any five out of eight questions.*
2) *Figures to the right indicate full marks.*
3) *Scientific non-programmable calculator is allowed.*

Q1) Attempt the following:

a) Write a note on mono alphabetic substitution ciphers. **[4]**

b) Consider English language and associated alphabets with the mapping $A \Leftrightarrow 0,\ B \Leftrightarrow 1 ....Z \Leftrightarrow 25$. Encrypt the plain text P(T) = CRYPTOGRAPHY using shift cipher with a value K = 3. **[3]**

c) Find $\gcd(a,b) = d$ and express '*d*' as a linear combination of '*a*' and '*b*' where **[3]**

$$a = 586$$
$$b = 139$$

Q2) Attempt the following:

a) Find the smallest positive integer '*x*' such that **[4]**

$$x \equiv 5 (\mathrm{mod}\, 7)$$
$$x \equiv 7 (\mathrm{mod}\, 11)$$
$$x \equiv 3 (\mathrm{mod}\, 13)$$

b) What are the valid choices for '*a*' and thus the size of the key space for an affine cipher that is based on the English language and associated alphabet? **[3]**

c) Consider English language and associated alphabet with the mapping $A \Leftrightarrow 0,\ B \Leftrightarrow 1, ...Z \Leftrightarrow 25$. Encrypt the plain text P(T) = MEET ME, using multiplicative cipher, with K = 3. **[3]**

P.T.O.

Q3) Attempt the following:

a) Compute the affine cipher key $K=(a,b)$, if the letter 'A' represented as 'zero', maps to 'J', represented as 'nine' and the letter 'B' represented as 'one', maps the letter 'O' represented as 'fourteen'. **[4]**

b) Use keyword cipher to encrypt the word 'ALGEBRA' where

keyword is 'mathematics' and

key letter is 'V' **[3]**

c) Decrypt the following message using permutation cipher 'σ', where

$$\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 4 & 3 & 1 & 2 & 6 & 5 \end{pmatrix}$$

Message 'agsuirewsste'. **[3]**

Q4) Attempt the following:

a) Write a note on Hill's cipher. **[4]**

b) Explain why the multiplicative cipher of any key associates plain text 'm' to the Cipher text M? **[3]**

c) Explain in brief the block ciphers and stream ciphers. **[3]**

Q5) Attempt the following:

a) Explain in short the 'Diffie-Helman' key exchange algorithm. **[4]**

b) Explain the working of symmetric key Cryptosystem. **[3]**

c) Define elliptic curve and check whether the point (7, 9) is a point on elliptic curve $y^2 = x^3 + x + 6 \pmod{11}$. **[3]**

Q6) Attempt the following:

a) Write a note on DES, the data encryption standards. **[4]**

b) Write a note on digital signature. **[3]**

c) Explain the concept of one-time pad. **[3]**

Q7) Attempt the following:

a) Define primitive root and check whether 2 is primitive root modulo 17 or not? **[5]**

b) Using RSA digital signature scheme with the parameters $p = 2$, $q = 5$ and $a = 3$, sign the message $x = 3$ and then verify the signature. **[5]**

Q8) Attempt the following:

a) Define 'discrete logarithm'; and explain what is discrete logarithm problem. **[5]**

b) Show that the pseudo-random sequence generated by the function $f(x_i) = (x_i^2 + 9) \bmod 19$.

Identify the μ-tail and the λ-cycle and x_μ where the collision occurs, if the initial point $x_0 = 5$. **[5]**

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