[5542]-101

M.Sc. (Semester - I)
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 101 Real Analysis
(2013 Pattern)

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) If f and g are continuous real functions on [a, b] which are differentiable in (a, b), then show that there exists a point $x \in (a,b)$ at which
$[f(b) - f(a)]g'(x) = [g(b) - g(a)]f'(x)$ **[4]**

   b) If $p > 0$ and α is real, then show that   **[4]**

$$\lim_{n \to \infty} \frac{n^{\alpha}}{(1+p)^n} = 0$$

   c) Find the radius of convergence of the power series $\sum n^3 z^n$ **[2]**

Q2) a) Given f is a mapping of a metric space X into a metric space Y. Prove that f is continuous on X if and only if $f^{-1}(v)$ is open in X for every open set V in Y.   **[4]**

   b) Let f be continuous on [a, b], then prove that $f \in R(\alpha)$ on [a, b]. **[4]**

P.T.O.

c) Let $K \subset \mathbb{R}$ consisting of O and numbers $\dfrac{1}{n}$ for $n = 1, 2, 3.....$ prove that k is closed in $\mathbb{R}$. **[2]**

Q3) a) Prove that the convergence of $\sum a_n$ implies the convergence of $\sum \dfrac{\sqrt{a_n}}{n}$ if $a_n \geq 0$. **[4]**

b) Prove that closed subsets of compact sets are compact. **[4]**

c) Let f be a continuous real function on a metric space X. Let $z(f) = \{p \in X | f(p) = 0\}$ prove that $z(f)$ is closed in X. **[2]**

Q4) a) Investigate the convergence or divergence of $\sum a_n$ if $a_n = \dfrac{\sqrt{n+1} - \sqrt{n}}{n}$. **[4]**

b) If $f(x) = |x|^3$. Compute $f'(x), f''(x)$ for all real x and show that $f^{(3)}(0)$ does not exist. **[4]**

c) Given $f(x) = x^2 + 2$ and $\alpha(x) = 3x^2 + x + 1$ compute $\int_0^1 f \, d\alpha$. **[2]**

Q5) a) Suppose f is a continuous real function on a compact metric space X and $M = \sup\limits_{p \in X} f(p)$, $m = \inf\limits_{p \in X} f(p)$. Then show that there exist points $p, q \in X$ such that $f(p) = M$ and $f(q) = m$. **[4]**

b) Let $f_n(x) = \dfrac{\sin(nx)}{\sqrt{n}}$ where x is real and $n = 1, 2, 3.......$ Show that $\{f_n'\}$ does not converge to f'. **[4]**

c) Define $f(x) = \begin{cases} \sin\left(\dfrac{1}{x}\right) & (x \neq 0) \\ 0 & (x = 0) \end{cases}$ show that f has a discontinuity of second kind at $x = 0$ **[2]**

Q6) a) Show that *e* is irrational. **[4]**

b) For any collection $\{G_\alpha\}$ of open sets show that $\underset{\alpha}{\cup}G_\alpha$ is open. **[4]**

c) Prove that the convergence of $\{s_n\}$ implies the convergence of $\{|s_n|\}$. **[2]**

Q7) a) Prove that $f \in R(\alpha)$ 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) Prove that every K - cell is compact. **[5]**

Q8) a) If $f \in R$ on [a, b] and if there is a differentiable function F on [a, b] such that $F' = f$ then prove that **[5]**

$$\int_a^b f(x)dx = F(b) - F(a)$$

b) Let $f_n(x) = \dfrac{x^2}{(1+x^2)^n}$ where *x* is real and $n = 0,1,2,.....$ **[5]**

i) Compute $f(x) = \sum_{n=0}^{\infty} f_n(x)$.

ii) Is *f* a continuous function for all $x \in \mathbb{R}$?

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[5542]-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) *Attempt any five questions.*
   2) *Figures to the right indicate full marks.*
   3) *Use of non programmable scientific calculator is allowed.*

Q1) a) Give an example of a subspace of dimension 2 of a vector space R^3 over R with respect to usual addition and scalar multiplication in R^3 **[2]**

   b) Find t for which $u = (\cos t, \sin t), v = (\sin t, \cos t)$ form a linearly independent set in R^2. **[4]**

   c) Find coordinate vector of $(1, 0, 0)$ with respect to basis
      $B = \{(1,2,1),(2,1,0),(1,-1,2)\}$ of R^3 **[4]**

Q2) a) Determine whether the transformation $T : R^2 \rightarrow R^2$ given by $T(x, y) = (x + y, x - y)$ is linear. **[2]**

   b) Prove that a linear transformation $T : V \rightarrow W$ is injective if and only if $\mathrm{Ker}(T) = \{\bar{O}\}$. **[4]**

   c) Verify cayley Hamilton theorem for the matrix $A = \begin{bmatrix} 3 & -2 \\ -1 & 2 \end{bmatrix}$ **[4]**

P.T.O.

Q3) a) Define a quotient space of a vector space V. **[2]**

b) State and prove Cauchy schwarz Inequality. **[4]**

c) Show that for the vectors $u = (u_1, u_2)$ and $v = (v_1, v_2)$ in R^2, $\langle u, v \rangle = 5u_1v_1 - u_1v_2 - u_2v_1 + 10u_2v_2$ defines an inner product on R^2. **[4]**

Q4) a) If a 2 × 2 transformation matrix $[T] = \begin{bmatrix} 3 & 1 \\ -1 & 1 \end{bmatrix}$ is applied to a circle of radius 2 units, then find the area of the resulting figure. **[2]**

b) Describe an algorithm to reflect an object through an arbitrary line in R^2 **[4]**

c) Find the concatenated transformation matrix for a 30° rotation about the point S[–1, 1]. Apply this rotation onto the triangle with vertices A[2, 1], B[–2, 3] and C[–3, –1]. **[4]**

Q5) a) State any two properties of orthographic projection. **[2]**

b) Determine the four diametric projections, if a foreshortening factor along the z axis is $\frac{1}{3}$. **[4]**

c) State any four properties of perspective projection. **[4]**

Q6) a) State any two properties of Bezier curve. **[2]**

b) Write an algorithm to generate 20 equally spaced points on the periphery of the ellipse $\dfrac{(x-2)^2}{4} + \dfrac{y^2}{1} = 1$. **[4]**

c) The object is to be rotated about the line passing through A[4, 5, 7] and B[6, 8, 10]. Determine the angle of rotation about 'x' axis say α and angle of rotation about the 'y' axis say – β so that the line coincides with the 'z' axis. **[4]**

Q7) a) State and prove Rank - Nullity Theorem. **[5]**

b) Let $T : R^3 \to R^2$ be a linear transformation defined by $T(x, y, z) = (2x + y - z, 3x - 2y + 4z)$ Find the matrix A of T with respect to bases of $B_1 = \{(1,1,1), (1,1,0), (1,0,0)\}$ and $B_2 = \{(1,3), (1,4)\}$ of R^3 and R^2 respectively. **[5]**

Q8) a) It is required to reflect in the face ABC of the pyramid OABC given by O[0, 0, 0], A[1,0,0], B[0, 1, 0] C[0,0,1]. Determine the transformation matrices for translation and the rotations so that the required face coincides with the *xy* plane. **[5]**

b) Derive the conditions on a 2×2 transformation matrix that preserves the length, inclinations and angle between two intersecting lines. **[5]**

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[5542]-103
M.Sc. (IMCA)
MATHEMATICS
Discrete Mathematical Structures
(2013 Pattern) (Semester - I)

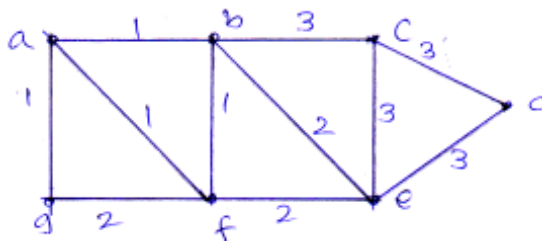*Time : 3 Hours]*   *[Max. Marks : 50*

Instructions to the candidates :
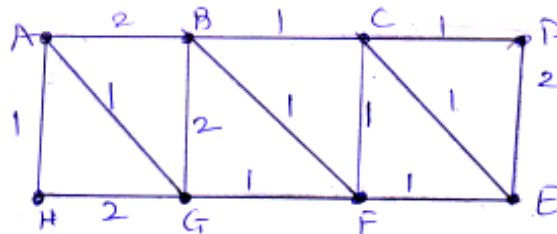
    1)   *Attempt any five questions out of eight.*

    2)   *Figures to the right indicate full marks.*

Q1)   a)   Show that $(p \vee q) \wedge (p \vee r) \rightarrow (q \vee r)$ is a tautology.   **[5]**

     b)   Find a minimal spanning tree of the following graph using Kruskal's Algorithm Also, find the weight of the minimal spanning tree.   **[5]**

Q2)   a)   Solve the Chinese Postman Problem for the following graph.   **[5]**

     b)   Prove that a simple graph is connected if and only if it has a spanning tree.   **[5]**

Q3) a) Explain the notion of Digraph. Give an example. **[2]**

b) Prove that it is impossible to have a group of 13 people at a party such that each one knows exactly five of the others in the group. **[3]**

c) How many arrangements of the letters *a, e, i, o, u, x, x, x, x, x, x, x, x*, are there if no two vowels can be consecutive? **[5]**

Q4) a) Define an Euler Graph. Give an example of an Euler graph. **[2]**

b) Show that $\sim(p \vee (\sim p \wedge q))$ and $\sim p \wedge \sim q$ are logically equivalent by developing a series of logical equivalences. **[3]**

c) Prove that a connected graph with at least two vertices has an Euler circuit then each of its vertices has even degree. **[5]**

Q5) a) Define a pendant vertex. Give an example of a graph with three pendant vertices. **[2]**

b) Does there exist a complete bipartite graph that is a complete graph? Justify your answer. **[3]**

c) Let *u* and *v* be distinct vertices of a tree *T*, then prove that there is precisely one path from *u* to *v*. **[5]**

Q6) a) How many non empty different collections can be formed from 10 (identical) mangoes and 12 (identical) oranges? **[2]**

b) Prove that a tree is a bipartite graph. **[3]**

c) Use Inclusion - Exclusion Principle to find the number of positive integers less than or equal to 70 which are relatively prime to 70. **[5]**

Q7) a) Prove that complete graph K_6 is non planar. **[2]**

b) How many different 10 - digit quaternary sequences are there with exactly four 2s and two 3s? **[3]**

c) Using Inclusion - Exclusion Principle, find the number of different integers solutions to the equation : **[5]**

$$x_1 + x_2 + x_3 = 15, 0 \leq x_i \leq 6$$

Q8) a) Prove or disprove : Every graph with even number of vertices, in which every vertex is of even degree is bipartite. **[2]**

b) If graph G is a cycle with 5 edges and 5 vertices. Then prove that G and its complement are isomorphic. **[3]**

c) Let f be a flow on a network $N = (V, A)$ and let f have value d, If $A(X, \bar{X})$ is a cut in N then prove that $d = f(X, \bar{X}) - f(\bar{X}, X)$ and $d \leq c(X, \bar{X})$. **[5]**

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[5542]-104

M.Sc. (Semester - I)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 104 : C Programming

(2013 Pattern)

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 'while' loop with example. **[4]**

b) Explain malloc ( ) and calloc ( ) function with example. **[4]**

c) Write down the use of conditional operator. **[2]**

Q2) Attempt each of the following:

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

b) Write a note on 'Command Line Arguments'. **[4]**

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

```
main ( )
{
        int x = 3, y = 5;
        if (x = = 3)
                printf ("\n %d ",x);
        else
                printf ("\n %d", y);
}
```

Q3) Attempt each of the following:

    a)   Explain break and continue statement with an example.   **[4]**

    b)   Write a recursive function to calculate sum of digits of a number.   **[4]**

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

```
main ( )
{
    int x = 1;
    while (x = = 1)
    {
        x = x – 1;
        printf ("\n %d ", x);
    }
}
```

Q4) Attempt each of the following.

    a)   Write a short note on structures in 'C'.   **[4]**

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

    c)   What are limitations of an array?   **[2]**

Q5) Attempt each of the following:

    a)   Explain the concept of formal and actual parameters with an example.**[4]**

    b)   Write a note on Bitwise operator.   **[4]**

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

Q6) Attempt each of the following:

    a)   Explain the various file opening modes.   **[4]**

    b)   Write the differences between structures and unions.   **[4]**

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

```
main ( )
{
    int x = 4, y, z;
    y = = – – x;
    z = x – – ;
    Printf ("\n %d %d %d ", x, y, z);
}
```

Q7) Attempt each of the following:

    a)   Write a short note on Data types in 'C'. **[5]**

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

Q8) Attempt each of the following:

    a)   Write a 'C' program using structure to accept name, author, rate, quantity of n books from user and display name of book, author name and total cost in sorted order of rate. **[5]**

    b)   Write a program to find factorial value of any number entered through the keyboard. **[5]**

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[5542]-201
M.Sc. (IMCA) (Semester - II)
MATHEMATICS
MIM - 201 : Complex Analysis
(2013 Pattern)

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

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

Q1) a) If $\sum a_n z^n$ is given power series with radius of convergence R, then

   prove that $R = \lim\limits_{n \to \infty} \left| \dfrac{a_n}{a_n + 1} \right|$ if this limit exists.   **[4]**

   b) State and prove the Liouville's Theorem.   **[4]**

   c) Find all values Log (2 + 7i).   **[2]**

Q2) a) If G is open and connected and $f : G \to \mathbb{C}$ is differentiable with $f'(z) = 0$
   for all z in G, then show that f is constant.   **[4]**

   b) Evaluate the integral $\int_C \dfrac{z^2 + 1}{z(z^2 + 4)}$ dz where C is the circle $|z| = 3$.   **[4]**

   c) Find the image of the region $\{0 \le x \le \pi, y \ge 0\}$ under the map $w = ie^{iz}$ **[2]**

Q3) a) State and prove Morera's Theorem.   **[5]**

   b) Find pole and the corresponding residue of $f(z) = \dfrac{\text{Log } z}{(z^2 + 1)^2}$.   **[3]**

   c) Find the image of 6 + 5i under stereographic projection on unit sphere.
                                                                                       [2]

Q4) a) If $p(z)$ is a non constant polynomial then prove that there is a complex number a with $p(a) = 0$. **[5]**

b) Prove that sinh $2z = 2$ sinh z cosh z. **[3]**

c) Find the radius of convergence of $\sum_{n=0}^{\infty} b^n z^n, b \in \mathbb{C}$ **[2]**

Q5) a) Suppose that a function $f(z)$ is continuous on a domain D. If the integrals of $f(z)$ around closed contours lying entirely in D all have value zero then prove that $f(z)$ has an antiderivative $F(z)$ throughout D. **[4]**

b) If f has an isolated singularity at a then prove that the point $z = a$ is a removable singularity if and only if $\lim_{z \to a} (z - a) f(z) = 0$. **[4]**

c) Find all values of $(1 + i)^i$. **[2]**

Q6) a) Let the degrees of the polynomials. **[4]**

$$p(z) = a_0 + a_1 z + a_2 z^2 + \dots + a_n z^n \quad a_n \neq 0$$

$$q(z) = b_0 + b_1 z + b_2 z^2 + \dots + b_m z^m \quad b_m \neq 0$$

be such that $m \geq n + 2$. Show that if all the zeros of Q (z) are interior to the simple closed contour C then $\int_C \frac{P(z)}{Q(z)} dz = 0$.

b) If $f(z)$ and $\overline{f(z)}$ are both analytic in a domain D, show that f is constant in D, **[3]**

c) Prove that the real and imaginary parts of an analytic function $f(z) = u + iv$ are harmonic fucntions. **[3]**

Q7) a) State and prove Taylor's Theorem. **[5]**

b) Evaluate improper integral $\int_0^\infty \frac{x^2}{(x^2 - 4)(x^2 + 5)} dx$ by using residues. **[5]**

Q8) a) Represent a function $f(z) = \dfrac{1}{z(z-1)(z-2)}$ by its Laurent series in its domain $2 < |z| < \infty$. **[5]**

b) Let *a* function f be continuous on a closed bounded region R, and let it be analytic and not constant throughout the interior of R. Assuming that f (z) $\neq$ 0 anywhere in R, prove that |f (z)| has a minimum value *m* in R which occurs on the boundary of R. **[5]**

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[5542]-202
M.Sc. (IMCA) (Semester - II)
MATHEMATICS
MIM - 202 : Algebra - I
(2013 Pattern)

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

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

Q1) a) For a fixed point $(a,b) \in \mathbb{R}^2$, define $T_{a,b} : \mathbb{R}^2 \to \mathbb{R}^2$ by $(x, y) \to (x + a, y + b)$. Then prove that $T(\mathbb{R}^2) = \{T_{a,b} \mid a, b \in \mathbb{R}\}$ is a group under composition of functions. **[4]**

   b) Prove that the center Z(G) of a group G is a subgroup of G. For any group G and a $\in$ G, prove that $Z(G) \subseteq C(a)$, Where C(a) is centralizer of a. **[4]**

   c) Let G be a group and let a $\in$ G. Prove that $C(a) = C(a^{-1})$. **[2]**

Q2) a) Let G = < a > be a cyclic group of order n. Then prove that G = < a^k > if and only if gcd (k,n) = 1. **[4]**

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

   c) Write all subgroups of $\mathbb{Z}_{30}$. **[2]**

Q3) a) Prove that every permutation in S_n, n > 1 is a product of 2-cycles. Hence write (1 2 3 4 5) in S_5 as a product of 2 - cycles. **[4]**

   b) Let G be a group and let Z (G) be the center of G. If G/Z(G) is cyclic then prove that G is abelian. **[4]**

   c) Let H = {(1) , (12)} be a subgroup of S_3. Is H normal in S_3? **[2]**

Q4) a) Let G be a finite group whose order is power of a prime P. Then prove that Z(G) has more than one element. **[4]**

b) Define subring of a ring R. Let $a \in R$, prove that the set $S = \{x \in R \mid ax = 0\}$ is a subring of R. **[4]**

c) Let a, b and c be elements of an integral domain. If $a \neq 0$ and ab = bc then prove that b = c. **[2]**

Q5) a) If A and B are two ideals of a ring R with unity and A + B = R then show that $A \cap B = AB$. **[4]**

b) Let $\mathbb{R} = \left\{ \begin{bmatrix} a & b \\ b & a \end{bmatrix} \middle| a,b \in \mathbb{Z} \right\}$ and $\phi : R \to \mathbb{Z}$ be defined by

$\phi \left(\begin{bmatrix} a & b \\ b & a \end{bmatrix} \right) = a - b$. Show that $\dfrac{R}{\ker \phi} \cong \mathbb{Z}$.

Is kerϕ a prime ideal? Justify.

Is kerϕ a maximal ideal? Justify. **[4]**

c) Find quotient and remainder up on dividing

$f(x) = 3x^4 + x^3 + 2x^2 + 1$ by $g(x) = x^2 + 4x + 2$ Where

$f(x), g(x) \in \mathbb{Z}_5[x]$ **[2]**

Q6) a) If D is an integral domain then prove that D[x] is an integral domain. **[4]**

b) Prove that product of two primitive polynomials is primitive. **[4]**

c) Show that $f(x) = 21x^3 - 3x^2 + 2x + 9$ is irreducible over Q. **[2]**

Q7) a) Let G be a group and H a normal subgroup of G. Show that the set $G/H = \{aH \mid a \in G\}$ is a group under the operation (aH) (bH) = abH.**[5]**

b) Prove that every finite integral domain is a field. Hence prove that if R is finite commutative ring with unity then every prime ideal of R is maximal.

[5]

Q8) a) State and prove Eisenstein's criterion. **[5]**

b) Let F be a field and let $p(x) \in F[x]$ Then prove that < p(x) > is a maximal ideal in F[x] if and only if p(x) is irreducible over F. **[5]**

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[5542]-203
M.Sc. (IMCA) (Semester - II)
MATHEMATICS
MIM 203 : Numerical Analysis
(2013 Pattern)

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

Q1) a)   Find triangular factorization of the following matrix

$$A = \begin{bmatrix} -5 & 2 & -1 \\ 1 & 0 & 3 \\ 3 & 1 & 6 \end{bmatrix}$$ **[4]**

   b)   Use the false position method to find the root of $x\sin(x) - 1 = 0$ that is located in the interval [0, 2]. Perform three iterations.   **[4]**

   c)   Assume that g is a continuous function and that $\{P_n\}_{n=0}^{\infty}$ is a sequence generated by fixed point iteration. If $\lim\limits_{n\to\infty} P_n = P$, then prove that P is a fixed point of $g(x)$.   **[2]**

Q2) a)   Using Euler's method find approximations to the following initial value problem -

   $y' = t^2 - y$ over [0, 0.2] with y(0) = 1 and h = 0.05 perform four iterations.   **[4]**

   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 $\{C_n\}_{n}^{\infty} = 0$ represents the sequence of midpoints generated by the Bisection process, then prove that $|r - C_n| \le \dfrac{b-a}{2^{n+1}}$ for n = 0,1, ... Also prove that $\lim\limits_{n\to\infty} C_n = r$.   **[4]**

c) Find J (1.1, 2.0) for the following functions.

$$g(x, y) = \frac{8x - 4x^2 + y^2 + 1}{8}$$

$$f(x, y) = \frac{2x - x^2 + 4y - y^2 + 3}{4}$$ [2]

Q3) a) Let $f(x) = \frac{8x}{2^x}$. Use quadratic Lagrange interpolation based on the nodes $x_0 = 0$, $x_1 = 1$ and $x_2 = 2$ to approximate $f(1.5)$. [4]

b) For the following nonlinear system, compute (p_1, q_1) and (p_2, q_2) using fixed - point iteration.

$$g_1(x, y) = \frac{2x - x^2 + y}{2}$$

$$g_2(x, y) = \frac{2x - x^2 + 8}{9} + \frac{4y - y^2}{4}$$

Use $(p_0, q_0) = (1.4, 2)$. [4]

c) Define:

i) Similar Matrices [2]

ii) Normalized Eigenvector

Q4) a) Derive the formula for $f''(x)$ of order $O(h^2)$. [4]

b) Discuss the Heun's method to solve the initial value problem, $y'(t) = f(t, y(t))$ over [a, b] with $y(t_0) = y_0$. Give geometrical interpretation. [4]

c) Find the inverse of the matrix $\begin{bmatrix} -2 & -1 \\ 5 & 4 \end{bmatrix}$, using LU decomposition method. [2]

Q5) a) Assume that the sequence $\{P_n\}_{n=0}^{\infty}$ converges linearly to the limit p and that $P - P_n \neq 0$ for all $n \geq 0$. If there exists a real number A with $|A| < 1$, such that $\lim\limits_{n \to \infty} \dfrac{p - p_{n+1}}{p - p_n} = A$, then prove that the sequence $\{q_n\}_{n=0}^{\infty}$ defined by $q_n = p_n - \dfrac{(p_{n+1} - p_n^2)}{p_{n+2} - 2p_{n+1} + p_n}$ converges to P. **[4]**

b) Compute $\int\limits_0^1 [1 + e^{-x} \sin(4x)]\, dx$ using Boole's rule. $(h = \frac{1}{4})$ **[4]**

c) Show that there is no solution to the linear system,

$$4x_1 - x_2 + 2x_3 + 3x_4 = 20$$
$$7x_3 - 4x_4 = -7$$
$$6x_3 + 5x_4 = 4 \qquad \text{[2]}$$
$$3x_4 = 6$$

Q6) a) 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 $[1,\ 6]$. **[4]**

b) Start with $P_0 = 1.2$ and use accelerated Newton Raphson iteration to find the double root p = 1 of $f(x) = x^3 - 3x + 2$. **[4]**

c) Find error and relative error if x = 3.141592 and $\overline{x}$ = 3.14. **[2]**

Q7) a) Using the Runge – Kutta method, compute the numerical solution to the system of differential equations $\begin{cases} \dfrac{dx}{dt} = & x + 2y \\ \dfrac{dy}{dt} = & 3x + 2y \end{cases}$ with $\begin{cases} x(0) = 6 \\ y(0) = 4 \end{cases}$ over the interval $[0,\ 0.\,2]$ using 10 subintervals and the step size h = 0.0.2. **[5]**

b) Use Muller's method to find the root of $f(x) = x^3 - x - 2$. Use $P_0 = 1.0$, $P_1 = 1.2$ and $P_2 = 1.4$ to find P_3 and P_4. **[5]**

Q8) a) Derive the formula

$$f'''(x_0) \approx -\frac{-5f_0 + 18f_1 + 24f_2 + 14f_3 - 3f_4}{2h^3}.$$ **[5]**

b) Show that the matrix $A = \begin{bmatrix} 3 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 3 \end{bmatrix}$ is diagonalizable. **[5]**

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[5542]-204

M.Sc. Tech. (IMCA) (Semester - II)
MIM - 204 : Object Oriented Programming using C++
(2013 Pattern)

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

Instructions to the candidate:
   1) Attempt any five questions.
   2) Figures to the right indicate full marks.

Q1) Attempt the Following

   a) What is user defined data type? How it is different from derived data type?   **[4]**

   b) What is reference variable? What is its major use? Explain with a example.
                                                                        [4]

   c) How to invoke a constructor function in c++?   **[2]**

Q2) Attempt the Following

   a) Differentiate between a member function and a normal function.   **[4]**

   b) Explain how a inline function differ from a preprocessor macro? Explain significant advantage of inline function.   **[4]**

   c) Explain the term: message passing   **[2]**

Q3) Attempt the Following

   a) Compare dynamic memory allocation in C and C++   **[4]**

   b) What are manipulators? Describe the use of following manipulators in brief.   **[4]**

      i)   showbase ii) showpoint

   c) Explain : this pointer   **[2]**

Q4) Attempt the Following

    a)   How operator function is invoked if defined as   **[4]**

        i)   member function

        ii)   friend function

        Assuming the case of binary operator overloading explain it with suitable example.

    b)   Explain the concept of Exception handling with suitable example.   **[4]**

    c)   What are the important characteristics of the static member variable? **[2]**

Q5) Attempt the Following

    a)   What is a virtual base class? Why it is important to make a class virtual.   **[4]**

    b)   What is abstract class? When do we use the protected visibility specifiers to a class member?   **[4]**

    c)   Enlist the different applications of OOP.   **[2]**

Q6) Attempt the Following

    a)   Write a program to create a text file using constructor function.   **[4]**

    b)   What is a file mode? Describe the various file mode options available. **[4]**

    c)   What is the concept of namespaces?   **[2]**

Q7) Attempt the Following

    a)   Consider the following definition of a class

        class String 1   **[5]**

        {

        int length;

        char x ptr;

        public: // member function definition

        };

        Write the following functions:

        i]   Overload! operator to change the case of Sringl object

        ii]   constructor function to initialize the object.

b) Write a program in C++ to store the following details: **[5]**

Base class Patient: pname, page, psex

Base class IPD: ward_no, bed_no, charge_per_day

Derive a class IPD-Patient from these base classes with no_of_days_admitted attribute.

Write the necessary functions for:

i] input n records

ii] display all records

iii] search patient by pname

Q8) Attempt the Following

a) Write a c++ program to accept records of n student and score it in an array. The **[5]**

structure is as follows:

structure student

{

int roll_no;

char name[20];

int total;

}

Overload the following search function:

i] int search(student s[], int n, int roll_no);

ii] int search(student s[], int n, char name[]);

b) Write a function template for finding the minimum value contained in an array. **[5]**

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[5542]-205

M.Sc. (Semester - II)
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATION
MIM - 205 : Data Structures Using 'C'
(2013 Pattern)

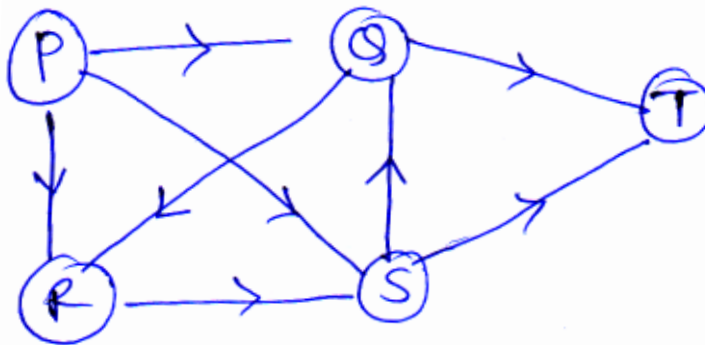*Time : 3 Hours]*   *[Max. Marks : 50*

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

Q1) Attempt all of the following:

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

- b)   Write adjacency matrix, adjacency list, Indegree and Outdegree of a graph.

[4]

- c)   Match the following: **[2]**

	Side A		Side B
i)	Bubble Sort	a)	o(logn)
ii)	Merge Sort	b)	o(n^2)
iii)	Linear Search	c)	o(nlogn)
iv)	Binary search	d)	o(n)

Q2) Attempt all of the following.

    a)   Construct Binary search Tree for following data. Show the tree at each step. **[4]**

           34, 91, 30, 31, 80, 85, 138

    b)   Write a add ( ) and delete ( ) operation function to implement Dynamic Linear Queue. **[4]**

    c)   Write the node structure to represent a polynomial in one variable using a Linked List. **[2]**

Q3) Attempt all of the following.

    a)   Show the stack contents and output while converting the following Infix string to Postfix expression. **[4]**

           PQ + RS – *

           Where P = 9 , Q = 8, R = 7, S = 4.

    b)   Define traversal of Tree. Explain different types of traversal of Binary Search Tree. **[4]**

    c)   Define : i) Big - oh (O) Notation

                ii) Omega (Ω) Notation **[2]**

Q4) Attempt all of the following.

    a)   Sort the following numbers using Insertion Sort. And show all the Intermediate steps. **[4]**

           21, 5, 17, 28, 24, 3, 13, 18

    b)   Write a function to insert a node at particular position in Singly Linked List. **[4]**

    c)   Define DeQueue. What are the operations performed on DeQueue. **[2]**

Q5) Attempt all of the following.

    a)   Write the functions to push ( ) operation and pop ( ) operation for stack implemented using Linked List. **[4]**

    b)   Write an algorithm to implement recursive Depth First Search (DFS). **[4]**

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

Q6) Attempt all of the following.

a) What is the advantages of circular Queue Over Linear Queue using simple array? Explain with example. **[4]**

b) Explain linear and non - linear Data structures with suitable example. **[4]**

c) Define : Data type and Data structures. **[2]**

Q7) Attempt all of the following.

a) Consider the following set of Numbers. Sort them using Quick Sort. Clearly indicate the Pivot element and partition at each step. **[5]**

20, 54, 48, 37, 12, 92, 86, 07

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

Q8) Attempt all of the following.

a) Discuss all the possibilities while deleting a node from a doubly linked list. **[5]**

b) Write an algorithm to convert an Infix expression to prefix expression. **[5]**

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[5542]-301

M. Sc. (IMCA)

MATHEMATICS

MIM : 301 - General Topology

(2013 Pattern) (Semester - III)

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.

Q1) a) Let X be a topological space. Suppose that C is a collection of open sets of X such that for each open set U of X and each *x* in U, there is an element c of C such that $x \in c \leq U$ Then prove that C is a basis for the topology of X. **[4]**

b) 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]**

c) Let $X = \{a, b, c, d, e\}$ and $L = \{\{a, b\}, \{b, c\}, \{a, d, e\}\}$. Find the topology on X generated by *L*. **[2]**

Q2) a) Show that subspace of a Hausdorff space is Hausdorff. **[4]**

b) Let X be a topological space. If U is open in X and A is closed in X, then show that U-A is open in X and is closed in X. **[4]**

c) Define interior and closure of a set in a topological space. **[2]**

Q3) a) Prove that a subset A of a topological space X is both open as well as closed if and only if boundary of A is a empty set. **[4]**

b) Show that every function on a discrete space is continuous. **[4]**

c) Give an example of a T_1-Space. **[2]**

Q4) a) Show that the space R_L is first countable. **[4]**

b) Show that R is homeomorphic to (0, 1). **[4]**

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

Q5) a) Let X be any uncountable set with discrete topology. Show that X is not a Lindelöf space. **[4]**

b) Let X be a T_2-space. Prove that every sequence in X converges to atmost one point in X. **[4]**

c) Define Locally compact space. **[2]**

Q6) a) Prove that every completely regular space is a regular space. **[4]**

b) If the sets C and D form a separation of a topological space X and Y is a connected subspace of X, then show that Y lies completely inside C or completely inside D. **[4]**

c) Describe components of a discrete topological space. **[2]**

Q7) a) Prove that a compact subspace of a Hausdorff space is closed. **[5]**

b) Prove that every path connected space is connected. **[5]**

Q8) a) Let X and Y be topological spaces and $f : X \rightarrow Y$ be a function. If f is continuous on X then prove that $f(\bar{A}) \subset \overline{f(A)}$, for every subset A of X. **[5]**

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

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[5542]-302

M. Sc.

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS MATHEMATICS

MIM : 302 - Design and Analysis of Algorithms

(2013 Pattern) (Semester - III)

Time : 3 Hours]   *[Max. Marks : 50*
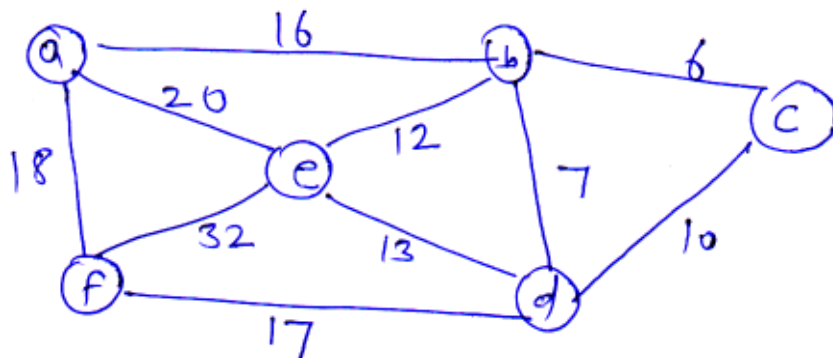
Instructions to the candidates:
   1)   Attempt any five questions.
   2)   Figures to the right indicate full marks.

Q1) a)   Explain divide-and-conquer approach.   **[5]**

   b)   Rank following functions in their increasing order of growth rates.

   Logn, 4n, 32n^3, 3n^2, e^n, nlogn.   **[5]**

Q2) a)   Using Prim's algorithm find minimum spanning tree for following graph.
                                                                                        [5]

   b)   Apply merge sort to sort following   **[5]**
        Set {30, 192, 41, 38, 30, 58, 90, 6, 42}

Q3) a)   Explain activity selection problem.   **[5]**
   b)   Explain "NP completeness".   **[3]**
   c)   State Master's theorem.   **[2]**

Q4) a) Illustrate the operation of COUNT-SORT on the array (3, 1, 2, 4, 2, 3, 1, 3, 5) . **[5]**

b) Obtain set of optimal Huffman codes for following set of frequencies **[3]**
a : 1, b : 1, c : 2, d : 3, e : 5, f : 8.

c) Show that $3n^2 + 4 = O(n^2)$. **[2]**

Q5) a) Determine longest common subsequences for
X = (A, B, A, C, B, D, D) and
Y = (B, A, A, C, B, D, A) **[5]**

b) Illustrate the operation of RADIX_SORT on
A = (425, 412, 331, 387, 218, 125, 811) **[3]**

c) State "Principle of optimality". **[2]**

Q6) a) Apply Floyd-Warshal's algorithm to find shortest path between every pair of vertices for following graph. **[5]**
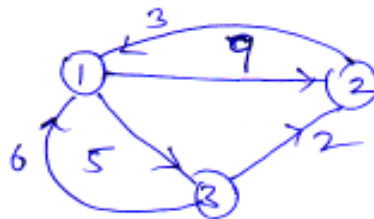
b) Give time complexity of quicksort in worst case and average case. **[2]**

c) What is Max. heap? Is the sequence (15, 6, 2, 1, 3, 4, 8) max_heap? **[3]**

Q7) a) What is topological sort? Give an algorithm for topological sort. **[5]**

b) Write note on greedy strategy. **[3]**

c) Define big O notation. **[2]**

Q8) a) Explain Depth first search algorithm. **[5]**

b) Use master method to solve the recurrence :

$$T(n) = 3T\left(\frac{n}{3}\right) + n$$ **[3]**

c) Write statement of Matrix chain multiplication problem. **[2]**

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[5542]-303

M. Sc. (Semester - III)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATION

MIM : 303 - Object Oriented Software Engineering

(2013 Pattern)

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

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

Q1) Attempt all of the following :   **[10]**

    a)   Explain the Goal and Various approaches of a Test Case Design process. **[4]**

    b)   Explain the factors in Distributed object architecture.   **[4]**

    c)   List any two advantages of Incremental approach to software development.   **[2]**

Q2) Attempt all of the following :   **[10]**

    a)   Explain varification and validation Model.   **[4]**

    b)   Draw a class diagram for college admission system which involves management, college, student, courses and subjects. Make assumption for above specification as needed.   **[4]**

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

Q3) Attempt all of the following :   **[10]**

    a)   Define Agile Method. Explain various principles of Agile Method.   **[4]**

    b)   Write a short note on socio Technical system.   **[4]**

    c)   What is Unit Testing.   **[2]**

Q4) Attempt all of the following :   [10]

    a)   Define software process. What are the key challenges facing by software engineering.   **[4]**

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

    c)   What are VI design principle.   **[2]**

Q5) Attempt all of the following :   [10]

    a)   What is DFD? Explain various notations used in DFD.   **[4]**

    b)   Write a short note on "Extreme Programming".   **[4]**

    c)   Define software. Write attribute of good software.   **[2]**

Q6) Attempt all of the following :   [10]

    a)   Explain various tools included in RAD (Rapid Application Development)   **[4]**

    b)   What are functional and non functional requirement.   **[4]**

    c)   What are critical systems.   **[2]**

Q7) Attempt all of the following :   [10]

    a)   Define system dependability. Explain various Dimension of system dependability.   **[5]**

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

Q8) Attempt all of the following :   [10]

    a)   Explain the importance of feasibility study in requirement engineering process.   **[5]**

    b)   Draw a state Transition Diagram for a simple Microwave oven which includes the sequence of action like

        i)   Select the power Level (rithem half or fill)

        ii)   Input the cooking time

        iii)   Press start and the food is cooked for the given time.   **[5]**

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[5542]-304

M. Sc. (Semester - III)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 304 : Operating Systems

(2013 Pattern)

Time : 3 Hours] *[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 different services provided by an operating system. **[4]**

b) Explain the structure and importance of Process Control Block. **[4]**

c) Define the terms : Over lays and page faults. **[2]**

Q2) Attempt the following :

a) Explain the concept of internal and external fragmentation with diagram.**[4]**

b) What is dead lock? Explain the necessary conditions for deadlock. **[4]**

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

Q3) Attempt the following :

a) Write a note on dinning-philosopher problem. **[4]**

b) Explain the concept of belady's anomaly with example. **[4]**

c) Define virtual memory. **[2]**

Q4) Attempt the following :

a) Write a note on bounded buffer problem using semaphore. **[4]**

b) Explain various file operations in detail. **[4]**

c) Explain race condition with example. **[2]**

Q5) Attempt the following :

a) What is system call? Explain use of any two system call. **[4]**

b) Write the difference between user level thread and kernel level thread.**[4]**

c) Explain the working of SCAN algorithm. **[2]**

Q6) Attempt the following :

a) Write a short note on : Semaphore **[4]**

b) What is a scheduler? What are different types of schedulers? Describe in brief. **[4]**

c) "RR algorithm is non-preemptive" state true/false. Justify. **[2]**

Q7) Attempt the following :

a) Consider the following reference string **[5]**

4, 3, 2, 1, 4, 3, 5, 4, 3, 2, 1, 5

How many page faults occurs for the following algorithms with 3 page frames.

i) FIFO

ii) LRV

b) Explain difference between paging and segmentation. **[5]**

Q8) Attempt the following :

a) Consider the system with 5 processes $P = \{P_0, P_1, P_2, P_3, P_4\}$ and four resources types {A, B, C, D}. There are 3 instances of type A, 14 instances of type B, 12 instances of type C and 12 instances of type D. The allocation and max demand matrix are as follows :

	Allocation					Max			
	A	B	C	D		A	B	C	D
P_0	0	6	3	2	P_0	0	6	5	2
P_1	0	0	1	2	P_1	0	0	1	2
P_2	1	0	0	0	P_2	1	7	5	0
P_3	1	3	5	4	P_3	2	3	5	6
P_4	0	0	1	4	P_4	0	6	5	6

Answer the following questions using bankers algorithm.

i) Is the system in a safe state?

ii) If a request from process P_4 arrives for (0, 0, 4, 1) can the request be immediately granted? **[5]**

b) What are the advantages and disadvantages of tree structured Directory. **[5]**

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[5542]-305

M.Sc. (IMCA)

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 the different types of database system users. **[4]**

b) Differentiate between fixed length and variable length records with example. **[4]**

c) Define data model. List the various types of data models. **[2]**

Q2) Attempt the following :

a) Consider the following database

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

department (<u>deptno</u>, deptname)

employee and department are related with many-to-one relationship.

Create a relational database in 3NF and give expression in SQL query for

i) List the details of employees in the descending order of their salary.

ii) Find the name of the department with highest number of employees. **[4]**

b) Consider the database from Q.2 a) and give expression in relational algebra for

i) List the names of employees having salary between 60,000 and 80,000.

ii) Find the salary and city of manager of 'Sales' department. **[4]**

c) Define Data Independence and state its types. **[2]**

Q3) Attempt the following :

    a)   Explain and differentiate between the terms primary key, candidate key and superkey with example. **[4]**

    b)   Explain the various types of attributes with respect to E-R model. **[4]**

    c)   What is an identifying relationship? Give an example. **[2]**

Q4) Attempt the following :

    a)   Explain with an example "Tabular representation of multivalued attributes". **[4]**

    b)   Give the various notations used to draw an E-R diagram. **[4]**

    c)   What is a Referential integrity constraint? Give an example. **[2]**

Q5) Attempt the following :

    a)   Explain the following Relational Algebra Operations with example. **[4]**

        i)   The Union Operation

        ii)   The set difference operation

    b)   Define normalization. Explain 1NF with example. **[4]**

   c)   What do you mean by compatible relations? **[2]**

Q6) Attempt the following :

    a)   Compare the deferred and immediate modification versions of the log based recovery scheme with an example. **[4]**

    b)   Write a short note on : **[4]**

        i)   Main memory

        ii)   Magnetic disk storage

    c)   What is meant by a shared lock and an exclusive lock? **[2]**

Q7) Answer the following :

    a)   Consider the relation schema R = (A, B, C, G, H, I) and the set of functional dependencies defined on R as

$$F = \{A \rightarrow B, A \rightarrow G, B \rightarrow C, B \rightarrow G, C \rightarrow G, GH \rightarrow I\}$$

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

b) Convert the following E-R model to corresponding relational model.**[5]**
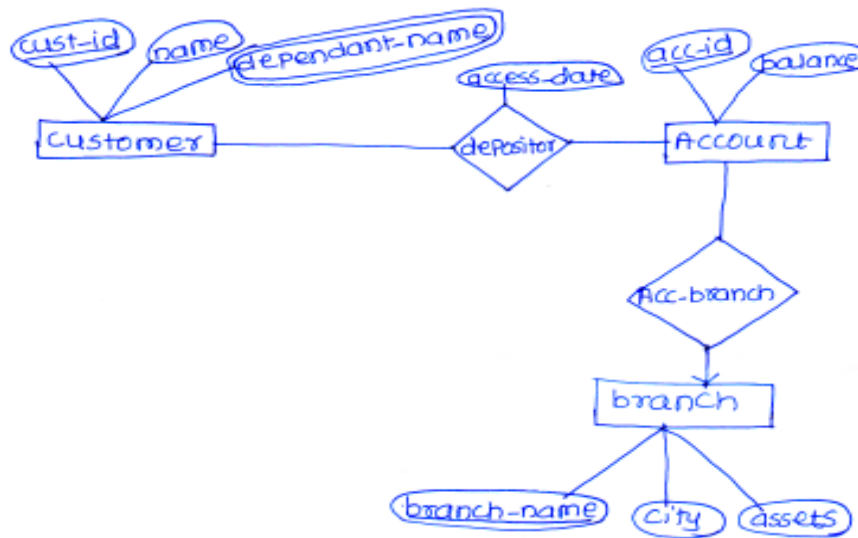
Q8) Attempt the following :

a) Consider the following concurrent schedule. **[5]**

T1	T2
read (A)	
A : = A–100	
Write (A)	
	read (A)
	temp : = A*0.1
	A : = A – temp
	Write (A)
read (B)	
B : = B + 100	
Write (B)	
	read (B)
	B : = B + temp
	Write (B)

Is this schedule serializable to a serial schedule <T1, T2>? Justify your answer.

b) Explain recoverable and non-recoverable schedule with example. **[5]**

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[5542]-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.***

Q1) a)   If $y_1(x)$ and $y_2(x)$ are linearly independent solutions of $y'' + P(x)y' + Q(x)y = 0$, then the zeros of $y_1(x)$ and $y_2(x)$ are distinct and occur alternately. **[4]**

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

c)   Solve : $y'' + 5y' + 6y = 0$. **[2]**

Q2) a)   Let $u(x)$ be any nontrivial solution of $u'' + q(x)u = 0$, where $q(x) > 0$ for all $x > 0$. If $\int\limits_{1}^{\infty} q(x)dx = \infty$, then $u(x)$ has infinitely many zeros on the positive x-axis. **[4]**

b)   Find the particular solution of the $y'' - 2y' + y = 6e^x$ using the method of undetermined coefficients. **[4]**

c)   State the sturm comparison theorem. **[2]**

Q3) a) Find the power series solution of $(1+x)y' = py$, where p-is constant.

[4]

b) Find a particular solution of $y'' + y = \sin x$. Using the method of variation of Parameters. [4]

c) State the Gauss's hypergeometric equation. [2]

Q4) a) Find the indicial equation of $2x^2y'' + x(2x+1)y' - y = 0$. [4]

b) If the homogeneous system

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

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

has two solutions (x_1, y_1) and (x_2, y_2) on [a, b] then $(c_1x_1 + c_2x_2,\ c_1y_1 + c_2y_2)$ is also solution on [a, b]. [4]

c) Verify that (e^{3t}, e^{3t}) and $(e^{2t}, 2e^{2t})$ is

solution of
$$\frac{dx}{dt} = 4x - y$$

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

[2]

Q5) a) If w(t) of the solutions (x_1, y_1) and (x_2, y_2) of

the system
$$\frac{dx}{dt} = a_1(t)x + b_1(t)y$$

$$\frac{dy}{dt} = a_2(t)x + b_2(t)y,\ \text{then}$$

w(t) is either identically zero or now here zero on [a, b]. [4]

b) Show that (0, 0) is critical point of

the system
$$\frac{dx}{dt} = -y$$

$$\frac{dy}{dt} = x$$

[4]

c) Is $x = 0$ as an irregular singular point of the equation
$x^2 y'' + (3x - 1) y' + y = 0$? Justity. [2]

Q6) a) Describe the phase potrait of the
system $\dfrac{dx}{dt} = x$

$\dfrac{dy}{dt} = -x + 2y$ [4]

b) Find the exact solution of the initial value problem $y' = y^2; y(0) = 1$.
Starting with $y_0(x) = 1$ using Picard's method. [4]

c) State the Picard's theorem. [2]

Q7) a) Let $f(x, y)$ be a continuous function such that
$|f(x, y_1) - f(x, y_2)| \le k |y_1, -y_2|$ on a strip $a \le x \le b \,\&\, -\infty < y < \infty$. If
(x_0, y_0) is any point of the strip, then the initial value problem $y' = f(x, y)$;
$y(x_0) = y_0$ has one and only one solution $y = y(x)$ on $a \le x \le b$. [5]

b) Explain the method of variation of parameters to solve the equation
$y'' + P(x)y' + Q(x)y = R(x)$. [5]

Q8) a) Find the power series solution of the equation $y'' + y = 0$. [5]

b) If there exists a Liapunov function $E(x, y)$

for the system $\dfrac{dx}{dt} = a_1 x + b_1 y$

$\dfrac{dy}{dt} = a_2 x + b_2 y$,

Then prove that the critical point (0, 0) is stable. [5]

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[5542]-402

M.Sc. (IMCA)

MATHEMATICS

MIM-402 Coding Theory

(2013 Pattern) (Semeseter - IV)

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

Instructions to the candidates:
1) *Attempt any five questions out of eight.*
2) *Figures to the right indicates full marks.*

Q1) a)   Let $\bar{x}, \bar{y}, \bar{z}$ be words of length over A.   **[4]**

      Prove that

      i) $0 \leq d(\bar{x}, \bar{y}) \leq n$

      ii) $d(\bar{x}, \bar{y}) = 0$ if and only if $\bar{x} = \bar{y}$

      iii) $d(\bar{x}, \bar{y}) = d(\bar{y}, \bar{x})$

      iv) $d(\bar{x}, \bar{y}) \leq d(\bar{x}, \bar{z}) + d(\bar{z}, \bar{y})$

   b)   Write a short note on Maximum Likelyhood decoding rule.   **[4]**

   c)   Define μ-error detecting code.   **[2]**

Q2) a)   Let α be a root of $2 + x + x^2 \in F_3[x]$. find the minimal polynomial of α^2 with respect to F_3.   **[4]**

   b)   Show that the code $C = \{0000, 0101, 1010, 1111\}$ in F_2^4 is self dual.   **[4]**

   c)   Give an example of an irreducible polynomial in $F_3[x]$.   **[2]**

Q3) a) Assign message to the words in F_2^3 as follows :

   A = 000 D = 010 G = 110 N = 011
   C = 100 E = 001 I = 101 O = 111

   Let C be the linear code with generator matrix $G = \begin{pmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 \end{pmatrix}$

   Using G, encode the message "AND". **[4]**

  b) Let C be a linear code over the find field. Fq. Prove that d(C)=wt(C).**[4]**

  c) Define generator polynomial of a cyclic code C. **[2]**

Q4) a) Let $q \geq 2$ be a prime power. Then prove that $B_q(n,d) \leq A_q(n,d) \leq q^n$ for all $1 \leq d \leq n$. **[4]**

  b) Find a generator matrix and a parity check matrix for the binary linear code $C = \langle S \rangle$, wherer $S = \{11101, 10110, 01011, 11010\}$. **[4]**

  c) State sphere packing bound. **[2]**

Q5) a) Let $g(x)$ be the generator polynomial of an ideal of $F_q[x]/{<x^n - 1>}$.

   Then prove that corresponding cyclic code has dimension K if the degree of $g(x)$ is n-K. **[4]**

  b) Find the dimension of a narrow sense binary BCH code of length 63 and designed distance 5. Is the lower bound attained? **[4]**

  c) Define quadratic -residue codes. **[2]**

Q6) a) Let C and D be linear codes over F_q of the same length. Show that $C \cap D$ is a linear code over Fq. Is $C \cup D$ a linear code over F_q? **[4]**

  b) Consider the Ham (3, 2) code with parity check matrix **[4]**

$$H = \begin{pmatrix} 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 & 0 & 1 \end{pmatrix}$$

   construct syndrome lookup table and decode $\overline{w} = 1001001$.

c) Is $S = \{000, 100, 010, 001\}$ a cyclic code over F_2? Justify. **[2]**

Q7) a) Write decoding algorithm for cyclic codes. **[5]**

b) Show that $A_2(5,4) = 2$. **[5]**

Q8) a) Prove that the dual of a cyclic code is cyclic. **[5]**

b) Find the generator matrix and parity check matrix for the 7-days narrow sense reed-soloman code of length 6, designed distance $\delta = 4$ and with generator polynomial $g(x) = (x-3)(x-3^2)(x-3^3)$. **[5]**

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[5542]-403

M.Sc. (IMCA) (Semester - IV)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

Computer Networks

(2013 Pattern)

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 indicates full marks.*

Q1) Attempt each of the following.

  a)   Explain any two Layers of OSI reference model.   **[4]**

  b)   Write advantages and disadvantages of Firewall-Packet filters.   **[4]**

  c)   State optimality principle for Routing algorithm.   **[2]**

Q2) Attempt each of the following.

  a)   Explain polling and reservation methods for multiple channel access. **[4]**

  b)   Differentiate between TCP and UDP.   **[4]**

  c)   Calculate the Hamming distance of following coding scheme.   **[2]**

       00000, 01011, 10101, 11110

Q3) Attempt each of the following.

  a)   Write a note on stop-and-wait data link protocol.   **[4]**

  b)   Explain any two types of Virtual Private Network (VPN) protocols. **[4]**

  c)   What is flow control?   **[2]**

Q4) Attempt each of the following.

    a)   Explain ethernet frame structure.   **[4]**

    b)   Explain shortest path routing algorithm.   **[4]**

    c)   What is piggybacking method?   **[2]**

Q5) Attempt each of the following.

    a)   Write a note on ARP.   **[4]**

    b)   Explain the follwoing Analog-to-Digital methods in physical layer.   **[4]**

        i)   PCM (Pulse Code Modulation)

        ii)   DM (Delta Modulation)

    c)   Write any two features of Transport Layer.   **[2]**

Q6) Attempt each of the following.

    a)   Differentiate between parallel transmission and serial transmission.   **[4]**

    b)   Explain the manchester and differential manchester methods of Line coding scheme.   **[4]**

    c)   Define -   **[2]**

        i)   Network Security

        ii)   Internet Security

Q7) Attempt each of the following.

    a)   Discuss different Network Layer issues.   **[5]**

    b)   Write limitations of firewall.   **[5]**

Q8) Attempt each of the following.

    a)   Write a note on Steganography.   **[5]**

    b)   Differentiate between Pure ALOHA and Slotted ALOHA.   **[5]**

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[5542]-404

M.Sc. (IMCA) (Semester - IV)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 404 : Programming in PHP

(2013 Pattern)

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

Instructions to the candidates :

    1)   Attempt any five questions out of 8.

    2)   Figures to the right indicate full marks.

Q1) Attempt the following.

    a)   Explain different data types supported by PHP.   **[4]**

    b)   State any four features of PHP.   **[4]**

    c)   How to define multiline strings in PHP? Explain with example.   **[2]**

Q2) Attempt the following.

    a)   State variable scope in PHP with suitable examples.   **[4]**

    b)   Explain various string decomposition functions provided by PHP with suitable examples.   **[4]**

    c)   Is comparision of String "3" and integer 3 works in PHP? Explain.   **[2]**

Q3) Attempt the following.

    a)   Write note on any four sorting functions in array.   **[4]**

    b)   Explain different properties of object oriented concept supported by PHP.   **[4]**

    c)   Distinguish between array-slice () and array-splice () function supported by PHP.   **[2]**

Q4) Attempt the following.

    a)   Explain reading and writing file with suitable example. Also explain various modes of file handling.   **[4]**

    b)   Write a short note on XML parsers.   **[4]**

    c)   State any two features of XML.   **[2]**

Q5) Attempt the following.

    a)   Write any four advantages of XML over HTML.   **[4]**

    b)   Write a short note on : Regular expression.   **[4]**

    c)   How to declare class in PHP? Explain with syntax.   **[2]**

Q6) Attempt the following.

    a)   What is an array? Explain types of array with examples.   **[4]**

    b)   Explain functions with syntax and examples for converting between arrays and variables, supported by PHP.   **[4]**

    c)   What is natural order sorting? Explain function supported by PHP for natural order sorting with syntax and example.   **[2]**

Q7) Attempt the following.

    a)   What is session? Explain various functions supported by PHP to handle session.   **[5]**

    b)   Differentiate between GET and POST methods.   **[5]**

Q8) Attempt the following.

    a)   Write a PHP script to accept 2 strings and count the occurances of first string in second string.   **[5]**

    b)   Write a PHP script to accept the directory name and print the files with their sizes in tabular format.   **[5]**

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[5542]-405

M.Sc. (Semester - IV)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 405 : Java Programming

(2013 Pattern)

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

Instructions to the candidates :

    1)   *Attempt any <u>five</u> questions out of eight.*

    2)   *Figures to the right indicate full marks.*

Q1) a)   What is a static method and static member in java? Whats its use? Explain.
    [4]

    b)   Write a note on JDBC driver types.   **[4]**

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

Q2) a)   Explain the concept of abstract class and interfaces in java. Illustrate with an example.   **[4]**

    b)   Explain the JDBC connection set-up phase.   **[4]**

    c)   Explain the role of commands: javac and java.   **[2]**

Q3) a)   Write a program to encrypt a file using an integer. Store the result in another file. Both are passed as command line arguments.   **[4]**

    b)   With an example show how a user defined exception can be created. **[4]**

    c)   String objects are immutable. Comment.   **[2]**

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

   b) Write a program to create a frame with a button and a text box. When the button is clicked, display message "Hello" in the text box. **[4]**

   c) State the use of keyword super. **[2]**

Q5) a) Write a note on byte and character streams in java. **[4]**

   b) Write a program to store names of n cities in a suitable collection such that no duplicate elements are allowed. Traverse this collection using an iterator. **[4]**

   c) An abstract class cannot be instantiated. State True or false and justify. **[2]**

Q6) a) What is Layout Manager? Explain any one in detail. **[4]**

   b) Write a program to create a package MyPack with class Number Operations with methods is Negative and is Prime. Use this package to perform the two operations on an object. **[4]**

   c) State the use of final keyword. **[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) Explain the event delegation model in java. **[5]**

Q8) a) Write a program to create the following class hierarchy : Item (id, name, price)-> Food Item (expiry Date). Accept details of 'n' Food Items and display the having the nearest expiry date. **[5]**

   b) Accept n integers from the command line and store them in an array. Display the array elements in the reverse order and also find the largest number. **[5]**

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[5542]-501

M.Sc. (IMCA) (Semester - V)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 501 : Digital Image Processing

(2013 Pattern)

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)   Use of scientific non-programmable calculator is allowed.

Q1) Attempt the following.

    a)   Explain the role of image processing in industry application.   **[4]**

    b)   Write the basic principle of detecting the points with suitable example.**[4]**

    c)   Define the terms :   **[2]**

        i)   Perimeter of a region

        ii)   Diameter of a boundary

Q2) Attempt the following.

    a)   Write a short note on spatial filtering.   **[4]**

    b)   Explain in brief a model of image restoration process.   **[4]**

    c)   Let $V = \{2, 3, 4\}$. Compute the length of the shortest 8-path between the pixels 'P' and 'q'.   **[2]**

$$
I = \begin{array}{ccccc}
3 & 4 & 1 & 2 & 0 \\
0 & 1 & 0 & 4 & 2 = q \\
2 & 2 & 3 & 1 & 4 \\
P = 3 & 0 & 4 & 2 & 1 \\
1 & 2 & 0 & 3 & 4 \\
\end{array}
$$

P.T.O.

Q3) Attempt the following.

    a) Show that the erosion and dilation are duals of each other. **[4]**

    b) How to filter an image in the frequency domain? Give its flow chart. **[4]**

    c) Explain in short image negative. **[2]**

Q4) Attempt the following.

    a) Discuss in brief auto correlation function with the help of suitable example. **[4]**

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

       i) Alising

       ii) Shifting property

    c) Check whether the following image subsets S_1 & S_2 are 8-adjacent where $V = \{1\}$. **[2]**

	S_1				S_2		
0	0	0	0	0	0	1	1
0	0	1	0	0	1	0	0
0	0	1	0	1	1	0	0
0	1	1	1	0	0	0	0

Q5) Attempt the following.

    a) Explain with suitable diagram an image aquisition using sensor strip. **[4]**

    b) Consider a 3-bit image I (L = 8) of size 64×64 pixels. The intensity distribution shown as below. Draw histogram equalization transformation and give $P_s(S_k)$ for each S_k. **[4]**

r_k	n_k
$r_0 = 0$	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

    c) Explain the basic principle of detecting the edges in the image. **[2]**

[5542]-501   2

Q6) Attempt the following.

 a) Write a short note on unsharp masking and high boost filtering. **[4]**

 b) Give the comparison of convolution and coorelation of image. **[4]**

 c) Obtain first and second derivative of the following 1-D image. **[2]**

  0 0 0 0 0 0 1 2 3 4 5 6 6 6 6 6 6 1 1 1 1 1

Q7) Attempt the following.

 a) Write a note on components of general purpose image processing system.
                                   [5]

 b) Discuss the image sharpening in the frequency domain. **[5]**

Q8) Attempt the following.

 a) Write a note on order statistics filters. **[5]**

 b) Explain the morphological operation opening with suitable example. **[5]**

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[5542]-501   **3**

[5542] - 502

M.Sc. (Industrial Mathematics with Computers 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 is CLR? Explain the functionality of CLR in detail?   **[4]**

    b)   Write note on Assembly and its components   **[4]**

    c)   What is Nullable Datatype?   **[2]**

Q2) Attempt the following :

    a)   Define delegate. Explain its types and functionality.   **[4]**

    b)   Explain ASP.Net page life cycle in detail.   **[4]**

    c)   What are sealed classes?   **[2]**

Q3) Attempt the following :

    a)   Explain structures and enumerators in c #.   **[4]**

    b)   Explain openfile dialogbox with an example.   **[4]**

    c)   What are Indexers?   **[2]**

Q4) Attempt the following :

    a)   What is state management? Explain any three techniques with example.**[4]**

    b)   What is ASP.Net MVC Model? Explain with diagram.   **[4]**

    c)   Differentiate between web.config and machine. config file.   **[2]**

Q5) Attempt the following :

    a)   Explain any four collection classes in C# with example. **[4]**

    b)   What is validation? Explain regular expression validator and required field validator controls with example. **[4]**

    c)   What is managed and unmanaged code in .Net? **[2]**

Q6) Attempt the following:

    a)   What is deployment? Enlist the steps to deploy a.Net application. **[4]**

    b)   What is masterpage? Enlist the ways to apply masterpage to Asp. Net page. **[4]**

    c)   What is page directive? **[2]**

Q7) Attempt the following:

    a)   Write a program in C# to throw and handle the following exception.

        Temp Is Zero Exception: Temperature should be zero.

        Temp Raise Exception: If temperature raises to 100. **[5]**

    b)   Create a custom control "Palindrome" in.Net. **[5]**

Q8) Attempt the following :

    a)   Write a program is C# to read a file using stream Reader Class. **[5]**

    b)   What is ADO.Net? Explain the implementation of select and update commands using connected architecture. **[5]**

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[5542] - 503

M.Sc. (IMCA) (Semester - V)

Industrial Mathematics With Computer Applications

MIM : 503 UNIX

(2013 Pattern)

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) Write a note on u-area?   **[4]**

b) What are the operation kernel doses for fork?   **[4]**

c) Explain use of ISeek.   **[2]**

Q2) a) Write a note on structure of buffer pool.   **[4]**

b) Write and explain algorithm for process termination.   **[4]**

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

Q3) a) Write a note on paging in unix   **[4]**

b) Write a Note on Race Condition.   **[4]**

c) Explain need of Buffer.   **[2]**

Q4) a) Explain Mount system call.   **[4]**

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

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

Q5) a) Write and explain exit system call?   **[4]**

b) Explain different services of UNIX operating system   **[4]**

c) Explain the content of system level Context.   **[2]**

Q6) a) Draw and explain block diagram of Unix system kernel. **[4]**

b) Write and explain getbik ( ) system call. **[4]**

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

Q7) a) Write a note on signal. **[5]**

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

Q8) a) Draw and Explain nine state process state transition diagram. **[5]**

b) Explain high - level architecture of UNIX system **[5]**

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