

Total No. of Questions : 8]
P3265

SEAT No. :
[Total No. of Pages : 3

[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]**

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

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 0 and numbers $\frac{1}{n}$ for $n=1,2,3,\dots$. prove that K is closed in $\mathbb{R}$. [2]

Q3) a) Prove that the convergence of $\sum a_n$ implies the convergence of $\sum \frac{\sqrt{a_n}}{n}$ 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 $z(f) = \{p \in X \mid f(p) = 0\}$ prove that $z(f)$ is closed in X . [2]

Q4) a) Investigate the convergence or divergence of $\sum a_n$ if $a_n = \frac{\sqrt{n+1} - \sqrt{n}}{n}$. [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 $M = \sup_{p \in X} f(p)$, $m = \inf_{p \in X} f(p)$. Then show that there exist points $p, q \in X$ such that $f(p) = M$ and $f(q) = m$. [4]

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

c) Define $f(x) = \begin{cases} \sin\left(\frac{1}{x}\right) & (x \neq 0) \\ 0 & (x = 0) \end{cases}$ 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 $\bigcup_\alpha G_\alpha$ 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 $\epsilon > 0$ there exists a partition P such that $U(p, f, \alpha) - L(p, f, \alpha) < \epsilon$. [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 $f_n(x) = \frac{x^2}{(1+x^2)^n}$ where x is real and $n = 0, 1, 2, \dots$. [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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SEAT No. :
[Total No. of Pages : 3

[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 $\mathbb{R}^3$ over $\mathbb{R}$ with respect to usual addition and scalar multiplication in $\mathbb{R}^3$ [2]
- b) Find t for which $u = (\cos t, \sin t), v = (\sin t, \cos t)$ form a linearly independent set in $\mathbb{R}^2$. [4]
- c) Find coordinate vector of $(1, 0, 0)$ with respect to basis $B = \{(1, 2, 1), (2, 1, 0), (1, -1, 2)\}$ of $\mathbb{R}^3$ [4]
- Q2)** a) Determine whether the transformation $T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$ 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 $\text{Ker}(T) = \{\bar{0}\}$. [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 $\frac{(x-2)^2}{4} + \frac{y^2}{1} = 1$. [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 $-\beta$ so that the line coincides with the 'z' axis. [4]

- Q7)** a) State and prove Rank - Nullity Theorem. [5]
- b) Let $T: \mathbb{R}^3 \rightarrow \mathbb{R}^2$ 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 $\mathbb{R}^3$ and $\mathbb{R}^2$ 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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SEAT No. :

[Total No. of Pages : 3

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

Time : 3 Hours]

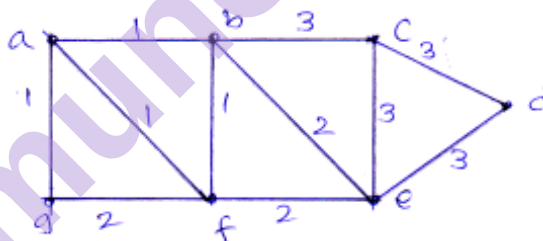
[Max. Marks : 50

Instructions to the candidates :

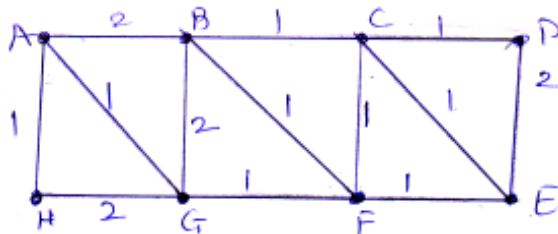
- 1) *Attempt any five questions out of eight.*
- 2) *Figures to the right indicate full marks.*

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]**

P.T.O.

- 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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SEAT No. :

P3268

[Total No. of Pages : 3

[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);  
}
```

P.T.O.

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]



Total No. of Questions : 8]

SEAT No. :

P3270

[Total No. of Pages : 3

[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 $R = \lim_{n \rightarrow \infty} \left| \frac{a_n}{a_{n+1}} \right|$ if this limit exists. **[4]**

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

c) Find all values $\text{Log}(2 + 7i)$. **[2]**

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

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

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

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

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

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

P.T.O.

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 $\lim_{z \rightarrow a} (z - a) f(z) = 0$. [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 functions. [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 $f(z) = \frac{1}{z(z-1)(z-2)}$ 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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SEAT No. :

P3271

[Total No. of Pages : 3

[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 $T_{a,b} : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ by $(x,y) \rightarrow (x+a, y+b)$.
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 $G = \langle a \rangle$ be a cyclic group of order n . Then prove that $G = \langle a^k \rangle$ 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]**

P.T.O.

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 $R = \left\{ \begin{bmatrix} a & b \\ b & a \end{bmatrix} \mid a, b \in \mathbb{Z} \right\}$ and $\phi: R \rightarrow \mathbb{Z}$ be defined by

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

Is $\ker \phi$ a prime ideal? Justify.

Is $\ker \phi$ a maximal ideal? Justify. [4]

c) Find quotient and remainder up on dividing

$$f(x) = 3x^4 + x^3 + 2x^2 + 1 \text{ by } g(x) = x^2 + 4x + 2 \text{ Where}$$

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

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 $\mathbb{Q}$. [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 $\langle p(x) \rangle$ 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

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

- 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 $\lim_{n \rightarrow \infty} P_n = P$, 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 -

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

- 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 $\{C_n\}_{n=0}^{\infty}$ represents the sequence of midpoints generated by the Bisection process, then prove that $|r - C_n| \leq \frac{b-a}{2^{n+1}}$ for $n = 0, 1, \dots$. Also prove that $\lim_{n \rightarrow \infty} C_n = r$. [4]

P.T.O.

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

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

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

- 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 $\lim_{n \rightarrow \infty} \frac{p - p_{n+1}}{p - p_n} = A$, then prove that the sequence $\{q_n\}_{n=0}^{\infty}$ defined

$$\text{by } q_n = p_n - \frac{(p_{n+1} - p_n)^2}{p_{n+2} - 2p_{n+1} + p_n} \text{ converges to } P. \quad [4]$$

- b) Compute $\int_0^1 [1 + e^{-x} \sin(4x)] dx$ using Boole's rule. ($h = 1/4$) [4]

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

$$\begin{aligned} 4x_1 - x_2 + 2x_3 + 3x_4 &= 20 \\ 7x_3 - 4x_4 &= -7 \\ 6x_3 + 5x_4 &= 4 \\ 3x_4 &= 6 \end{aligned} \quad [2]$$

- 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 $\bar{x} = 3.14$. [2]

- Q7) a)** Using the Runge – Kutta method, compute the numerical solution to the system of differential equations $\begin{cases} \frac{dx}{dt} = x + 2y \\ \frac{dy}{dt} = 3x + 2y \end{cases}$ with $\begin{cases} x(0) = 6 \\ y(0) = 4 \end{cases}$ over the

interval $[0, 0.2]$ using 10 subintervals and the step size $h = 0.02$. [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

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

- 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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Total No. of Questions : 8]

SEAT No. :

P3273

[Total No. of Pages : 3

[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]

P.T.O.

Q4) Attempt the Following

- a) How operator function is invoked if defined as [4]
 - i) member function
 - ii) friend functionAssuming 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 [5]

```
class String 1
{
    int length;
    char x ptr;
public: // member function definition
};
```

Write the following functions:
 - i] Overload! operator to change the case of String 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]



[5542]-205
M.Sc. (Semester - II)
INDUSTRIAL MATHEMATICS WITH COMPUTER
APPLICATION
MIM - 205 : Data Structures Using 'C'
(2013 Pattern)

Time : 3 Hours]

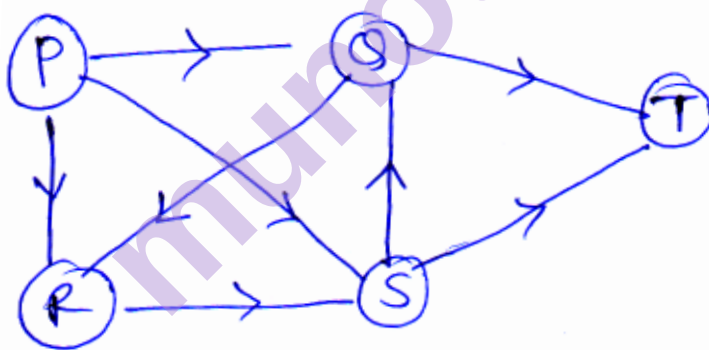
[Max. Marks : 50

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 scheduling 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) $O(\log n)$ |
| ii) Merge Sort | b) $O(n^2)$ |
| iii) Linear Search | c) $O(n \log n)$ |
| 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]



Total No. of Questions : 8]

SEAT No. :

P3275

[Total No. of Pages : 2

[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 $x \in c \subseteq U$. 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 $(Y, \mathcal{U})$. Let $\tau = \{f^{-1}(G) \mid G \in \mathcal{U}\}$. 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]

P.T.O.

- 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 at most 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 $f(\overline{A}) \subset \overline{f(A)}$, for every subset A of X . [5]
 b) Prove that product of regular spaces is regular. [5]



Total No. of Questions : 8]

SEAT No. :

P3276

[Total No. of Pages : 2

[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:

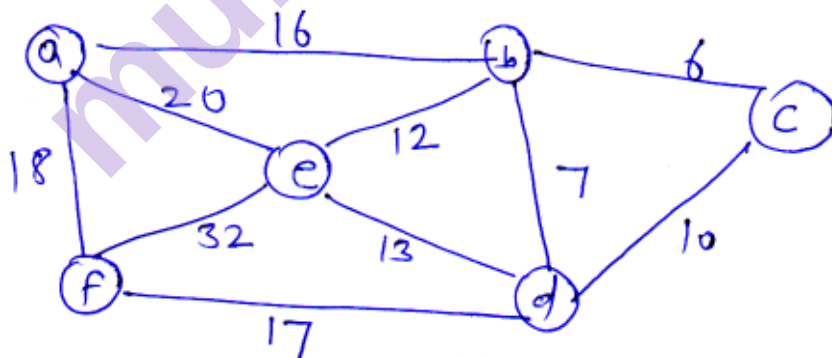
- 1) Attempt any five questions.
- 2) Figures to the right indicate full marks.

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

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

$\text{Log}n$, $4n$, $32n^3$, $3n^2$, e^n , $n\text{log}n$. [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]

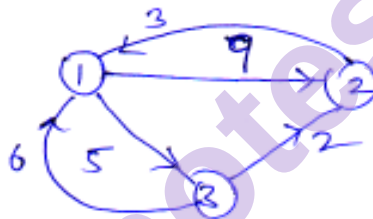
c) State Master's theorem. [2]

P.T.O.

- 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]



Total No. of Questions : 8]

SEAT No. :

P3277

[Total No. of Pages : 2

[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 verification 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]

P.T.O.

- 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]**



Total No. of Questions : 8]

SEAT No. :

P3278

[Total No. of Pages : 3

[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]

P.T.O.

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.

- Is the system in a safe state?
 - 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]



Total No. of Questions : 8]

SEAT No. :

P3279

[Total No. of Pages : 3

[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 (empno, empname, salary, city, designation)
department (deptno, 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]

P.T.O.

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]

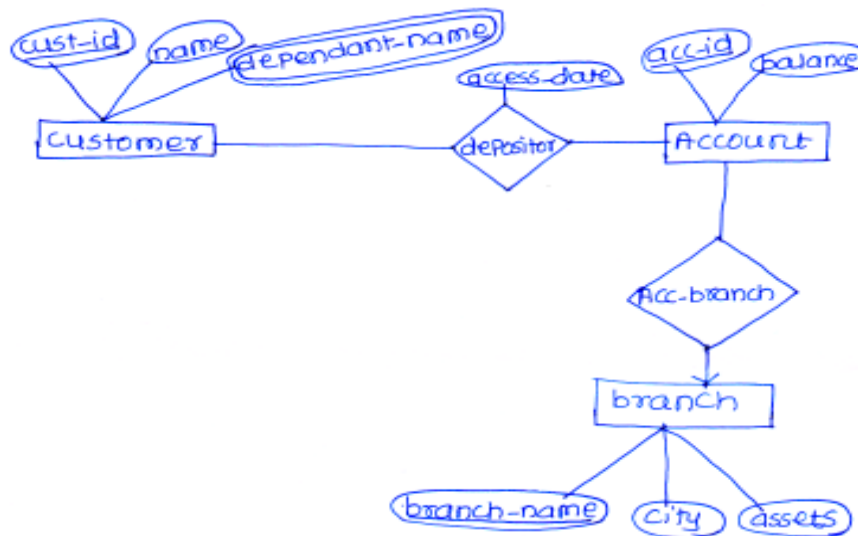
Q6) Attempt the following :

- 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)	read (A)
A := A-100	temp := A*0.1
Write (A)	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 $\langle T1, T2 \rangle$? Justify your answer.

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



Total No. of Questions : 8]

SEAT No. :

P3280

[Total No. of Pages : 3

[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 $x^2y'' + xy' - 4y = 0$, 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 $\int_1^{\infty} q(x)dx = \infty$, 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]

P.T.O.

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

Q6) a) Describe the phase portrait of the

system
$$\begin{aligned} \frac{dx}{dt} &= x \\ \frac{dy}{dt} &= -x + 2y \end{aligned}$$
 [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 $|f(x, y_1) - f(x, y_2)| \leq k|y_1 - y_2|$ on a strip $a \leq x \leq b$ & $-\infty < y < \infty$. 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 $a \leq x \leq b$. [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
$$\frac{dx}{dt} = a_1 x + b_1 y$$

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

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



[5542]-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 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 Likelihood 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 field F_q . Prove that $d(C) = \min_{C \neq \emptyset} \text{wt}(C)$. [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 $C = \langle S \rangle$, where $S = \{11101, 10110, 01011, 11010\}$. [4]

c) State sphere packing bound. [2]

Q5) a) Let $g(x)$ be the generator polynomial of an ideal of $F_q[x]/\langle x^n - 1 \rangle$. 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 F_q . 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 $\bar{w} = 1001001$.

- 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]



Total No. of Questions : 8]

SEAT No. :

P3282

[Total No. of Pages : 2

[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]

P.T.O.

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 following 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]

▽▽▽▽

Total No. of Questions : 8]

SEAT No. :

P3283

[Total No. of Pages : 2

[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 comparison 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]

P.T.O.

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 occurrences 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]

▽▽▽▽

Total No. of Questions : 8]

SEAT No. :

P3284

[Total No. of Pages : 2

[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 five 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]

P.T.O.

- 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]



Total No. of Questions : 8]

SEAT No. :

P3285

[Total No. of Pages : 3

[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]

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

P.T.O.

Q3) Attempt the following.

- Show that the erosion and dilation are duals of each other. [4]
- How to filter an image in the frequency domain? Give its flow chart. [4]
- Explain in short image negative. [2]

Q4) Attempt the following.

- Discuss in brief auto correlation function with the help of suitable example. [4]
- Explain the following : [4]
 - Aliasing
 - Shifting property
- 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.

- Explain with suitable diagram an image acquisition using sensor strip. [4]
- 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

- Explain the basic principle of detecting the edges in the image. [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 correlation 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]

▽▽▽▽

Total No. of Questions : 8]

SEAT No. :

P3286

[Total No. of Pages : 2

[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 OpenFileDialog 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]

P.T.O.

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 in 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]



Total No. of Questions : 8]

SEAT No. :

P3287

[Total No. of Pages : 2

[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]

P.T.O.

- 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]

