

3 Hours

Marks: 100

(N.B.: All questions are Compulsory)

SECTION I

1. Write note on **any Three** of the following: 18
 - a) Forms of Violations of Rights
 - b) Hybrid Disasters
 - c) Features of technology
 - d) Right to health
 - e) Stages in Team building

2. Attempt **any Two** of the following: 16
 - a) Explain the main provisions of the Persons with Disabilities Act 1995, to protect the rights of disabled.
 - b) Define Disaster Mitigation. Suggest various measures to be taken before, during and after Drought.
 - c) Discuss the meaning and characteristics of Science.

3. Attempt **any Two** of the following: 16
 - a) Name and explain the types of communication in detail.
 - b) Discuss the styles of leadership.
 - c) Write a note on obstacles to free and compulsory education to all.

SECTION II

4. Write note on **any Three** of the following: 18
 - a) Features of Right to Information Act
 - b) Global Positioning System (GPS)
 - c) Sustainability and polluter pays principle
 - d) Magregor's Theory X and Y

5. Attempt **any Two** of the following: 16
 - a) Explain in detail the Consumer Protection Act.
 - b) What is Public Interest Litigation (PIL)? Elaborate the need for PIL.
 - c) Define the term Ecology. Explain the different approaches towards ecological studies.

6. Attempt **any Two** of the following: 16
 - a) What are the global efforts in bringing down carbon emission? Explain.

Note : 1) All questions are compulsory.

2) From Q.2 to Q.7 subquestion (a) is compulsory . Attempt only one from subquestion (b) and (c).

Q.1 Attempt any **ONE** of the following. (10)

- a) State and Prove Nested Interval Theorem of \mathbb{R} (set of real number).
- b) Prove that necessary and sufficient condition for $Mdx + Ndy = 0$ to be exact is $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$.

Q.2

- a) Prove that intersection of any finite collection of open sets in \mathbb{R} (set of real number) is open. (8)
- b) Determine the Set $B = \left\{ x \in \mathbb{R} / \left(\frac{2x+1}{x+2} \right) < 1 \right\}$. (7)

OR

- c) State and prove Hausdroff Property of \mathbb{R} (set of real number). (7)

Q.3

- a) If $\langle x_n \rangle$ in \mathbb{R} (set of real number) is monotonically increasing and bounded above then prove that it is Convergent. (8)
- b) Show that $\langle x_n \rangle = \left(\frac{1}{n} \right)$ is a Cauchy sequence in \mathbb{R} (set of real number). (7)

OR

- c) If $f : [a , b] \rightarrow \mathbb{R}$ is continuous on $[a , b]$ then show that f is bounded on $[a , b]$. (7)

Q.4

- a) State the Ratio test of convergence of series , using it discuss the convergence of $\sum_{n=1}^{\infty} \frac{5^n}{2^n + 5}$. (8)

- b) Prove that the necessary and sufficient condition for a series $\sum a_n$ to be convergent is for any $\varepsilon > 0 \exists n_0 \in \mathbb{N}$ Such that $\left| \sum_{p=m+1}^n a_p \right| < \varepsilon \forall m > n \geq n_0$. (7)

OR

- c) Find the fourier series for periodic function $f(x) = x - \pi < x < \pi$. (7)

[TURN OVER

Q.5

- a) Solve the differential equations i) $\tan y dx + \tan x dy = 0$ ii) $(x^2 - y^2) dx + xy dy = 0$. (8)
- b) Solve $y'' + 4y = x^2$ using UDC method. (7)

OR

- c) Solve the differential equation $(xy^2 - x^2) dx + (3x^2y^2 + x^2y - 2x^3 + y^2) dy = 0$. (7)

Q.6

- a) Draw the sketch of region R and interchange the order of integration $\int_0^1 \int_{x^2}^1 f(x,y) dy dx$. (8)

- b) Using Cylindrical Co-ordinates evaluate $\int_{-2}^2 \int_{-\sqrt{4-x^2}}^{\sqrt{4-x^2}} \int_0^{4-x^2-y^2} x^2 dz dy dx$. (7)

OR

- c) Find volume of solid S where S is the interior of the sphere $x^2 + y^2 + z^2 = a^2$ using double integration. (7)

Q.7

- a) Evaluate $\oint_C y \sin z ds$ where C is the circular helix given by the equation
 $x = \cos t$, $y = \sin t$, $0 \leq t \leq 2\pi$ (8)

- b) Find the Flux of $F = (x - y) \hat{i} + x \hat{j}$ across the circle $x^2 + y^2 = 1$ in xy-plane. (7)

OR

- c) Using Green's Theorem find the area of disk of radius a. (7)

————— X X X —————

Time: 3Hrs

Marks:100

N.B. (1) All questions are compulsory.

(2) Figures to the right indicate full marks to the sub-question.

(3) From Questions 2 to 7, sub-question (a) is compulsory. Attempt any one from sub-question (b) and (c).

Q.1]

(a) Use gram Schmidt process to find an orthogonal basis of \mathbb{R}^3 from an linearly independent set $\{(0,1,1), (1,-1,0), (2,0,1)\}$. [10]

(b) Solve the given equations by Gauss elimination method. [10]

$$2x_1 - 3x_2 - 7x_3 + 5x_4 + 2x_5 = -2, \quad x_1 - 2x_2 - 4x_3 + 3x_4 + x_5 = -2,$$

$$2x_1 - 4x_3 + 2x_4 + x_5 = 3, \quad x_1 - 5x_2 - 7x_3 + 6x_4 + 2x_5 = -7.$$

Q.2]

(a) Show that any upper triangular matrix with non-zero diagonal elements is invertible. [8]

(b) Reduce the matrix $\begin{bmatrix} 1 & -2 & 3 & -1 \\ 2 & -1 & 2 & 2 \\ 3 & 1 & 2 & 3 \end{bmatrix}$ to row echelon form. [7](c) Show that $A = \begin{bmatrix} 1 & 1 & 3 \\ 5 & 2 & 6 \\ -2 & -1 & -3 \end{bmatrix}$ is nilpotent of class 3. [7]

Q.3]

(a) Show that "a subset of a linearly independent set in a vector space is linearly independent". [8]

(b) Let $V = \mathbb{R}^3$ and $S = \{(1, 1, 0), (2, 0, 2)\}$, Check whether $(5, 2, 3)$ and $(4, 1, 5)$ are in $L(S)$. [7](c) If $W = \{(x, y, z)/x + y + z = 4; x, y, z \text{ are real number}\}$ then show that W is not subspace of \mathbb{R}^3 . [7]

[TURN OVER

Q.4]

- (a) State and prove Cauchy-Schwarz inequality theorem. [8]
- (b) Show that $(\mathbb{R}^2, \langle, \rangle)$, where $\langle x, y \rangle = 2x_1y_1 + x_1y_2 + x_2y_1 + x_2y_2$. [7]
- (c) Show that the sum of the square of the diagonals of a parallelogram is equal to the sum of the square of the sides. [7]

Q.5]

- (a) State and prove rank- nullity theorem. [8]
- (b) Let $T: V \rightarrow W$ be a linear transformation. Show that T is one-one if and only if $\text{kernel } T = \{0\}$. [7]
- (c) $f: \mathbb{R}^3 \rightarrow \mathbb{R}^3$ defined by $f(x, y, z) = (x + y - 2z, x + 2y + z, 2x + 2y - 3z)$. Show that f is invertible linear transformation. [7]

Q.6]

- (a) Define determinants of $n \times n$ matrix of reals define adjoint of A . show that $A(\text{adjoint } A) = (\det A)I$. [8]
- (b) Solve using Cramer's rule: [7]
 $3x + 2y + 4z = 1, 2x - y + z = 0, x + 2y + 3z = 1.$
- (c) Let A, B be two $n \times n$ matrices over \mathbb{R} , then show that $\det(AB) = \det(A) \cdot \det(B)$. [7]

Q.7]

- (a) If A is an invertible square matrix, prove that any B with $A \sim B$ is also invertible. [8]
- (b) Find all eigen values and eigen vectors for $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 1 \\ 0 & -2 & 5 \end{bmatrix}$. [7]
- (c) Prove that "each eigen space E_λ is subspace of V ". [7]

Duration : 3 hours

Total Marks : 90

N.B: 1. Part 'a' of each question is compulsory. Solve any one question from part 'b' and part 'c'.

2. All questions carry equal marks.

3. Figures to right indicate full marks.

4. Use of non-programmable scientific calculator is allowed.

Q.1.a. List all the steps used to search for 8 in the sequence 1, 3, 4, 5, 6, 8, 9, 11 using (i) a linear search (ii) a binary search. (8)

b. Describe an algorithm that finds sum of first 'n' even natural numbers. Trace it for n=8. (7)

c. Show that (i) n^k has lower order than a^n for $a > 1$. (7)
(ii) $h(n) = 1 + 2 + \dots + n$ is $\Theta(n^2)$.

Q.2.a. Give two examples of isomorphic graphs on five vertices with proper justification. (8)

b. Draw a multigraph corresponding to the matrix.

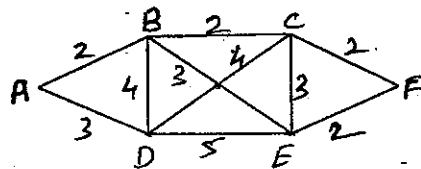
[i]
$$\begin{bmatrix} 1 & 1 & 1 & 2 \\ 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 2 \\ 2 & 0 & 2 & 2 \end{bmatrix}$$

[ii]
$$\begin{bmatrix} 0 & 1 & 2 & 1 & 2 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 & 1 \\ 2 & 1 & 1 & 1 & 0 \end{bmatrix}$$
 (7)

c. Show that in a graph G, the number of vertices of odd degree is even. Further, show that if G has n vertices and n - 1 edges then G has either a vertex of degree 1 or an isolated vertex. (7)

Q.3.a. Write a note on breath first search. (8)

b. What is a spanning tree? Find spanning tree with minimum weight using Kruskal's algorithm in the graph. (7)



c. Define and give one example of (7)
[i] Eulerian graph [ii] Hamiltonian graph.

Q.4.a. If $a > 0$, prove that $\int_a^{\infty} x^t dx$ is convergent for all $t < -1$ and divergent for all $t \geq -1$. (8)

b. Find the length of the area of $y = x^2$ about X-axis from 0 to 2. (7)

c. Evaluate [i] $\int_0^{\infty} 5^{-x^2} dx$ [ii] $\int_0^{\infty} \frac{1}{1+x^2} dx$ (7)

Q.5.a. Derive Newton Raphson formula. (8)

b. Discuss convergence of secant method. (7)

c. Solve by Dolittle LU-decomposition. (7)

$$2x + y + 3z = 12; \quad 3x + 2y + 2z = 8; \quad 5x + 10y - 8z = 10$$

Q.6.a. Solve $y'(x) = xe^y$ with $y(0) = 0$, by Picard's method. (8)

b. Explain Taylor's series method for first order differential equation. (7)

c. Using Milne- Simpson predictor -corrector method solve with $y' = 2xy$ with $y(0) = 1$. Estimate $y(1)$ taking $h = 0.25$. (7)

Note:

1. All questions are compulsory.
2. Figures to the right indicate marks.
3. Mixing of sub-questions is not allowed.
4. Answers to both the sections have to be written in same answer book.

Section - I

- Q1. Attempt any two:
- a) State and prove DeMorgans laws. 5
 - b) What are the different ways to describe a set? Explain each, giving an example. 5
 - c) Explain the following terms giving proper example of each: 5
 - 1) Absolute complement of a set A
 - 2) Boolean Matrix
- Q2. Attempt any two:
- a) Prove that conjunction operation is commutative. 5
 - b) Explain the following terms giving an example of each: 5
 - 1) Square Matrix 2) Diagonal Matrix 3) Boolean Matrix 4) Transpose of a Matrix
 - 5) Symmetric Matrix
 - c) Explain the following terms giving proper example of each: 5
 - 1) Tautology 2) Contradiction
- Q3. Attempt any two:
- a) Find the explicit formula for the sequence defined by the following recurrence relation 5
using the roots of homogenous equation techniques.
 $C_n = 3C_{n-1} - 2C_{n-2}$
 $C_1 = 5, C_2 = 3.$
 - b) $A = \{1, 2, 3, 4, 5\}$ 5
 $R = \{(1, 2), (1, 3), (2, 5), (3, 2), (3, 3), (4, 5), (5, 1), (5, 2)\}$
Draw a Diagraph and give matrix of R.
 - c) Find the explicit formula for the sequence defined by the following recurrence relation 5
using
Backtracking techniques:
 $a_n = a_{n-1} + 18, a_1 = 2$

Section - II

- Q4. Attempt any two:
- a) Write short note on the following: 5
 - a) Scaling
 - b) Translation

[TURN OVER

- b) Explain the Bresenham's line drawing algorithm with example. 5
- c) Consider the line from (0, 0) to (-6,-6). Use simple DDA to rasterize this line. 5

- Q5. Attempt any two:
 - a) Write any five applications of computer graphics. 5
 - b) Explain character clipping and its techniques. 5
 - c) Describe Transparency effect with diagram. 5

- Q6. Attempt any two:
 - a) Draw a circle with center (0, 0) and radius $r = 10$ using Mid-Point circle algorithm. 5
 - b) Describe Z-buffer algorithm. Also give its advantages and disadvantages. 5
 - c) What is texture mapping? Define it using linear parametric function. 5

- N.B.: 1) All questions are compulsory.
 2) Figures to the right indicate full marks.
 3) Answers to both the sections to be written in same answer book.
 4) Mixing of sub-questions are not allowed.

SECTION - I

- Q1. Attempt any two:
- What is the use of scope resolution operator? Explain with an example. 05
 - Explain while and do...while loop with an example. 05
 - Define constructor. Can we create multiple constructors in the same class? Justify your answer. 05
- Q2. Attempt any two:
- Explain operator overloading with an example. 05
 - What is inheritance? Explain different types of inheritance. 05
 - Write a short note on virtual functions in C++. 05
- Q3. Attempt any two:
- What is STL? Explain its components. 05
 - What is exception in C++? Explain exception throwing mechanism. 05
 - Write a note on member function templates. 05

SECTION - II

- Q4. Attempt any two:
- Explain arithmetic and logical operators in JAVA. 05
 - Explain if...else and switch statements in JAVA. 05
 - Define a class in JAVA. Explain with an example. 05
- Q5. Attempt any two:
- With a suitable example explain the use of super keyword in JAVA. 05
 - Explain any three Java's Built-in exceptions. 05
 - Differentiate between byte stream classes and character stream classes. 05
- Q6. Attempt any two:
- What is an applet? Explain the life cycle of an applet. 05
 - Explain AWT controls: Panel and Label with an example. 05
 - What is an event handling in JAVA? 05

- N:B:** (1) All questions are compulsory.
(2) Figures to the right indicate marks.
(3) All Question carry equal marks.

Q.1 Attempt the following (any Two) (10)

- (i) Discuss the advantages and disadvantages of DBMS.
- (ii) Explain the steps involved in ER Modelling.
- (iii) Discuss entity integrity & referential integrity.

Q.2 Attempt the following (any Two) (10)

- (i) What are aggregate function? Explain with example.
- (ii) Define Relation. Differentiate between Selection & Projection.
- (iii) Consider the following relations:
Works (person_name, company_name, salary);
Lives (person_name, city);
Managers(Person_name, manager_name);
Where manager name refers to person name.

Write Relational algebra queries for the following:

1. Find the names of the person who work for company 'FBC'(company name = 'FBC').
2. List the names of the persons who work for company 'FBC' along with the cities they live in.
3. Find the names of the persons who do not work for company 'FBC'.
4. Find the names of the persons who live & work in the same city.
5. Find the names of the persons who live in the same city & on the same street as their managers.
- 6.

Q.3 Attempt the following (any Two) (10)

- (i) State advantages & disadvantages of triggers.
- (ii) What is indexing? What is its need?.
- (iii) Explain types of joins.

Q.4 Attempt the following (any Two) (10)

- (i) Write Short note on RAD model.
- (ii) Explain any five phases of SDLC.
- (iii) Compare Waterfall Model & Spiral Model.

Q.5 Attempt the following (any Two) (10)

- (i) Draw a DFD diagrams for Online Shopping. State the names and use of the symbols used in designing a DFD diagram
- (ii) Define Feasibility & Feasibility Analysis.
- (iii) State & explain the components of SRS.

Q.6 Attempt the following (any Two) (10)

- (i) What is Object Model? State and explain its elements.
- (ii) Draw an ERD for online shopping..
- (iii) Compare OODBMS & RDBMS.