

Total No. of Questions : 5]

SEAT No. :

PE-4857

[Total No. of Pages : 2

[6523]-1

M.Sc. (Industrial Mathematics with Computer Application)

IMT-501 MJ : LINEAR ALGEBRA

(2023 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *Question 1 is compulsory.*
- 2) *Attempt any three questions from Q2 to Q5.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of non-programmable scientific calculator is allowed.*

Q1) Attempt any five of the following :

[5 × 1 = 5]

- a) Determine whether the transformation $T : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ given by $T(x, y) = (3x + y, x - 5y + 1)$ is linear.
- b) Is the matrix $[A] = \begin{bmatrix} 6 & -9 \\ -4 & 6 \end{bmatrix}$ invertible? Justify.
- c) Find the largest possible value for rank of A and the smallest possible value for nullity of A if A is a matrix of order 3×5 .
- d) Test the linear dependence of the following set of vectors in $\mathbb{R}^3$
 $(1, 1, 2), (3, 1, 2), (-1, 0, 0)$.
- e) Does the vector $[X] = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$ belong to Null A, $[A] = \begin{bmatrix} 1 & -2 \\ -2 & 4 \end{bmatrix}$.
- f) What is the rank of a 4×5 matrix, whose null space is 3 dimensional?
- g) Define a subspace of a vector space. Give one example of a subspace $\mathbb{R}^2$ of a vector space.

P.T.O.

Q2) a) Find rank of following matrix $[A] = \begin{bmatrix} 1 & 1 & 0 & -1 \\ 1 & 2 & 3 & 0 \\ 2 & 3 & 3 & -1 \end{bmatrix}$ and hence write it's nullity. [5]

b) Convert the augmented matrix into the row echelon form and hence write solution $\left[\begin{array}{ccc|c} 1 & 0 & 2 & -5 \\ -2 & 5 & 0 & 11 \\ 2 & 5 & 8 & -7 \end{array} \right]$. [5]

Q3) a) Find all eigen values of the following matrix $[A] = \begin{bmatrix} -1 & 4 & -2 \\ -3 & 4 & 0 \\ -3 & 1 & 3 \end{bmatrix}$ & hence state whether it is diagonalizable. [5]

b) Decide for or against the positive definiteness of $A = \begin{bmatrix} 2 & 15 & -5 \\ 15 & 18 & 0 \\ -5 & 0 & 11 \end{bmatrix}$. [5]

Q4) a) Let R^3 have the Euclidean inner product use the Gram Schmidt process to transform the basis $\{\{1, 1, 1\}, \{2, 1, 0\}, \{5, 1, 3\}\}$ to an orthonormal basis. [5]

b) Show that the set $\{p(x) \in P_3 \mid p(1) = p(2)\}$ is subspace. [5]

Q5) a) Construct the projection matrix P onto the space spanned by $(1, 1, 0, 1)$ and $(0, 0, 1, 0)$. [5]

b) Which of the following subsets of R^3 are actually subspaces? [5]

i) The plane of vectors (b_1, b_2, b_3) with first component $b_1 = 0$.

ii) The plane of vectors (b_1, b_2, b_3) that satisfy $b_3 - b_2 + 3b_1 = 0$.



Total No. of Questions : 7]

SEAT No. :

PE-4858

[Total No. of Pages : 3

[6523]-2

M.Sc.

**INDUSTRIAL MATHEMATICS WITH COMPUTER
APPLICATIONS**

**IMT-503MJ : Discrete Mathematical Structure
(2023 Pattern) (Semester - I)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q1 is compulsory.*
- 2) *Attempt any FIVE questions from 2 to 7.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of non-programmable scientific calculator is allowed.*

Q1) Solve any FIVE of the following.

[10]

- a) Let $Q(x, y)$ denote " $x + y = 0$ ". What are the truth values of the quantifications $\exists y, \forall x, Q(x, y)$, where the domain for all variables consists of all real numbers?
- b) Draw a graph which is neither Hamiltonian nor Eulerian.
- c) Does there exist a complete bipartite graph that is a complete graph? Justify your answer.
- d) How many arrangements of the word "MALAYALAM" are there?
- e) Suppose that the roots of the characteristic equation of a linear homogeneous recurrence relation are 2, 2, 2, 5, 5 and 9. What is the form of the general solution?
- f) Show that the distributive law $x + yz = (x + y)(x + z)$ is valid using Boolean function tables.
- g) How many different license plates can be made if each plate contains a sequence of three uppercase English letters followed by three digits (and no sequences of letters are prohibited, even if they are obscene)?

P.T.O.

Q2) Attempt the following.

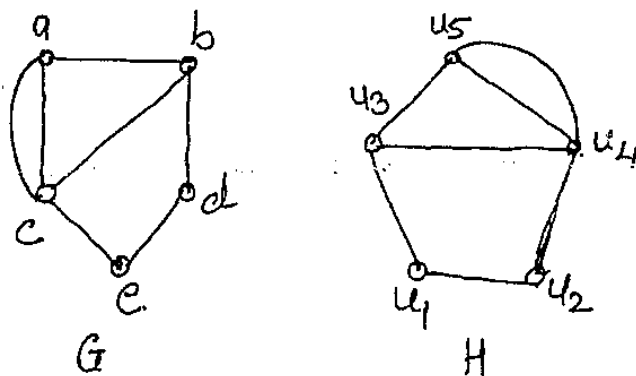
- Find the solution to the recurrence relation $a_n = 6a_{n-1} - 11a_{n-2} + 6a_{n-3}$ with the initial conditions $a_0 = 2, a_1 = 5, a_2 = 15$. [7]
- Construct a truth table for $(p \leftrightarrow q) \vee (\sim p \leftrightarrow q)$. State whether it is Tautology or Contingency. [5]

Q3) Attempt the following.

- Find the number of positive integers not exceeding 1000 that are not divisible by 3, 17 or 35. [7]
- Find sequence of Fibonacci numbers and then an explicit recurrence formula for the Fibonacci numbers. [5]

Q4) Attempt the following.

- Let G be a connected planar simple graph with e edges and v vertices. Let r be the number of regions in a planar representation of G . Then prove that $r = e - v + 2$. [7]
- Determine whether the graphs $G = (V, E)$ and $H = (W, F)$ shown below are isomorphic : [5]



Q5) Attempt the following.

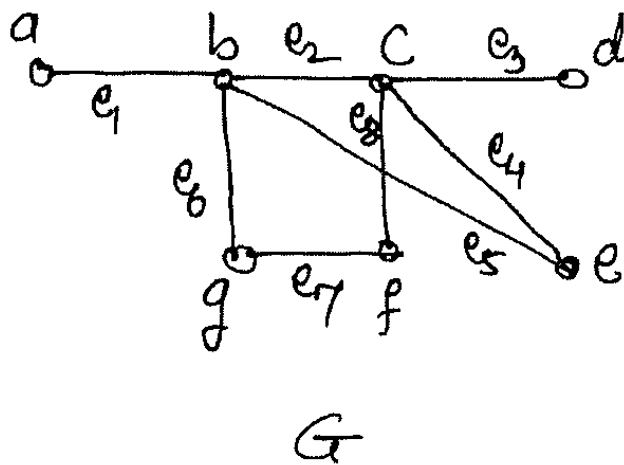
- Find the values of the Boolean function represented by $F(x, y, z) = (x + y)\bar{z}$ and also write their disjunctive normal form. [7]
- What is the coefficient of $x^{12}y^{13}$ in the expansion of $(2x - 3y)^{25}$? [5]

Q6) Attempt the following.

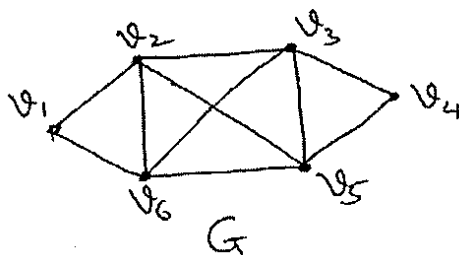
- a) Use Mathematical induction to prove that $n^3 - n$ is divisible by 3 whenever n is a positive integer. [7]
- b) How many bit strings of length eight either start with a 1 bit or end with the two bits 00? [5]

Q7) Attempt the following.

- a) For the given graph G answer the following questions [6]



- i) List all cut vertices in G .
 - ii) List all bridges in G .
 - iii) Verify Handshaking lemma for this graph G .
- b) Determine whether the following graph is Eulerian. If yes, find Euler line in it. [6]



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Total No. of Questions : 5]

SEAT No. :

PE-4859

[Total No. of Pages : 2

[6523]-3

**M.Sc. (Industrial Mathematics with Computer Applications)**  
**IMT-504-MJ : OBJECT ORIENTED PROGRAMMING**  
**USING C++**  
**(2023 Pattern) (Semester - I)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates :*

- 1) Q1 is compulsory.
- 2) Attempt any THREE questions from 2 to 5.
- 3) Figures to the right indicate full marks.
- 4) Use of non-programmable scientific calculators is allowed.

**Q1) Attempt any FIVE of the following.**

**[5 × 1 = 5]**

- a) What is Abstraction?
- b) How to define user define function?
- c) What is data binding?
- d) Define virtual class.
- e) What are different access specifiers in CPP?
- f) Write syntax of switch statement.
- g) What is friend function in CPP?

**Q2) a) Explain abstract base class with suitable diagram.**

**[5]**

b) Explain array of object in C++ with example.

**[5]**

**Q3) a) Explain different operator in CPP**

**[5]**

b) Differentiate between structure and classes

**[5]**

**P.T.O.**

- Q4)** a) Explain the object oriented concept in CPP. [5]  
b) Explain hybrid Inheritance with example. [5]
- Q5)** a) Define a CPP class for student information. [5]  
b) Explain any two Classes for file stream operations. [5]



Total No. of Questions : 5]

SEAT No. :

PE-4860

[Total No. of Pages : 2

[6523]-4

**M.Sc. (Industrial Mathematics with Computer Application)  
IMT - 505 - MJ : DATA BASE MANAGEMENT SYSTEM  
(2023 Pattern) (Semester - I)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates :*

- 1) *Q.1 is compulsory.*
- 2) *Attempt any THREE questions from Q.2 to Q.5.*
- 3) *Figures to the right indicate full marks.*
- 4) *Draw the diagrams wherever necessary.*

**Q1) Attempt any FIVE of the following.**

**[5 × 1 = 5]**

- a) What is view?
- b) Define Foreign Key.
- c) Explain disadvantages of NoSQL.
- d) Enlist the DML Commands
- e) What is Data?
- f) Define Cartesian Product.
- g) What is the role of DBA.

**Q2) Attempt the following:**

**[2 × 5 = 10]**

- a) What is RDBMS ? Explain Advantages and Disadvantages of RDBMS.
- b) Explain do-while loop in PL/PGSQL.

**Q3) Attempt the following:**

**[2 × 5 = 10]**

- a) Explain DDL commands with example.
- b) What is constraint? Explain Unique Constraint with example.

**P.T.O.**

**Q4) Attempt the following:**

**[2 × 5 = 10]**

- a) What are the Applications of NoSQL Databases.
- b) Explain data types in PL/PGSQL

**Q5) Attempt the following:**

**[2 × 5 = 10]**

- a) Consider the following databases

Student (roll no, name, marks);

Teacher (tno, tname, experience).

The relation between student & teacher is many-to-many with descriptive attribute class.

- Write a function to count the number of teachers having experience > 10 years
- b) What is Project operation in relational algebra ? Explain with example.



Total No. of Questions : 5]

SEAT No. :

PE-4861

[Total No. of Pages : 2

[6523]-5

**M.Sc. (Industrial Mathematics with Computer Applications)**

**IMT-510(A)-MJ : STATISTICAL METHODS**

**(2023 Pattern) (CBCS) (Semester - I)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates :*

- 1) Q1 is compulsory.
- 2) Attempt any *THREE* questions from 2 to 5.
- 3) Figures to the right indicate full marks.
- 4) Use of non-programmable scientific calculators is allowed.

**Q1) Attempt any Five of the following.**

**[5 × 1 = 5]**

- a) State any two limitations of statistics.
- b) Identify which of the following variables are attributes? Blood group, No of accidents, Gender, Scores obtained in examination.
- c) State two merits of Karl Pearson's correlation coefficient.
- d) State the normal equations for fitting a second degree curve of type  $Y = a + bX + cX^2$ .
- e) Give two examples of multiple regression.
- f) For a bivariate data the two regression coefficients are  $b_{xy} = 0.2$  and  $b_{yx} = 0.8$ . Obtain correlation coefficient between X and Y.
- g) State the probability mass function of Poisson distribution.

**Q2) Attempt each of the following :**

**[2 × 5 = 10]**

- a) What is dispersion? Explain why the relative measures of dispersion are superior to absolute measures?
- b) Differentiate between the stratified random sampling and cluster sampling method.

**P.T.O.**

**Q3) Attempt each of the following :**

**[2 × 5 = 10]**

- a) What is kurtosis? Explain the different types of kurtosis with sketches.
- b) Explain Spearman's rank correlation coefficient.

**Q4) Attempt each of the following :**

**[2 × 5 = 10]**

- a) Explain the concept of partial correlation. Also state the formula of partial correlation between  $X_2$  and  $X_3$  after eliminating the linear effect of  $X_1$ .
- b) Monthly income and savings of 10 employees in a certain company are given below :

|                     |    |    |    |    |    |    |    |    |    |    |
|---------------------|----|----|----|----|----|----|----|----|----|----|
| Income (in '000 Rs) | 25 | 75 | 85 | 90 | 78 | 36 | 98 | 39 | 65 | 62 |
| Savings (in '00 Rs) | 60 | 68 | 62 | 86 | 84 | 51 | 91 | 47 | 53 | 58 |

Obtain the least square regression line of savings on income.

**Q5) Attempt each of the following :**

**[2 × 5 = 10]**

- a) Define Geometric distribution. State its mean and variance. Also discuss its real life situations.
- b) Suppose height of soldiers follow normal distribution with mean 170 cm and standard deviation of 50 cm. In a regiment of 1000 soldiers how many would be expect to be
  - i) less than 180 cm.
  - ii) Between 160 cm and 190 cm



Total No. of Questions : 5]

SEAT No. :

PE-4862

[Total No. of Pages : 2

[6523]-6

**M.Sc. (Industrial Mathematics with Computer Application)**

**IMT-510(B) MJ : NUMERICAL ANALYSIS**

**(2023 Pattern) (Semester - I)**

**Time : 2 Hours]**

**[Max. Marks : 35**

**Instructions to the candidates:**

- 1) Question 1 is compulsory.
- 2) Attempt any three questions from Q2 to Q5.
- 3) Figures to the right indicate full marks.
- 4) Use of non-programmable scientific calculator is allowed.

**Q1) Attempt any five of the following :**

**[5 × 1 = 5]**

- a) Find approximate value of  $\frac{\pi}{3}$  correct to 4 decimal places. Find percentage error.
- b) Find the characteristic equation of matrix  $A = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 2 \\ -1 & 3 & 2 \end{bmatrix}$ .
- c) Construct forward difference table for the following data:  

|    |     |      |      |      |
|----|-----|------|------|------|
| x: | 4   | 5    | 6    | 7    |
| y: | 4.2 | 12.5 | 19.3 | 30.4 |
- d) Using Newton Raphson method, obtain a real root of the equation  $x = e^{-x}$  with  $x = 0$  as initial approximation. (Perform 1 iteration)
- e) Find the Jacobian matrix  $j(x, y)$  at the point (2, 3) for the functions,  
 $f_1(x, y) = x^3y^2$   
 $f_2(x, y) = x^2 + 1$ .
- f) Solve  $\frac{dy}{dx} = (x + y)^2 : y(0) = 1$ . Find  $y(0.1)$  using Euler's method.
- g) State Simpson's (3/8)th rule.

**P.T.O.**

**Q2) a)** Solve  $y' = xy + y^2$  with  $y(0) = 1$  using fourth order Runge Kutta Method. Find  $y(0.1)$ . (Take  $h = 0.1$ ). [5]

**b)** Use Gauss Seidel iterative method to solve the system. [5]

$$5x - y + z = 10$$

$$2x + 8y - z = 11.$$

$$-x + y + 4z = 3. \quad (\text{Perform 4 iterations}).$$

**Q3) a)** Show that matrix  $A = \begin{bmatrix} 3 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 3 \end{bmatrix}$  is diagonalizable. [5]

**b)** Find  $y(4.4)$  using Newton's forward difference formula from the following data : [5]

$$y(0) = 12, y(2) = 7, y(4) = 6, y(6) = 7, y(8) = 13$$

**Q4) a)** Find the lowest degree polynomial using Lagrange's interpolation method from the following data: [5]

$$x: \quad 0 \quad 1 \quad 3 \quad 4$$

$$y: \quad -2 \quad -4 \quad -2 \quad 2$$

**b)** Express the following system in augmented form and solve. [5]

$$x_1 + 2x_2 + x_3 + 4x_4 = 13$$

$$2x_1 + 4x_3 + 3x_4 = 28$$

$$4x_1 + 2x_2 + 2x_3 + x_4 = 20$$

$$-3x_1 + x_2 + 3x_3 + 2x_4 = 6$$

**Q5) a)** Solve  $LY = B$ ,  $UX = Y$  and verify that  $AX = B$  for  $B^T (7, 2, 10)$ , where  $A = LU$  is, [5]

$$\begin{bmatrix} 1 & 1 & 6 \\ -1 & 2 & 9 \\ 1 & -2 & 3 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ -1 & 1 & 0 \\ 1 & -1 & 1 \end{bmatrix} \begin{bmatrix} 1 & 1 & 6 \\ 0 & 3 & 15 \\ 0 & 0 & 12 \end{bmatrix}$$

**b)** Evaluate  $\int_2^6 \log_{10} x \, dx$  using Simpson's  $\frac{1}{3}^{rd}$  Rule. (Take  $n = 8$ ) [5]



Total No. of Questions : 5]

SEAT No. :

PE-4863

[Total No. of Pages : 2

[6523]-8

**M.Sc. (Industrial Mathematics with Computer Application)**

**IMT-507-RM : RESEARCH METHODOLOGY**

**(2023 Pattern) (Semester - I)**

*Time : 2 Hours]*

*[Max. Marks :35*

*Instructions to the candidates:*

- 1) *Question No.1 is Compulsory.*
- 2) *Attempt any Three questions from Question No.2 to 5*
- 3) *Figures to the right indicates full marks.*
- 4) *Use of non programmable scientific calculator is allowed.*

**Q1) Multiple Choice Questions :**

**[5]**

- i) Primary data is original in nature & collected directly from first - hand experience.
  - a) True
  - b) False
- ii) Statistical design does not deal with the number of items to be observed & the ways of data collection & methods of analysis of data.
  - a) True
  - b) False
- iii) Which of the following is a primary data collection method in qualitative research?
  - a) Experiments
  - b) Surveys
  - c) Content analysis
  - d) In-depth interviews
- iv) When conducting research, what is the term for a sample that accurately represents the characteristics of the population from which it is drawn?
  - a) Biased sample
  - b) Convenience sample
  - c) Random sample
  - d) Stratified sample
- v) What is the purpose of a literature review in the research process?
  - a) To present the research findings
  - b) To summarize the research methodology
  - c) To identify' and analyze existing research on the topic
  - d) To propose a new research topic

**P.T.O.**

- Q2)** a) Protection of IPR. [5]  
b) Explain Sampling. [5]
- Q3)** a) Write a note on ethics in Research. [5]  
b) Write a note on Mathematical Software used in Research. [5]
- Q4)** a) Write a Note Data Analysis. [5]  
b) Define Components of Research Paper. [5]
- Q5)** a) Define Review of Literature. [5]  
b) Write a note on research gap. [5]



Total No. of Questions : 7]

SEAT No. :

PE-4864

[Total No. of Pages : 2

[6523]-21

**M.Sc. (Industrial Mathematics With Computer Application)**

**IMT - 551 MJ : FOUNDATION OF ANALYSIS**

**(2023 Pattern) (Semester - II)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Q 1 is compulsory.*
- 2) *Attempt only five questions from Q2 to Q7.*
- 3) *Figure to the right indicate full marks.*
- 4) *Use of non-Programmable scientific calculators is allowed.*

**Q1) Solve any FIVE from the following.**

**[10]**

- a) Define Metric Space.
- b) Find limsup and liminf of the sequence  $S_n = (-1)^n$ .
- c) Define
  - i) Connected Set
  - ii) Compact Set
- d) Show that the series  $\sum_{n=1}^{\infty} \cos\left(\frac{1}{n}\right)$  is divergent.
- e) With example show that, in Collection  $\{G_\alpha\}$  of open sets,  $\bigcap_\alpha G_\alpha$  is not an open set.
- f) Find  $\lim_{x \rightarrow 3} \frac{x^2 - 9}{x - 3}$ .
- g) Define Root Test.

**Q2) a) A Set E is Open if and only if its complement is closed.**

**[7]**

- b) If  $(X, d)$  is a metric space then show that  $d'(x, y) = \frac{|x - y|}{1 + |x - y|}$  is also metric on X.

**[5]**

**Q3) a) A monotonic Sequence  $\{S_n\}$  is convergent if and only if it is bounded.**

**[7]**

- b) Show that the Sequence  $S_n = \left(\frac{1}{n}\right)$  is a Cauchy sequence.

**[5]**

**P.T.O.**

**Q4) a)** Prove that series  $\sum_{n=1}^{\infty} \frac{1}{n^p}$  converges if  $p > 1$  and diverges if  $p \leq 1$ . **[7]**

b) By using Ratio test show that the  $\sum_{n=1}^{\infty} \frac{n^5}{3^n}$  is convergent. **[5]**

**Q5) a)** A mapping  $f$  of a metric space  $X$  into a metric space  $Y$  is continuous if and only if  $f^{-1}(V)$  is closed in  $X$  for every closed set  $V$  in  $Y$ . **[7]**

b) By Using L hospital rule find  $\lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n$ . **[5]**

**Q6) a)** State and prove fundamental theorem of Calculus. **[7]**

b) Show that the following function is not Riemann integrable on any interval.

$$f(x) = \begin{cases} 0, & \text{when } x \text{ is rational} \\ 1, & \text{when } x \text{ is irrational} \end{cases} \quad \mathbf{[5]}$$

**Q7) a)** If  $f$  is continuous on  $[a, b]$  then  $f \in R(\alpha)$  on  $[a, b]$  **[6]**

b) Prove that  $\sum_{n=1}^{\infty} \frac{1}{1+n^2x^4}$  is uniformly convergent on  $[1, \infty)$ . **[6]**



Total No. of Questions : 7]

SEAT No. :

PE-4865

[Total No. of Pages : 2

[6523]-22

M.Sc. (Industrial Mathematics with Computer Applications)

IMT-552 MJ : APPLIED ALGEBRA

(2023 Pattern) (Semester - II)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Questions 1 is compulsory.
- 2) Answer any five questions from Q2 to Q7.
- 3) Figures to the right indicate full marks.
- 4) Use of non-programmable scientific calculators is allowed.

Q1) Solve any five from the following :

[10]

- a) Prove that in a group  $G$ , there is only one identity.
- b) Define order of an element with example.
- c) Define alternating group with example.
- d) Suppose  $\phi$ , is an isomorphism from group  $G$  to  $\bar{G}$ . For any elements  $a$  and  $b$  in  $G$ ,  $a$  and  $b$  commute if and only if  $\phi(a)$  and  $\phi(b)$  commute.
- e) Find  $\phi(100)$ .
- f) State Division algorithm for divisibility of integers.
- g) Define linear congruence with one example.

Q2) a) Find all generators of group  $(\mathbb{Z}_8, +_6)$ .

[7]

- b) Let  $H$  be a non empty finite subset of a group  $G$ . Prove that  $H$  is a subgroup of  $G$  if  $H$  is closed under the operation of  $G$ .

[5]

Q3) a) Let  $G$  be an abelian group with identity  $e$ . Then  $H = \{x \in G \mid x^2 = e\}$  is subgroup of  $G$ .

[7]

- b) For each  $a$  in a group  $G$ , the centralizer of  $a$  is a subgroup of  $G$ .

[5]

P.T.O.

**Q4) a)** State and prove Lagrange's theorem. [7]

b) Let  $\alpha = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 1 & 3 & 5 & 4 & 6 \end{bmatrix}$  and  $\beta = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 6 & 1 & 2 & 4 & 3 & 5 \end{bmatrix}$  Compute each of the following [5]

i)  $\alpha^{-1}$

ii)  $\beta\alpha$

iii)  $\alpha\beta$

**Q5) a)** Find g.c.d. of 2210 and 357 and express the g.c.d. in the form  $2210m + 357n$  for some  $m, n \in \mathbb{Z}$ . [7]

b) By using mathematical induction, show that [5]

$$1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}.$$

**Q6) a)** A word has been broken into blocks of two letters and converted to two digit numbers using the correspondance

$$a = 0, b = 1, c = 2, d = 3, o = 4, k = 5, f = 6, h = 7, l = 8, j = 9$$

Then blocks are then encoded using the public key code with base 87 and exponent 19. The coded message is 04/10. Find the word which was coded. [7]

b) Find remainder of  $7^{361} + 7^{362}$  when divided by 11. [5]

**Q7) a)** Solve the congruence [6]

$$6x \equiv 9 \pmod{15}$$

b) Find the inverse of 72 modulo 91 using Euclidean algorithm. [6]



Total No. of Questions : 5]

SEAT No. :

PE-4866

[Total No. of Pages : 2

[6523]-23

**M.Sc. (Industrial Mathematics with Computer Applications)**

**IMT-553-MJ : DATA STRUCTURE**

**(2023 Pattern) (Semester - II)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates :*

- 1) *Q1 is compulsory.*
- 2) *Attempt any THREE questions from 2 to 5.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of non-programmable scientific calculators is allowed.*

**Q1) Attempt any FIVE of the following.**

**[5 × 1 = 5]**

- a) Define Data Structure.
- b) Give any two applications of an array.
- c) What are the basic operations performed on a queue?
- d) Define stack.
- e) What is complete binary tree?
- f) Define DeQueue.
- g) Explain node structure of linked list.

**Q2) a) Write a function to add a node at the beginning of a singly linked list. [5]**

- b) Convert the following infix expression to postfix and evaluate. Show the stack contents for evaluation. **[5]**

$$p * q - t/u, p = 1, q = 3, t = 4, u = 2$$

**Q3) a) Sort the following numbers using Bubble Sort. And show all the Intermediate steps. [5]**

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

- b) Write a short note on Priority queue. **[5]**

**P.T.O.**

- Q4)** a) Write a short note on binary search method. [5]  
b) Compare the data structure stack and queue. [5]
- Q5)** a) Explain with example AVL tree. [5]  
b) Explain with example heap sort. [5]



Total No. of Questions : 5]

SEAT No. :

PE-4867

[Total No. of Pages : 2

[6523]-24

**F.Y.M.Sc. (Industrial Mathematics with Computer Applications)**

**IMT-560(A) MJ: WEB TECHNOLOGY**

**(2023 Pattern) (Semester - II)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates :*

- 1) *Q1 is compulsory.*
- 2) *Attempt any THREE questions from 2 to 5.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of non-programmable scientific calculator is allowed.*

**Q1) Attempt any FIVE of the following.**

**[5 × 1 = 5]**

- a) What are the different levels of heading in HTML?
- b) Explain Document Object Model.
- c) What is JavaScript Function Expression?
- d) How is Node.js different from JavaScript?
- e) Describe package.json file.
- f) What is http?
- g) How to define JSON in JavaScript?

**Q2) a) Give the syntax and purpose of following FORM Elements**

**[5]**

- i) text
- ii) checkbox
- iii) radio
- iv) password
- v) button

b) Explain the structure of the HTML webpage with an example.

**[5]**

**P.T.O.**

**Q3) a)** What are the ways to add JavaScript code to HTML Web Pages and explain one of them by example. [5]

b) What is an array object? How to create an array object? Explain any two array methods. [5]

**Q4) a)** Describe the Node.js process model and how it differs from traditional web server models. [5]

b) What is a module in NodeJS? Explain core module with suitable example. [5]

**Q5) a)** Explain the following keywords in the context of NPM. [5]

i) install

ii) uninstall

iii) update

iv) outdated

v) init

b) Demonstrate how to define routes in an Express.js application and handle GET, POST HTTP methods. [5]



Total No. of Questions : 7]

SEAT No. :

PE-4868

[Total No. of Pages : 2

[6523]-31

M.Sc.

**INDUSTRIAL MATHEMATICS WITH COMPUTER  
APPLICATIONS**

**IMT-601MJ : Ordinary Differential Equations  
(2023 Pattern) (Semester - III)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Q1 is compulsory.*
- 2) *Attempt any FIVE questions from 2 to 7.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of non-programmable scientific calculator is allowed*

**Q1)** Solve any FIVE from the following.

**[10]**

- a) Determine whether the functions  $\phi_1(x) = \cos x$ ,  $\phi_2(x) = \sin x$  are linearly dependent or independent.
- b) Find all solutions of the differential equation with constant coefficient  $y' - 4y = 0$
- c) Solve  $y' = x^2y$ .
- d) Verify the function  $\phi(x) = e^{-\sin x}$  is the solution of the differential equation  $y' + (\cos x)y = 0$
- e) Show that the function  $f(x, y) = 4x^2 + y^2$  satisfies Lipschitz condition on  $|x| \leq 1$ ,  $|y| \leq 1$ .
- f) Compute the indicial polynomial and their roots for the differential equation  $4x^2y'' + (4x^4 - 5x)y' + (x^2 + 2)y = 0$ .
- g) Check whether the differential equation is exact or not  $2xydx + (x^2 + 3y^2)dy = 0$ .

**Q2)** a) Prove that two solutions  $\phi_1, \phi_2$  of  $y'' + a_1y' + a_2y = 0$  are linearly independent on an interval I if and only if  $W(\phi_1, \phi_2)(x) \neq 0$ ,  $\forall x \in I$ . **[7]**

b) Solve the differential equation  $y''' - 8y = 0$  **[5]**

**P.T.O.**

**Q3) a)** Solve the non-homogenous differential equation [7]

$$y'' - 6y' + 9y = \frac{e^{3x}}{x^2}$$

b) Find singular points and determine those which are regular singular points  
 $(x^2 + x - 2)^2 y'' + 3(x + 2)y' + (x - 1)y = 0$  [5]

**Q4) a)** If  $\phi_1, \phi_2$  are two solutions of  $y'' + a_1 y' + a_2 y = 0$  on an interval I containing a point  $x_0$  then  $W(\phi_1, \phi_2)(x) = e^{-a_1(x-x_0)} W(\phi_1, \phi_2)(x_0)$  [7]

b) Solve the initial value problem  $y'' - 2y' - 3y = 0, y(0) = 0, y'(0) = 1$  [5]

**Q5) a)** If one solution of  $x^2 y'' - 7xy' + 15y = 0$  is  $\phi_1(x) = x^3$  then find the another solution by method of reduction of order. [7]

b) Find all solution of the differential equation  $y' - 2y = x^2 + x$  [5]

**Q6) a)** Solve  $(2x + 1)^2 y'' - 2(2x + 1)y' - 12y = 0$  [7]

b) Solve  $y' + \frac{y^2}{x^2} = \frac{y}{x}$  [5]

**Q7) a)** Find two linearly independent power series solutions of the differential equation  $y'' - xy = 0$  [7]

b) Find all solutions of the differential equations for  $x > 0$ ,  
 $x^2 y'' + 2xy' - 6y = 0$  [5]



Total No. of Questions : 5]

SEAT No. :

PE-4869

[Total No. of Pages : 2

[6523]-32

**S.Y.M.Sc. (Industrial Mathematics with Computer Applications)**

**IMT-602 MJ: COMPUTER NETWORKS**

**(2023 Pattern) (Semester - II)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates :*

- 1) Q1 is compulsory.
- 2) Attempt any *THREE* questions from 2 to 5.
- 3) Figures to the right indicate full marks.
- 4) Use of non-programmable scientific calculators is allowed.

**Q1) Attempt any FIVE of the following.**

**[5 × 1 = 5]**

- a) What is flow control?
- b) Write any two features of Transport Layer.
- c) Define Computer network.
- d) What is Analog signal?
- e) What is NAT?
- f) Explain port number.
- g) Define plain text.

**Q2) a) Explain any two Layers of OSI reference model.**

**[5]**

b) Differentiate between TCP and UDP.

**[5]**

**Q3) a) Write a note on stop-and-wait data link protocol.**

**[5]**

b) Explain in details types of computer network.

**[5]**

**P.T.O.**

- Q4)** a) Write a short note on transmission media. [5]  
b) Explain in details Classful addressing. [5]
- Q5)** a) Explain any two Application layers protocols in details. [5]  
b) Write a note on Repeater and Hub. [5]



Total No. of Questions : 7]

SEAT No. :

PE-4870

[Total No. of Pages : 2

[6523]-33

M.Sc.

**INDUSTRIAL MATHEMATICS WITH COMPUTER  
APPLICATIONS**

**IMT-603MJ : Design and Analysis of Algorithm  
(2023 Pattern) (Semester - III)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Q1 is compulsory.*
- 2) *Attempt any FIVE questions from 2 to 7.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of non-programmable scientific calculators is allowed*

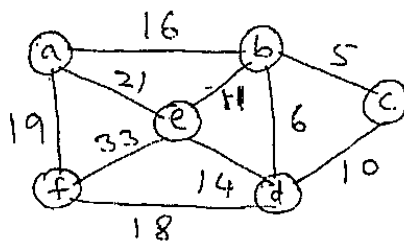
**Q1)** Solve any FIVE from the following.

**[10]**

- a) Show that  $5n^2 + 4n = O(n^2)$
- b) State “Principle of optimality”.
- c) What is the time complexity of Linear and binary search algorithms?
- d) Explain “NP Hard”
- e) State any two different ways to represent the graph.
- f) Define 1. $\theta$  notation, 2. $\Omega$  notation
- g) Explain general method of backtracking.

**Q2) a)** Write down dijkstra’s algorithm to find shortest path from source to destination. **[7]**

- b) Using kruskal’s algorithm find minimum spanning tree for following graph. **[5]**



**P.T.O.**

- Q3) a)** What is Huffman codings? Construct Huffman coding tree for following table. [7]

| Character                    | a  | b  | c  | d  | e | f |
|------------------------------|----|----|----|----|---|---|
| Frequency<br>in<br>thousands | 45 | 13 | 12 | 16 | 9 | 5 |

- b) Define the following term : [5]
- live node E-node
  - Dead node
  - Least cost (LC) search
  - least cost

- Q4) a)** Find all pairs shortest path using ford war shall algorithm for following directed graph. [7]

- b) Explain Articulation point and Bridge edge [5]

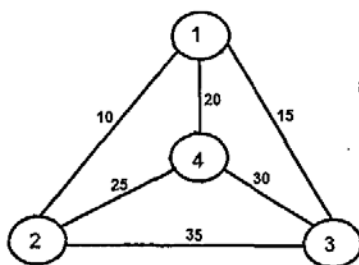
- Q5) a)** Explain breadth first search with example. [7]

- b) Explain graph coloring problem with example. [5]

- Q6) a)** Solve following knapsack problem using greedy method  $n=7$ ,  $m=15$ ,  $(w_1, w_2, w_3, w_4, w_5, w_6, w_7) = (1, 3, 5, 4, 1, 3, 2)$ ,  $(p_1, p_2, p_3, p_4, p_5, p_6, p_7) = (5, 10, 15, 7, 8, 9, 4)$  [7]

- b) Sort the following data using a bubble sort set  $\{30, 192, 41, 38, 30, 58, 90, 6, 42\}$ . [5]

- Q7) a)** Traveling salesman problem using dynamic programming [7]



- b) Explain Relationship among P class, NP class, NP-hard and NP-Complete [5]



Total No. of Questions : 5]

SEAT No. :

PE-4871

[Total No. of Pages : 2

[6523]-35

**M.Sc. (Industrial Mathematics with Computer Application)**

**IMT - 611(B) MJ: DOT .NET PROGRAMMING**

**(2023 Pattern) (Semester - III)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates :*

- 1) *Q.1 is compulsory.*
- 2) *Attempt any THREE questions from Q.2 to Q.5.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of non-programmable scientific calculator is allowed.*

**Q1) Attempt any FIVE of the following.**

**[5 × 1 = 5]**

- a) What are the advantages of C#.
- b) How do you declare and initialize an array in C#?
- c) What are the key features of LINQ.
- d) Explain the use of RichTextBox in C#.
- e) Does C# support multiple inheritance? Justify your answer.
- f) Define Overriding?
- g) What is the purpose of the StreamReader class in C#?

**Q2) a) Define inheritance. Explain the various types of inheritance supported by C#. [5]**

**b) Explain exception handling in C# with example. [5]**

**Q3) a) Write a short note on Connection, Command, Dataset, DataReader & DataAdapter objects in C#. [5]**

**b) Explain the .NET Framework Architecture with block diagram. [5]**

**P.T.O.**

- Q4)** a) What are collections in C#? Describe the different types of collections available in the .NET framework. [5]
- b) What is Assembly? Differentiate between private and shared assembly. [5]
- Q5)** a) Write a C# program to check whether given number is even or odd. [5]
- b) Write a C# program to find factorial of a given number. [5]



Total No. of Questions : 7]

SEAT No. :

PE-4872

[Total No. of Pages : 2

[6523]-41

S.Y. M.Sc.

**INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATION**

**IMT - 651 MJ : Software Engineering and Testing**

**(NEP 2023 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Q 1 is compulsory.*
- 2) *Attempt any five questions from Q2 to Q7.*
- 3) *Figure to the right indicate full marks.*
- 4) *Use of non-Programmable scientific calculators is allowed.*

**Q1) Solve any Five of the following.**

**[5 × 2 = 10]**

- a) Name any two prescriptive process models.
- b) What is a product backlog in Scrum?
- c) What is requirement elicitation?
- d) What is an activity model?
- e) Define verification and validation.
- f) What is Test Reporting in automation testing?
- g) Define data design in software engineering.

**Q2) a)** Explain how testing metrics help in software testing with metrics life cycle. **[7]**

b) How do software quality attributes affect software engineering? **[5]**

**Q3) a)** Compare top-down and bottom-up integration testing. **[7]**

b) Discuss the role of the Scrum Master in Agile methodology. **[5]**

**Q4) a)** Explain sequence and activity diagrams with examples-Online Banking System. **[7]**

b) Explain software requirement specification (SRS) with an example. **[5]**

**P.T.O.**

- Q5)** a) How does architectural design impact software performance? [7]  
b) Discuss deployment modeling in UML. Draw component and deployment diagram for Online shopping system. [5]
- Q6)** a) What are the advantages and disadvantages of agile development? [7]  
b) Compare alpha and beta testing with example. [5]
- Q7)** a) Discuss the importance of defect tracking and how it impacts software quality. [6]  
b) Discuss how software has evolved over time and its impact on software engineering. [6]



Total No. of Questions : 7]

SEAT No. :

PE-4873

[Total No. of Pages : 4

[6523]-42

S.Y. M.Sc. (IMCA)

**IMT-652 MJ : OPTIMIZATION TECHNIQUES  
(2023 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Question No. 1 is compulsory.*
- 2) *Solve any five questions from Q2 to Q7.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of non-programmable scientific calculator is allowed.*

**Q1) Solve any five of the following :**

**[10]**

- a) What is example of CPM?
- b) What is mixed Strategy?
- c) Find the saddle point of game to the given two-person zero sum game?

Player B

|         |       |       |       |
|---------|-------|-------|-------|
|         |       | $B_1$ | $B_2$ |
| PlayerA | $A_1$ | 9     | 2     |
|         | $A_2$ | 8     | 6     |
|         | $A_3$ | 6     | 4     |

- d) What is failure and give its type?
- e) Which symbol describes the interarrival time distribution.
  - i) D
  - ii) M
  - iii) G
  - iv) All of the above
- f) Write the Hessian matrix for real valued function variables.  $f(x_1, x_2, x_3)$  of three variables.
- g) State the term 'fair game'.

**P.T.O.**

**Q2) a)** The cost of maintenance of a machine is given as a function increasing with time, whose scrap value is constant. Prove that If time is measured continuously then the average annual cost will be minimized by replacing the machine when the average cost to date becomes equal to the current maintenance cost. [7]

**b)** Draw the network diagram for the activities relations and duration given below : [5]

|                  |     |     |     |     |     |     |     |
|------------------|-----|-----|-----|-----|-----|-----|-----|
| Activity         | 1-2 | 1-3 | 1-4 | 2-5 | 3-5 | 4-6 | 5-6 |
| Duration in days | 7   | 2   | 8   | 1   | 9   | 1   | 15  |

**Q3) a)** A firm is considering replacement of a machine, whose cost price is Rs. 12,200; and the scrap value is Rs. 200. The running cost are found from experience to be as follows : [7]

|                     |     |     |     |      |      |      |      |      |
|---------------------|-----|-----|-----|------|------|------|------|------|
| Year                | 1   | 2   | 3   | 4    | 5    | 6    | 7    | 8    |
| Running cost (Rs.): | 200 | 500 | 800 | 1200 | 1800 | 2500 | 3200 | 4000 |

When should the machine be replaced?

**b)** What is the optimum period of replacement. [5]

**Q4) a)** Draw the network for the following information. [7]

|                 |   |   |   |   |     |     |   |   |
|-----------------|---|---|---|---|-----|-----|---|---|
| Activity :      | A | B | C | D | E   | F   | G | H |
| Predecessor(s): | - | - | A | A | B,C | B,C | D | E |

**b)** A farmer wants to plant one of the crops Crop A, Crop B or Crop C. The estimated profit for each crop depending on the rainfall, is given below. Use pessimism criterion to determine best crop for farmer to plant. [5]

| Rainfall | Estimated profit in rupees |        |        |
|----------|----------------------------|--------|--------|
|          | Crop A                     | Crop B | Crop C |
| High     | 8,000                      | 3,500  | 5,000  |
| Medium   | 4,500                      | 4,500  | 5,000  |
| Low      | 2,000                      | 5,000  | 4,000  |

- Q5) a)** A small project consists of seven activities for which the relevant data are given below. [7]

|               |   |   |   |      |      |         |         |
|---------------|---|---|---|------|------|---------|---------|
| Activity :    | A | B | C | D    | E    | F       | G       |
| Predecessor : | - | - | - | A, B | A, B | C, D, E | C, D, E |
| Duration :    | 4 | 7 | 6 | 5    | 7    | 6       | 5       |

- Draw the project network
  - Calculate total and free float of each activity.
- b)** Obtain the solution of the following problem by using method of Lagrangian multipliers. [5]

$$\text{Min } Z = -2x_1^2 + 5x_1x_2 - 4x_2^2 + 18x_1$$

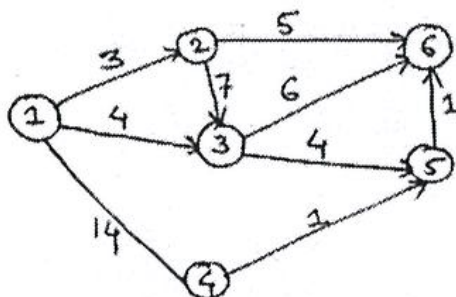
$$\text{Subject to } x_1 + x_2 = 7$$

$$\text{and } x_1, x_2 \geq 0$$

- Q6) a)** The pay-off matrix for three strategies  $S_1, S_2$  and  $S_3$  against the states of nature  $N_1, N_2$  and  $N_3$  is given as below. Use regret criterion to find the best strategy. [7]

| Strategy | State of Nature |       |       |       |
|----------|-----------------|-------|-------|-------|
|          | $N_1$           | $N_2$ | $N_3$ | $N_4$ |
| $S_1$    | 4000            | 100   | 6000  | 18000 |
| $S_2$    | 20000           | 5000  | 400   | 0     |
| $S_3$    | 20000           | 15000 | -2000 | 1000  |

- b)** Determine the project completion time and critical path for the following network project. [5]



- Q7) a)** Use graphical method to solve the following game. Also, find optimal strategies of each player and the value of game. **[7]**

| Player A | Player B |       |       |       |
|----------|----------|-------|-------|-------|
|          | $B_1$    | $B_2$ | $B_3$ | $B_4$ |
| $A_1$    | 8        | -2    | 9     | -3    |
| $A_2$    | 6        | 5     | 6     | 8     |

- b)** Explain Johnson's procedure for n jobs through 2 machine? **[5]**



Total No. of Questions : 5]

SEAT No. :

PE-4874

[Total No. of Pages : 2

[6523]-44

**S.Y.M.Sc. (Industrial Mathematics with Computer Applications)  
IMT-654(B)MJ: DEFI BLOCK CHAIN TECHNOLOGY  
(2023 Pattern) (Semester - IV)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates :*

- 1) Q1 is compulsory.
- 2) Attempt any *THREE* questions from 2 to 5.
- 3) Figures to the right indicate full marks.

**Q1) Attempt any FIVE of the following.**

**[5 × 1 = 5]**

- a) Define blockchain technology.
- b) Name one cryptographic technique used in blockchain.
- c) What are consensus mechanisms used in blockchain?
- d) How does the Bitcoin network ensure the security of transactions?
- e) What is the Ethereum Virtual Machine (EVM) responsible for?
- f) What does “DApp” stand for in the context of Ethereum?
- g) What is the difference between a hard fork and a soft fork in blockchain?

**Q2) a)** What was the primary purpose of creating blockchain technology? Discuss how it works.

- b) Explain the concept of a Merkle tree and its role in blockchain

**[2 × 5 = 10]**

**Q3) a)** What is a digital signature? How does it work in blockchain technology to ensure data integrity and authenticity?

- b) Explain different types of Blockchain.

**[2 × 5 = 10]**

**P.T.O.**

- Q4)** a) Explain the key differences between Proof of Work (PoW) and Proof of Stake (PoS) in blockchain Technology.
- b) Explain initial Coin offering.

**[2 × 5 = 10]**

- Q5)** a) What is a Decentralized Autonomous Organization (DAO)? Explain
- b) Explain the difference between the Ethereum mainnet and testnets.

**[2 × 5 = 10]**

