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M.Sc. - I (Industrial Mathematics With Computer Applications)
MATHEMATICS
MIM-101 : Real Analysis
(2019 Pattern) (Semester - I)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:

1) *Attempt any five questions out of eight questions.*
2) *Figures to the right indicate full marks.*
3) *Scientific calculator and statistical tables are allowed.*

Q1) Attempt each of the following.

a) If *p* is *a* limit point of a set E, then prove then every neighbourhood of *p* contains infinitely many points of E.   **[5]**

b) Prove that a set E is open if and only if its complement is closed. **[5]**

c) Give an example of infinite family of open sets whose intersection is not open.   **[2]**

d) Prove that any finite subset of $\mathbb{R}$ with usual metric is closed. **[2]**

Q2) Attempt each of the following.

a) If $\{p_n\}$ is a sequence in a compact metric space X, then prove that there exists a subsequence of $\{p_n\}$ converges to a point of X.   **[5]**

b) If $\bar{E}$ is the closure of a set E in a metric space X then prove that $\text{diam}\,\bar{E} = \text{diam}\,E$.   **[5]**

c) If p > 0 then prove that $\lim_{n\to\infty} \dfrac{1}{n^p} = 0$.   **[2]**

d) Define Cauchy sequence. Give an example of a Cauchy sequence. **[2]**

Q3) Attempt each of the following.

a) Show that the series $\sum_{n=1}^{\infty} x^n$ converges for $0 \le x < 1$ and diverges for $x \ge 1$. **[5]**

b) Show that the series $\sum_{n=1}^{\infty} \frac{1}{n^p}$ converges if $p > 1$ and diverges if $p \le 1$. **[5]**

c) Find radius of convergence of $\sum_{n=1}^{\infty} \frac{z^n}{n}$. **[2]**

d) Let f be a continuous real valued function on a metric space X. Let $Z(f) = \{p \in X \mid f(p) = 0\}$ be the set of zeros of f. Prove that $Z(f)$ is a closed. subset of $\mathbb{R}$. **[2]**

Q4) Attempt each of the following.

a) Suppose f is a continuous mapping of a compact metric space X in to a metric space Y then prove that $f(X)$ is compact. **[5]**

b) A mapping f of a metric space X in to a metric space Y is continuous if and only if $f^{-1}(C)$ is closed in X for every closed set C in Y. **[5]**

c) Using $- \varepsilon\ \delta$ definition of continuity show that $f : \mathbb{R} \to \mathbb{R}$ defined by

$f(x) = \frac{x}{2}$ is a continuous function. **[2]**

d) Define simple discontinuity. **[2]**

Q5) Attempt each of the following.

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

b) If $f(x) = |x|^3$. Compute $f'(x)$, $f''(x)$ for all real x and show that $f^{(3)}(0)$ does not exist. **[5]**

c) If $C_0 + \frac{C_1}{2} + ... + \frac{C_{n-1}}{n} + \frac{C_n}{n+1} = 0$, where C_0, C_1,....,C_n are real constants
then prove that the equation $C_0 + C_1x + ... + C_{n-1}x^{n-1} + C_nx^n = 0$ has at least one real root between 0 and 1. **[4]**

Q6) Attempt each of the following.

    a) If P* is a refinement of a partition P of [*a, b*] and α is monotonically increasing function on [*a, b*] then prove that L(P, *f*, α) $\leq$ L(P*, *f*, α).**[5]**

    b) If $f \in \mathscr{R}(\alpha)$ on [*a, b*] then prove that $|f| \in \mathscr{R}(\alpha)$ and also prove that

$$\left| \int_a^b f d\alpha \right| \leq \int_a^b |f| d\alpha. \qquad \text{[5]}$$

    c) If $\in \mathscr{R}$ on [a, b] and it there is differentiable function F on [a, b] such that

      F' = f then prove that $\int_a^b f(x)dx = F(b) - F(a).$ **[4]**

Q7) Attempt each of the following.

    a) Prove that the sequence of functions $\{f_n\}$ defined on E, converges uniformly on E if and only if for every $\varepsilon > 0$ there exists an integer N such that $m \geq N$, $n \leq N$, $x \in$ E implies $|f_n(x) - f_m(x)| < \varepsilon.$ **[5]**

    b) State and prove weierstrass M-test.   **[5]**

    c) Show that the series of functions $\sum_{n=1}^{\infty} \dfrac{x}{1 + n^2 x}$, $(0 \leq x < \infty)$ is uniformly

      convergrnt.   **[4]**

Q8) Attempt each of the following.

    a) Suppose $\lim_{n\to\infty} f_n(x) = f(x)$ on E and put $M_n = \sup_{x \in E} |f_n(x) - f(x)|.$ Then

      prove that $f_n \to f$ if and only if $M_n \to 0$ as $n \to \infty$.   **[5]**

    b) If $f_n(x) = nx(1-x^2)^n$, $(0 \leq x \leq 1, n = 1,2,...)$ then prove that

$$\lim_{x\to\infty} \int_0^1 f_n(x)dx \neq \int_0^1 \left[\lim_{x\to\infty} f_n(x) \right] dx. \qquad \text{[5]}$$

    c) If $f_n(x) = \dfrac{x}{n}, (0 \leq x \leq 1, n = 1,2,....)$ then prove that $\{f_n(x)\}$ converges

      uniformly to 0.   **[4]**

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M.Sc. (Industrial Mathematics with Computer Applications)
MATHEMATICS
MIM - 102 : Linear Algebra & its Applications
(2019 Pattern) (Semester - I)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:

   1)   *Attempt any Five of the given Eight questions.*

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

Q1) Attempt each of the following: **[14]**

    a)   If W is a non-empty subset of a vector space V, then prove the W is a subspace of V if and only if the following conditions hold:

       i)   If, $\bar{u}, \bar{v} \in W$, then $\bar{u}, + \bar{v} \in W$

       ii)   If k is any scalar and $\bar{u}, \in W$, then $k\bar{u}, \in W$.   **[5]**

    b)   Determine whether the set of pairs of real numbers (x, y) forms a vector space with the operations. $(x, y) + (x', y') = (x + x' + 1, y + y' + 1)$ and $k(x, y) = (kx, ky)$. If it is not a vector space, state which axioms fail. **[5]**

    c)   Express $\bar{0} = 0 + 0x + 0x^2$ as a linear combination of $\bar{p}_1 = 2 + x + 4x^2$, $\bar{p}_2 = 1 - x + 3x^2$, $\bar{p}_3 = 3 + 2x + 5x^2$,.   **[2]**

    d)   Determine the solution space of the system   **[2]**

       $x - 2y + 3z = 0$

       $2x - 4y + 6z = 0$

       $3x - 6y + 9z = 0$

Q2) Attempt each of the following: **[14]**

a) Let M_{22} have the usual inner product. Find the angle between $A = \begin{bmatrix} 2 & 6 \\ 1 & -3 \end{bmatrix}$

and $B = \begin{bmatrix} 3 & 2 \\ 1 & 0 \end{bmatrix}$. **[5]**

b) Consider the vector space $\mathbb{R}^3$ with the Euclidean inner product. Apply the Gram Schmidt process to transform the basis vectors. $\bar{u}_1 = (1,1,1)$, $\bar{u}_2 = (0,1,1)$, $\bar{u}_3 = (0,0,1)$ into an orthonormal basis. **[5]**

c) Let $\mathbb{R}^3$ have the Euclidean inner product

Let $\bar{u} = (1,1,-1)$ and $\bar{v}(6,7,-15)$. If $\| k\bar{u} + \bar{v} \| = 13$, what is k? **[4]**

Q3) Attempt each of the following: **[14]**

a) Let T: V → W be a linear transformation. Prove that **[5]**
   i)   Kernel of T is a subspace of V.
   ii) Range of T is a subspace of W.

b) Suppose that the linear transformations $T_1: \mathbb{P}_2 \to \mathbb{P}_2$ and $T_2: \mathbb{P}_2 \to \mathbb{P}_3$ are given by $T_1 (p(x)) = p (x + 1)$ and $T_2 (p(x)) = xp(x)$. Find $(T_2 o\ T_1)$ $(a_0 + a_1 x + a_2 x^2)$. **[5]**

c) Let $T : \mathbb{R}^2 \to \mathbb{R}^2$ be defined by T $(x, y) = (2x, y + 1)$. Is T a linear transformation? Justify. **[2]**

d) Find nullity of T if $T : \mathbb{R}^5 \to \mathbb{R}^7$ has rank 3. **[2]**

Q4) Attempt each of the following: **[14]**

a) Find a matrix P that diagonalizes $A = \begin{bmatrix} 1 & 0 \\ 6 & -1 \end{bmatrix}$ and also find $P^{-1} AP$. **[5]**

b) Find the eigen values of $A = \begin{bmatrix} 4 & 0 & 1 \\ -2 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix}$. **[5]**

c) Define eigen values and eigen vectors of a square matrix A. **[2]**

d) Find a basis for the eigenspace of $A = \begin{bmatrix} 3 & 0 \\ 8 & -1 \end{bmatrix}$ corresponding to the eigen value $\lambda = -1$. **[2]**

Q5) Attempt each of the following: **[14]**

a) Let V be the space spanned by $\bar{v}_1 = \cos^2 x$, $\bar{v}_2 = \sin^2 x$, $\bar{v}_3 = \cos 2x$. Show that $S = \{\bar{v}_1, \bar{v}_2, \bar{v}_3\}$ is not a basis for V. **[5]**

b) Find a basis for the space spanned by the vectors $\bar{v}_1 = (1, -2, 0, 0, 3)$, $\bar{v}_2 = (2, -5, -3, -2, 6)$, $\bar{v}_3 = (0, 5, 15, 10, 0)$, $\bar{v}_4 = (2, 6, 18, 8, 6)$. **[5]**

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. **[2]**

d) Determine a basis for the subspace W of $\mathbb{R}^3$, where

$$W = \{(x, y, z) / 3x - 2y + 5z = 0\}.$$ **[2]**

Q6) Attempt each of the following: **[14]**

a) Sketch the image of the square with vertices (0, 0), (1, 0), (0, 1) and (1,1) under multiplication by $A = \begin{bmatrix} -3 & 0 \\ 0 & 1 \end{bmatrix}$. **[5]**

b) Find an LU decomposition of $A = \begin{bmatrix} 6 & -2 & 0 \\ 9 & -1 & 1 \\ 3 & 7 & 5 \end{bmatrix}$. **[5]**

c) Consider the transition matrix $P = \begin{bmatrix} 0.4 & 0.5 \\ 0.6 & 0.5 \end{bmatrix}$ Calculate $x^{(n)}$, for $n = 1, 2, 3, 4$. **[4]**

Q7) Attempt each of the following: **[14]**

    a)   Let T be a linear operator on a finite dimensional space V and let c be a scalar. Prove that the following are equivalent: **[5]**

        i)   c is a characteristic value of T.

        ii)   The operator (T-cI) is singular.

    b)   Find the minimal polynomial of $A = \begin{bmatrix} 2 & 1 & -1 \\ 2 & 1 & -1 \\ 2 & 2 & -1 \end{bmatrix}$. **[5]**

    c)   Let T be the linear operator on $\mathbb{R}^2$ the matrix of which in the standard ordered basis is $A = \begin{bmatrix} 1 & -1 \\ 2 & 2 \end{bmatrix}$.

        Prove that the only subspaces of $\mathbb{R}^2$ invariant under T are $\mathbb{R}^2$ and the zero subspace. **[4]**

Q8) Attempt each of the following: **[14]**

    a)   Prove that all bases for a finite dimensional vector space have the same number of vectors. **[5]**

    b)   Show that the characteristic equation of a 2×2 matrix A can be expressed as $\lambda^2 - \text{tr}(A)\lambda + \det(A) = 0$, where tr (A) = trace of A. **[5]**

    c)   Let $T: \mathbb{R}^2 \to \mathbb{R}^2$ be the linear transformation given by $T(x, y) = (2x-y, -8x + 4y)$. Determine which of the following vectors are in ker (T). **[4]**

        i)   (5, 10)

        ii)   (3, 2)

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M.Sc. (Industrial Mathematics with Computer Applications)
MIM - 103 : C PROGRAMMING
(2019 Pattern) (Semester - I)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:

1) *Attempt any Five out of Eight questions given.*

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

Q1) Attempt the following: **[14]**

a) What is pointer? What are different operations can be performed on pointers. **[5]**

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

c) Predict the output and justify your answer. **[2]**

   main( )

   {

       Int i = 4, z = 12;

       If (i = 5 && z > 5)

       printf("\n In C language ");

   Else

       printf("\n any other language ");

   }

d) Define the term Recursion. **[2]**

Q2) Attempt the following: **[14]**

a) Write a 'C' program to perform swapping of two numbers using pointer.**[5]**

b) Explain how switch case control structure works in 'C' Programming?**[5]**

c) Write the use and syntax of sizeof ( ) operator. **[2]**

d) Predict the output and justify your answer. **[2]**

```
#define PRODUCT (n) (n*n)
main( )
{
    int i =3, j;
    j = PRODUCT (i+l);
    printf("n%d ",j);}
```

Q3) Attempt the following: **[14]**

a) Write down the difference between While and do-while loop. **[5]**

b) Write a program to check whether the given number is palindrome or not. **[5]**

c) What is the use of getchar( ) and putchar( ) functions? **[2]**

d) What is 2 - D array? Write syntax and example of 2-d array. **[2]**

Q4) Attempt the following: **[14]**

a) Write a C program that defines a structure employee containing the details such as empno, empname, department name and salary. The structure has to store 20 employees in an organization. Use the appropriate method to accept and display employee details? **[5]**

b) Explain call by value and call by reference with suitable example? **[5]**

c) List any four Bitwise Operator. **[2]**

d) Predict the output and justify your answer. **[2]**

```
main( )
{ int i = abc(10);
  printf("%d",--i);
}
  int abc(int i)
{
  return(i++);
}
```

Q5) Attempt the following: **[14]**

a) Explain various file opening mode in 'C' with suitable example and syntax. **[5]**

b) Write a C program to perform addition of 2 matrices size n*n. Use appropriate function to accept and display matrix. **[5]**

c) Explain Increment and decrement operator with suitable example. **[4]**

Q6) Attempt the following: **[14]**

a) Distinguish between structure and union. **[5]**

b) Explain : Function prototype, Function call and return statement. **[5]**

c) Explain: **[4]**

   i) Precedence of Operators

   ii) Order of evaluation of operators

Q7) Attempt the following: **[14]**

a) Write a C program to copy the contents from one file to another file. **[5]**

b) Explain with example: **[5]**

   i) Array of pointers

   ii) Pointers to Pointers

c) Define an array. How to initialize one-dimensional array? Explain. **[4]**

Q8) Attempt the following: **[14]**

a) Write a 'C' menu driven program to calculate factorial of number, number is odd or even and prime number. **[5]**

b) Write a note on Command Line Argument. **[5]**

c) Explain the following preprocessor directives with example: **[4]**

   i) #include

   ii) #define

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M.Sc. - I (Industrial Mathematics with Computer Applications)
MIM-104 : DBMS
(2019 Pattern) (Semester - I)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:

    1) Attempt any five out of the eight questions given.

    2) Figures to the right indicate full marks.

Q1) Attempt the following:

    a)   What is data abstraction? Explain the various levels of data abstraction.**[5]**

    b)   Explain with an example "Tabular representation of specialization". **[5]**

    c)   What is data redundancy and data inconsistency?   **[2]**

    d)   State the Armstrong's axioms.   **[2]**

Q2) Attempt the following.

    a)   Explain the aggregate functions of SQL with example.   **[5]**

    b)   Explain the structure of PL/pgSQL code block.   **[5]**

    c)   What is a partial participation? Give an example.   **[2]**

    d)   Define DBMS. List any two applications of DBMS.   **[2]**

Q3) Attempt the following:

a)   Give the syntax and explain % TYPE and % ROWTYPE variable attributes
     of PL/pgSQL.   **[5]**

b)   Define a trigger. State and explain its syntax.   **[5]**

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

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

     i)   Attribute

     ii) Relationship set

Q4) Attempt the following:

a)   Consider the following database.   **[5]**

     Customer (<u>customer_no</u>, customer_name, age, city)

     Account (<u>account_no</u>, balance)

     Customer and account are related with one-to-many relationship.

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

     i)   List the name of customer with minimum number of accounts

     ii) Find the names of customers having less than 3 accounts

b)   Consider the database from Q4 a) and give expression in relational algebra
     for   **[5]**

     i)   List the names of all customers.

     ii) List all the accounts of "Mr. Joshi".

     iii) Display the account details of customers whose age is more than 60.

c)   What is the use of delete command? Give its syntax.   **[2]**

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

Q5) Attempt the following.

a) Consider the following database.

Project (project number integer, name varchar (30), budget integer)

Write a PL/pgSQL function which will accept project number and displays the name and budget of the project. **[5]**

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

F = {A->B, A->C, B->D, CD->E, BE->F, C->F}

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

c) Consider the relation schema R(A, B, C, D, E) and set of functional dependencies F for R as F = (A->BC, CD->E, B->D, E->A). Find a candidate key for R. **[4]**

Q6) Attempt the following:

a) Explain with example the various types of anomalies that might arise if we have redundant data. **[5]**

b) Give the various notations used to draw an E-R diagram. **[5]**

c) Differentiate between specialization and generalization. **[4]**

Q7) Attempt the following.

a) Explain any two fundamental Relational Algebra operations with example.**[5]**

b) Consider the following database **[5]**

Employee (employee id, name, age, salary, city)

Project (project_id, project_name, duration, budget)

Project and Employee are related with one-to-many relationship.

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

i) List the details of employees whose name strats with "p".

ii) Find the sum of salaries of all employees.

iii) List the details of employees in the ascending order of their salary.

iv) Give the average age of an employee.

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c) Consider the detabase from Q7 b) and give expression in relational algebra for **[4]**

    i) List the name and age of all employees.

    ii) Give the names of employees having salary less than 40,000.

    iii) Give the names of projects having budget more than 50,000.

    iv) List the details of employees who do not live in "Pune" city.

Q8) Attempt the following.

a) What is normalization? Explain 2NF, 3NF forms of normalization with example. **[5]**

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

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

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[5922]-21
First Year M.Sc. (IMCA)
MIM - 201 : COMPLEX ANALYSIS
(2019 Pattern) (Semester - II)

Time : 3 Hours]   *[Max. Marks : 70*
Instructions to the candidates:
   1)   *Attempt any five questions out of eight questions.*
   2)   *Figures to the right indicate full marks.*

Q1) a)   Show that $\int_0^\infty \frac{x^2}{x^6+1} = \frac{\pi}{6}$.   **[5]**

     b)   Obtain the Maclaurin series represents $z\cosh(z^2) = \sum_{n=0}^\infty \frac{z^{4n+1}}{(2n)!}\left(|z|<\infty\right).$ **[5]**

     c)   Show that $\overline{\cos(iz)} = \cos(i\,\overline{z})$.   **[2]**

     d)   Determine singular points of the function $f(z) = \frac{z^3+i}{z^2-3z+2}$.   **[2]**

Q2) a)   Suppose that a function $f(z)$ is continuous on a domain D.   **[5]**

        i)   The integral of $f(z)$ around closed contours lying entirely in D all have value zero.

        ii) $f(z)$ has an antiderivative $F(z)$ throughout D.

          Prove that : imples

     b)   Show that the singular point of the function $f(z) = \frac{1-\exp(2z)}{z^4}$ is a pole.

        Determine the order m of that pole and corresponding residue B.   **[5]**

     c)   Find $(-16)^{\frac{1}{4}}$.   **[2]**

d)   Show that   **[2]**

   i) $(1 - i)^4 = -4$,

   ii) $\dfrac{4+i}{2-3i} - \dfrac{5}{13} + \dfrac{14}{13}i.$

Q3) a)   Show that : An isolated singular point z_0 of a function f is a pole of order

   m if and only if $f(z)$ can be written in the form $f(z) = \dfrac{\phi(z)}{(z-z_0)^m},$

   where $\phi(z)$ is analytic and nonzero at z_0. Moreover

   $\underset{z=z_0}{\text{Res}} f(z) = \phi(z_0),$ if $m = 1;$

   $\underset{z=z_0}{\text{Res}} f(z) = \dfrac{\phi^{(m-1)}(z_0)}{(m-1)!},$ if $m \geq 2.$ **[5]**

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

c)   Find the values of z such that $e^z = -2$.   **[2]**

d)   Evaluate the integral $\int_0^{\frac{\pi}{4}} e^{it} dt.$ **[2]**

Q4) a)   Find Laurent series representation for $f(z) = \dfrac{-1}{(z-1)(z-2)}$ in the domain

   $1 < |z| < \infty.$ **[5]**

b)   Suppose that a function f is analytic inside and on a positively oriented
   circle C_R, centred at z_0 and with radius R. If M_R denotes the maximum

   value of $|f(z)|$ on C_R then prove that $|f^n(z_0)| \leq \dfrac{n! M_R}{R^n}, \ (n=1, \ 2,...).$ **[5]**

c)   Find a harmonic conjugate $v(x, y)$ for $u(x, y) = 2x - x^3 + 3xy^2.$ **[2]**

d)   Write the function $f(z) = z^3 + z + 1$ in the form $f(z) = u(x, y) + iv(x, y).$ **[2]**

Q5) a) Show that $\int_0^\infty \dfrac{dx}{(x^2+1)^2} = \dfrac{\pi}{4}$. **[5]**

b) Derive Cauchy Riemann Differential Equations for an analytic function in the Cartesian form. **[5]**

c) Show that $\int_c \dfrac{5z-2}{2(z-1)}dz = 10\pi i$, where C is circle of $|z| = 2$. **[4]**

Q6) a) Show that if $f(z)$ and $\overline{f(z)}$ both are analytical in a given domain D then $f(z)$ is constant throughout D. **[5]**

b) Find Laurent series representation for $f(z) = z^2 \sin\left(\dfrac{1}{z^2}\right)$ in the domain $0 < |z| < \infty$. **[5]**

c) Let two functions p and q be analytic at a point z_0. If $p(z_0) \neq 0$, $q(z_0) = 0$ and $q'(z_0) \neq 0$ then prove that z_0 is a simple pole of the quotient $\dfrac{p(z)}{q(z)}$

and $\displaystyle\operatorname*{Res}_{z=z_0} \dfrac{p(z)}{q(z)} = \dfrac{p(z_0)}{q'(z_0)}$. **[4]**

Q7) a) Find $f'(z)$; if $f(z) = \sqrt{r}\,\dfrac{i\theta}{e^2}, r > 0, \alpha < \theta < \alpha + 2\pi$. **[5]**

b) Let C denote a contour of length L, and suppose that a function $f(z)$ is piecewise continuous on C. If M is a non-negative constant such that $|f(z)| \leq M$ for all points z on C at which $f(z)$ is defined, then $\left|\int_c f(z)dz\right| \leq ML$. **[5]**

c) Find the Laurent series representation for $f(z)\dfrac{1-\cosh z}{z^3}$. Determine the types of singularity of $f(z)$ and residue at z = 0. **[4]**

Q8) a) i) Show that $\int\limits_{-c} f(z)dz = -\int\limits_{c} f(z)\, dz$

ii) Find $\int_c \bar{z}dz$, if $z = 2e^{i\theta}$ $\left(-\dfrac{\pi}{2} \le 0 \le \dfrac{\pi}{2}\right)$ where C is right half of circle

$|z| = 2$ from $z = -2i$ to $z = 2i$. **[5]**

b) Find the zeroes of sin z and cos z. **[5]**

c) Find the value of integral $\int_c \dfrac{3z^3 + 2}{(z-1)(z^2+9)}dz$, where C is the positively

oriented circle $|z - 2| = 2$. **[4]**

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First Year M.Sc. (Industrial Mathematics with Computer Applications)
MIM-202 : DISCRETE MATHEMATICAL STRUCTURES
(2019 Pattern) (Semester-II)

Time : 3 Hours]   *[Max. Marks : 70*
Instructions to the candidates:
   1)   Attempt any Five of the given Eight questions.
   2)   Figures to the right indicate full marks.

Q1) Attempt each of the following :   **[14]**

   a)   How many positive integers between 100 and 999 inclusive are

      i)   are divisible by 3 or 4?

      ii)   are divisible by 3 and 4?

      iii) are not divisible by either 3 or 4?   **[5]**

   b)   How many functions are there from the set { 1,2,....,n} where n is a
        positive integer to the set {0,1}

      i)   That are one-one?

      ii)   That assign 0 to both 1 and n?

      iii) That assign 1 to exactly one of the positive integers less than n?**[5]**

   c)   A drawer contains a dozen brown socks and a dozen black socks, all
        unmatched. A man takes socks out at random in the dark.

      i)   How many socks must he take out to be sure that he has atleast two
            socks of the same colour?

      ii)   How many socks must he take out to be sure that he has atleast two
            black socks?   **[2]**

   d)   What is the coefficient of x^9 in $(2–x)^{19}$?   **[2]**

Q2) Attempt each of the following: **[14]**

    a)   Solve the recurrence relation $a_n = 5a_{n-1} - 6a_{n-2}$ for $n \geq 2$, $a_0 = 1$, $a_1 = 0$ **[5]**

    b)   Find the solution to the recurrence relation $a_n = 2a_{n-1} + 3^n$, $a_1 = 5$ **[5]**

    c)   Let n be a positive integer. Prove that $\sum_{k=0}^{n} (-1)^k \binom{n}{k} = 0$ **[2]**

    d)   How many bit strings are there of length 6 or less? **[2]**

Q3) Attempt each of the following: **[14]**

    a)   Determine whether the sequence 3,3,3,3,2 is graphical. If yes, then draw a graph having the above degree Sequence. **[5]**

    b)   Prove that in a self complementary graph the number of vertices is of the form 4k or 4k+1, for some positive integer k. **[5]**

    c)   Draw an undirected graph with the following adjacency matrix. **[2]**

$$\begin{bmatrix} 1 & 2 & 0 & 1 \\ 2 & 0 & 3 & 0 \\ 0 & 3 & 1 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

    d)   Define:

       i)   Euler Graphs

       ii)   Hamiltonian Graphs. **[2]**

Q4) Attempt each of the following: **[14]**

    a)   Represent the expression $((x+2) \uparrow 3) * (y - (3+x)) - 5$ using a binary tree. Write this expression in frefix notation. **[5]**

    b)   Draw all possible non-isomorphic trees with 7 vertices. **[5]**

    c)   Write a note on Breadth First search method for producing a spanning tree of a simple graph. **[2]**

    d)   Determine the number of internal vertices in a binary tree with 17 vertices. **[2]**
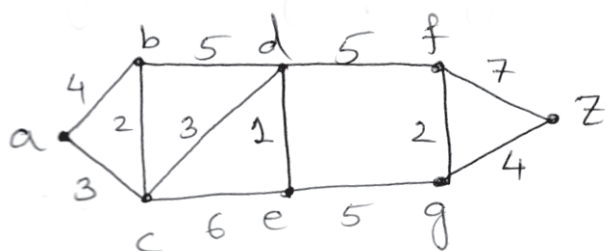
Q5) Attempt each of the following: **[14]**

a) Construct circuits from inverters, AND gates and OR gates to produce the option. $\overline{(\overline{x}+z)(y+\overline{z})}$ **[5]**

b) Use the Quine-Mc cluskey method to simplify the Sum-of-product expansion $\overline{x}\,y\,z+x\,\overline{y}\,z$. **[5]**

c) Find the sum-of-product expansion for the function F $(x,\ y,\ z) = (x+y)\ \overline{z}$.**[4]**

Q6) Attempt each of the following: **[14]**

a) Prove that there are (n + r − 1,r) r– combinations from a set with n elements when repetetion of elements is allowed. **[5]**

b) How many strings of six lower case letters of the English alphabet contain exactly two vowels? **[5]**

c) How many ways are there to distribute hands of 5 cards to each of four players from the standard deck of 52 cards. **[4]**

Q7) Attempt each of the following: **[14]**

a) Use Djikstra's algorithm to find shortest path between 'a' and 'z' in the weighted graph given below. **[5]**

b) Let G be a simple graph with n vertices and k components. Let n_i be the number of vertices in the ith component ($i=1,2,.....,$ k). Then prove that

$$\sum_{i=1}^{k} n_i^{2} \le (n-k)^{2} + (2n-k)$$ **[5]**

c) What is the chromatic number of the graph Cn, where $n \ge 3$ **[4]**

Q8) Attempt each of the following: **[14]**

a) Suppose a large family has 14 Children, including two sets of identical triplets, three sets of identical twins and two individual children. How many ways are there to seat these children in a row if the identical triplets or twins cannot be distinguished from one another. **[5]**

b) Use Kruskal's algorithm to find a minimal spanning tree in the following graph. **[5]**
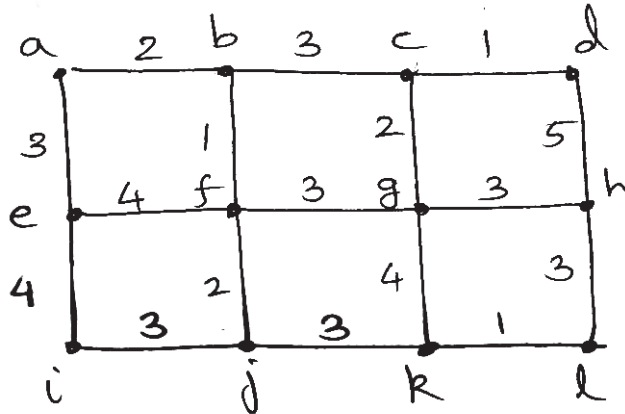
c) Verify the Absorption law: **[4]**

$x + xy = x$

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[5922]-23

M.Sc. -I (IMCA)
MIM-203 : DATA STRUCTURES
(2019 Pattern) (Semester - II)

Time : 3 Hours]

[Max. Marks : 70

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) What are the various applications of Stack? **[5]**

    b) What are the differences between singly linked list and doubly linked list. **[5]**

    c) "A linked list can only be traversed sequentially" state true/false. Justify.**[2]**

    d) State the best case and worst case complexity of bubble sort. **[2]**

Q2) Attempt the following:

    a) Write a short note on : Doubly Ended queue. **[5]**

    b) Define queue. List its applications. **[5]**

    c) Name stable sorting methods (any two). **[2]**

    d) What are the advantage of doubly linked list. **[2]**

Q3) Attempt the following.

    a) List characteristics of Algorithm. **[5]**

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

    c) Represent following array interms of binary tree. **[2]**

0	1	2	3	4	5	6	7	8	9	10
A	B	C	D	E					F	G

    d) Define stack. What are the premitive operations m the stack? **[2]**

P.T.O.

Q4) Attempt the following:
   a) Write a short note on : Binary search tree. **[5]**
   b) Construct binary search tree for the following data-show the tree at each step. 33, 91, 30 31, 79, 84, 137 **[5]**
   c) What is the difference between complete and strictly binary tree? **[2]**
   d) Define linked list. Explain its node structure. **[2]**

Q5) Attempt the following:
   a) What do you mean by traversal? What are different types of traversals?**[5]**
   b) What are various methods of representing binary tree? Explain with example. **[5]**
   c) What is ADT? Give any two examples of Abstract Data Type (ADT):**[4]**

Q6) Attempt the following:
   a) Convert the following expression into postfix and then evaluate.
      A/B $ CD *E–A*C, A=4, B=3, C=2, D=1, E=2 **[5]**
   b) Write a function in C to count non leaf nodes in binary tree. **[5]**
   c) Write an algorithm for BFS traversal of a graph. **[4]**

Q7) Attempt the following:
   a) Consider the following adjacency matrix **[5]**

$$\begin{array}{c} \quad 1\ 2\ 3\ 4 \\ \begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \end{array}\left[\begin{array}{cccc} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{array}\right] \end{array}$$

   i) Draw the graph
   ii) Draw the adjacency list
   b) Write a short onte on : Heap sort. **[5]**
   c) Explain various types of graph with example. **[4]**

Q8) Attempt the following:
   a) Write a short note onstatic implementation of tree using arrays. **[5]**
   b) Write differences between stack & queue. **[5]**
   c) What is circular linked list? Explain. **[4]**

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SEAT No. :

[**Total No. of Pages : 2**]

[5922]-24

M.Sc. - I (I.M.C.A.)

MIM-204 : SOFTWARE ENGINEERING

(2019 Pattern) (Semester-II)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:
1) *Attempt any five out of 8.*
2) *Figures to the right indicate full marks.*

Q1) Attempt the following:

    a)   Explain Waterfall model in detail.   **[5]**

    b)   Discuss the components of Sequence diagram.   **[5]**

    c)   Define : i) Class ii) object.   **[2]**

    d)   What is the purpose of package?   **[2]**

Q2) Attempt the following:

    a)   What is Inheritance? Explain its types.   **[5]**

    b)   Write a short note on: Booch methodology.   **[5]**

    c)   Give any Two advantages of using UML.   **[2]**

    d)   Differentiate between user and actor.   **[2]**

Q3) Attempt the following:

    a)   What is UML? Explain its advantages in detail.   **[5]**

    b)   Distiguish between Aggregation and Generalization.   **[5]**

    c)   Define : i) Collaboration ii) Deployment.   **[2]**

    d)   What is meant by test Case?   **[2]**

Q4) Attempt the following:

    a)   Write a short note on: Object Oriented Testing.   **[5]**

    b)   What is an agile process? Explain any five principles to achieve agility.**[5]**

    c)   What is the use of extends relationship in use case diagram?   **[2]**

    d)   What is meant by interface? Explain with example.   **[2]**

Q5) Attempt the following:

    a)   What is Elaboration? State the significance of elaboration. **[5]**

    b)   What is the use of Component diagram? Explain it with suitable example.**[5]**

    c)   What is framework? Explain its benefits. **[4]**

Q6) Attempt the following:

    a)   What do you mean by an iterative development? Give its benefits. **[5]**

    b)   Write a short note on: Object Oriented Methodology. **[5]**

    c)   Explain the uses of class diagram. **[4]**

Q7) Attempt the following:

    a)   Explain how use case model helps in analysis phase from inception to elaboration. **[5]**

    b)   List and explain the stereo types used for modeling and interaction among objects. **[5]**

    c)   Explain forward and Reverse Engineering with suitable example. **[4]**

Q8) Attempt the following:

    a)   Consider ATM for banking system. Identify all the classes and draw a class diagram. **[5]**

    b)   Write a short note on : Understanding requirements. **[5]**

    c)   Explain any four notations of collaboration diagram. **[4]**

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[5922]-25

M.Sc. (IMCA)

MIM-205 : JAVA

(2019 Pattern) (Semester-II)

Time : 3 Hours]   *[Max. Marks : 70*

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

Q1) Attempt the following questions:

  a) Explain the meaning of each word of following line "Public static void main (String arys[ ])".   **[5]**

  b) Write a note on static members and static methods.   **[5]**

  c) When do we declare a method or class final? and Why?   **[2]**

  d) What are checked exceptions?   **[2]**

Q2) Attempt the following questions:

  a) Write a program to accept the details of items as item code, itemname and price. If price>9999 then throw exception as Overprice Exception and give proper message otherwise display item details define required exception class.   **[5]**

  b) Explain the concept of stream, stream classes and predefined streams.**[5]**

  c) Why swing objects are not called as heavy weight components? **[2]**

  d) Which method is used to specify containers layout? Write its syntax.**[2]**

Q3) Attempt the following questions:

  a) Explain the event handling mechanism in java in brief with help of an example?   **[5]**

  b) Explain any 5 components of AWT.   **[5]**

  c) Which stream is used to read primitive data from a file?   **[2]**

  d) Write a difference between throw and throws?   **[2]**

Q4) Attempt the following questions:

a) Explain the concept of dynamic binding with suitable example. **[5]**

b) Write a program to get a filename from command prompt. Check wheather a file given by given name exists. If file is regular file then display various details about file. But if it is directory then display the number of files in that directory. **[5]**

c) Explain the index of () method of string class with suitable example. **[2]**

d) What is use of keyword assert? Give syntax and suitable example. **[2]**

Q5) Attempt the following questions:

a) How to create and access package in java? Explain with suitable example.**[5]**

b) Explain different types of classes in Java. **[5]**

c) List any four methods of MouseListener interface. **[4]**

Q6) Attempt the following questions:

a) State advantages that Java's layout managers provide over traditional windowing systems. Explain any two layouts supported in swing. **[5]**

b) Explain the difference between string and string Buffer classes. **[5]**

c) Explain any four methods of object class. **[4]**

Q7) Attempt the following questions:

a) State the differences between AWT and saving. **[5]**

b) Write a java program that accepts username and password and throws exception "Invalid login" if they do not match. **[5]**

c) What is use of final keyword? Explain with suitable example. **[4]**

Q8) Attempt the following questions:

a) Explain AWT class hierarchy in detail. **[5]**

b) Write a java program to create an applet which contains a list of courses. Display the selected course in textbox. **[5]**

c) What is polymorphism? What are types of polymorphism? **[4]**

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[5922]-31

S.Y. M.Sc. (Industrial Mathematics with Computer Applications)
MATHEMATICS
MIM-301: Operational Research
(2019 Pattern) (Semester - III)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates :

  1) *Attempt any Five out of Eight questions given.*

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

Q1) a) Solve the following LPP by graphical method: **[5]**

   max z $= 15x_1 + 10x_2$

   subject to

   $$4x_1 + 6x_2 \leq 360$$
   $$3x_1 \leq 180$$
   $$5x_2 \leq 200$$
   $$x_1, x_2 \geq 0$$

  b) Explain Penalty Rule for Artificial Variables in Big M-Method.   **[5]**

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

  d) How do you identify alternative solution in assignment problem?   **[2]**

Q2) a) Reddy Mikks produces both interior and exterior paints from two raw materials M_1, M_2. The following table provides the basic data of problem:

	Tons of raw material per ton		
	Exterior paint	Interior paint	Max daily availability
Raw material, M_1	6	4	24
Raw material, M_2	1	2	6
Profit per ton ($1000)	5	4	

A market survey indicates that the daily demand for interior paint cannot exceed that for exterior paint more than 1 ton. Also, the maximum daily demand for interior paint is 2 tons. Reddy Mikks wants to determine the optimum (best) product mix of interior and exterior paints that maximizes the total daily profit? **[5]**

b) Find IBFS of the following Transportation Problem using Vogel's Approximation Method (VAM):

Origins	Destinations			Supply
	E	F	G	
A	5	1	8	12
B	2	4	0	14
C	3	6	7	4
Demand	9	10	11	

Is the solution Degenerate? Justify. **[5]**

c) Define Convex set. **[2]**

d) Explain the difference between Transportation and Assignment problems? **[2]**

Q3) a) Solve by listing all the possible solutions of the following Assignment Problem : **[5]**

	I	II	III
A	2	3	0
B	1	2	3
C	0	3	3

b) What are the steps in Revised Simplex Algorithm? **[5]**

c) Is dual of the dual a primal? Justify. **[2]**

d) Explain how degeneracy is located in Transportation problem. **[2]**

Q4) a) The following table gives the activities involved in a project and their duration.

Activity	Immediate Predecessors	Estimated duration
A	-	3
B	-	2
C	-	4
D	-	3
E	A, B	2
F	E	4
G	F	2
H	D	1
I	G, H	2
J	C, I	4

Draw the project network and find critical path. **[5]**

b) Find the initial basic feasible solution of the following Transportation problem by **[5]**

i) North-West Corner Method.

ii) Matrix-Minima Method.

iii) Which method gives better solution?

	I	II	III	Supply
A	1	5	7	10
B	6	4	6	80
C	3	2	5	15
Demand	50	20	50	

c) What is the basic difference between PERT and CPM? **[2]**

d) Write the LPP in Standard form. **[2]**

$$\max Z = x_1 + x_2$$

subject to

$$x_1 + 4x_2 \leq 5$$
$$x_1 + 4x_2 \leq 3$$
$$x_1, x_2 \geq 0$$

Q5) a) Explain Hungarian Method of an Assignment Problem. **[7]**

b) Use Two-Phase method to solve the LPP: **[7]**

Max $Z = 5x_1 + 8x_2$
subject to
$$3x_1 + 2x_2 \geq 3$$
$$x_1 + 4x_2 \geq 4$$
$$x_1 + x_2 \leq 5$$
and $x_1, x_2 \geq 0$

Q6) a) What is Balanced and Unbalanced Transportation Problem means? Explain with the help of an example. **[5]**

b) Use Simplex method to solve the LPP and comment on the solution. **[5]**
Max $Z = 8x_1 + 19x_2 + 17x_3$
subject to
$$3x_1 + 4x_2 + x_3 \leq 25$$
$$x_1 + 3x_2 + 3x_3 \leq 50$$
and $x_1, x_2, x_3 \geq 0$

c) Obtain the dual problem of the following LPP. **[4]**
Max $Z = x_1 + x_2 + x_3$
subject to
$$x_1 - 3x_2 + 4x_3 = 5$$
$$x_1 - 2x_2 \leq 3$$
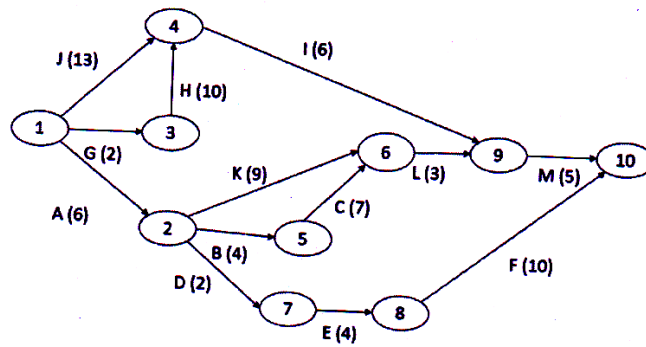$$2x_2 - x_3 \geq 4$$
and $x_1, x_2 \geq 0$ and x_3 unrestricted in sign.

Q7) a) Solve the following Assignment Problem for Maximization. **[5]**

	I	II	III	IV
A	42	35	28	21
B	30	25	20	15
C	30	25	20	15
D	24	20	16	12

[5922]-31   4

b) Determine the critical path for the project network in the following figure.**[5]**

c) Explain Method of Matrix-Minima with the help of an example. **[4]**

Q8) a) Use Branch and Bound Method to solve the Integer Programming Problem: **[7]**

Max $Z = 3x_1 + 5x_2$

subject to

$$2x_1 + 4x_2 \leq 25$$
$$x_1 \leq 8$$
$$2x_2 \leq 10$$
$$x_1, x_2 \geq 0 \text{ are integers.}$$

b) A salesman has to visit Five cities A, B, C, D and E. The distances (in hundred kilometers) between Five cities are given below. If the salesman starts from city A and has to come back to city A, which route should he select so that the total distance travelled is minimum? **[7]**

		To City				
		A	B	C	D	E
	A	-	1	6	8	4
From	B	7	-	8	5	6
City	C	6	8	-	9	7
	D	8	5	9	-	8
	E	4	6	7	8	-

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M.Sc.

MIM 302 : INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

Algebra

(2019 Pattern) (Semester - III)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:

1)   Attempt any FIVE out of the EIGHT questions given.

2)   Figures to the right indicate full marks.

Q1) Attempt each of the following :   **[14]**

a)   Let H be a non empty finite subset of a group G. Prove that H is a subgroup of G if and only if H is closed under the operation of G.   **[5]**

b)   Prove that every cyclic group is abelian. Is the converse true? Justify.
[5]

c)   Prove that identify in a group is unique.   **[2]**

d)   Find the number of generators in a cyclic group of order 30.   **[2]**

Q2) Attempt each of the following :   **[14]**

a)   Let G be a group and '*a*' be a fixed element of G. Prove that the mapping $\phi : G \rightarrow G$ defined by $\phi(x) = axa^{-1}$ is an automorphism of G.   **[5]**

b)   Prove that the number of elements in the Alternating group A_n is $\dfrac{n!}{2}$

$(n \geq 2)$.   **[5]**

c)   Let $\phi : (\mathbb{R}, +) \rightarrow (\mathbb{R}, +)$ be defined by $\phi(x) = |x|$. Is ϕ a group homomorphism? Justify.   **[2]**

d)   Find the order of each of the given permutations in S_6.   **[2]**

i)   (1 2) (1 3 4) (1 5 2)

ii)   (1 2 4 3) (3 5 2)

P.T.O.

Q3) Attempt each of the following :   **[14]**

    a)   Prove that every field is an Integral Domain. Is the converse true? Justify.
                                                                                   [5]

    b)   Let R be a ring with additive identity O. Prove that   **[5]**

          i) $a.O = O.a = O,\ \forall a \in R$

          ii) $a.(-b) = (-a).b = -(a.b),\ \forall a,\ b \in R$

          iii) $(-a).(-b) = ab,\ \forall a,\ b \in R.$

    c)   The set $\{\bar{0}, \bar{2}, \bar{4}\}$ under addition and multiplication modulo 6 has unity.
           Find it.   **[2]**

    d)   Find all zero divisors in the ring (Z_{12}, t_{12}, X_{12}).   **[2]**

Q4) Attempt each of the following :   **[14]**

    a)   Let R be a commutative ring with unity and S be an ideal of R. Prove that R/S is an Integral Domain if and only if S is a prime ideal.   **[5]**

    b)   Obtain the Field of Quotients of the Integral Domain

          $Z[i] = \{a + ib/a,\ b \in Z\}$.   **[5]**

    c)   In the ring of integers, find a positive integer 'a' such that   **[2]**

          i) $\langle a \rangle = \langle 2 \rangle + \langle 3 \rangle$

          ii) $\langle a \rangle = \langle 3 \rangle + \langle 6 \rangle$

    d)   Let ϕ be a homomorphism from a ring R to a ring S. If R has unity 1, $S \neq \{0\}$ and ϕ is onto, prove that $\phi(1)$ is the unity of S.   **[2]**

Q5) Attempt each of the following :   **[14]**

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

    b)   Let G be a group and Z(G) be the centre of G. If G/Z(G) is cyclic, prove that G is abelian.   **[5]**

    c)   Find the order of each element in the group $Z_2 \oplus Z_4$.   **[4]**

Q6) Attempt each of the following : **[14]**

a) Prove that a group of order 105 contains a subgroup of order 35. **[5]**

b) Let G be a finite group and p a prime that divides the order of G. Prove that G has an element of order p. **[5]**

c) If an ideal I of a ring R contains a unit, prove that I = R. **[4]**

Q7) Attempt each of the following : **[14]**

a) Let $f(x) = x^3 + 2x + 4$ and $g(x) = 3x + 2$ in $Z_5(x)$. Determine the quotient and remainder upon dividing $f(x)$ by $g(x)$. **[5]**

b) Prove that the product of two primitive polynomials is primitive. **[5]**

c) Show that $x^2 + 3x + 2$ has four zeros in Z_6. **[4]**

Q8) Attempt each of the following : **[14]**

a) In $Z[\sqrt{-5}]$, show that 21 does not factor uniquely as a product of irrducibles. **[5]**

b) Use Euclidean algorithm to find a gcd of $16 + 7i$ and $10 - 5i$ in $Z[i]$. **[5]**

c) In a Principal Ideal Domain, prove that every strictly ascending chain of ideals is of finite length. **[4]**

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SEAT No. :

[**Total No. of Pages : 2**

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M.Sc. (Industrial Mathematics with Computer Applications)
MIM- 303 : ADVANCED JAVA
(2019 Pattern) (Semester - III)

Time : 3 Hours] *[Max. Marks : 70*

Instructions to the candidates:

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

Q1) Attempt the following questions:

    a)   Explain JSP directives in detail. **[5]**

    b)   Explain servlet class hierarchy in detail. **[5]**

    c)   What is metadata? List types of metadata. **[2]**

    d)   What is main thread? What is its use? **[2]**

Q2) Attempt the following questions:

    a)   Explain in detail Type - 3 database drivers. **[5]**

    b)   Describe the linked list class in collection framework. **[5]**

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

        i)   Post   ii)   Socket

    d)   How to create new thread using thread class? **[2]**

Q3) Attempt the following questions:

    a)   What is use of vector class? Explain with example. **[5]**

    b)   How Row set extends result set? **[5]**

    c)   State the disadvantages of JDBC drivers. **[2]**

    d)   What is thread group? What is its use? **[2]**

Q4) Attempt the following questions:

a) Explain the design of JDBC in brief. **[5]**

b) What are servlet life cycle methods? Explain in detail. **[5]**

c) What are thread priorities? **[2]**

d) State different concurrency types of result set. **[2]**

Q5) Attempt the following questions:

a) What are advantages of servlet? Explain in detail. **[5]**

b) What is Hash set? Explain Hash set class in detail. **[5]**

c) Write a detailed note on result set. **[4]**

Q6) Attempt the following questions:

a) Write a program which accepts a word and directory name as command line argument and searches a word in each text file in directory. A separate thread is used for each file in directory. Display count of occurrence. **[5]**

b) Describe the steps to communicate with database. **[5]**

c) Write a note on Array list. **[4]**

Q7) Attempt the following questions:

a) What is list iterator? Brief with example. **[5]**

b) Explain any 5 methods of Tree set. **[5]**

c) What is use of socket class? Explain any 3 methods of socket class. **[4]**

Q8) Attempt the following questions:

a) Explain various methods used to execute queries in JDBC. **[5]**

b) Explain the concept of thread synchronization with example. **[5]**

c) What are steps used for creating server socket and client socket. **[4]**

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[5922]-34

M.Sc. (Semester-III)

(Industrial Mathematics With Computer Application)

MIM-304 : OPERATING SYSTEM

(2019 Pattern)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:

*1)   **Attempt any five out of Eight questions.***

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

Q1) Attempt each of the following: **[14]**

   a)   Explain the following computer - system architecture: **[5]**

      i)   Multiprocessor systems

      ii)   Clustered systems

   b)   Explain the following: **[5]**

      i)   Multilevel Queues

      ii)   Multilevel Feedback Queues

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

   d)   Explain the terms - logical address and physical address.   **[2]**

Q2) Attempt each of the following :   **[14]**

   a)   Explain any five types of system calls.   **[5]**

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

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

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

P.T.O.

Q3) Attempt each of following : **[14]**

a) Consider the following Snapshot of the system : **[5]**

Job	Arrival Time	Burst Time
J_1	0	5
J_2	1	7
J_3	2	4
J_4	3	11

Calculate average turn around time and average waiting time using SJF (non - preemptive) and Round robin (Time quantum=2).

b) Explain following deadlock detection techniques : **[5]**

i) Single instance of each resource type.

ii) Several instance of a resource type.

c) Define - context switch. **[2]**

d) What is demand paging? **[2]**

Q4) Attempt each of the following : **[14]**

a) Explain dining philosophers problem. **[5]**

b) Explain any two file allocation methods. **[5]**

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

d) Give any two advantages of clustered systems. **[2]**

Q5) Attempt each of the following : **[14]**

a) Consider the following Snapshot of the system : **[5]**

	Allocation			Max			Total		
	A	B	C	A	B	C	Resource		
							A	B	C
P_0	2	8	5	3	10	6			
P_1	2	2	3	3	4	3	0	2	1
P_2	3	2	2	3	7	8			
P_3	1	3	3	1	2	3			
P_4	3	3	4	3	8	7			

Answer the following questions :

i) What are the contests of Need matrix?

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

b) Explain any fire Kernel I/o subsystems. **[5]**

c) Write a note on following operations of Processes : **[4]**

i) Process creation

ii) Process Termination

Q6) Attempt each of the following : **[14]**

a) How many page faults occur using LRU and optimal replacement algorithm for the following page reference string with three page frames : **[5]**

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

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

c) Write a note on remote file system. **[4]**

Q7) Attempt each of the following : **[14]**

a) Discuss the following points of free space management : **[5]**

i) bit vector

ii) grouping

b) State and explain in brief, different services provided by an operating system. **[5]**

c) i) Define - Dispatcher Latency Time **[4]**

ii) What is waiting time and response time.

Q8) Attempt each of the following : **[14]**

a) Suppose that a disk drive has 200 cylinders numbered 0 to 199. The drive is currently serving at cylinder 125 and the pending request queue is 86, 147, 91, 170, 95, 130, 102, 70 starting from the current head position. What is the total distance that the disk arm moves to satisfy all the pending requests for each of the following disk scheduling algorithms: **[5]**

   i)   SCAN   ii)   SSTF

b) What is the process? Explain the various states of process. Also draw the neat diagram of process state transition. **[5]**

c) What is the resource allocation graph? Draw resource allocation graph for the following sets : **[4]**

   $P=\{P_1, P_2, P_3\}$ $R=\{R_1, R_2, R_3\}$

   $E=\{P_1 \rightarrow R_1, P_2 \rightarrow R_3, R_3 \rightarrow R_1, R_1 \rightarrow P_2, R_2 \rightarrow P_3\}$

   Resource instances of $R_1=2$, $R_2=3$ $R_3=2$.

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[5922]-35

M.Sc. (Industrial Mathematics With Computer Application)
MIM 306 : COMPUTER NETWORKS
(2019 Pattern) (Semester - III)

Time : 2 Hours] *[Max. Marks : 70*

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

Q1) Attempt the following.

a) With a schematic diagram explain the OSI reference model. Also enlist the responsibilities of each of the layers. **[5]**

b) Define the following terms: **[5]**

   i) Phase

   ii) Bandwidth

   iii) Wavelength

   iv) Frequency

   v) Baud rate

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

d) What is a DC component? **[2]**

Q2) Attempt the following.

a) What is the need of network address translation? How NAT router maintains translation table. **[5]**

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

c) Calculate hamming distance of codes 00000, 10100, 01011, 11110. **[2]**

d) Consider a noiseless channel with a bandwidth of 3000Hz transmitting a signal of two levels. What will be the maximum data rate? **[2]**

Q3) Attempt the following.

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

  b)   Compare virtual circuits with datagrams.   **[5]**

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

  d)   Find the error if any in the following IPv4 address: **[2]**

     i)   11000110.23,14.67.

     ii) 193.131.268.20.

Q4) Attempt the following.

  a)   What is pipelining? Discuss the Go Back n Protocol.   **[5]**

  b)   Explain 1 bit sliding window protocol with its advantages and
       disadvantages.   **[5]**

  c)   State optimality principle.   **[2]**

  d)   What is tunneling?   **[2]**

Q5) Attempt the following.

  a)   What do you mean by transmission impairment? Explain the following.**[5]**

     i)   Attenuation

     ii) Distortion

  b)   Explain the difference between circuit switching and packet switching.**[5]**

  c)   Explain mesh and star topology.   **[4]**

Q6) Attempt the following.

  a)   Write a note on process to process delivery.   **[5]**

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

  c)   What is congestion? Discuss data link layer policies to avoid congestion.
                                                                               [4]

Q7) Attempt the following.

    a)   Write a note on remote procedure call. **[5]**

    b)   Explain the bluetooth architecture with a neat diagram. **[5]**

    c)   Construct CRC message for the bit stream 10011101 where generator polynomial is x^3+1. **[4]**

Q8) Attempt the following.

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

    b)   Compare fiber optic with copper wire. **[5]**

    c)   Explain the concept of piggybacking. Discuss the advantages and disadvantages of piggybacking. **[4]**

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[5922]-36

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

MIM - 307 : R PROGRAMMING FOR BASIC DATA ANALYSIS

(2019 Pattern) (Semester - III)

Time : 2 Hours]   *[Max. Marks : 35*

Instructions to the candidates:

1) All questions are compulsory.

2) Figures to the right indicate full marks.

3) Symbols and abbreviations have their usual meaning.

Q1) **Attempt any Five questions out of Seven questions.**   **[5]**

a)   Write syntax of if else in R.

b)   Write any 2 math functions in R.

c)   What is the use of legend() function?

d)   Create a 3-dimensional array in R.

e)   Write applications of R programming.

f)   Find the minimum and maximum for 14, 23, 16, 20, 0, –17, 100.

g)   Explain the importance of dataframe?

Q2) **Attempt any Two questions out of Three questions.**   **[10]**

a)   Explain linear algebra operations on vectors and matrices.

b)   Explain in detail about dataframe and arrays with example R code.

c)   Explain about text() and locator() functions with examples.

P.T.O.

Q3) **Attempt any Two questions out of Three questions.** **[10]**

   a) Write R function to check whether the given number is prime or not.

   b) Explain the functioning of apply() and sapply() in a R program with one example.

   c) Discuss about loops in R programming with examples.

Q4) **Attempt any One questions out of Two questions.** **[10]**

   a) Write R program to create pie chart for the following data

   Housing ---------- 600

   Food ----------300

   Clothes ---------150

   Entertainment ------ 100

   Others ----------- 200

   b) The maximum temperature in celcius in a week is given as (35, 42, 38, 25, 28, 36, 40). Draw the bar plot for the given data. Also use legend function to describe hists.

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[5922]-41

M.Sc. (Industrial Mathematics with Computer Applications)
MIM 401 : DIFFERENTIAL EQUATIONS
(2019 Pattern) (Semester - IV)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:

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

Q1) a)   Consider the two functions $f(x) = x^3$ and $g(x) = x^2|x|$ on the interval $[-1,1]$.   **[5]**

      i)   Show that the wronskian w(f,g) vanishes identically.

      ii)   Show that *f* and *g* are not linearly dependent.

    b)   Suppose Φ is any solution of Bessel's equation $x^2y'' + xy' + x^2 y = 0$ for $x > 0$ and $\Psi(x) = x^{1/2}\phi(x)$. Show that Ψ satisfies the equation $x^2 y'' + \left(x^2 + \dfrac{1}{4}\right)y = 0$ for $x > 0$.   **[5]**

    c)   Verify that , $y_1 = C_1e^{-x} + C_2 5e^{-x}$ is a general solution of the equation $y'' - 2y' + y = 0$.   **[2]**

    d)   Find the general solution of the following differential equation $y' = 2xy^2$.**[2]**

Q2) a)   Solve Legendre's equation using power series.   **[5]**

    b)   Find the indicial equation and its roots for the differential equation.   **[5]**

      $x^3y'' + (\cos 2x - 1)\, y' + 2xy = 0$.

    c)   Define Lipschitz's condition.   **[2]**

    d)   Show that, the two functions $\sin 2x$ and $\cos 2x$ are linearly independent solutions of $y'' + 4y = 0$.   **[2]**

Q3) a) Solve $(2x-1)^2 \dfrac{d^2y}{dx^2} + (2x-1)\dfrac{dy}{dx} - 2y$ **[5]**

$= 8x^2 - 2x + 3$.

b) Prove that if P_1, P_2, P_3, P_4 are polynomials of degree two, then they are linearly dependent on $-\infty < x < \infty$. **[5]**

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

d) Show that $y^2 = e^{2x} + C$ is a solution of differential equation $yy' = e^{2x}$. **[2]**

Q4) a) Find a perticular solution of the following differential equation

$\dfrac{d^2y}{dx^2} - 3\dfrac{dy}{dx} + 2y = 0$; $y(0) = 1$ and $y'(0) = 0$. **[5]**

b) Find the general solution of the following system

$\dfrac{dx}{dt} = x - 2y$, $\dfrac{dy}{dt} = 4x + 5y$. **[5]**

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

d) Find the solution of the initial value problem, $y' = e^y 5^x$, $y(0) = \log(\log 5)$. **[2]**

Q5) a) Prove that, a function ϕ is solution of the initial value problem $y' = f(x,y)$, $y = (x_0) = y_0$ on an interval I if and only if it is a solution of the integral

equation. $y = y_0 + \displaystyle\int_{x_0}^{x} f(t, y)\,dt$ on I **[5]**

b) Find singular point of the following equation and determine whether it is a regular singular point. $(1-x^2)y'' - 2xy' + 2y = 0$. **[5]**

c) Consider initial value problem, $y' = y^2$, $y(0) = 0$ then compute first four approximations ϕ_0, ϕ_1, ϕ_2, ϕ_3 of the solution. **[4]**

[5922]-41   2

Q6 a) Let ϕ be the vector-valued function defined for all real x by, $\phi(x) = (x, x^2, ix^4)$. compute, **[5]**

i) $\phi'(x)$, $\phi'(2)$

ii) $\int_{-1}^{1} \phi(x) dx$

b) Prove that, solutions ϕ_1, ϕ_2, of L(Y) are linearly independent on an interval I, if and only if $W(\phi_1, \phi_2) \ x \neq 0$ for all x in I. **[5]**

c) Find a solution ϕ of the following system, **[4]**

$y_1' = y_1,$

$y_2' = y_1 + y_2$

Which satisfies $\phi(0) = (1,2)$.

Q7) a) Consider the following system, **[5]**

$y_1' = y_1 + \in y_2$

$y_2' = \in y_1 + y_2$

Where, $\in > 0$

Then show that, every solution exists for all real x.

b) Find the general solution of the following equation $x > 0$. **[5]**
$x^3 y''' + 2x^2 y'' - xy' + y = 0$

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

Q8) a) Consider Euler's equidimensional equation $x^2 y'' + pxy' + qy = 0$ where p,q are constants. Show that, the change of independent variable given by $x = e^z$, transforms it into an equation with constant coefficients. **[5]**

b) Show that there is a basis $\{\phi_1, \phi_2\}$ for the solutions of

$x^2 y'' + 4xy' + (2 + x^2) y = 0 \ (x > 0)$ of the form $\phi_1(x) = \dfrac{\Psi(x)}{x^2}, \phi_2(x) = \dfrac{\psi(x)}{x^2}$.

[5]

c) Find the general solution of the following equation $y''' - y' = x$. **[4]**

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[5922]-42

M.Sc. (Industrial Mathematics with Computer Applications)
MIM - 402 : STATISTICAL METHODS
(2019 Pattern) (Semester - IV)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:

1) *Attempt any five questions out of eight questions.*
2) *Figures to the right indicate full marks.*
3) *Scientific calculators and statistical tables are allowed.*

Q1) a)   Describe paired t-test for the difference of means.   **[5]**

b)   Find the correlation coefficient for given data.   **[5]**

X	8	10	15	11	12	9	13	14	10	9
Y	45	55	70	80	65	70	90	90	76	67

c)   A die is loaded in such a way that an even number is twice as likely to occur as an odd number. If E is the event that a number less than 4 occurs on a single toss of the die. Find P(E).   **[2]**

d)   Write down R - code if $X \rightarrow N$ ($\mu = 50$, $\sigma^2 = 15$).

Find k such that (i) $P[X \geq k] = 9$ (ii) $P[X < k] = 0.01$.   **[2]**

Q2) a)   Describe one sample mean tests for a small sample space.   **[5]**

b)   Show that for continuous random variables X and Y with means μ_X and μ_Y, respectively and Covariance σ_{XY}, we have $\sigma_{XY} = E(XY) - \mu_X \mu_Y$.   **[5]**

Further, let $f(x, y) = \begin{cases} 8xy, & 0 \leq y \leq x \leq 1; \\ 0, & \text{elsewhere.} \end{cases}$

Show that $f(x, y)$ is joint probability density function

Find E(X), E(Y).

P.T.O.

c) Write down R-code if $X \rightarrow P (\lambda = 2.3)$. Find **[2]**

  i) $P[X > 2]$

  ii) $P[3 \le X \le 5]$.

d) Suppose X and Y are two vectors containing elements, 1,3,2 and 0,7,6,1 respectively. Write down R-code and output for **[2]**

  i) Augment X by adding Y to the left.

  ii) Augment Y by adding elements 4,3,5 at the end.

Q3) a) Derive moment generating function for the standard Normal random variable X. **[5]**

b) A special types of fertilizer was used in four agricultural field A, B, C and D. Each field was divided into four beds and fertilizer was applied over them. The respective yields of the beds of four fields are given below. Find whether the difference in the mean yields of fields is significant or not. **[5]**

A	B	C	D
8	9	3	3
12	4	8	7
1	7	2	8
9	1	5	2

c) Write down R-code if $X \rightarrow B (5, 0.2)$. Find (i) $P[X \le 2]$ (ii) $P[X > 0]$. **[2]**

d) Write down R-code to find the correlation coefficient between A and B.

  A : 34 56 78 21 45 32 78 53 65 54

  B : 32 45 62 27 49 59 90 76 43 65

  [2]

Q4) a) Describe chi-square test for the independence of attributes. **[5]**

b) If the density of the normal random variable X is

$$n(x;\ \mu,\ \sigma) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}, -\infty < x < \infty.$$ Prove that $E[X] = \mu$ and

Variance $= \sigma^2$. **[5]**

c) Write down R-code with output to create a vector X with elements 1,5,2,3,7,6,8 and create vector $y = x^2$, $z = 1/x$. **[2]**

d) How many different arrangements can be made from the letters in the word STATISTICS? **[2]**

Q5) a) Describe two sample proportion test for large sample space. **[5]**

b) Let X be a uniform random variable on interval [a,b]. Write down the probability density function for X and find mean and variance of X. **[5]**

c) Three cards are drawn in succession, without replacement, from an ordinary deck of playing cards. Find the probability that the event $A_1 \cap A_2 \cap A_3$ occurs, where A_1 is the event that the first card is a red ace, A_2 is the event that the second card is a 10 or a jack, and A_3 is the event that the third card is greater than 3 but less than 7. **[4]**

Q6) a) Describe two sample mean test for large sample space. **[5]**

b) In a shooting competition, the probability of a man hitting a target is 1/5. If he hits the target for 5 times, what is the probability of hitting the target? **[5]**

   i) Only two times

   ii) At least 2 times

   iii) Atmost two times

c) Prove that :- If the events B_1, B_2, ..., B_k constitute a partition of the sample space S such that $P(B_i) \neq 0$ for $i = 1,2, ...k$, then for any event A of S, $P(A) = \sum_{i=1}^{k} P(B_i \cap A) = \sum_{i=1}^{k} P(B_i)P(A \mid B_i)$. **[4]**

Q7) a) Prove that for a Poisson random variable, Mean = Variance. **[5]**

b) Let the random variable X represent the numebr of automobiles that are used for official business purposes on any given workday. The probability distribution for company A is **[5]**

x	1	2	3
$f(x)$	0.3	0.4	0.3

and that for company B is

x	0	1	2	3	4
$f(x)$	0.2	0.1	0.3	0.3	0.1

Show that the variance of the probability distribution for company B is greater than that for company A.

c)   The probability that a regularly scheduled flight departs on time is $P(D) = 0.83$; the probability that it arrives on time is $P(A) = 0.82$; and the probability that it departs and arrives on time is $P(D \cap A) = 0.78$. Find the probability that a plane i) arrives on time, given that it departed on time, and ii) departs on time, given that it has arrived on time.   **[4]**

Q8) a)   Given a random variable X having a normal distribution with $\mu = 50$ and $\sigma = 10$, find the probability that X assumes a value between 45 and 62.
   [5]

b)   Describe two-way Annova table.   **[5]**

c)   If a car agency sells 50% of its inventory of a certain foreign car equipped with side airbags, find a formula for the probability distribution of the number of cars with side airbags among the next 4 cars sold by the agency. Find the cumulative distribution function of the random variable X.   **[4]**

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[5922]-43

M.Sc. (IMCA) (Semester - IV)
MATHEMATICS
MIM-403 : Design and Analysis of Algorithms
(2019 Pattern)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) **Answer the following :**

a) How Strassen's Matrix Multiplication works? What is the recurrence relation? Multiply the below matrices using Strassen's Matrix Multiplication method.

$$A = \begin{bmatrix} 1 & 3 \\ 5 & 7 \end{bmatrix} \quad B = \begin{bmatrix} 8 & 4 \\ 6 & 2 \end{bmatrix}$$

[5]

b) Perform Merge sort on the numbers given: 14,7,3,12,9,11,6,2 **[5]**

c) What are the applications of dynamic programming problem? **[2]**

d) How the Performance of an algorithm is analyzed? **[2]**

Q2) **Answer the following :**

a) Find an optimal solution to the knapsack instances n = 5 w = 60 kg

weight = (5, 10, 15, 22, 25) Profit = (30, 40, 45, 77, 90) **[5]**

b) Apply Quick sort on the following numbers : **[5]**

9, 7, 5, 11, 12, 2, 14, 3, 10, 6

c) Define Bio 'Oh' Notations with example. **[2]**

d) Find the time complexity of the recurrence relation: T(n)=T(n−1) +1**[2]**

P.T.O.

Q3) **Answer the following :**

a) Consider the jobs, their deadlines and associated profits as shown: **[5]**

Jobs	J1	J2	J3	J4	J5	J6
Deadlines	5	3	3	2	4	2
Profits	200	180	190	300	120	100

Find the optimal schedule that gives maximum profit.

b) Write the Matrix-chain Multiplication Algorithm. **[5]**

c) Find the time complexity for the following code. **[2]**

int recursive (int n)

{

    if(n==1)

    then return 1;

    else

    return recursive(n-1)+recursive(n-1)

}

d) List out the areas where Convex Hull can be used? **[2]**

Q4) **Answer the following :**

a) Given the program lengths L = {5,10,3}. Store them on three taps and minimize MRT. **[5]**
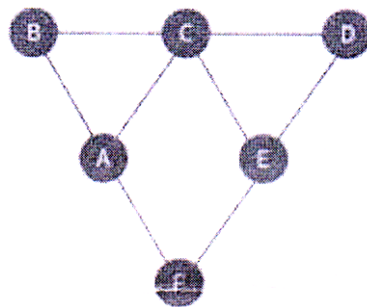
b) Consider the given files, f_1, f_2, f_3, f_4 and f_5 with 20,30,10,5,30 number of elements respectively. Find the optimal merge pattern. **[5]**

c) What is the principle of optimality? **[2]**

d) What is the worst case and best-case time complexity of Quick sort method. **[2]**
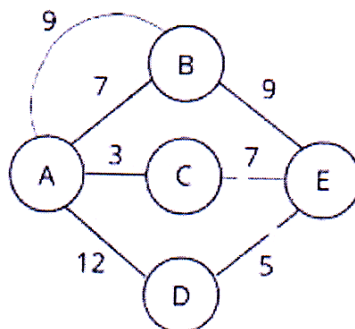
Q5) **Answer the following :**

a)   Find the minimum spanning tree from a graph using Prim's Algorithm.

[5]

b)   Explain Tree Vertex Splitting with one example.   [5]

c)   Write a Graham's scan algorithm.   [4]

Q6) **Answer the following :**

a)   Find the minimum spanning tree from a graph using Kruskal's Algorithm.   [5]

b)   Show that the Time Complexity of Matrix Chain Multiplication problem is $O(n^3)$.   [5]

c)   Explain Time complexity of Binary search algorithm with one example.

[4]

Q7) **Answer the following :**

a)   Write a note on Convex Hull.   [5]

b)   Explain Dynamic Programming strategy / approach.   [5]

c)   Write a note on String Editing.   [4]

Q8) **Answer the following :**

    a)   Explain in brief single source shortest path with an example.   **[5]**

    b)   Explain the General method of Greedy approach with example.   **[5]**

    c)   Construct a Huffman Tree for the given frequencies and find the codes for each character. Character (a, e, i, o, u, s, t) frequencies (10,15,12,3,4,13,1)   **[4]**

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PA-3463

[5922]-44

M.Sc. (Industrial Mathematics with Computer Applications)
MIM- 404 : INTERNET PROGRAMMING
(2019 Pattern) (Semester - IV)

Time : 3 Hours]   *[Max. Marks : 70*

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 various types of data types supported by PHP. **[5]**

b) State any five features of XML. **[5]**

c) State True/False. Justify "XML is a replacement of HTML". **[2]**

d) What is session? **[2]**

Q2) Attempt the following.

a) Write a short note on: Introspection. **[5]**

b) Write a short note on: XML parsess. **[5]**

c) What is the purpose of $ this variable? **[2]**

d) State the syntax and example of define ( ) function supported by PHP. **[2]**

Q3) Attempt the following.

a) Explain different ways of printing strings, supported by PHP. **[5]**

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

c) Explain the concept of variable interpolation? **[2]**

d) What is the difference between soundex ( ) and metaphene ( ) function in PHP? **[2]**

P.T.O.

Q4) Attempt the following.

    a)   Explain reading and writing file with suitable example. Also explain modes of files. **[5]**

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

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

    d)   Explain array- slice ( ) function with syntax and example. **[2]**

Q5) Attempt the following:

    a)   What is array? Explain types of arrays supported by PHP in detail (with examples) **[5]**

    b)   Write a short note on: RE in PHP. **[5]**

    c)   Explain XML document structure in detail. **[4]**

Q6) Attempt the following:

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

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

    c)   Explain the concept of constructor and destructor in detail with example. **[4]**

Q7) Attempt the following:

    a)   Explain various functions used to handle files and directories in PHP. **[5]**

    b)   Write a PHP script to find UNION of two arrays. **[5]**

    c)   Explain the statements supported by PHP for traversing array elements. Give example. **[4]**

Q8) Attempt the following:

    a)   Write a PHP script to accept two files and append second file to first file. **[5]**

    b)   Explain array stack function with suitable example. **[5]**

    c)   Explain various string searching functions supported by PHP. **[4]**

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M.Sc. (Industrial Mathematics with Computer Application)
MIM-405 - Mobile Technologies
(2019 Pattern) (Semester-IV)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates :
  1) *Attempt any <u>Five</u> out of Eight questions given.*
  2) *Figures to the right side indicate full marks.*

Q1) **Attempt the following questions:**

  a) Write applications of mobile computing in detail.   **[5]**

  b) Discuss layered architecture of iOS.   **[5]**

  c) How wireless networks are useful for business purpose?   **[2]**

  d) Define the term "Toast".   **[2]**

Q2) **Attempt the following questions:**

  a) Explain different types of layouts in android.   **[5]**

  b) What are different phone services? Explain call service in detail. **[5]**

  c) What is the use of run-OnUithread ( ) method?   **[2]**

  d) What are disadvantages of Swift?   **[2]**

Q3) **Attempt the following questions:**

  a) Explain the features of android.   **[5]**

  b) Discuss location based services in detail.   **[5]**

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

      i)   Bounded service

      ii) Unbounded service

  d) What is the use of Dalvik Virtual Machine?   **[2]**

P.T.O.

Q4) **Attempt the following questions:**

   a)   What is Broadcast receiver? Explain in detail.   **[5]**

   b)   Explain Base adapter with example.   **[5]**

   c)   What is Content Provider?   **[2]**

   d)   What is use of Event Handler?   **[2]**

Q5) **Attempt the following questions:**

   a)   Write a code for android application which will display " welcome to android!" Message on Screen.   **[5]**

   b)   Explain pop-up menu with example?   **[5]**

   c)   What is difference between android libraries and android runtime?   **[4]**

Q6) **Attempt the following questions:**

   a)   What is notification? Explain different methods used for creating notification?   **[5]**

   b)   Explain any five methods of JSON array.   **[5]**

   c)   Why we use phonegap? Explain in Brief   **[4]**

Q7) **Attempt the following questions:**

   a)   Write a code for android application having rating bar on screen. Create appropriate UI to display rating given by user on same screen.   **[5]**

   b)   Explain the concept of mobility and portability with example.   **[5]**

   c)   Discuss different types of event handlers   **[4]**

Q8) **Attempt the following questions:**

   a)   Explain alarm and toast with example.   **[5]**

   b)   What are types of intents? Explain with example.   **[5]**

   c)   Explain different android form widgets   **[4]**

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[5922]-51

M.Sc. - III

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 501 : Numerical Analysis
(2019 Pattern) (Semester - V)

Time : 3 Hours]   *[Max. Marks : 70*

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 calculators is allowed.*

Q1) a) Use the false position method to determine the roots of the equation $x\log x - 1.2 = 0$ correct up to 3 decimal places. **[5]**

   b) Estimate the root of the equation $x^3 - 2x - 5 = 0$ between $x_0 = 2$ and $x_1 = 3$ upto 4 decimal places using Newton Raphson Method. **[5]**

   c) Find the absolute error and relative error in the approximation of $x = 3.1428571$ and $\bar{x} = 3.14$. **[2]**

   d) Find the root of equation $x^3 - x - 3 = 0$ using bisection method which lies in the interval $[1, 2]$. (Perform 2 iterations). **[2]**

Q2) a) Construct the difference table from the following data and hence Find $f(50.5)$; $f(50) = 39.1961, f(51) = 39.7981, f(52) = 40.3942, f(53) = 40.9843, f(54) = 41.5687.$ **[5]**

   b) Find a root correct to three decimal places lying between $[0, 1]$ of the equation $e^x - 3x = 0$ by using bisection method. **[5]**

   c) Is the following system consistent? **[2]**

$$4x_1 - x_2 + 2x_3 + 3x_4 = 20$$

$$7x_3 - 4x_4 = -7$$

$$3x_3 + \frac{5}{4}x_4 = 2$$

$$2x_4 = 4.$$

d) Define: **[2]**

   i) Eigen Values

   ii) Eigen vector

Q3) a) State and prove 'composite trapezoidal rule'. **[5]**

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

   $4x - y + z = 7$

   $4x - 8y + z = -21$

   $-2x + y + 5z = 15$

   Consider $(x_0, y_0, z_0) = (1, 2, 2)$

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

   d) Define: **[2]**

   i) Simpson's $\left(\dfrac{1}{3}\right)^{rd}$ Rule

   ii) Simpson's $\left(\dfrac{3}{8}\right)^{th}$ Rule

Q4) a) Assume that $f \in C^3 [a, b]$ and that $x - h, x, x + h \in [a, b]$.

   Prove that $f'(x) \approx \dfrac{f(x+h) - f(x-h)}{2h}$. **[5]**

   b) Find the inverse of the matrix $\begin{bmatrix} 2 & 0 & 1 \\ 3 & 2 & 5 \\ 1 & -1 & 0 \end{bmatrix}$. **[5]**

   c) Round off the following numbers to four significant digits. **[2]**

   i) 0.467268

   ii) 40.0468

d) Find the Jacobian matrix J(x, y, z) at point (1, 2, 3) for functions,

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

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

$$f_3(x, y, z) = \frac{y}{xz}.$$ [2]

Q5) a) Find the Eigen vectors of the matrix $A = \begin{bmatrix} 3 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 3 \end{bmatrix}$. [5]

b) Using Lagrange's Interpolation method to find $f(3)$ from the following data. [5]

x	0	1	2	4
f(x)	3	2	7	59

c) If $P_n = \frac{1}{2^n}$ then using Aitken Δ^2 process show that $q_n = 0, \forall\ n$. [4]

Q6) a) Apply Runge Kutta method of order 4 to find a solution to the initial value problem $\frac{dy}{dx} = \frac{x-y}{z}$ with $y(0) = 1$ at $x = 0.5$. (Take $h = 0.5$). [5]

b) Find the polynomial of lowest degree which passes through the points (1, 6), (2, 11), (3, 18), (4, 27). [5]

c) Determine the degree of Precision of Simpson's $\frac{3}{8}^{th}$ rule. [4]

Q7) a) Calculate the approximate value of $\int_0^1 \dfrac{1}{1+x^2} dx$ by using Simpson's one third rule. Take $h = 0.25$. **[5]**

b) Solve $\dfrac{dy}{dx} = x + 2y$, with the initial condition $y(0) = 0$. Find $y(0.1)$, $y(0.2)$ and $y(0.3)$ by Euler's method. **[5]**

c) Discuss the Newton Cotes integration formula. **[4]**

Q8) a) Solve the following system of linear equations using L-U decomposition. **[5]**

$3x + 2y + 4z = 7$

$2x + y + z = 7$

$x + 3y + 5z = 2$

b) Use the power method to find the dominant eigenvalue and eigenvector

for the matrix $A = \begin{bmatrix} 0 & 11 & -5 \\ -2 & 17 & -7 \\ -4 & 26 & -10 \end{bmatrix}$. **[5]**

c) Find $\int_0^1 1 + e^{-x} \sin(4x) \, dx$ using Boole's Rule. **[4]**

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[5922]-52

M.Sc. (Industrial Mathematics with Computer Applications)
MATHEMATICS
MIM - 502 : Computational Geometry
(2019 Pattern) (Semester - V)

Time : 3 Hours]   *[Max. Marks : 70*

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

Q1) Attempt each of the following.

  a) In two dimensional space, derive the transformation matrix for rotation about the origin through an angle 'θ'. **[5]**

  b) If the 2×2 transformation matrix transforms the points P and Q to the points P* and Q*, then prove that the same transformation transforms the midpoint of the line segment PQ to the midpoint of the line segment P*Q*. **[5]**

  c) Obtain the transformation matrix for shearing in both 'x' and 'y' direction by –1 and 2 units respectively. **[2]**

  d) State any two properties of Bezier curves. **[2]**

Q2) Attempt each of the following.

  a) If a transformation matrix $[T] = \begin{bmatrix} 2 & -1 \\ -2 & 1 \end{bmatrix}$ is used to transform the intersecting lines $x + 2y = 2$ and $x - y = 4$, then find the point of intersection of the transformed lines. **[5]**

  b) Describe an algorithm to reflect an object through an arbitrary line in the xy plane. **[5]**

c) Suppose the line segment between the points A[2, 1] and B[–3, 3] is transformed to the line segment A*B* using the transformation matrix

$$[T] = \begin{bmatrix} -1 & 1 \\ 2 & 1 \end{bmatrix}$$, then find the slope of A*B*. **[2]**

d) If a 2×2 transformation matrix, $[T] = \begin{bmatrix} 2 & -3 \\ 2 & -1 \end{bmatrix}$ is applied to the circle of

radius 2 units, then find the area of the resulting figure. **[2]**

Q3) Attempt each of the following.

a) Find the concatenated transformation matrix to first translate an object in y direction by –3 units and then rotate about the origin through an angle – 65°. **[5]**

b) Reflect the point P [–5, 3] through the line x = 2 and find the new coordinates of the point. **[5]**

c) Define affine linear transformation. **[2]**

d) The line segment A [3, 4], B [5, 6] is transformed to the line segment

A* B* by the transformation matrix $[T] = \begin{bmatrix} 2 & 1 \\ 1 & 4 \end{bmatrix}$. Find the midpoint of

A*B*. **[2]**

Q4) Attempt each of the following.

a) The triangle ABC with vertices A [3, –1], B [4, 2], C [2, 1] is first rotated through 90° about the origin and then reflected through Y axis. Find the vertices of the transformed triangle. **[5]**

b) Show that the combined two dimensional transformation, first reflection about X axis and then about the line $y = –x$ is identical to rotation about origin by an angle θ = 270°. **[5]**

c) Write the transformation matrix for shearing in '*z*' coordinate proportional to '*x*' coordinate by a factor 2 and proportional to '*y*' coordinate by a factor 3. **[2]**

d) Write the transformation matrix for translation in '*x*' coordinate by – 2 units, '*y*' coordinate by 5 units and in '*z*' coordinate by 4 units. **[2]**

Q5) Attempt each of the following.

   a)   Obtain the concatenated transformation matrix for the following successive transformations. **[5]**

       i)   Translate in '*x*', '*y*', '*z*' direction by 2, 3, 5 units respectively.

       ii)   Shearing in '*x*' coordinate by a factor of 2 units proportional to '*z*' coordinate.

       iii)   Reflection in yz plane.

   b)   Write an algorithm to rotate an object through an angle θ about the local axis passing through a point A. **[5]**

   c)   Develop the transformation matrix to reflect through the plane passing through the point A $[x_0, y_0, z_0]$ and parallel to the yz plane. **[4]**

Q6) Attempt each of the following.

   a)   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 the angle of rotation about the *y* axis say '$-\beta$' so that the line coincides with the '*z*' axis. **[5]**

   b)   Determine the principal foreshortening factors if the matrix for axonometric projection is given by **[5]**

$$[T] = \begin{bmatrix} 0.99 & 0 & 0 & 0 \\ -0.09 & -0.66 & 0 & 0 \\ 0.08 & -0.74 & 0 & 0 \\ -2.5 & 3.05 & 0 & 1 \end{bmatrix}.$$

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

Q7) Attempt each of the following.

   a)   State any five properties of perspective projection. **[5]**

   b)   Generate 8 uniformly spaced points on the circle $x^2 + y^2 = 1$. **[5]**

   c)   Write the transformation matrices for four isometric projections. **[4]**

Q8) Attempt each of the following. **[14]**

   a) Generate five points of the parabolic segment $y^2 = 8x$ in the first quadrant for $4 \le y \le 20$. **[5]**

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

   c) Write the parametric equation of the Bezier curve with control points B_0 [–1, –1], B_1 [2, 3] and B_2 [4, 0]. Find the position vector of the point on the curve corresponding to parameter value 0.1. **[4]**

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[5922]-53

M.Sc. - III (Industrial Mathematics with Computer Applications)
MIM - 503 : DATA ANALYSIS WITH PYTHON
(2019 Pattern) (Semester - V)

Time : 3 Hours]   *[Max. Marks : 70*

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)   Define function. Write its advantages.   **[5]**

   b)   Give the Syntax for control statements supported by python. Illustrate
        with examples. (any two)   **[5]**

   c)   Explain how the elements of the list reversed?   **[2]**

   d)   What is class? State the syntax of define a class.   **[2]**

Q2) Attempt the following:

   a)   Define the Pandas. List significant features of Pandas Library. **[5]**

   b)   Write a short note on : Python Data types.   **[5]**

   c)   What is string? Explain how subset of a string can be obtained with
        proper example.   **[2]**

   d)   What is anonymous function? Explain with syntax and example.   **[2]**

Q3) Attempt the following:

   a)   Explain multiple inheritance with example.   **[5]**

   b)   Describe the concept of precedence and associativity of operators with
        example.   **[5]**

   c)   Define recursive function.   **[2]**

   d)   What is command line argument? Give examples.   **[2]**

P.T.O.

Q4) Attempt the following:

    a)   Write a short note on : Exception handling in Python.   **[5]**

    b)   Write a short note on : File accessing modes supported by Python. **[5]**

    c)   List any two advantages of files.   **[2]**

    d)   What is meant by immutable strings?   **[2]**

Q5) Attempt the following:

    a)   Differentiate between list & tuple.   **[5]**

    b)   What is module? Explain in detail.   **[5]**

    c)   Write the features of Dictionary.   **[4]**

Q6) Attempt the following:

    a)   Write a short note on : Regular Expressions.   **[5]**

    b)   What is set class? Explain various set operations supported by Python with example.   **[5]**

    c)   What is the concept of web framework? Explain various advantages of Django framework.   **[4]**

Q7) Attempt the following:

    a)   What are statements? How are they constructed from variable and expressions in Python.   **[5]**

    b)   Explain following file built-in functions with Syntax example.   **[5]**

        i)   Open ( )   ii)   File ( )   iii)   Seek ( )

        iv)   Tell ( )   v)   Read ( )

    c)   What are the uses of file object? Explain different built-in attributes related to file objects.   **[4]**

Q8) Attempt the following:

    a)   Write a program in Python to return prime numbers from the following list.

        List 1 = [3, 17, 9, 2, 4, 8, 97, 43, 39]   **[5]**

    b)   What are the different ways used to create list? Explain with suitable examples.   **[5]**

    c)   What is a binary file? List its applications.   **[4]**

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[5922]-54

M.Sc. (IMCA)

MIM-504 : DIGITAL IMAGE PROCESSING

(2019 CBCS Pattern) (Semester - V)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:

   1)   *Attempt any five out of the eight questions given.*

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

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

Q1) Attempt the following.   **[5]**

   a)   Give the meaning of

        i)   Pixel

        ii)   CCD

        iii) MPEG

        iv) JPEG

        v)   TIFF

   b)   What is spatial operation? Explain any three types of spatial operations.**[5]**

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

        i)   Luminance

        ii)   Radiance

   d)   List six applications of image processing.   **[2]**

Q2) Attempt the following.

   a)   Explain components in digital image processing.   **[5]**

   b)   What is adjacency? Give m-adjacency for V = {1}   **[5]**

        0_a 1_b 1_c i)   b & c

        0_d 1_e 0_f ii) b & e

        0_g 0_h 1_i iii) e & i

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

        i)   Region

        ii)   Noise

   d)   What is time shifting property in Fourier transform?   **[2]**

Q3) Attempt the following.

    a)   Discuss in brief auto correlation function with the help of suitable example.**[5]**

    b)   Write in brief the image degradation process.   **[5]**

    c)   What is nuffman coding?   **[2]**

    d)   What is image compression?   **[2]**

Q4) Attempt the following.

    a)   What is path? Consider the following image segment. Compute length of shortest 4, shortest - 8 & shortest - m paths between pixels p & q, where $V = \{1, 2\}$.

        4 2 3 2^g

        3 3 1 3

        2 3 2 2

        P^2 1 2 3   **[5]**

    b)   Explain the termsalising and filtering.   **[5]**

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

    d)   What is the role of mathematics in image processing?   **[2]**

Q5) Attempt the following.

    a)   Draw histogram & give P(s) (S_k) for each S_k **[5]**

r_k	n_k
$r = 0$	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

    b)   What is image segmentation? Explain in brief.   **[5]**

    c)   How is image represented mathematically?   **[4]**

Q6) Attempt the following.

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

    b)   Explain in brief gamma correction. **[5]**

    c)   Explain unsharp masking and high-boost filtering. **[4]**

Q7) Attempt the following.

    a)   Define the term closing and show with example that **[5]**

        $(A \cdot B) \cdot B = A \cdot B$

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

    c)   Mention any four types of grey level transformation. **[4]**

Q8) a)   Explain DFT of one variable in brief. **[5]**

    b)   Explain the terms with equations. **[5]**

        i)   Geometric mean filter

        ii)   Harmonic mean filter

    c)   Explain in short 'the frequency domain techniques in fourier domain are most effective at removing periodic noise'. **[4]**

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SEAT No. :

[Total No. of Pages : 2

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M.Sc. (IMCA)

MIM-507 : INTERNET OF THINGS

(2019 Pattern) (Semester-V)

Time : 2 Hours]   *[Max. Marks : 70*

Instructions to the candidates:
  1) *Attempt any five out of 8.*
  2) *Figures to the right indicate full marks.*

Q1) Attempt the following questions:

  a) Explain the concept of IOT in detail.   **[5]**

  b) Explain challenges faced in Internet of Things.   **[5]**

  c) State any two health care related sensor devices?   **[2]**

  d) Explain Device-Centric identity.   **[2]**

Q2) Attempt the following questions:

  a) Explain application of IOT in smart card devices in detail.   **[5]**

  b) What is Sensor Network? What is its role in IOT?   **[5]**

  c) What is use of Satellite technology?   **[2]**

  d) State any two traffic characteristics of IOT.   **[2]**

Q3) Attempt the following questions:

  a) Write a note on communication capabilities in Internet of Things.   **[5]**

  b) Explain in brief role of Data Link Layer protocol in IOT.   **[5]**

  c) State any two observations behind IOT.   **[2]**

  d) Explain the concept of electronic product code.   **[2]**

Q4) Attempt the following questions:

    a)   Explain architecture of sensor network.   **[5]**

    b)   What are the components Satellite Technology? Explain in detail.   **[5]**

    c)   What is mean by object representation?   **[2]**

    d)   Define the terms : i) trust ii) identity.   **[2]**

Q5) Attempt the following questions:

    a)   Write a note on IOT protocols.   **[5]**

    b)   Discuss the role of RFID in IOT.   **[5]**

    c)   State any 4 differences between H2M and M2M devices.   **[4]**

Q6) Attempt the following questions:

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

    b)   What are different integration approaches in IOT?   **[5]**

    c)   Explain the term Data Synchronization.   **[4]**

Q7) Attempt the following questions:

    a)   Write a note on design guidelines of IOT.   **[5]**

    b)   What are disadvantages of IOT?   **[5]**

    c)   What is interoperability between devices? Explain with example.   **[4]**

Q8) Attempt the following questions:

    a)   Write a note objects and services in IOT.   **[5]**

    b)   What are applications of IOT in city automation?   **[5]**

    c)   Explain the applications of WSN.   **[4]**

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