Total No. of Questions : 8]

SEAT No. :

P501

[Total No. of Pages : 3

[5843] - 101

M.Sc. (Industrial Mathematics With Computer Applications)

MATHEMATICS

MIM101: Real Analysis

(2019 Pattern) (Semester - I)

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) ***Scientific calculators and stastistical tables are allowed.***

Q1) a) Let X be a metric space and $\{G_\alpha\}$ be any collection of open sets. Prove that $U_\alpha G_\alpha$ is open. **[5]**

b) Prove that compact subsets of a metric space are closed. **[5]**

c) Define closure of a set E. Prove that a set E is closed if and only if $E=\bar{E}$. **[2]**

d) Give an example of an open cover of the interval (0, 1) which has no finite subcover. **[2]**

Q2) a) Let $\{P_\alpha\}$ be a sequence in a metric space X. Prove that $\{P_\alpha\}$converges to a point $P \in X$ then every neighbourhood contains all but finitely many terms of$\{P_\alpha\}$. **[5]**

b) If K_n is a sequence of compact sets in a metric space X such that $K_n \supset K_{n+1}$, n = 1, 2, ... and if $\lim_{n\to\infty}$ diam K_n = 0 then prove that $\bigcap_{n=1}^{\infty} K_n$ contains exactly one point. **[5]**

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

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

P.T.O.

Q3) a) Define absolute convergence of a series. Prove that if $\sum_{n=1}^{\infty} a_n$ converges absolutely then $\sum_{n=1}^{\infty} a_n$ converges. **[5]**

b) Suppose $a_1 \geq a_2 \geq a_3 \geq ...... \geq 0$. Prove that the series $\sum_{n=1}^{\infty} a_n$ converges if and only if the series $\sum_{k=0}^{\infty} 2^k a_{2^k}$ converges. **[5]**

c) Suppose $a_n > 0$ and $\sum_{n=1}^{\infty} a_n$ diverges. Prove that $\sum_{n=1}^{\infty} \frac{a_n}{1+a_n}$ diverges. **[2]**

d) Test the convergence of the series $\sum_{n=1}^{\infty} \frac{n+1}{n}$. **[2]**

Q4) a) Prove that 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 is closed in *X* for every closed set *C* in *Y*. **[5]**

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

c) Let *f* be monotonic on (a, b). Prove that the set of points of (a, b) at which *f* is discontinuous is at most countable. **[2]**

d) Let $f(x) = \begin{cases} -x-2 & , -2 \leq x < 0 \\ x+2 & , 0 \leq x < 1 \end{cases}$

Prove that *f* has simple discontinuity at x = 0. **[2]**

Q5) a) Suppose *f* is a real continuous function on [*a, b*] which is differentiable in (*a, b*), then prove that there is a point $x \in (a, b)$ at which $f(b) - f(a) = (b-a) f'(x)$. **[5]**

b) Suppose *f* is a real differentiable function on [*a, b*] and suppose $f(a) < \lambda < f(b)$. Prove that there exists a point $x \in (a, b)$ such that $f'(x) = \lambda$. **[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 $C_0 + C_1x + ... + C_{n-1}\, x^{n-1} + C_n x^n = 0$ has at least one real root between 0 and 1. **[4]**

Q6) a) If f is continuous on $[a,b]$ then prove that $f \in \mathbb{R}(\alpha)$ on $[a, b]$. **[5]**

b) Let f be Riemann integrable in $[a,b]$ for $a \le x \le b$, consider $F(x) = \int_a^x f(t)\,\mathrm{dt}$ .Prove that F is continuous on $[a, b]$. **[5]**

c) If α is monotonically increasing function on $[a, b]$ and f is bounded on $[a,b]$ then prove that $\underline{\int_a^b} f\,d\alpha \le \overline{\int_a^b} f\,d\alpha$. **[4]**

Q7) a) If f is a continuous mapping of a metric space X into a matric space Y. Prove that $f(\bar{E}) \subset \overline{f(E)}$ for every set $E \subset X$. **[5]**

b) Suppose $\lim_{n\to\infty} f_n(x) = f(x)\ (x \in E)$ and $M_n = \sup_{x\in E} |f_n(x) - f(x)|$ .Prove that $f_n \to f$ uniformly on E if and only if $M_n \to 0$ as $n \to \infty$. **[5]**

c) Let $f_n(x) = x^n$, $0 \le x \le 1$, $n = 1,2,3,.......$ show that $f_n(x)$ is not uniformly convergent on [0, 1]. **[4]**

Q8) a) Let α be monotonically increasing on $[a, b]$. Suppose $f_n \in \mathbb{R}(\alpha)$ on $[a, b]$ for n = 1, 2, 3,... and suppose $f_n \to f$ uniformly on $[a, b]$. Prove that $f \in \mathbb{R}(\alpha)$ on $[a, b]$ and $\int_a^b f\,\mathrm{d}\alpha = \lim_{n\to\infty} \int_a^b f_n \mathrm{d}\alpha$. **[5]**

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

c) Show that the series $\sum_{n=1}^{\infty} \frac{\sin n^x}{n^2}$ is uniformly convergent. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P502

[Total No. of Pages : 4

[5843]-102

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 side indicate full marks.***

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

a) Let V be a vector space, $\overline{u}$ a vector in V and k a scalar. Prove that **[5]**

i) $o\overline{u} = o$ ii) $k\overline{o} = \overline{o}$ iii) $(-1)\overline{u} = -\overline{u}$

iv) If $k\overline{u} = \overline{o}$ then either $k = o$ or $\overline{u} = \overline{o}$.

b) Determine whether $\overline{v}_1 = (1,1,2), \overline{v}_2 = (1,0,1), \overline{v}_3 = (2,1,3)$ span the vector space $\mathbb{R}^3$. **[5]**

c) Let $w = \{(x, y) \in \mathbb{R}^2 / 2x + 3y = 5\}$. Is w a subspace of $\mathbb{R}^2$?Justify.**[2]**

d) Let $\overline{u} = (1,2,-1)$ and $\overline{v} = (6,4,2)$ in $\mathbb{R}^3$. Show that $\overline{w} = (9,2,7)$ is a linear combination of $\overline{u}$ and $\overline{v}$. **[2]**

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

a) State and prove the Cauchy Schwarz inequality. **[5]**

b) Let $\mathbb{R}^3$ have the Euclidean inner product use the Gram Schmidt process to transform the basis $\overline{u}_1 = (1,1,1), \overline{u}_2 = (-1,1,0), \overline{u}_3 = (1,2,1)$ into an orthonormal basis. **[5]**

c) If $\overline{u}$ and $\overline{v}$ are orthogonal vectors in an inner product space, then prove that $\| \overline{u} + \overline{v} \|^2 = \| \overline{u} \|^2 + \| \overline{v} \|^2$. **[2]**

P.T.O.

d) Let $\mathbb{R}^2$ have the Euclidean inner product and $s = \{\overline{w}_1, \overline{w}_2\}$, where $\overline{w}_1 = \left(\frac{3}{5}, \frac{-4}{5}\right), \overline{w}_2 = \left(\frac{4}{5}, \frac{3}{5}\right)$. Find $\overline{u}$ if $(\overline{u})_s = (1,1)$. **[2]**

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

a) Let $T_A : \mathbb{R}^6 \to \mathbb{R}^4$ be multiplication by

$$A = \begin{bmatrix} -1 & 2 & 0 & 4 & 5 & -3 \\ 3 & -7 & 2 & 0 & 1 & 4 \\ 2 & -5 & 2 & 4 & 6 & 1 \\ 4 & -9 & 2 & -4 & -4 & 7 \end{bmatrix}$$

Find the rank & nullity of T_A. **[5]**

b) Let $T : \mathbb{R}^3 \to \mathbb{R}^3$ be the linear operator $T(x_1, x_2, x_3) = (3x_1 + x_2, -2x_1 - 4x_2 + 3x_3, 5x_1 + 4x_2 - 2x_3)$. Determine whether T is one-one. If so find T^{-1}. **[5]**

c) Consider the basis $s = \{\overline{v}_1, \overline{v}_2, \overline{v}_3\}$ for $\mathbb{R}^3$, where $\overline{v}_1 = (1,1,1), \overline{v}_2 = (1,1,0)$ and $\overline{v}_3 = (1,0,0)$. Let $T : \mathbb{R}^3 \to \mathbb{R}^2$ be the linear transformation given by $T(\overline{v}_1) = (1,0), T(\overline{v}_2) = (2,-1), T(\overline{v}_3) = (4,3)$. Find a formula for $T(x_1, x_2, x_3)$; then use this formula to compute $T(2, -3, 5)$. **[4]**

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

a) Find the eigen values of **[5]**

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 4 & -17 & 8 \end{bmatrix}$$

b) Find a matrix P that diagonalizes **[5]**

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

c) Find the eigen values of A^9 if **[2]**

$$A = \begin{bmatrix} 1 & 3 & 7 & 11 \\ 0 & \frac{1}{2} & 3 & 8 \\ 0 & 0 & 0 & 4 \\ 0 & 0 & 0 & 2 \end{bmatrix}$$

d) Show that $X = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$ is an eigen vector of $A = \begin{bmatrix} 3 & 0 \\ 8 & -1 \end{bmatrix}$ corresponding to the eigen value $\lambda = 3$. **[2]**

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

a) Let V be a finite dimensional vector space and let $\{\overline{v}_1, \overline{v}_2, ..., \overline{v}_n\}$ be any basis for V. If a set has more than n vectors of V, prove that the set is linearly dependent. **[5]**

b) Do the vectors $\overline{p}_1 = 1 - 3x + 2x^2, \overline{p}_2 = 1 + x + 4x^2, \overline{p}_3 = 1 - 7x$ Span $\mathbb{P}_2$? Justify. **[5]**

c) Find the coordinate vector of $\overline{w} = (3, -7)$ relative to the basis $s = \{\overline{u}_1, \overline{u}_2\}$ for $\mathbb{R}^2$ where $\overline{u}_1 = (2, -4), \overline{u}_2 = (3, 8)$. **[2]**

d) Find a basis for the row space of **[2]**

$$A = \begin{bmatrix} 1 & -2 & 0 & 0 & 3 \\ 2 & -5 & -3 & -2 & 6 \\ 0 & 5 & 15 & 10 & 0 \\ 2 & 6 & 18 & 8 & 6 \end{bmatrix}$$

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

a) The matrix $A = \begin{bmatrix} 3 & 1 \\ 2 & 1 \end{bmatrix}$ maps the line $y = 2x + 1$ into another line. Find the equation of the transformed line. **[5]**

b) Find the least squares approximation of $f(x) = 1 + x$ over the interval $[0, 2\pi]$ by a trignometric polynomial of order 2 or less. **[5]**

c) Find an LU - decomposition of **[4]**

$$A = \begin{bmatrix} 2 & 6 & 2 \\ -3 & -8 & 0 \\ 4 & 9 & 2 \end{bmatrix}$$

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

a) Verify Cayley Hamiltonian theorem for the matrix **[5]**

$$A = \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

b) Let a, b, c be elements of a field F and let $A = \begin{bmatrix} 0 & 0 & c \\ 1 & 0 & b \\ 0 & 1 & a \end{bmatrix}$

Prove that the characteristic polynomial for A is also the minimal polynomial for A. **[5]**

c) Prove that similar matrices have the same characteristic polynomial. **[4]**

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

a) Determine the dimension and a basis for the solution space of the system

$x_1 - 3x_2 + x_3 = 0$

$2x_1 - 6x_2 + 2x_3 = 0$

$3x_1 - 9x_2 + 3x_3 = 0$ **[5]**

b) Let $\bar{u}, \bar{v}$ be vectors in an inner product space V. Prove that $\| \bar{u} + \bar{v} \|^2 + \| \bar{u} - \bar{v} \|^2 = 2 \| \bar{u} \|^2 + 2 \| \bar{v} \|^2$ **[5]**

c) Prove that a linear transformation $T : V \rightarrow W$ has an inverse if and only if T is bijective. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P503

[Total No. of Pages : 4

[5843]-103

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 of the given EIGHT questions.***
2) ***Figures to the right side indicate full marks.***

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

a) Differentiate between break and continue statement. **[5]**

b) Write a 'C' program to sort the given array elements in Ascending order. **[5]**

c) Define the use of conditional operator with syntax. **[2]**

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

```
main ( )
{
int fruit = 1;
switch(fruit+2)
{
default: printf("apple");
case 4: printf("banana");
case 5: printf("orange");
case 8: printf("grape");
}
}
```

P.T.O.

Q2) 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]**

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

a) Explain : **[5]**

i) Nested structures

ii) Array of structures

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

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

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

```
#define PRODUCT (n) (n * n)
main ( )
{
int i = 3, j ;
j = PRODUCT (i + 1) ;
printf ( " n%d " , j);
}
```

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

b) Explain Switch control statement with example. **[5]**

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

i) #include

ii) #define

Q6) 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]**

Q7) 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) Explain with example : **[5]**

i) Array of Pointers

ii) Pointers to Pointers

c) Write a 'C' program to display the followig pattern. **[4]**

```
*  *  *  *
 *  *  *
  *  *
   *
```

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

a) Write down the difference between structure and union. **[5]**

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

c) Write a note on Command Line Argument. **[4]**

♣ ♣ ♣

Total No. of Questions : 8]

SEAT No. :

P504

[Total No. of Pages : 4

[5843]-104

F.Y. M.Sc. (IMCA)

MIM - 104 : DBMS

(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.***

Q1) Attempt the following :

a) Explain any five significant differences between file-processing system and DBMS. **[5]**

b) Explain with an example "Tabular representation of many-to-many relationship". **[5]**

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

d) Give the E-R notations used to draw an identifying relationship and multivalued attribute. **[2]**

Q2) Attempt the following :

a) Explain the following SQL set operations with example. **[5]**

i) Except operation

ii) Except all operation

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

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

d) Define instance and schema. **[2]**

P.T.O.

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: i) attribute. ii) entity set. **[2]**

Q4) Attempt the following : **[5]**

a) Consider the following database

Customer(<u>customer_no</u>,customer_name,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 highest number of accounts.

ii) Find the names of customers having more than three 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. Patil".

iii) Display the account details of customers who live in "Pune" city.

c) What is the use of insert 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

Employee (<u>employee_number</u> integer, name varchar(30), salary integer)

Write a PL/pgSQL function which will accept employee number and displays the name and salary of an employee. **[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 the division operation of Relational Algebra with example. **[5]**

b) Differentiate between specialization and generalization. **[5]**

c) Write a short note on mapping cardinalities. **[4]**

Q7) Attempt the following :

a) Explain the following Relational Algebra operations with example. **[5]**

i) Union operation

ii) Set difference operation.

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

Employee(<u>Employee_id</u>, name,age,salary,city)

Project(<u>Project_id</u>, 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 starts with "R".

ii) Find the count of employees.

iii) Give the names of projects having budget between 70000 and 80000.

iv) List the details of employees who live in "Pune" city.

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

   i) List the name and salary of all employees.

   ii) Give the names of employees having age less than 40.

   iii) Give the names of projects having budget more than 50000.

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

Q8) Attempt the following :

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

b) Explain the functions of a database administrator (DBA). **[5]**

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

Total No. of Questions : 8]

SEAT No. :

P505

[Total No. of Pages : 3

[5843]-201

F.Y. 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 the singular point of the function $f(z)=\dfrac{1-\exp(2z)}{z^3}$ is a pole. Determine the order m of that pole and corresponding residue B. **[5]**

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

c) Show that $\log i=\left(2n+\dfrac{1}{2}\right)\pi i$. **[2]**

d) Determine singular points of the function $f(z)=\dfrac{z^3+i}{z^2+5z+4}$ **[2]**

Q2) a) State and prove Liouville's theorem. **[5]**

b) Show that P.V. $\displaystyle\int_{-\infty}^{\infty}\frac{x^2}{x^6+1}=\frac{\pi}{3}$ **[5]**

c) Find cube roots of the unity. **[2]**

d) Show that i) $(1-i)^4=-4$, ii) $\dfrac{-1+3i}{2-i}=-1+i$ **[2]**

P.T.O.

Q3) a) 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

$$\left|f^n(z_0)\right| \le \frac{n!M_R}{R^n}, (n = 1, 2, ...).$$ **[5]**

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

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

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

Q4) a) Find Laurent series representation for $f(z) = \frac{-1}{(z-1)(z-2)}$ in the domain $|z| < 1$. **[5]**

b) 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 $f(z) = \frac{\phi(z)}{(z-z_0)m}$,

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

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

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

c) Find a harmonic conjugate $v(x, y)$ for $u(x, y) = 2x(1 - y)$. **[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 $\int_0^{\infty} \frac{dx}{(x^2+1)^2} = \frac{\pi}{4}$. **[5]**

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

c) Show that $\int_C \frac{5z-2}{2(z-1)} dz = 10\pi i$, 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) Derive the formula for $\sin^{-1} z$ and use it to find $\sin^{-1}(-i)$. **[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 $\frac{p(z)}{q(z)}$ and $\underset{z=z_0}{Res} \frac{p(z)}{q(z)} = \frac{p(z_0)}{q'(z_0)}$. **[4]**

Q7) a) Show that $\int_C \frac{1}{(z-i)^{n+3}} dz = \begin{cases} 0 & \text{when } n \neq -2 \\ 2\pi i & n = -2 \end{cases}$ **[5]**

b) Prove that :- A function $f(z) = u(x, y) + i\, v(x, y)$ is analytic in a domain D if and only if v is harmonic conjugate of u. **[5]**

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

Q8) a) i) Show that $\int_{-C} f(z)dz = -\int_C f(z)dz$

ii) Find $\int_C \overline{z}\, dz$, if $z = 2e^{i\theta} \left(-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}\right)$ where C is right half of circle $|z| = 2$ from $z = -2i$ to $z = 2i$.

[5]

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

c) Find the value of integral $\int_C \frac{3z^3 + 2}{(z-1)(z^2+9)} dz$, where C is the positively oriented circle $|z - 2| = 2$. **[4]**

Total No. of Questions : 8]

SEAT No. :

P506

[Total No. of Pages : 4

[5843] - 202

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) In how many ways can a photographer at a wedding arrange six people in a row, including the bride and the groom if **[5]**

i) the bride must be next to the groom

ii) the bride is positioned somewhere to the left of the groom?

b) Give a combinatorial proof for the identity

$\binom{n+1}{k} = \binom{n}{k-1} + \binom{n}{k}$; where n and k are positive integers with $n \geq k$. **[5]**

c) Show that among any group of five integers, there are two with the same remainder when divided by 4. **[2]**

d) How many one-one functions are there from a set with 5 elements to a set with 7 elements? **[2]**

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

a) Find the solution to the recurrence relation $a_n = 2a_{n-1} - 1$, $a_0 = 1$. **[2]**

b) Solve the recurrence relation $a_n = -4a_{n-1} - 4a_{n-2}$ for $n \geq 2$, $a_0 = 6$, $a_1 = 8$. **[5]**

c) Find a recurrence relation and give initial conditions for the number of bit strings of length n that do not have two consecutive O's. How many such bit strings are there of length 5? **[5]**

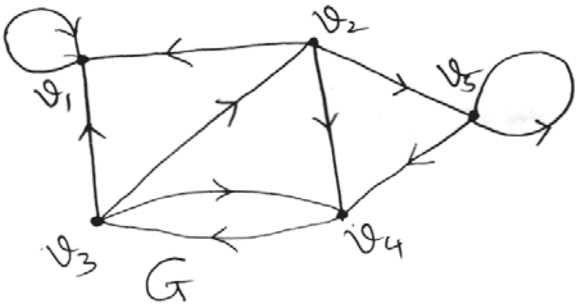
d) Suppose that the roots of the characteristic equation of a linear homogeneous recurrence relation are 2, 2, 2, 5, 5 and 9. What is the form of the general solution? **[2]**

P.T.O.

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

a) Prove that a connected multigraph with atleast two vertices has an Euler circuit iff each of its vertices is of even degree. **[5]**

b)

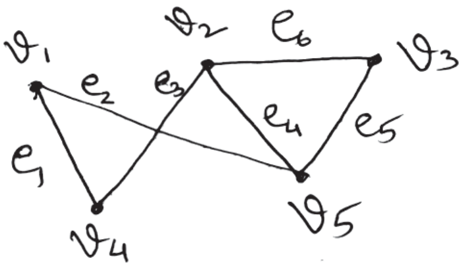


For the graph G given above, determine the sum of the in-degrees of the vertices and the sum of the out-degrees of the vertices directly. Show that they are both equal to the number of edges in the graph. **[5]**

c) Give the values of *n* for which the following graphs are bipartite. **[2]**

i) K_n ii) C_n

d)

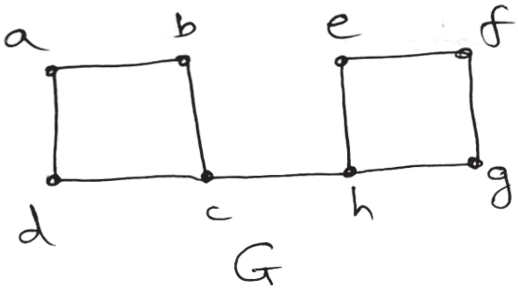


Represent the above graph with an incidence matrix. **[2]**

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

a) Prove that a tree with *n* vertices has $n - 1$ edges. **[5]**

b) Draw all spanning trees of G given below : **[5]**



c) What is the value of the prefix expression **[2]**

* / 93 + * 24 – 76.

d) Draw all non-isomorphic binary trees with 7 vertices. **[2]**

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

a) Use K-maps to minimize the sum-of-product expansion **[5]**

$x\,y\,z + x\,y\,\overline{z} + x\,\overline{y}\,z + x\,\overline{y}\,\overline{z} + \overline{x}\,y\,z + \overline{x}\,\overline{y}\,z + \overline{x}\,\overline{y}\,\overline{z}$

b) Use a table to express the values of the Boolean function **[5]**

$F(x, y, z) = x(yz + \overline{y}\,\overline{z})$.

c) Show that **[4]**

i) $\overline{x} = x \downarrow x$

ii) $xy = (x \downarrow x) \downarrow (y \downarrow y)$

iii) $x + y = (x \downarrow y) \downarrow (x \downarrow y)$, where $\downarrow$ denotes the NOR operator.

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

a) Prove that the number of r-combinations of a set with n elements, where n is a non-negative integer with $0 \le r \le n$ equals $C(n,r) = \dfrac{n!}{r!(n-r)!}$. **[5]**

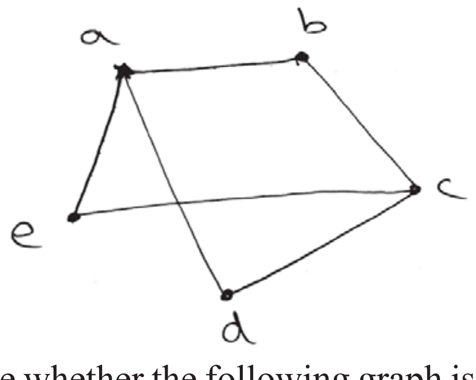
b) How many strings can be made by reordering letters of the word 'SUCCESS'. **[5]**

c) How many solutions are there to the equation $x_1 + x_2 + x_3 + x_4 + x_5 = 21$, where x_i, i = 1, 2, 3, 4, 5 is a non-negative integer such that $0 \le x_1 \le 3$, $1 \le x_2 < 4$ and $x_3 \ge 15$. **[4]**

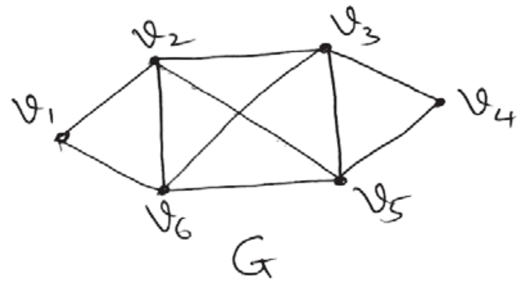
Q7) Attempt each of the following : **[14]**

a) Show that the complete graph K_5 is non-planar. **[5]**

b) Find the chromatic number of the graph given below : **[5]**



c) Determine whether the following graph is Eulerian. If yes, find an Euler line in it. **[4]**

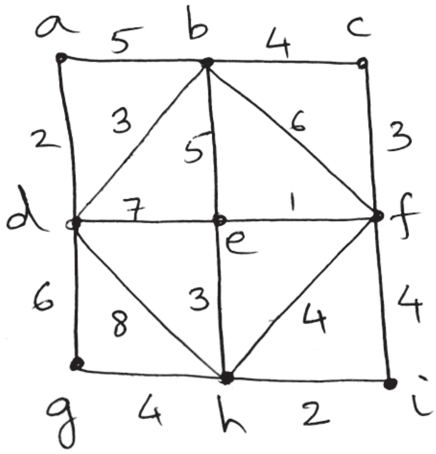


Q8) Attempt each of the following : **[14]**

a) How many bit strings of length 10 either begin with three 0s or end with three 1s? **[5]**

b) Prove that if N objects are placed into *k* boxes, then there is atleast one box containing atleast [N/k] objects. **[5]**

c) Use Prim's algorithm to find a minimum spanning tree for the given weighted graph : **[4]**



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Total No. of Questions : 8]

SEAT No. :

P507

[Total No. of Pages : 3

[5843] - 203

M.Sc. (Industrial Mathematics with Computer Applications)

MIM - 203 : DATA STRUCTURES

(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 the right indicate full marks.***

Q1) Attempt the following :

a) What is generalized linked list? Explain with example. Also write its Applications. **[5]**

b) Write an algorithm to convert infix expression to postfix. **[5]**

c) Define : **[2]**

i) Data Structure

ii) ADT

d) Convert the following infix expression to postfix. **[2]**

A * B – C $ D + E

Q2) Attempt the following :

a) Write a short note on : Static implementation of Trees using arrays. **[5]**

b) What is Queue? Explain various types of Queues in detail. **[5]**

c) Give any two applications of an array. **[2]**

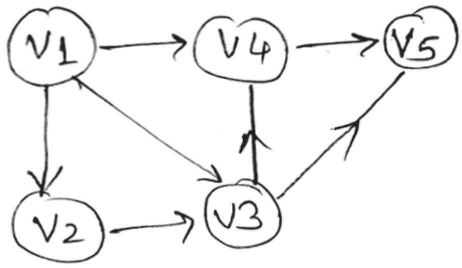
d) Represent the following expression as binary tree. **[2]**

A + (B – C) * D / (E * F)

P.T.O.

Q3) Attempt the following :

a) Write the adjacency matrix and adjacency list of following graph. **[5]**



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

c) Define : **[2]**

i) Heap sort

ii) DE queue

d) What are the basic operations performed on a queue? **[2]**

Q4) Attempt the following :

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

b) State advantages of Data Structures. **[5]**

c) State any two characteristics of an algorithm. **[2]**

d) Define : **[2]**

i) NULL Tree

ii) Degree of a Tree

Q5) Attempt the following :

a) Define Graph. Explain various methods used for Graph traversal. **[5]**

b) Show the steps of creating a Binary Search Tree for the following data: **[5]**

35, 66, 45, 12, 76, 55, 43, 90, 10

c) Write a short note on : Circular Queue. **[4]**

Q6) Attempt the following :

a) Write a function to insert a node in the doubly linked list. **[5]**

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

c) Explain linear and non linear data structure with suitable example. **[4]**

Q7) Attempt the following :

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

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

b) Explain following terms with example. **[5]**

i) Weighted Graph

ii) Spanning Tree

c) Explain how stack can be used in recursion. **[4]**

Q8) Attempt the following :

a) Write a 'C' function to reverse a string using stack. **[5]**

b) Write an algorithm to find the shortest path between two given vertices of a directed graph. **[5]**

c) Write a short note on : Orthogonal list. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P508

[Total No. of Pages : 2

[5843] - 204

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

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 spiral model in detail. **[5]**

b) Discuss the component of activity diagram. **[5]**

c) Give any two benefits of iterative development. **[2]**

d) What are the advantages of link attributes? **[2]**

Q2) **Attempt the following :**

a) Write short note on integration testing. **[5]**

b) What are the different types of relationship supported in UML? **[5]**

c) What is a Meta Model? **[2]**

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

i) Abstract class ii) Fork

Q3) **Attempt the following :**

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

b) Prepare a class diagram for airport system. Define appropriate classes, relationships and associations with multiplicity. **[5]**

c) What is Association? What is Binary Association? **[2]**

d) Give any two benefits of iterative development. **[2]**

P.T.O.

Q4) **Attempt the following :**

a) Explain Black box testing with any two methods used in it. **[5]**

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

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

d) What do you mean by Components? **[2]**

Q5) **Attempt the following :**

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

b) What is Activity? Explain activity diagram in detail. **[5]**

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

Q6) **Attempt the following :**

a) What is meant by stereotypes? Explain with any two examples. **[5]**

b) Explain Object diagrams with suitable example. **[5]**

c) Discuss any FOUR components of sequence diagram. **[4]**

Q7) **Attempt the following :**

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

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

c) What is the use of Deployment diagram? Explain with suitable example. **[4]**

Q8) **Attempt the following :**

a) Draw a class diagram for "Newspaper advertisement agency". Define at least three classes. Define appropriate relationship, association with multiplicity. **[5]**

b) What is recursive aggregation? Explain in detail. **[5]**

c) Discuss advanced classes in detail. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P509

[Total No. of Pages : 2

[5843]-205
M.Sc.
MIM 205 : JAVA
Industrial Mathematics With Computer Application
(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 the right indicate full marks.***

Q1) Attempt the following questions :

a) Explain Life cycle of applet **[5]**

b) Write a java program which accepts 'n' integers from the user and writes only even numbers to the file 'even. txt'. **[5]**

c) State any two differences between abstract class and interface. **[2]**

d) What is garbage collection in java? **[2]**

Q2) Attempt the following questions :

a) Write a note on Wrapper classes in Java? What are uses of wrapper classes? **[5]**

b) Explain primitive types in java. **[5]**

c) What are characteristics of components in MVC architecture? **[2]**

d) List any two methods of file class along with syntax. **[2]**

Q3) Attempt the following questions :

a) What is inheritance? Explain different types of inheritances with example. **[5]**

b) What is finalize( ) method used for? Explain with example. **[5]**

c) State any two methods of key listener. **[2]**

d) What is use of following predefined packages **[2]**

i) java.util.* ii) java.lang.*

Q4) Attempt the following questions :

a) Explain any five methods of J frame class. **[5]**

b) What is stream? What are different types of streams in java? **[5]**

c) What is exception in java? **[2]**

d) Explain the use of initialization block with example. **[2]**

Q5) Attempt the following questions :

a) What is Buffered Reader? Demonstrate buffered reader with suitable example. **[5]**

b) Write a note on Mouse Motion Listener. **[5]**

c) What is constructor? What are different types of constructor in Java. **[4]**

Q6) Attempt the following questions :

a) Explain the use of comparable and comparator interface in java. **[5]**

b) What is Method overriding? Explain with example. **[5]**

c) What is Grid Layout? **[4]**

Q7) Attempt the following questions :

a) Write a note on character stream. **[5]**

b) What are user-defined exception? Illustrate with suitable example. **[5]**

c) How to achieve multiple inheritance in java? **[4]**

Q8) Attempt the following questions :

a) Define a class student having data members rno, name and percentage. Define default and parameterized constructor. Accept the details of 5 students in array and display student with maximum marks. **[5]**

b) Discuss different types of events in Java. **[5]**

c) Explain use of super keyword with example. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P510

[Total No. of Pages : 7

[5843]-301

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 the Eight questions given.***
2) ***Figures to the right indicate full marks.***

Q1) a) A firm manufactures two products A and B on which the profits earned per unit are ₹3 and ₹4 respectively. Each product is processed on two machines M_1 and M_2. Product A requires one minute of processing time on machine M_1 and two minutes on M_2, while B requires one minute on M_1 one minute on and one minute on M_2. Machine M_1 is available for not more than 450 minutes, while machine M_2 is available for 600 minutes during any working day.

Formulate the L.P.P and solve it graphically. **[5]**

b) Solve the following LPP graphically **[5]**

max $z = 4x_1 + 3x_2$

subject to,

$$3x_1 + 4x_2 \leq 24$$
$$8x_1 + 6x_2 \geq 48$$
$$x_1 \leq 5$$
$$x_2 \leq 6$$
$$x_1, x_2 \geq 0$$

c) Define Transportation Problem. **[2]**

d) Describe briefly a Network. **[2]**

P.T.O.

Q2) a) Find the optimal solution of the following L.P.P by algebraic method **[5]**

$\max z = 2x_1 + 3x_2$

subject to,

$2x_1+x_2 \leq 4$

$x_1+x_2 \geq 5$

$x_1,x_2 \geq 0$

b) Solve by Two Phase Method **[5]**

$\max z = 10x_1 + 6x_2 + 2x_3$

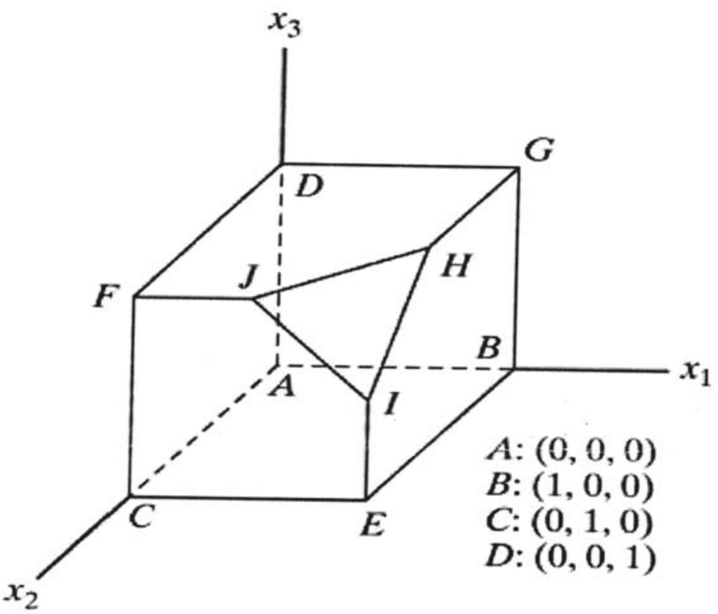
subject to

$-x_1+ x_2 + x_3 \geq 1$

$3x_1 + x_2 + x_3 \geq 2$

$x_1, x_2, x_3 \geq 0$

c) Consider the three dimensional LP solution whose feasible extreme points are A, B and J.



i) Which of the following pairs of corner points cannot represent successive simplex iteration (A, B), (B, D), (E, H), and (A, I)? Explain why? **[2]**

ii) Suppose that the simplex iteration starts at A and the optimum occurs at H. Indicate whether any of the following paths are not legitimate for the simplex algorithm and state the reason. **[2]**

1) $A \rightarrow B \rightarrow G \rightarrow H$

2) $A \rightarrow C \rightarrow I \rightarrow H$

Q3) a) Find the optimal dual value of the objective function **[5]**

max $z = 5x_1 + 12x_2 + 4x_3$

subject to

$x_1 + 2x_2 + x_3 \leq 10$

$2x_1 - x_2 + 3x_3 = 8$

$x_1, x_2, x_3 \geq 0$

b) Consider the TOYCO model and their optimal table is given below

max $z = 3x_1 + 2x_2 + 5x_3$

subject to

$x_1 + 2x_2 + x_3 \leq 430$ (operation 1)

$3x_1 + 2x_3 \leq 460$ (operation 2)

$x_1 + 4x_2 \leq 420$ (operation 3)

$x_1, x_2, x_3 \geq 0$

Consider the following simplex table

CB_i	**c_j**	**3**	**2**	**5**	**0**	**0**	**0**	**Solution**
	B.V.	x_1	x_2	x_3	s_1	s_2	s_3	
2	x_2	$\frac{-1}{4}$	1	0	$\frac{1}{2}$	$\frac{-1}{4}$	0	**100**
5	x_3	$\frac{3}{2}$	0	1	0	$\frac{1}{2}$	0	**230**
0	s_3	2	0	0	–2	1	1	**20**
	$z_j - c_j$	**4**	**0**	**0**	**1**	**2**	**0**	**z = 1350**

Situation 1: TOYCO recognize that in implementation may take time.

Another proposal was thus made to shift the slack capacity of operation 3 (S_3=20 min) to the capacity of operation 1.

How would this change impact the optimum solution? **[5]**

c) Show the feasible region for the following constraints of a L.P.P using a graph. **[2]**

$$x - y \leq 0$$
$$x \leq 4$$
$$x, y \geq 0$$

d) Write the following L.P.P in standard form. **[2]**

max $z = 3x_1 + 4x_2$

subject to,

$$x_1 + 2x_2 \leq 9$$
$$2x_1 - 4x_2 \geq 7$$
$$x_1, x_2 \geq 0$$

Q4) a) Find the initial basic feasible solution using Vogel's Approximation method (VAM) and optimize it using MODI method. **[5]**

Factories	**Stores**			**Production Supply**
	D_1	D_2	D_3	
O_1	8	16	16	**152**
O_2	32	48	32	**164**
O_3	16	32	48	**154**
Demand	**144**	**204**	**82**	

b) Solve the Assignment model by Hungarian Method. **[5]**

Sources	**I**	**II**	**III**	**IV**
A	1	3	5	2
B	8	6	9	8
C	3	4	10	6
D	7	6	7	4

c) What is meant by balancing the Transportation Problem. **[2]**

d) Define Integer Programming Problem. **[2]**

Q5) a) Consider the details of a project as shown in the table: **[5]**

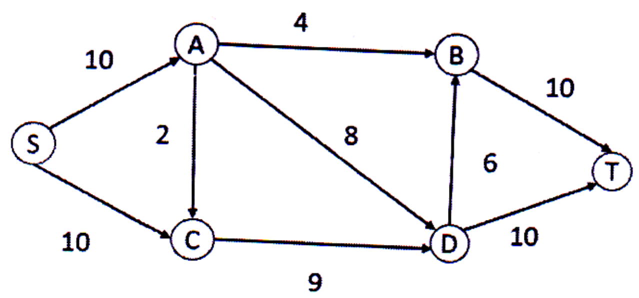
Activity	A	B	C	D	E	F	G	H	I	J
Predecessor	-	-	A,B	A,B	B	C	D	F,G	F,G	E,H
Duration	4	3	2	5	6	4	3	7	4	3

i) Construct the CPM network.

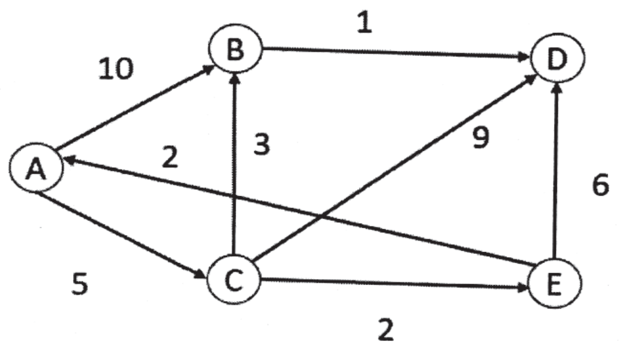
ii) Determine the critical path.

iii) Compute total float and free float for noncritical activity.

b) Find maximal flow **[5]**



c) Use Dijkstra's algorithm to find the shortest route from node A to all the remaining nodes in the network : **[4]**



Q6) a) Explain the following terms - **[5]**

i) Dual Feasibility condition

ii) Dual Optimality condition

b) Explain in brief 'Dual Simplex Method'. **[5]**

c) Use dual simplex method to solve LPP. **[4]**

max $z = 2x_1 + 2x_2$

subject to,

$$2x_1 - x_2 - x_3 \geq 3$$
$$x_1 - x_2 + x_3 \geq 2$$
$$x_1, x_2, x_3 \geq 0$$

Q7) a) Explain North-West corner method. **[5]**

b) Consider the following L.P.P

max $z = x_1 + 4x_2 + 7x_3 + 5x_4$

subject to

$2x_1 + x_2 + 2x_3 + 4x_4 = 10$

$3x_1 - x_2 - 2x_3 + 6x_4 = 5$

$x_1, x_2, x_3, x_4 \geq 0$

Generate the simplex tableau associated with Basis B = (P_1, P_2). **[5]**

c) Write the dual of the following L.P.P. **[4]**

Max $z = 5x_1 + 6x_2$

subject to

$x_1 + 2x_2 = 5$

$-x_1 + 5x_2 \geq 3$

$x_1 + 2x_2 \leq 8$

x_1 unrestricted, $x_2 \geq 0$

Q8) a) Solve the assignment problem. **[5]**

	P	**Q**	**R**	**S**
A	10	5	13	15
B	3	9	18	13
C	10	7	2	2
D	7	11	9	7
E	10	12	13	13

b) Solve by simplex method. **[5]**

Max $z = 12x_1+16x_2$

subject to,

$10x_1+20x_2 \leq 120$

$8x_1+8x_2 \geq 80$

$x_1, x_2 \geq 0$

c) Find the initial basic feasible solution using North-West Corner Method: **[4]**

Factories	**Stores**				**Production**
	A	**B**	**C**	**D**	**Supply**
P	10	2	20	11	**15**
Q	12	7	9	20	**25**
R	4	14	16	18	**10**
Demand	5	15	15	15	

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Total No. of Questions : 8]

SEAT No. :

P511

[Total No. of Pages : 3

[5843]-302

M.Sc. (Industrial Mathematics with Computer Applications)

MIM 302 : 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 G be a finite group with identity 'e'. Show that the number of elements x of G such that $x \neq x^{-1}$ is even. **[5]**

b) Let H be a non-empty subset of a group G. Prove that H is a subgroup of G if and only if $ab^{-1} \in$ H, $\forall\ a, b \in$ H. **[5]**

c) Find the order of each element in the group $(Z_6, +_6)$ **[2]**

d) Prove that the left cancellation law holds in a group. **[2]**

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

a) Prove that every subgroup of a cyclic group is cyclic. **[5]**

b) Let $\alpha = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 1 & 3 & 5 & 4 & 6 \end{pmatrix}$ and $\beta = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 6 & 1 & 2 & 4 & 3 & 5 \end{pmatrix}$.

Compute: **[5]**

i) α^{-1}

ii) $\alpha\beta$

iii) Determine whether β is even

c) Let ϕ be a homomorphism from a group G into a group $\overline{G}$. Prove that for all elements 'a' in G, **[2]**

$\phi\ (a^n) = [\phi(a)]^n, \forall\ n \in \mathbb{N}.$

d) Prove that $\mathbb{Z}$ under addition is not isomorphic to $\mathbb{Q}$ under addition. **[2]**

P.T.O.

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

a) Prove that every finite integral domain is a field. **[5]**

b) Let R be a commutative ring with unity and let U(R) denote the set of all units of R. Prove that U(R) is a group under the multiplication of R. **[5]**

c) Prove that the characteristic of a Boolean ring is 2. **[2]**

d) Find a non-zero element in a ring that is neither a zero divisor nor a unit. **[2]**

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

a) Determine all maximal ideals of the ring Z_{12}. **[5]**

b) Show that a homomorphism from a field into a ring is either one-one or maps every element to 0. **[5]**

c) State all ring homomorphisms from $\mathbb{Z}$ to $\mathbb{Z}$. **[2]**

d) Draw the addition table for the quotient ring $2\mathbb{Z}/6\mathbb{Z}$. **[2]**

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

a) Prove that if H is a subgroup of G such that index of H in G is 2, then H is normal in G. **[5]**

b) Describe the quotient group of A_3 in S_3. **[5]**

c) Determine the subgroup lattice of $\mathbb{Z}_2 \oplus \mathbb{Z}_2$. **[4]**

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

a) Let ϕ be a group homomorphism from G to $\overline{G}$. Prove that the mapping from $G/\ker\phi$ to $\phi(G)$, given by $g\ker\phi \to \phi(g)$, is an isomorphism. **[5]**

b) Let '~' be a relation defined on a group G by a ~ b if and only if a and b are conjugates of each other. Prove that '~' is an equivalence relation on G and obtain the equivalence class of an element 'a' in G. **[5]**

c) Prove that a group of order 56 cannot be simple. **[4]**

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

a) If D is an Integral Domain, prove that D[x] is also an Integral domain. **[5]**

b) Is $\mathbb{Q}[x] / < x^2 + 5x + 6>$ a field? Justify. **[5]**

c) Show that the polynomial $2x + 1$ in $\mathbb{Z}_4[x]$ has a multiplicative inverse in $\mathbb{Z}_4[x]$. **[4]**

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

a) Show that $1 - i$ is an irreducible in $\mathbb{Z}[i]$. **[5]**

b) Prove that every Euclidean Domain is a principle Ideal Domain. **[5]**

c) List all irreducible polynomials of degree 2 in $\mathbb{Z}_2[x]$. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P512

[Total No. of Pages : 2

[5843]-303

M.Sc. (Industrial Mathematics with Computer Application)

MIM 303: ADVANCED JAVA

(2019 Pattern) (Semester - III)

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

Instructions to the candidates:

1) ***Attempt the following FIVE out of EIGHT given questions.***
2) ***Figures to the right indicates full marks.***

Q1) Attempt the following questions:

a) How to display image in container like panel using javax. imageio. ImageIO class? **[5]**

b) Explain tasks performed by JDBC driver in detail. **[5]**

c) Define the terms.

i) Race condition ii) Synchronization **[2]**

d) Write a difference between vector & ArroyList. **[2]**

Q2) Attempt the following questions:

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

b) Write a detailed note on InetAddress class. **[5]**

c) What is use of include directive in JSP? **[2]**

d) What is metadata in JDBC? **[2]**

Q3) Attempt the following questions:

a) Explain any five interfaces in java. sql package. **[5]**

b) Discuss live cycle of Thread in brief. **[5]**

c) What is difference between process-based multitasking and thread-based multitasking? **[2]**

d) What is URL? What is use of URL? **[2]**

P.T.O.

Q4) Attempt the following questions:

a) Explain interfaces available in java.net package. **[5]**

b) Describe types of elements in JSP. **[5]**

c) What is Cookie? Explain with example. **[2]**

d) Give any 4 database names and their respective JDBC driver name.**[2]**

Q5) Attempt the following questions:

a) What is Inter Thread communication? Explain with suitable example.**[5]**

b) Write a program to accept name of the image from user and display it in panel such that it occupies whole panel area. **[5]**

c) Write a note on JSP sessions. **[4]**

Q6) Attempt the following questions:

a) Explain HTTP servlet in detail. **[5]**

b) What is mean by transaction? What are advantages of transaction? **[5]**

c) What is the use of sleep () method? Explain with example. **[4]**

Q7) Attempt the following questions:

a) What is JDBC driver? Explain types JDBC drivers in detail. **[5]**

b) Write a note on list interface. **[5]**

c) State the advantages of collection framework. **[4]**

Q8) Attempt the following questions:

a) Write a java program in which declare class student (name, percentage). Use ArrayList to store details of 5 students and sort them according to percentage. Use comparator interface. **[5]**

b) Explain Iterator in detail with example. **[5]**

c) Write advantages of servlet. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P513

[Total No. of Pages : 3

[5843]-304
M.Sc. (I.M. C.A.)
MIM 304 : OPERATING SYSTEMS
(2019 Pattern) (Semester - III)

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

Instructions to the candidates:

1) *Attempt any FIVE out of EIGHT questions gives.*
2) *Figures in the right indicate full marks.*

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

a) Explain in brief: **[5]**
   i) Dual Mode Operation
   ii) Timer

b) Define the following terms: **[5]**
   i) CPU Scheduler
   ii) Dispatcher
   iii) CPU Utilization
   iv) Throughput
   v) Waiting time

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

d) Define fragmentation. List the types of fragmentation. **[2]**

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

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

b) Explain in brief, following page replacement algorithms: **[5]**
   i) FIFO
   ii) Second Chance

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

d) List any Four File attributes. **[2]**

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

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

b) Define wait - for- graph and resource allocation graph. Explain how resource allocation graph is converted to wait - for - graph with the help of example. **[5]**

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

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

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

a) Define the critical section problem and explain how it can be overcome from race condition? **[5]**

b) Explain following file allocation methods: **[5]**

i) Linked

ii) Indexed.

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

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

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

a) Consider the following snapshot of the system. **[5]**

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

Answer the following questions using Banker's algorithm:

i) What are the contents of need array?

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

b) Explain any five Kernel I/O subsystems. **[5]**

c) Write a note on process control block. **[4]**

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

a) Write a note on contiguous memory allocation. **[5]**

b) Write a note on dining philosopher problem. **[5]**

c) Explain any four types of directory and disk structure. **[4]**

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

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

i) Client server model.

ii) Distributed information systems.

b) Explain different services provided by as operating system. **[5]**

c) Consider the following reference string and find the total no.-of page faults using three frames:

i) Optimal chance

ii) LRU **[4]**

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

a) Write a note on the following disk scheduling algorithms: **[5]**

i) FCFS

ii) Look

b) What is the process? Draw and explain various states in the process state diagram. **[5]**

c) Write a note on - deadlock recovery techniques. **[4]**

Total No. of Questions : 8]

SEAT No. :

P514

[Total No. of Pages : 2

[5843]-305

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

MIM - 306 : COMPUTER NETWORKS

(2019 Pattern) (Semester - III)

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 the following:

a) Explain TCP/IP reference model. **[5]**

b) Write a short note on the Go back N protocol. **[5]**

c) Define Bandwidth and Baud rate. **[2]**

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

Q2) Attempt the following:

a) Explain 1 bit sliding window protocol. **[5]**

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

c) Explain Manchester coding. **[2]**

d) Give the names of layers of OSI Model which perform the following task. **[2]**

i) Error Correction and Retransmission.

ii) Responsible for carrying frames.

Q3) Attempt the following:

a) Write a note on CSMA/CD. **[5]**

b) Explain VPN with a suitable diagram. **[5]**

c) Explain the terms Continuous time and slotted time. **[2]**

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

i) 111.20.20.2.30.

ii) 74.45.301.14

Q4) Attempt the following:

a) Explain the UDP Header format. **[5]**

b) Explain any 5 fields from the TCP segment header. **[5]**

c) Define Digital data and Analog data. **[2]**

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

P.T.O.

Q5) Attempt the following:

a) Write a short note on pure ALOHA. **[5]**

b) Explain any five fields of IEEE 802.3 MAC frame. **[5]**

c) Write the correct layer for following functions. **[4]**

   i) Dialog control.

   ii) Encryption.

   iii) Service point address.

   iv) Transmission mode.

Q6) Attempt the following:

a) Explain different transport service primitives. **[5]**

b) What is the role of packet filtering router and application gateway in firewall? **[5]**

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

Q7) Attempt the following:

a) Compare circuit and packet switching. **[5]**

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

c) Construct CRC message for the frame 1101011011 where generator polynomial is $x^4 + x + 1$. **[4]**

Q8) Attempt the following:

a) Explain following congestion control policies in brief. **[5]**

   i) Retransmission policy.

   ii) Acknowledgement policy.

b) Compare virtual circuit and datagram subnet. **[5]**

c) Discuss various functions of the network layer. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P515

[Total No. of Pages : 4

[5843]-401

M.Sc. (Industrial Mathematics with Computer Applications)

MIM - 402 : 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 single memory, non-programmable scientific calculator is allowed.***

Q1) a) Solve Legendre's equation using power series. **[5]**

b) Solve, $2y'' + 3y' + y = e^{-3x}$ **[5]**

c) Find Wronskian of the set $\{x^2, x^3\}$ on $(-\infty,\infty)$ **[2]**

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

Q2) a) Show that, if y_1 and y_2 are two solutions of $y'' + P(x)\,y' + Q(x)\,y = 0$ on $[a, b]$, then show that, they are linearly dependent iff their Wronskain $w = w(y_1, y_2)$ is identically zero. **[5]**

b) Find the indicial equation and its roots for the following differential equation.

$$4x^2\,y'' + (2x^4 - 5x)y' + (3x^2 + 2)\,y = 0$$ **[5]**

c) Show that the two functions $\sin 2x$, $\cos 2x$ are linearly independent. **[2]**

d) Find the solution to the initial value problem. **[2]**

$$y' = e^{y-x} : y(0) = 0$$

P.T.O.

Q3) a) Suppose y, z, w are the following vectors in C_3: **[5]**

$y = (8+i, 3i, -2)$, $z = (i, -i, z)$

$w = (2 + i, 0, 1)$

i) Compute $y + z$

ii) Compute $y - z$

iii) Let $w = z + s\,(y - z)$ Find S.

b) Let $f(x, y)$ be a continous function that satisfies a Lipschitz condition $|f(x, y_1) - f(x, y_2)| \leq |\,k\,|y_1 - y_2|$ on a strip defined by $a \leq x \leq b, -\infty < y < \infty$. Prove that, if (x_0, y_0) is any point of the strip, then the initial value problem $y' = f(x, y)$; $y(x_0) = y_0$ has one and only on solution $y = y(x)$ on the interval $a \leq x \leq b$. **[5]**

c) Verify that $y = c_1 e^{-x} + c_2 5e^{-x}$ is a general solution of the $y'' - 2y' + y = 0$. **[2]**

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

Q4) a) Prove that, a function ϕ is a 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, $y = y_0 + \int_{x_0}^{x} f(t, y)\; dt$ on I. **[5]**

b) Prove that, the correspondence which associates with each $L = a_0 D^n + a_1 D^{n-1} + \text{---} + a_n$, its characteristic polynomial P is given by,

$P(r) = a_0 r^n + a, r^{n-1} + \text{---} + a_n$

is a one - to - one correspondence between all linear differential operators with constant coefficients and all polynomials. If L, m are associated with p, q respectively, then $L + m$ is associated with $p + q$, mL is associated with pq, and α L is associated with $\alpha\, p$, where α is a constant. **[5]**

c) Show that, every bounded function satisfies Lipschitz's condition. **[2]**

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

Q5) a) Find the general solution of the following differential equation. $y''''-y = \cos x$. **[5]**

b) Let ϕ be any solution of $L(y) = y^{(n)} + a_1 y^{(n-1)} + --- + a_n y = 0$ on an interval I containing a point x_0. Then prove that, for all x in I, **[5]**

$$\| \phi(x_0) \|^{e^{-k|x-x_0|}} \le \| \phi(x) \|$$

$$\le \| \phi(x_0) \| e^{k|x-x_0|}$$

where, $k = | + |a| + ---- + |a_n|$ **[5]**

c) Find the general solution of the following differential equation. **[4]**

$y''' - 5y'' + 6y' = 0$

Q6) a) Find the solution of the following initial value problem, **[5]**

$y'' + 10y = 0; y(0) = \pi, y'(0) = 1$

b) By computing appropriate Lipschitz's constant, show that, the following function satisfy Lipschitz condition on the set S indicated: **[5]**

$f(x,y) = 4x^2 + y^2$ on S ;

$|x| \le | , |y| \le |$

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

$$y_1' = y_1$$

$$y_2' = 6y_1 + y_2$$

which satisfies $\phi(0) = (1, -1)$

Q7) a) Prove that, let α_1 x_2, ---- α_n be any n constants and let x_0 be any real number. There exists a solution ϕ of $L(Y) = 0$ on $-\infty < x < \infty$ satisfying $\phi(x_0) = \alpha_1$, $\phi'(x_0) = \alpha_2$---- $\phi^{(n+1)}(x_0) = \alpha_n$. **[5]**

b) Compute the first four successive approximation $\phi_0, \phi_1, \phi_2, \phi_3$,

$y^1 = y^2$; $y(0) = 1$ **[5]**

c) Let α, β be any two constant, and let x_0 be any real number on any interval I containing x_0, there exists atmost one solution ϕ of the initial value problem. **[4]**

Q8) a) Find real valued solution of the following equation. **[5]**

$y\,y' = x$

b) Solve, **[5]**

$$(2x-1)^2\frac{d^2y}{dx^2}+(2x-1)\frac{dy}{dx}-2y$$

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

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

$$y_1' = y_2$$

$$y_2' = 6y_1 + y_2$$

which satisfies $\phi(0) = (1,-1)$

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Total No. of Questions : 8]

SEAT No. :

P516

[Total No. of Pages : 3

[5843]-402

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) The weekly demand for a drinking-water product, in thousands of litres, from a local chain of efficiency stores is a continuous random variable X having the probability density. $f(x) = \begin{cases} 2(x-1), & 1 < x < 2; \\ 0, & elsewhere \end{cases}$

Find the mean and variance of X. What will be mean and variance of 2X? **[5]**

b) Describe one sample proportion test for large sample space. **[5]**

c) Write down R-code with output to create a vector X with elements 1, 2, 3, 4 and create vector $y = x^3$, $z = 1/x$. **[2]**

d) Suppose that we have a fuse box containing 20 fuses, of which 5 are defective. If 2 fuses are selected at random and removed from the box in succession without replacing the first. What is the probability that both fuses are defective? **[2]**

Q2) a) For the given lines of regression $3x - 2y = 5$ and $x - 4y = 7$, find regression coefficient and correlation coefficient. **[5]**

b) Describe two sample mean tests for a small sample space. **[5]**

c) Write down R-code if $X \rightarrow B(5, 0.2)$.

Find.

i) $p[x \leq 2]$ **[2]**

ii) $p[x \geq 1]$

d) A bag contains 4 white and 3 red balls. Two balls are drawn at random one after the other without replacement. Find the probability that both balls are red. **[2]**

Q3) a) Describe paired t-test for a sample space. **[5]**

b) Let X be a binomial random variable with n trials and p be the probability of success; then derive mean and variance of X. **[5]**

c) Let A and B be two events connected with a random experiment such that P(A)=1/2, $P(A \cup B)=3/4$, P(B')=5/8.

Find:

i) $P(A \cap B)$.

ii) $P(A' \cup B')$. **[2]**

d) Suppose X and Y are two vectors containing elements 1, 5, 2 and 3, 7, 9,8 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, 2 at the end.

Q4) a) Prove that for the exponential random varible, $(\text{Mean})^2$=Variance. **[5]**

b) Suppose that a large conference room at a certain company can be reserved for no more than 4 hours. Both long and short conferences occur quite often. In fact, it can be assumed that the length X of a conference has a uniform distribution on the interval [0, 4].

i) What is the probability density function of X?

ii) What is the probability that any given conference lasts at least 3 hours?

iii) Find Mean of X.

iv) Find variance of X.

v) What is the probability that conference lasts at most 2 hours? **[5]**

c) A card is selected at random from a well shuffled ordinary deck of 52 playing cards. Find the probability of getting.

i) A spade card.

ii) A face card. **[2]**

d) Write down R-code if $X \rightarrow B(5, 0.3)$.

Find:

i) $P[X \leq 2]$.

ii) $P[X \geq 1]$. **[2]**

Q5) a) Prove that if X and Y are random variables with joint probability distribution *f* (X,Y) and *a*, *b* and *c* are constants, then

$$\sigma^2_{a\mathrm{X}+b\mathrm{Y}+c} = a^2\sigma_x^2 + b^2\sigma_y^2 + 2ab\sigma\,\mathrm{XY}$$ **[5]**

b) Describe one sample mean test for a large sample sapce. **[5]**

c) In a certain assembly plant, three machines, B1, B2, and B3, make 30%, 45%, and 25%, respectively, of the products. It is known from past experience that 2%, 3%, and 2% of the products made by each machine, respectively, are defecitve. Now, suppose that a finished prodcut is randomly selected. What is the probability that it is defective? **[4]**

Q6) a) Describe chi-square test for the goodness of fit. **[5]**

b) For 5 pairs of observations the following results are obtained $\sum x = 15$, $\sum y = 25$, $\sum x^2 = 55$, $\sum y^2 = 135$, $\sum xy = 83$. Find the equation of lines of regression and estimate the value of X on the first line when y = 12 and value of Y on the second line if $x = 8$ Find correlation coefficient. **[5]**

c) One bag contains 4 white balls and 3 black balls, and a second bag contains 3 white balls and 5 black balls. One ball is drawn from the first bag and placed unseen in the second bag. What is the probability that a ball now drawn from the second bag is black? **[4]**

Q7) a) Find the correlation coeffient for given data. **[5]**

X	1	3	4	6	8	9	11	14
Y	1	2	4	4	5	7	8	9

b) Derive moment generating function for Poission random variable X with mean = λ. **[5]**

c) A town has two doctors X and Y operating independently. If the probability that doctor X is available is 0.9 and that for Y is 0.8, What is probability that at least one doctor is available, when needed? **[4]**

Q8) a) Prove that if X is exponential random vairable then $P(X > s + t \mid X > s) = P(X > t)$ **[5]**

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

c) Suppose that the error in the reaction temperature, in °C, for a controlled laboratory experiment is a continuous random variable X having the probability density function. $f(x) = \frac{x^2}{3}, -1 < x < 2;$ **[4]**

$$= 0, \quad elsewhere$$

i) Verify that f(x) is a density function.

ii) Find $P(0 < X \leq 1)$.

iii) Find F (x).

iv) Find $P(-1 < X \leq 0)$

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Total No. of Questions : 8]

SEAT No. :

P517

[Total No. of Pages : 2

[5843]-403
M.Sc. (I.M.C.A.)
MIM - 403 : DESIGN AND ANALYSIS OF ALGORITHMS
(2019 Pattern) (Semester - IV)

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) Attempt the following:

a) Write a short note on Strassen's Matrix Multiplication. **[5]**

b) Write an algorithm to find the minimum and maximum element from a given array. **[5]**

c) What is an algorithm? What are the properties and algorithm should satisfy, list any two? **[2]**

d) What is Time and Space Complexity of an algorithm? **[2]**

Q2) Attempt the following:

a) Find an optimal solution to the knapsack instances $n = 7$, $m = 15$.
Profit = {10, 5, 15, 7, 6, 18, 3}
Weight = {2, 3, 5, 7, 1, 4, 1} **[5]**

b) Consider the array of given elements, 14, 7, 3, 12, 9, 11, 6, 2. Sort all these elements using Merge sort method. Show all the steps. **[5]**

c) Define Asymptotic Notations. List any two. **[2]**

d) Solve the recurrence relation. $T(n) = 3T(n/3) + n$, $T(1) = 1$. **[2]**

Q3) Attempt the following:

a) Consider the jobs, their deadlines and associated profits as shown

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

Find the optimal schedule that gives maximum profit. **[5]**

b) Find a minimum nuber of multiplications required to multiply;
A [1×5],B [5×4], C [4×3], D [3×2], and E [2×1]. **[5]**

c) What is a recursive algorithm? **[2]**

d) What is Convex Hull? **[2]**

P.T.O.

Q4) Attempt the following:

a) Given the program lengths L = {12, 34, 56, 73, 24, 11, 34, 56, 78, 91, 34, 91, 45,}. Store then on three taps and minimize MRT. **[5]**

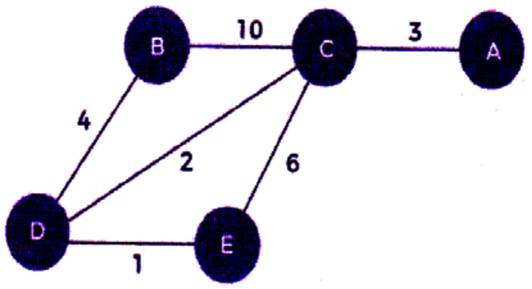
b) Consider the given files, f_1, f_2, f_3, f_4 and f_5 with 20, 30, 10, 5 and 30 number of elements respectively. Find the optimal merge pattern. **[5]**

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

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

Q5) Attempt the following:

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

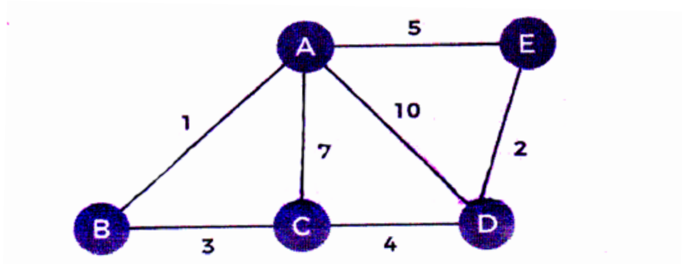


b) Explain Tree Vertex Splitting with one example. **[5]**

c) Write a note on Quick sort performance analysis. **[4]**

Q6) Attempt the following:

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



b) Order the follwoing functions by growth rate: $N, \sqrt{N}, N^{1.5}, N2, N \log N$ **[5]**

c) Write a Binray Search Algorithm. **[4]**

Q7) Attempt the following:

a) Given a chain of four matrices A_1, A_2, A_3 and A_4 with p 0 = 0, $p_1 = 4$ p_2–6, $p_3 = 2$ and $p_4 = 7$ Find m [1, 4]. **[5]**

b) Write the QuickHull Algorithm. **[5]**

c) Write a note on single source shortest path. **[4]**

Q8) Attempt the following:

a) Write a note on String Editing. **[5]**

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

c) Write a note on Huffman codes. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P519

[Total No. of Pages : 2

[5843]-405

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

MIM - 405 : MOBILE TECHNOLOGIES

(2019 Pattern) (Semester - IV)

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 questions:

a) What are limitations of Mobile Competing? **[5]**

b) What is Android OS? Explain its architecture in detail. **[5]**

c) What is Menu? Explain any two types of Menus. **[2]**

d) What is Worker thread? Explain with example. **[2]**

Q2) Attempt the following questions:

a) What is a Service? Explain types of services in Android. **[5]**

b) What is a layout? Brief different types of android layouts in detail? **[5]**

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

i) View

ii) Viewgroup

d) What is Async Task? What is its use? **[2]**

Q3) Attempt the following questions:

a) Explain content providers in detail. **[5]**

b) What is phone Gap? Explain its working. **[5]**

c) What are different ways to register event listeners in android? **[2]**

d) What are steps to setup broad cast receiver? **[2]**

Q4) Attempt the following questions:

a) Explain restful web services in detail. **[5]**

b) What is Accelerometer? Brief its usage in phonegap programming. **[5]**

c) Explain the following terms. **[2]**

i) Portability

ii) Mobility

d) What is linear layout? **[2]**

P.T.O.

Q5) Attempt the following questions:

a) Explain simple cursor Adapter with example. **[5]**

b) Discuss the components of android application. **[5]**

c) What is difference between JVM and Dalvik virtual machine. **[4]**

Q6) Attempt the following questions:

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

b) What is Intent? What are uses of intents? **[5]**

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

Q7) Attempt the following questions:

a) Explain navigation functions in cursor class. **[5]**

b) What is phonegap plug-in? What are different predefined phonegap plug-ins? **[5]**

c) Explain features of swift. **[4]**

Q8) Attempt the following questions:

a) Explain callback methods in service lifecycle in android. **[5]**

b) Give the limitations of phonegap. **[5]**

c) What is JSON? What are the componets of JSON? **[4]**

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Total No. of Questions : 8]

SEAT No. :

P520

[Total No. of Pages : 3

[5843]-501

T.Y.M.Sc.

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) Find Newton Raphson formula for r^{th} root of any number. **[5]**

b) Using Regula Falsi method, compute the real root of the equation $\cos x = 3x - 1$. (Perform 4 iterations). **[5]**

c) Find approximate value of $\frac{\pi}{3}$ correct to 4 decimal places. Find percentage error. **[2]**

d) Using Newton Raphson method, obtain a real root of the equation $x = e^{-x}$ with $x = 0$ as initial approximation. (Perform 2 iterations). **[2]**

Q2) a) Use numerical differentiation formula

$$f''(x) = \frac{f(x+h) - 2f(x) + f(x-h)}{h^2}$$ to approximate '$f(x) = \cos x$' at $x = 0.8$, with h = 0.01. Compare your result with the true value of f'' (0.8). **[5]**

b) Find a root correct to three decimal places lying between [2, 3] of the equation $x^3 - 9x + 1 = 0$ by using bisection method. **[5]**

c) Find the characteristic equation of matrix $A = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 2 \\ -1 & 3 & 2 \end{bmatrix}$. **[2]**

d) Give the formula for: **[2]**

i) Dominant eigenvector.

ii) Similar matrices.

P.T.O.

Q3) a) Solve $y' = xy + y^2$ with $y(0) = 1$ using fourth order Runge Kutta Method. Find $y(0.1)$. (Take $h = 0.1$) **[5]**

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

$5x - y + z = 10$

$2x + 8y - z = 11$

$-x + y + 4z = 3$. (Perform 4 iterations)

c) Find the Jacobian matrix J (x, y) at the point (2,3) for the functions, **[2]**

$f_1(x, y) = x^3 y^2$

$f_2(x, y) = x^2 + 1$

d) Construct forward difference table for the following data: **[2]**

x:	4	5	6	7
y:	4.2	12.5	19.3	30.4

Q4) a) Derive the formula for $f''(x)$ of order O (h^2). **[5]**

b) Find triangular factorization of the matrix $\begin{bmatrix} -5 & 2 & -1 \\ 1 & 0 & 3 \\ 3 & 1 & 6 \end{bmatrix}$. **[5]**

c) Show that there is no solution to the linear system, **[2]**

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

$7x_3 - 4x_4 = -7$

$6x_3 + 5x_4 = 4$

$3x_4 = 6$.

d) Define an ill conditioned system. **[2]**

Q5) a) Show that matrix $A = \begin{bmatrix} 3 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 3 \end{bmatrix}$ is diagonalizable. **[5]**

b) Derive the Newton's forward interpolation formula. **[5]**

c) Derive the formula, $f'''(x_0) \approx \dfrac{-5f_0 + 185f_1 - 24f_2 + 14f_3 - 3f_4}{2h^3}$. **[4]**

Q6) a) Use Euler's method to solve $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0)=1$. Find $y(0.02)$, $y(0.04)$, $y(0.06)$ and $y(0.08)$. (Take $h = 0.02$). **[5]**

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

x :	1	2	3	4
y :	16	16	32	54

c) Find the parabola $y = A + Bx + Cx^2$ that passes through the point (1, 6), (2, 5), (3, 2). **[4]**

Q7) a) Consider $f(x) = 2 + \sin\left(2\sqrt{x}\right)$. Use the composite trapezoidal rule with 11 sample points to approximate the integral of $f(x)$ taken over [1,6]. **[5]**

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

$y(0) = 12, y(2) = 7, y(4) = 6, y(6) = 7, y(8) = 13, y(10) = 32, y(12)=77.$

c) Use the power method to find the dominant eigenvalue and eigenvector for the matrix, $A = \begin{bmatrix} 1 & 2 & -1 \\ 1 & 0 & 1 \\ 4 & -4 & 5 \end{bmatrix}$. (Take 3 iterations.) **[4]**

Q8) a) Solve LY=B, UX=Y and verify that AX=B for $B^T= (7, 2, 10)$, where A=LU is, **[5]**

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

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

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

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

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

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

c) Evaluate $\int_2^6 \log_{10} x \, dx$ using Simpson's $\frac{1}{3}$rd Rule. (Take $n = 8$). **[4]**

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Total No. of Questions : 8]

SEAT No. :

P521

[Total No. of Pages : 4

[5843]-502

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

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) Suppose a 2×2 transformation matrix $[T]=\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is used to transform the line segment PQ to the line segment P*Q*. If slope of the line segment PQ is m, then Prove that the slope of the line segment P*Q* is $m^*=\dfrac{b+dm}{a+cm}$. **[5]**

b) Find the concatenated transformation for the following : first shearing in x and y directions, respectively by –2,4 and 1,1 units: followed by a rotation about the origin through an angle of 20º. Apply this anto the point P[–1,3]. **[5]**

c) Obtain the transformation matrix for scaling in x coordinate by 2 units and y coordinate by 3 units respectively **[2]**

d) Write the transformation matrix for reflection through the line $x + y = 0$.**[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]**

P.T.O.

b) Define a solid body transformation Also determine if the transformation $[T]=\begin{bmatrix} -3/5 & 4/5 \\ -4/5 & -3/5 \end{bmatrix}$ is a solid body transformation. **[5]**

c) State any two properties of oblique projections. **[2]**

d) Suppose we apply the transformation matrix $[T]=\begin{bmatrix} 3 & 1 \\ -1 & 1 \end{bmatrix}$ on a square, then we get a paralleogram of area 64 cm^2 Determine the length of each side of the square. **[2]**

Q3) Attempt each of the following.

a) Write down the sequence of transformation required to reflect the point A [a,b] through the line $x-4y+8=0$ **[5]**

b) Point [4, 2, 1] in a plane is transformed to the point A* [x*, y*,1] under the homogeneous transformation matrix, $[T]=\begin{bmatrix} 0 & -2 & 2 \\ -2 & 2 & -2 \\ 1 & 0 & 1 \end{bmatrix}$, Prove that $x^{*2}+y^{*2}=1$. **[5]**

c) The lines $L_1=\{(x,y)\,|\,3x+2y=12\}$ and $L_2=\{(x,y)\,|\,2x-3y+5=0\}$ are transformed to L_1^* and L_2^* under the transformation matrix $[T]=\begin{bmatrix} 2 & 1 \\ -1 & 1 \end{bmatrix}$, Find the point of intersection of L_1^* and L_2^*. **[2]**

d) Define affine transformation. **[2]**

Q4) Attempt each of the following.

a) Position vector [2,5] is rotated about the point [4,3] by an angle θ=90º using homogeneous coordinate system. Obtain position vector of transformed point. **[5]**

b) Find the concatenated transformation matrix for reflection through the line y = – 4 Apply it on the position vector [–1,2]. **[5]**

c) Write the transformation matrix to transform the point [1, 2, 3] to [0, 0, 0]. **[2]**

d) Write the transformation matrix for rotation about the Z axis through an angle of –45º. **[2]**

Q5) Attempt each of the following.

a) Write the transformation matrix to reflect the pyramid OABC with O[0, 0, 0] , A [1, 0, 0] , B[0, 1, 0], C[0, 0, 1] in the plane z = – 5

b) Consider the line with direction ratios 1, –2, 2 and passing through the origin. Determine the angles through which the line should be rotated about X axis and then about *y* axis so that it coincides with the Z axis. **[5]**

c) State any Four properties of Bezier curves. **[4]**

Q6) Attempt each of the following.

a) Write an algorithm to generate uniformly speced n points on the circle $(x-h)^2 + (y-k)^2 = r^2$. **[5]**

b) Write an algorithm to reflect an object in a plane parallel to the coordinate plane. **[5]**

c) Obtain the transformation matrix for the trimetric projection formed by rotation a bout the *y* axis through 30º, followed by rotation about the *x* axis by 35º, followed by orthographic projection on *z*=0 plane. **[4]**

Q7) Attempt each of the following.

a) Determine the four diametric projections if the Foreshortening factor along the Z axis is 1/3. **[5]**

b) State any Five properties of perspective transformation. **[5]**

c) State any four properties of axonometric transformations. **[4]**

Q8) Attempt each of the following.

a) Generate 5 uniformly spaced points on the hyperbolic segment in the first quadrant for $4 \le x \le 8$, where the hyperbola is given by $\frac{x^2}{4} - \frac{y^2}{16} = 1$. **[5]**

b) Describe an algorithm to generate uniformly spaced 'n' points on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. **[5]**

c) Find the parametric equation of the Bezier curve for the control points B_0 [2,1] , B_1 [4, 4], B_2 [5, 3] and B_3[5, 1]. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P522

[Total No. of Pages : 2

[5843]-503

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

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

Q1) Attempt the following.

a) Define Python. List any four features of Python. **[5]**

b) What is tuple? What is difference between list and tuple? **[5]**

c) Write any two features of lists in Python. **[2]**

d) What is docstring? Explain. **[2]**

Q2) Attempt the following.

a) State and explain with example, standard data types in Python. **[5]**

b) i) What is chained conditional statement?

ii) Write the syntax and wage of for-loop. **[5]**

c) Explain what is range () function and how it is used in lists? **[2]**

d) List any two built-in functions used in Tuple. **[2]**

Q3) Attempt the following:

a) Write a short note on types of operators in Python with appropriate example. **[5]**

b) Explain the features of dictimary. **[5]**

c) Explain with syntaxand example, how the lists are updated in python. **[2]**

d) What is meant by key-value pairs in a dictionary? Explain with example. **[2]**

Q4) Attempt the following:

a) What are packages? Give an example of package in python. **[5]**

b) What are modules in python? Explain. **[5]**

c) What is seek () function? Explain with examples. **[2]**

d) What is the difference between break and continue statement. **[2]**

P.T.O.

Q5) Attempt the following:

a) What is string slicing? Illustrate how it is done in python with example. **[5]**

b) How exceptions are handled in python? Explain with examples. **[5]**

c) Define a file and list its advantages. **[4]**

Q6) Attempt the following:

a) Define function write a syntax to define function give example of function defination. **[5]**

b) What is regular expression? What are different types of regular expression? **[5]**

c) Write a python code to print fibon acciseries up to 10 terms (use for loop). **[4]**

Q7) Attempt the following:

a) Write a python code to pass a list to a function. Calculate total number of positive and negative numbers from the list and then display the count in terms of Dictionary. **[5]**

b) Explain math module. List its functions. **[5]**

c) List different modes of opening a file. Explain. **[4]**

Q8) Attempt the following:

a) What is web framework? What are the advantages of using Django web framework? **[5]**

b) Write a short note on: in python method overriding. **[5]**

c) What is library? Write procedure to create own library in Python. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P523

[Total No. of Pages : 2

[5843]-504

M.Sc.

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 504 : Digital Image Processing

(CBCS Pattern) (Semester - V)

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

Q1) Attempt the following.

a) What is digital image processing? Explain fundamental steps in digital image processing. **[5]**

b) What are the applications of digital image processing? **[5]**

c) What is line detection in digital image processing? **[2]**

d) What do you mean by convex hull? **[2]**

Q2) Attempt the following.

a) Explain with example the spatial filter operation for smoothing of an image. **[5]**

b) What is pseudocolor image processing? **[5]**

c) What is digital image? **[2]**

d) State any two sources of noise. **[2]**

Q3) Attempt the following:

a) Explain the terms mean and standard deviation. **[5]**

b) Write a short note on image restoration. **[5]**

c) What is image histogram? **[2]**

d) Give the meaning of texture. **[2]**

Q4) Attempt the following:

a) What is moving window operations? Mathematically Explain heighbourhood averaging filters. **[5]**

b) Write a short note on mathematical morphology. **[5]**

c) Give the equation of DFT. **[2]**

d) What is the mathematical equation of inverse DFT? **[2]**

Q5) Attempt the following:

a) Give the difference between correlation and convolution. **[5]**

b) Discuss histogram equalisation. **[5]**

c) Write a short note on image enhancement. **[4]**

Q6) Attempt the following:

a) Explain sampling and quantisation of digital image. **[5]**

b) Discuss RGB model for color image. **[5]**

c) Explain in brief the HIS model. **[4]**

Q7) Attempt the following:

a) Explain the global thresholding algorithm. **[5]**

b) Explain edge detection technique of segmentation. **[5]**

c) How to filter an image in the frequency domain? Give its flowchart. **[4]**

Q8) Attempt the following:

a) Discuss image sharpening in the frequncy domain. **[5]**

b) Write a short note on array versus matrix operations. **[5]**

c) What are boundary descriptions? Explain in short. **[4]**

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Total No. of Questions : 8]

SEAT No. :

P524

[Total No. of Pages : 2

[5843]-506

M.Sc. (Industrial Mathematics with Computer Applications)
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 simple M2M architecture in detail. **[5]**

b) What are uses of wireless sensor network in military applications. **[5]**

c) State any two differences between Active tag and Passive Tag? **[2]**

d) Explain local network identity. **[2]**

Q2) Attempt the following questions:

a) Explain the concept of web of things with example. **[5]**

b) What is wireless communication? What is its role in IOT? **[5]**

c) What is use of Satellite technology? **[2]**

d) State any two features of IOT. **[2]**

Q3) Attempt the following questions:

a) Write a note on security challenges in EPC. **[5]**

b) Explain in brief role of IOT in financial/retail sector. **[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 EPC global architecture. **[5]**

b) What are different tasks handled by different protocols in IOT? **[5]**

c) What is mean by Sensor nodes? **[2]**

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

i) H2M Communication.

ii) M2M Communication.

Q5) Attempt the following questions:

a) Write a note on Open Architecture of IOT. **[5]**

b) Difference between EPC and RFID. **[5]**

c) How to maintain security and privacy during communication along wireless network? **[4]**

Q6) Attempt the following questions:

a) Explain Wireless Sensor Network Architecture in detail. **[5]**

b) What is device identity? What are types of identities? **[5]**

c) Explain the working definitions of IOT. **[4]**

Q7) Attempt the following questions:

a) What are clustering principles in Internet of things? **[5]**

b) What are environmental characteristics of IOT device? **[5]**

c) Explain the concept of scalability in detail. **[4]**

Q8) Attempt the following questions:

a) Write a note evolution of IOT. **[5]**

b) What are applications of IOT in Home Automation? **[5]**

c) What are technological challenges in EPC global architecture? **[4]**

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