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F.Y.M.Sc. (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) *Questions 1 is compulsory.*
2) *Attempt any five questions from Q.2 to Q.7*
3) *Figures to the right indicate full marks.*
4) *Scientific calculator and statistical tables are allowed.*

Q1) Attempt any five the following: **[10]**

   a) Prove that any finite subset of $\mathbb{R}$ with usual metric is closed.

   b) Define Cauchy sequence. Give an example of a Cauchy sequence of real numbers.

   c) Find radius of convergence of $\sum_{n=1}^{\infty} \dfrac{z^n}{n}$.

   d) Define discontinuity of first kind.

   e) Evaluate: $\int_0^1 x \, dx^2$

   f) Show that the sequence of functions $f_n(x) = x^n$ converges pointwise on [0.1].

   g) Show that $\lim_{x \to 0} x \cos \dfrac{1}{x} = 0$

Q2) a) Define open set in a metric space. Prove that a set E is open if and only if its complement is closed.   **[7]**

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

Q3) a) Prove that a mapping f of a metric space X in to a metric space Y is continuous if and only if $f^{-1}(V)$ is open in X for every open set V in Y. **[7]**

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

Q4) a) Define the derivative of a real valued function. Show that the function.

$$f(x) = \begin{cases} x^2 \sin\dfrac{1}{x}, & x \neq 0; \\ 0, & x = 0 \end{cases}$$

is differentiable at all $x \in \mathbb{R}$ by f' is not a continuous function. **[7]**

b) If $C_0 + \dfrac{C_1}{2} + \ldots + \dfrac{C_{n-1}}{n} + \dfrac{C_n}{n+1} = 0$, where $C_0, C_1, \ldots, C_n$ are real constants then prove that the equation $C_0 + C_1 x + \ldots + C_{n-1}x^{n-1} + C_n x^n = 0$ has at least one real root between 0 and 1. **[5]**

Q5) 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 $L(P, f, \alpha) \leq L(P^*, f, \alpha)$ **[7]**

b) If f is continuous on [a,b] and α is a monotonically increasing function on [a,b] then prove that $f \in \mathfrak{R}(\alpha)$ on $[a,b]$ **[5]**

Q6) a) Prove that the sequence of function $\{f_n\}$ defined on E, converges uniformly on E if and only if for every $\in > 0$ there exists an integer N Such that $m \geq N, n \geq N, x \in E$ implies $|f_n(x) - f_m(x)| < \in$. **[7]**

b) If $f \in \mathfrak{R}$ on [a,b] and if there is differentiable function F on [a,b] such that F'=f then prove that $\displaystyle\int_a^b f(x)dx = F(b) - F(a)$. **[5]**

Q7) a) State and prove Weierstrass M-test. **[6]**

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

$$\lim_{n \to \infty} \int_0^1 f_n(x)dx \neq \int_0^1 \left[\lim_{n \to \infty} f_n(x)\right] dx$$ **[6]**

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[6076]-214

F.Y.M.Sc. (IMCA)
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)   Define UML. Explain advantages of UML.   **[5]**

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

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

    d)   Define the elaboration concept.   **[2]**

Q2) Attempt the following:

    a)   Write short note on 'The Booch Method'.   **[5]**

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

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

    d)   How subsystem can be organized?   **[2]**

Q3) Attempt the following:

    a)   Differentiate between aggregation and generalization.   **[5]**

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

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

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

Q4) Attempt the following:

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

b) Explain object-oriented testing strategy. **[5]**

c) What are Packages? Explain its purpose. **[2]**

d) Explain how to partition the Activity diagram. **[2]**

Q5) Attempt the following:

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

b) Discuss the generic components of the object-oriented Design model.**[5]**

c) What are frameworks? Explain its benefits. **[4]**

Q6) Attempt the following:

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

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

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

Q7) Attempt the following. (Any two)

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

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

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

Q8) Attempt the following.

a) What is Use Case? Explain different components of Use case diagram.**[5]**

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

c) Consider ATM for banking system. Identify all the classes and draw a class diagram. **[4]**

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[6076]-311

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 indicate full marks.*
3) *Use of non-programmable calculators allowed.*

Q1) a) Solve the following LPP graphically: **[5]**

$$\text{Max } z = 4x_1 + 3x_2$$
Subject to,
$$3x_1 + 4x_2 \le 24$$
$$8x_1 + 6x_2 \ge 48$$
$$x_1 \le 5$$
$$x_2 \le 6$$
$$x_1, x_2 \ge 0$$

b) 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 machine 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 M_1 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.   **[5]**

c) What is meant by balancing the transportation problem?   **[2]**

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

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

$$\max z = 2x_1 + 3x_2$$

subject to,

$$2x_1 + x_2 \leq 4$$
$$x_1 + 2x_2 \geq 5$$
$$x_1, x_2 \geq 0$$

b) Explain penalty Rule for artificial variables in Big M-method. **[5]**

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

d) Define convex set. **[2]**

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) What are the steps in revised simplex algorithm? **[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 from **[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 **[7]**

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

c) Is dual of the dual a primal? Justify. **[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]**
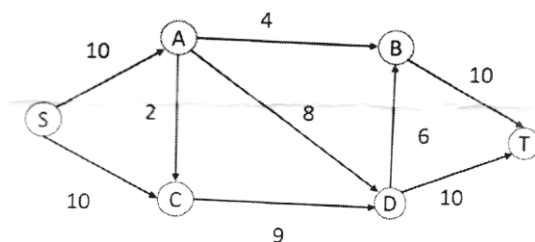
c) Use Dijkstra's algorithm to find the shortest route from node A to all the remaining nodes in the network. **[4]**
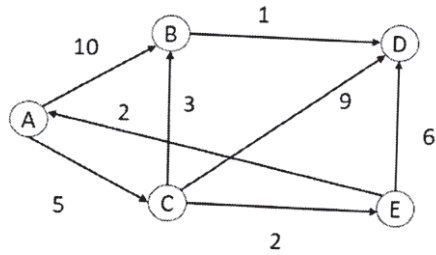
Q6) a) Explain Hungarian method of an assignment problem. **[7]**

b) Use two-phase method to solve the LLP. **[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 $x_1, x_2 \geq 0,$

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

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

i) Dual feasibility condition

ii) Dual optimality condition.

c) Solve the following assignment problem for maximization. **[4]**

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

Q8) a) Determine the critical path for the following project network. **[5]**
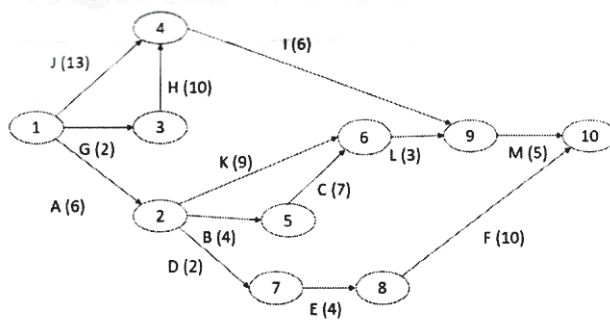
b) Find the initial basic feasible solution of the following transportation problem by **[5]**

i) North-west corner method.

ii) Matrix minima method.

iii) Which method gives better solution?

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

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

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S.Y.M.Sc. (IMCA)

MIM-404: INTERNET PROGRAMMING

(2019 Pattern) (Semester-IV)

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 all of the following:

   a) Define: Array Write any four array sorting functions with syntax and example in detail. **[5]**

   b) Explain in detail different types of data types supported by PHP. **[5]**

   c) Write the following functions with syntax and example. **[2]**

     i) Strcmp ()

     ii) Substr-count ()

   d) 'HTTP is a stateless protocol', state true/false. Justify. **[2]**

Q2) Attempt all the following:

   a) Write a short note on : introspection **[5]**

   b) What is variable? Explain variable scope in PHP with example. **[5]**

   c) Define: **[2]**

     i) Class

     ii) Object

   d) Explain concept of multiline string in PHP. **[2]**

P.T.O.

Q3) Attempt all of the following:

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

    b)   Explain XML document structure in detail. **[5]**

    c)   State the purpose of $ this variable. **[2]**

    d)   Explain functions supported by PHP to convert between arrays and variables. **[2]**

Q4) Attempt all of the following:

    a)   What is associative array? Explain with suitable example. How it is different from indexed array. **[5]**

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

    c)   Explain any two features of PHP. **[2]**

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

Q5) Attempt all of the following:

    a)   Explain constructor and destructor with suitable examples. **[5]**

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

    c)   Write a short note on anonymous or lambda function. **[4]**

Q6) Attempt all of the following:

    a)   Write a PHP script to create a form that accepts 2 strings. Compare these two strings and display message M submit button click. **[5]**

    b)   What is the use of soundex () & metaphone ()? Explain with proper example. **[5]**

    c)   Write a short note on : regular expression. **[4]**

Q7) Attempt all of the following:

a)   Explain in detail, different kinds parsers used in XML.   **[5]**

b)   Write a PHP script to read directory name from user and display all files
     with their sizes in tabular format.   **[5]**

c)   What is serialization? Explain it with different built in functions.   **[4]**

Q8) Attempt all of the following:

a)   Explain following control structures using both ways syntax with suitable
     example.   **[5]**

     i)   do-while

     ii)   For each

b)   Write a short note on : sticky form with suitable example.   **[5]**

c)   State any four ways to send output to browser.   **[4]**

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T.Y.M.Sc. (Industrial Mathematics with Computer application)
MIM-501 : NUMERICAL ANALYSIS
(2019 Pattern) (Semester-V)

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

Instructions to the candidates:

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

Q1) Solve any five of the following.   **[10]**

     a)   Define an ill conditioned system.

     b)   Investigate the nature of the fixed-point iteration when

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

     c)   Show that : $\Delta = E\nabla$

        Where, Δ is forward operator

           ∇ is backward operator

           E is shift operator

     d)   If the approximate value of 7.013 is 7, find the absolute error and relative error.

     e)   Find the jacobian matrix J (x,y) at the point (1,2) for the functions,

        $f_1(x,y) = x^3 y^2 - 5x^2 y^2$

        $f_2(x,y) = y^6 - 3y^3 x + 7$

     f)   Construct forward difference table for the following data.

x	0-19	20-39	40-59	60-79	80-99
y	41	62	65	50	17

     g)   Define:

        i)   Relative error

        ii)   Percentage error.

Q2) a) Find a root correct to four decimal places lying between [0,1] of the equation $3x-\cos x-1=0$ by using false position method. **[7]**

b) Find a root of equation $x \log x = 1.2$ using bisection method which lies in [2,3] correct up to three decimal places. **[5]**

Q3) a) Use lagrange's interpolation formula to find polynomial using the data given below.

$f(0) = -12, f(1) = 0, f(3) = 6, f(4) = 12$ **[7]**

b) Assume that $g \in C[a,b]$. The range of the mapping y $=g(x)$ satisfies $a \le y \le b$ for all $a \le x \le b$ then prove that g has a sixed point in [a,b]. **[5]**

Q4) a) Use Euler's method to solve $\dfrac{dy}{dx} = x^2 - y, y(0) = 1$. obtain $y(0.02), y(0.04)$ and $y(0.06)$. (Take $h=0.02$) **[7]**

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

$x + y + z = 7$

$x + 2y + 2z = 13$

$x + 3y + z = 13$. (Perform 4 iterations).

Q5) a) Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 4 & 5 \\ 0 & 4 & 3 \end{bmatrix}$.

Also check whether it is diagonalizable or not. **[7]**

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

Q6) a) Use Runge Kutta method of second order to find a solution to the initial value problem $y' = 3x + y^2$ with $y(1) = 1$ at $x = 1.1$ and $x = 1.2$ (Take $h=0.1$) **[7]**

b) Determine the degree of precision of Simpson's $\dfrac{3^{th}}{8}$ rule **[5]**

Q7) a) Solve LY=B, UX=Y and verify that AX=B for $B^T=(-4,10,5)$, and A=LU where, **[6]**

$$A = \begin{bmatrix} 2 & 4 & -6 \\ 1 & 5 & 3 \\ 1 & 3 & 2 \end{bmatrix}; L = \begin{bmatrix} 1 & 0 & 0 \\ \frac{1}{2} & 1 & 0 \\ \frac{1}{2} & \frac{1}{3} & 1 \end{bmatrix}; U = \begin{bmatrix} 2 & 4 & -6 \\ 0 & 3 & 6 \\ 0 & 0 & 3 \end{bmatrix}$$

b) Evaluate $\displaystyle\int_1^{2.5} \frac{x^3}{e^x - 1} dx$ using simpson's $\frac{1^{rd}}{3}$ rule by dividing the interval into six equal parts. **[6]**

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[6076]-112

F.Y. M.Sc. (I.M.C.A.)
MATHEMATICS
MIM-102 : Linear Algebra
(2019 Pattern) (Semester - I)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:
1) *All questions are compulsory.*
2) *Figures to the right indicate full marks.*
3) *Attempt any five questions from Q.2 to Q.7.*
4) *Scientific calculators and statistical tables are allowed.*

Q1) Attempt any five of the following :   **[5 × 2 = 10]**

a) Let W be the set of 2×2 matrices with determinant zero. Is W a subspace of $M_2(\mathbb{R})$? Justify.

b) Find the number of parameters in the general solution of $AX = 0$ if A is a matrix 5×7 of rank 3.

c) Let $u = (2, -1, 3)$ and $a = (4, -1, 2)$. Find the vector component of u along a and the vector component of u orthogonal to a.

d) What is the dimension of the vector space of all symmetric $n \times n$ matrices?

e) Show that a square matrix A is invertible if all its eigenvalues are nonzero.

f) If T is any linear operator on V, then show that the range space of T is invariant under T.

g) If f is a continuous function on $[a, b]$, and W is a finite-dimensional subspace of $C[a, b]$, then what is the least squares approximation to f from W.

P.T.O.

Q2) a) Let V be an *n*-dimensional vector space, and let S be a set in V with exactly n vectors. Then prove that S is a basis for V if and only if S spans V or S is linearly independent. **[7]**

b) Are the vectors $\{1, e^x, e^{2x}\}$ linearly independent in $C^2(-\infty, \infty)$? Justify. **[5]**

Q3) a) State and prove Cauchy-Schwarz Inequality. **[7]**

b) Prove that $\|u\| = \|v\|$ if and only if $u + v$ and $u - v$ are orthogonal. **[5]**

Q4) a) If A is a symmetric matrix, then prove that eigenvectors from different eigenspaces are orthogonal. **[7]**

b) Find a matrix P that diagonalizes A, if A is diagonalizable. **[5]**

$$A = \begin{bmatrix} 5 & 0 & 0 \\ 1 & 5 & 0 \\ 0 & 1 & 5 \end{bmatrix}$$

Q5) a) If $T : V \to W$ is a linear transformation, then prove that the kernel of T is a subspace of V and the range of T is a subspace of W. **[7]**

b) Use the matrix

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

to obtain the Hill cipher for the plaintext message : I AM HIDING. **[5]**

Q6) a) Let T be a linear operator on an n-dimensional vector space V. Prove that the characteristic and minimal polynomials for T have the same roots, except for multiplicities. **[7]**

b) The invertible matrix

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

maps the line $y = 2x + 1$ into another line. Find its equation. **[5]**

Q7) a) Express

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

as a product of elementary matrices, and then describe the geometric effect of multiplication by A in terms of shears, compressions, expansions and reflections. **[7]**

b) Find an LU-decomposition of **[5]**

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

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[6076]-113

F.Y. M.Sc. (Industrial Mathematics With Computer Applications)
MATHEMATICS
MIM-103 : C Programming
(2019 Pattern) (Semester - I)

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

Instructions to the candidates:

  1)   Q1 is compulsory.

  2)   Attempt any FIVE questions from Q2 to Q7.

  3)   Figures to the right indicate full marks.

  4)   Scientific calculator is allowed.

Q1) Attempt any FIVE of the following.   **[10]**

  a)   What is a conditional operator?

  b)   What are identifiers in C?

  c)   What will be the output of the arithmetic expression?.

       5+3*2%10−8*6

  d)   What will be the output of the following statements?

       int i = 1, j;

       j=i− − −2;

       printf("%d", j);

  e)   What is the meaning of EOF?

  f)   Why is a macro used in place of a function?

  g)   What is the scope of a register variable?

Q2) Attempt each of the following :

a) Write a C program to compute reverse of a given number. **[5]**

b) Write a short note on C preprocessors. **[7]**

Q3) Attempt each of the following :

a) Write a C program to check whether the given number is prime or composite. **[5]**

b) Write a short note on increment and decrement operators. Explain by giving suitable examples. **[7]**

Q4) Attempt each of the following:

a) Write a short note on printf() function. Explain by giving a suitable example. **[5]**

b) Write a C program to compute multiplication of two matrices of same order. **[7]**

Q5) Attempt each of the following :

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

b) Write a short note on for loop. Explain by giving suitable examples.**[7]**

Q6) Attempt each of the following:

a) Write a short note on multi-dimensional arrays. **[5]**

b) Differentiate between structure and union. Explain by giving suitable examples. **[7]**

Q7) Attempt any TWO of the following :

a) Write a short note on pointers. Explain by giving suitable examples.**[6]**

b) Compare static variables with external variables. **[6]**

c) Write a note on if-else statement. Explain by giving suitable examples. **[6]**

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[6076]-114

M.Sc. (Industrial Mathematics with Computer Applications)
COMPUTER SCIENCE
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) Define mapping cardinality. Explain various types of mapping cardinalities in brief. **[5]**

  b) Explain with an example "Tabular representation of strong and weak entity set." **[5]**

  c) What is a primary key? Give an example. **[2]**

  d) Give any two notations used to draw an E-R diagram. **[2]**

Q2) Attempt the following :

  a) Explain the following SQL set operations with example. **[5]**
      i) intersect
      ii) intersect all

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

  c) What is a composite attribute? 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) What is a cursor? State and explain its syntax. **[5]**

  c) Define specialization? Give an example. **[2]**

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

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

a) Consider the following database

Item(Item_no,Item_name, price)

Supplier (Supplier_id,Supplier_name,City)

Item and Supplier are related with many-to-many relationship.

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

i) List the names of items with highest price.

ii) List the names of all the suppliers supplying item "monitor".

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

i) List the names of all suppliers from "Pune".

ii) List the name and price of all items supplied by "Mr. Patil".

iii) List the names of suppliers who supply the item "keyboard" for less than 2000 rupees.

c) Give the basic structure of a SQL query. **[2]**

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

Q5) Attempt the following:

a) Consider the following database

Customer (customer-number integer, name varchar(30), city varchar(20))

Write a PL/pgSQL function which will accept customer name and displays the city of the customer. **[5]**

b) Consider the relation schema R(A,B,C,G,H,I) and the set of functional dependencies defined on R as

F= {A-> B, A->G, B->C, B->G, C->G, GH->l}

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 Left outer join and Right outer join operation with example.**[5]**

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

c) Explain the different types of attributes with respect to E-R model. **[4]**

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Q7) Attempt the following :   **[5]**

    a)   Give example to explain

        i)   Cartesian product

        ii)   Natural join

    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 ends with "a".

        ii)   Find the average salary of an employee.

        iii)   Display the count of projects.

        iv)   Display the employee details in the ascending order of their salary.

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

        i)   List the name and duration of all projects.

        ii)   Give the names of projects having budget less than 50000.

        iii)   List the names of employees who live in "Pune" city.

        iv)   Give the name and age of all employees.

Q8) Attempt the following:

    a)   What is normalization? Explain 1NF, 2NF forms of normalization with example.   **[5]**

    b)   Explain the five main functions of a Database Administrator (DBA)? **[5]**

    c)   Give example to explain   **[4]**

        i)   Primary key

        ii)   Candidate key

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[6076]-211

F.Y.M.Sc. (Industrial Mathematics with Computer Applications)
MATHEMATICS
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) Find Taylors series representation for $f(z) = e^z$ in the domain $|z - 1| < \infty$. **[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 $f(z) = \dfrac{\phi(z)}{(z - z_0)^m}$, where $\phi(z)$ is analytic and nonzero at z_0. Moreover

$$\operatorname*{Res}_{z=z_0} f(z) = \phi(z_0), if \ m = 1; \text{ and } \operatorname*{Res}_{z=z_0} f(z) = \frac{\phi^{(m-1)}(z_0)}{(m-1)!}, \text{ if } m \geq 2.$$ **[5]**

c) Define Harmonic function and give one example of such functions. **[2]**

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

Q2) a) Find the singularity of the function $f(z) = \dfrac{1 - \cos z}{z^2}$. Also discuss the type of this singularity. **[5]**

b) Obtain the Maclaurin series representation for sin z and cosz. **[5]**

c) Show that $\text{Log}(-ei) = 1 - \dfrac{\pi}{2}i.$ **[2]**

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

Q3) a) State and prove the Fundamental Theorem of Algebra. **[5]**

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

c) Find square roots of i. **[2]**

d) Find derivative of sinh z. **[2]**

Q4) 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 $|f^n(z_0)| \leq \frac{n!M_R}{R^n}, (n=1,2,...)$. **[5]**

b) Derive a formula for $\sin^{-1}z$. **[5]**

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

d) Evaluate the integral $\int_0^{23} 1 + 2t$ dt. **[2]**

Q5) a) Prove that $\int_0^{\infty} \frac{dx}{x^2+1} = \frac{\pi}{2}$. **[5]**

b) Suppose that $z_n = x_n + iy_n$ (n = 1, 2,...) and z = x + iy. Then prove that $\lim_{n\to\infty} z_n = z$ *if* and only if $\lim_{n\to\infty} x_n = x$ and $\lim_{n\to\infty} y_n = y$. **[5]**

c) Prove that composition of two continuous functions is again a continuous function. **[4]**

Q6) a) Show that $\int_C \frac{1}{(z-i)^{n+3}} dz = \begin{cases} 0 & n \neq -2 \\ 2\pi i & n = -2. \end{cases}$ When **[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 $f(z) = \frac{1}{z^2(1-z)}$ and specify the region in which the representation is valid. **[4]**

Q7) a) If w(*t*) is a piecewise continuous complex-valued function defined on an interval a ≤ t ≤ b then prove that $\left| \int_a^b w(t)\, dt \right| \le \int_a^b |w(t)|\, dt.$ **[5]**

b) Find a harmonic conjugate $v(x, y)$ for $u(x, y) = 2x(1- y)$. **[5]**

c) Find $\int_C \dfrac{dz}{z}$ where C is the right-hand half of the circle $|z| = 2$. **[4]**

Q8) a) Let C denote the line segment from $z = i$ to $z = 1$. By observing that of all the points on that line segment, the midpoint is closest to the origin, show that $\left| \int_C \dfrac{dz}{z^4} \right| \le 4\sqrt{2}$ without evaluating the integral. **[5]**

b) State and prove the Cauchy Integral Theorem. **[5]**

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

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[6076]-212
M.Sc. (I.M.C.A.)
MATHEMATICS
MIM-202 : Discrete Mathematical Structures
(2019 Pattern) (Semester - II)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

   1)   *Question 1 is compulsory.*

   2)   *Attempt any five questions from Q.2 to Q.7.*

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

   4)   *Scientific calculator is allowed.*

Q1) Attempt any FIVE of the following : **[10]**

   a)   State true or false: A tree with at least 2 vertices contains at least two pendant vertices. Justify.

   b)   State true or false : Kruskal's algorithm is used to find shortest path between any two vertices in a graph. Justify.

   c)   How many permutations of the letters ABCDEFGH contain the string ABC?

   d)   In how many ways can 6 people be seated at a round table?

   e)   State true or false: Maximum number of edges in a connected graph with 18 vertices are 153. Justify.

   f)   Construct circuit that produce the following output $(x + \overline{y})\overline{x}$.

   g)   What is the minimum number of vertices in a simple graph with 50 edges? Justify.

P.T.O.

Q2) Attempt each of the following :

a) Use Prim's algorithm to find a minimum spanning tree for the following weighted graph. **[5]**
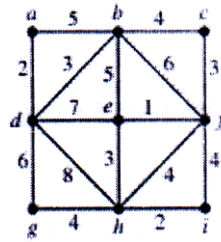
b) During a month with 30 days, a baseball team plays at least one game a day, but no more than 45 games. Show that there must be a period of some number of consecutive days during which the team must play exactly 14 games. **[7]**

Q3) Attempt each of the following :

a) Show that the distributive law $x(y + z) = xy + xz$ and $x + yz = (x + y)(x + z)$ is valid using Boolean function tables. **[5]**

b) Find a recurrence relation and give initial conditions for the number of bit strings of length n that do not have two consecutive 0s. How many such bit strings are there of length five? **[7]**

Q4) Attempt any TWO of the following :

a) What is the solution of the recurrence relation $a_n = a_{n-1} + a_{n-2}$ with $a_0 = 0$ and $a_1 = 1$? **[6]**

b) Find the solution to the recurrence relation $a_n = 6a_{n-1} - 11a_{n-2}\ 6a_{n-3}$ with the initial conditions $a_0 = 2$, $a_1 = 5$ and $a_2 = 15$. **[6]**

c) Explain the Quine-McCluskey method used to simplify a sum-of-products expression. **[6]**

Q5) Attempt each of the following :

a) Find the value of the prefix expression : **[5]**

$+ - \uparrow 32 \uparrow 23 / 6 - 42$?

b) Define a tree. Prove that a tree with n vertices has n − 1 edges. **[7]**

Q6) Attempt each of the following :

    a)   Find the sum-of-products expansion for the function $F(x, y, z) = (x + y)\overline{z}$. **[5]**

    b)   Let G be a connected planar simple graph with e edges and v vertices. Let r be the number of regions in a planar representation of G. Then prove that $r = e - v + 2$. **[7]**

Q7) Attempt each of the following :

    a)   How many solutions does the equation $x_1 + x_2 + x_3 = 15$ have, where x_1, x_2 and x_3 are non-negative integers? **[5]**

    b)   Use K-maps to simplify these sum-of-products expansion **[7]**

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

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[6076]-213
F.Y.M.Sc. (IMCA)
COMPUTER SCIENCE
MIM - 203 : Data Structures
(2019 Pattern) (Semester - II)

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

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

Q1) Attempt All :

a) Define asymptotic notation. Explain Bigohard Big Omega notations in detail. **[5]**

b) What is non-comparision sorting technique? Write as algorithm for counting sort with its analysis. **[5]**

c) Define adjacency matrix. Give an example. **[2]**

d) Detain Abstract data type. **[2]**

Q2) Attempt All :

a) Write as algorithm for Heap sort with its analysis. Also define heapify property. **[5]**

b) Explain working of Dequeue with its structure. **[5]**

c) Define an algorithm. Give its two characteristics. **[2]**

d) Define the structure of stack. **[2]**

Q3) Attempt All :

a) Explain circular queue with its structure. **[5]**

b) Explain polynomial manipulation with example. **[5]**

c) What is AOV network? **[2]**

d) Define Space Complexity. **[2]**

Q4) Attempt All :

    a)   Explain singly and doubly circular linked list with its structure.   **[5]**

    b)   Give the note on multiple queues.   **[5]**

    c)   Give the best case complexity for Bucket sort & Merge sort.   **[2]**

    d)   Write a short note on recursion using impilicit stack.   **[2]**

Q5) Attempt All :

    a)   Write the functions for insert and delete operation on BST. Define BST.
          [5]

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

        i)   DFS   ii)   BFS

    c)   Write the working of Bucket sort algorithm with example.   **[4]**

Q6) Attempt All :

    a)   Explain any two operations of singly linked list.   **[5]**

    b)   Write a note on comparision between insertion sort and bubble sort based on its analysis.   **[5]**

    c)   Explain any two tree traversal techniques.   **[4]**

Q7) Attempt All :

    a)   Define the structure of queue and explain its operations with required conditions.   **[5]**

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

        i)   Expression Tree   ii)   AVL trees.

    c)   Define the structure of linked list and give its static and dynamic representation.   **[4]**

Q8) Attempt All :

    a)   Write a note on Binary search tree with its analysis. Also give its static and dynamic representation.   **[5]**

    b)   Sort the following numbers in increasing order using quick sort. Give its working in detail. 5, 3, 1, 9, 8, 2, 4, 7. (Take middle element as pivot).**[5]**

    c)   Explain circular queue with its structure and example.   **[4]**

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[6076]-215

M.Sc. (Industrial Mathematics with Computer Applications)
MIM - 205 : JAVA
(2019 Pattern) (Semester - II)

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

Instructions to the candidates :

1) *Q.1 is compulsory.*
2) *Solve any FIVE questions from Q.2 to Q.7.*
3) *Q.2 to Q.7 carry equal marks.*
4) *Figures to the right indicate full marks.*

Q1) **Attempt any FIVE of the following :**   **[5 × 2 = 10]**

a) What is bytecode? What is benefit of bytecode?

b) What is use of extends keyword in java?

c) Define the term: Abstract class.

d) State the use of finalize() method.

e) String objects created by String class are immutable. State true/false. Justify.

f) State any two disadvantages of Swing.

g) Give the syntax of any two methods used to compare two string objects.

Q2) **Attempt the following questions :**

a) Describe java util Arrays class in java.   **[7]**

b) Write a program that reads a file containing names of persons along with their contact numbers. Display the content of file. Allow the user to jump to any position in the file and print the contents at that position. Use Random Access File.   **[5]**

P.T.O.

Q3) **Attempt the following questions :**

    a)   Explain the concept of Wrapper classes and methods of wrapper classes.

                  [7]

    b)   Explain any five event classes in java.   **[5]**

Q4) **Attempt the following questions :**

    a)   Discuss static fields, static methods and static blocks in details.   **[7]**

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

Q5) **Attempt the following questions :**

    a)   What is JVM? How does it work? Explain with suitable diagram.   **[7]**

    b)   Write a java program which accepts e-mail address from user and throws an exception 'Invalid Address' if it does not contain '@' symbol.   **[5]**

Q6) **Attempt the following questions :**

    a)   What is Inheritance? Explain different types of inheritance in java with suitable examples.   **[7]**

    b)   Explain any five methods of String class.   **[5]**

Q7) **Attempt the following questions :**

    a)   Write a java program to create a screen which contains three checkboxes (Linux, Windows, Android) and display selected items in text box.   **[7]**

    b)   Explain any five predefined packages in java and their applications.   **[5]**

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[6076]-312

S.Y. M.Sc. (Industrial Mathematics with Computer Applications)
MATHEMATICS
MIM 302 : Algebra
(2019 Pattern) (Semester - III)

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

Instructions to the candidates :
1) *Q1 is compulsory.*
2) *Attempt any five questions from Q2 to Q7.*
3) *Figures to the right indicate full marks.*
4) *Scientific calculators and statistical tables are allowed.*

Q1) **Solve any five of the following.** **[5 × 2 = 10]**

a) Give an example of a (i) finite non cyclic group and (ii) an infinite non cyclic group.

b) Express the following permutation in S_8 as a product of disjoint cycles:
   (1,2)(4,7,8)(2,1)(7,2,8,1,5)

c) Show by an example that the union of two normal subgroups of a group G may not be a normal subgroup of G.

d) Find all zero divisors in the ring Z_{12}.

e) List all ideals of the ring of rational numbers.

f) Give the characteristic of the following rings: (i) $Z_3 \times Z_4$ (ii) $Z_6 \times Z_{15}$.

g) Define a primitive polynomial and give one example.

Q2) a) Prove that every subgroup of a cyclic group is cyclic. **[7]**

b) Determine the order of every element in the group $(Z_6, +_6)$. **[5]**

Q3) a) Let G be a finite group of even order. Prove that there is at least one element $a \in G$, $a \neq e$ such that $a = a^{-1}$. **[7]**

b) Find all normal subgroups of the group $(Z_6, +_6)$. **[5]**

P.T.O.

Q4) a) Let G be a group and let R be a relation defined on G by 'aRb' if and only if $a = x^{-1}bx$, for some $x \in G$. Prove that R is an equivalence relation on G. Further show that if G is an abelian group then every conjugacy class is a singleton set. **[6]**

b) Show that there is no simple group of order 56. **[6]**

Q5) a) Let D be a Euclidean domain with Euclidean valuation υ. Prove that for non zero a, b in D we have $\upsilon(a) < \upsilon(ab)$ if and only if b is not a unit of D. Also prove that 'a' is a unit in D if and only if $\upsilon(a) = \upsilon(1)$. **[7]**

b) Give an example of a subring of $Z \times Z$ which is not an ideal of $Z \times Z$. Here Z denotes the ring of integers. **[5]**

Q6) a) Let R be a commutative ring with unity and N be an ideal of R. Prove that R/N is an integral domain if and only if N is a prime ideal in R. **[7]**

b) Find all irreducible polynomials of degree 2 in $Z_2[x]$. **[5]**

Q7) a) State and prove Eisenstein's Criterion for irreducibility of polynomials. **[7]**

b) Use Euclidean algorithm in Z[i] to find a gcd of $8 + 6i$ and $5 - 15i$ in Z[i]. **[5]**

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[6076]-313

S.Y. 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) Question 1 is compulsory.

2) Solve any five questions from Q.2 to Q.7.

3) Q.2 to Q.7 carry equal marks.

4) Figures to the right indicate full marks.

Q1) Attempt any FIVE of the following : **[5 × 2 = 10]**

a) Give the syntax of following methods of Graphics 2D class :

i) draw()

ii) fill()

b) What is thread priority? Give different levels of thread priorities.

c) What is the purpose of Prepared Statement?

d) List the classes in the collection framework.

e) Name the method to be overridden in Generic Servlet.

f) What is a Scriptlet?

g) Define the term: 'Socket'.

Q2) Attempt the following questions :

a) Explain in brief important classes of collection frameworks. **[7]**

b) What is Servlet? Explain the types of Servlets. **[5]**

P.T.O.

Q3) Attempt the following questions :

 a) Write a note on Font Metrics class. **[7]**

 b) Write a note on the JSP life cycle. **[5]**

Q4) Attempt the following questions :

 a) Write a note on Thread Lifecycle. **[7]**

 b) Explain scripting elements in JSP. **[5]**

Q5) Attempt the following questions :

 a) Explain the Result Set types in detail. **[7]**

 b) What are different ways of session tracking in servlet? **[5]**

Q6) Attempt the following questions :

 a) Create a bank object (account_number, name, balance). Write a program to withdraw and deposit money periodically in this account using two different threads. **[7]**

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

Q7) Attempt the following questions :

 a) Write a program to display details of students having percentage>60 from the student table (rollno, name, percentage). **[7]**

 b) Explain the process of displaying images in a container-like panel.**[5]**

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[6076]-314

M.Sc. (Computer Science)
Industrial Mathematics with Computer Applications
MIM-304 : Operating Systems
(2019 Pattern) (Semester - III)

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

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

Q1) Attempt All.

  a) Give any five characteristics of operating system.   **[5]**

  b) Write a note on process control bore.   **[5]**

  c) Define compaction.   **[2]**

  d) Give any two reasons of the segmentation fault.   **[2]**

Q2) Attempt All.

  a) Draw and describe - Process state transition diagram.   **[5]**

  b) Explain indexed memory allocation.   **[5]**

  c) Give the working of CSAN algorithm.   **[2]**

  d) What is a semaphore?   **[2]**

Q3) Attempt All.

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

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

  Calculate average turn around time and average waiting time using FCFS and SJF (Pre-emptive) CPU scheduling algorithms.

b)   Write a note on deadlock recovery techniques.   [5]

c)   Define physical and logical addresses.   [2]

d)   What is a dispatcher?   [2]

Q4) Attempt All.

a)   Explain bounded buffer problem in detail.   [5]

b)   Explain any five file attributes.   [5]

c)   Define wait - for graph.   [2]

d)   Give any two advantages of layered system structure of operating system.   [2]

Q5) Attempt All.

a)   Explain both the deadlock detection techniques.   [5]

b)   Explain - what is critical section problem and how to overcome with it?   [5]

c)   Explain any four types of directories.   [4]

Q6) Attempt All.

a)   Explain the following computer system architecture.   [5]

   i)   Multiprocessor systems.

   ii) Clustered systems

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

c)   Explain any two types of schedulars.   [4]

Q7) Attempt All.

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$_0$	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 the following types of system calls. **[5]**

i) Process control

ii) Information maintenance

iii) File Management

iv) Communication

v) Protection

c) Write a note on contigeous memory allocation. **[4]**

Q8) Attempt All.

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

i) CPU schedular

ii) CPU Utilization

iii) Troughput

iv) Waiting Time

v) Response Time

b) Define resource allocation graph. Explain how resource allocation graph can be convert into wait-for-graph with helf of example. **[5]**

c) Write a note on the following : **[4]**

i) FCFS

ii) Look

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[6076]-315

S.Y. M.Sc. (IMCA)

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) Compare OSI and TCP/IP model. **[5]**

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

c) What is network allocation vector(NAV)? **[2]**

d) Explain single bit error and burst error. **[2]**

Q2) **Attempt the following :**

a) Write a note on stop-and-wait data link protocol. **[5]**

b) Explain services provided by IPSec. **[5]**

c) Define: **[2]**
   i) Internet Security
   ii) Network Security

d) Find the error if any in the following IPv4 address: **[2]**
   i) 75. 45. 301. 14
   ii) 111. 20. 20. 2

Q3) **Attempt the following :**

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

    b)   What is controlled access? Explain any two methods of it.   **[5]**

    c)   What is the purpose of firewall?   **[2]**

    d)   State the Purpose of SNMP.   **[2]**

Q4) **Attempt the following :**

    a)   Write a note on Go-Back-N protocol.   **[5]**

    b)   Compare TCP header and the UDP header. List the fields in the TCP header that are missing from UDP header. Give the reason for their absence.
        [5]

    c)   What is an Analog System?   **[2]**

    d)   Name the polices that can prevent congestion.   **[2]**

Q5) **Attempt the following :**

    a)   Explain the behavior of three persistent method.   **[5]**

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

    c)   Explain four categories of standard Ethernet.   **[4]**

Q6) **Attempt the following :**

    a)   Describe in detail about Pure ALOHA and Slotted ALOHA.   **[5]**

    b)   Explain Authentication Header (AH) protocol in transport mode with the help of diagram.   **[5]**

    c)   Write a note on Switched Ethernet.   **[4]**

Q7) **Attempt the following :**

    a)   Explain four major components of a packet switch. **[5]**

    b)   Write a note on bit oriented protocol. **[5]**

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

Q8) **Attempt the following :**

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

    b)   Explain the responsibilities of transport layer. **[5]**

    c)   What is multiplexing? Explain Time division multiplexing with the help of diagram. **[4]**

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[6076]-316

M.Sc. (Industrial Mathematics with Computer Applications)
MIM-307 : R Programming for Basic Data Analysis
(2019 Pattern) (Semester - III) (4 Credits)

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

Instructions to the candidates :
1) *Q1 is compulsory.*
2) *Attempt any five questions from Q2 to Q7.*
3) *Figures to the right indicate full marks.*
4) *Scientific calculators and statistical tables are allowed.*

Q1) **Attempt any FIVE questions out of SEVEN questions:**   **[5 × 2 = 10]**
   a)   Write syntax of if else in R.
   b)   What will be the output of the following R code?
        x < - c (1, 2, 3, 4, 5)
        y < - c (6, 7, 8, 9, 10)
        ifelse (x > 2 & y < 9, "TRUE", "FALSE")
   c)   Write applications of R programming.
   d)   Write the code for minimum and maximum for 14, 23, 16, 20, 0, -17, 100.
   e)   Describe rbind() and cbind() functions.
   f)   What is the command to install a package in R?
   g)   What is the differences between vector and list?

Q2) **Attempt each of the following questions:**
   a)   How to pass default values for arguments in R.   **[7]**
   b)   Explain about return values in R programming.   **[5]**

Q3) **Attempt each of the following questions:**
   a)   Discuss about loops in R programming with examples.   **[7]**
   b)   Explain the functioning of apply() &sapply() in R program with one
        example each.   **[5]**

Q4) **Attempt each of the following questions:**
   a) What are the different R packages for data cleaning. **[7]**
   b) Write R function to check whether the given number is prime or not. **[5]**

Q5) **Attempt each of the following questions.**
   a) Explain thc concept of data frames in R with example. **[7]**
   b) How the Random vectors created with a set of functions explain with suitable example. **[5]**
      i) If a vector is passed to an arithmetic calculation how it will be computed?
      ii) If the vectors involved are of different lengths what will be the resultant vector?

Q6) **Attempt each of the following questions:**
   a) Explain if-else statement with examples. **[7]**
   b) How to create, name ,access , merging and manipulate list elements? Explain with examples. **[5]**

Q7) **Attempt each of the following questions:**
   a) Create the following vectors in R. **[7]**
      a= (5, 10, 15, 20, ..., 160)
      b=(87, 86, 85, ..., 56)
      Use vector arithmetic to multiply these vectors and call the result 'd'. Select subsets of d to identify the following.
      i) What are the 19th, 20th, and 21st elements of d?
      ii) What are all of the elements of d which are less than 2000?
      iii) How many elements of d are greater than 6000?
   b) Explain about Variables, Constants and Data Types in R Programming.**[5]**

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[6076]-411

S.Y.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 questions out of eight questions.*
2) *Figures to the right indicate full marks.*

Q1) Attempt the following.

a) Let φ be the solution of $L(y) = y'' + a_1 y' + a_2 y = 0$ on I containing a point x_0 then $\forall x \in I$, then prove that $\forall x \in I$,

$$\left\|\varphi(x_0)\right\| e^{-k|x-x_0|} \le \left\|\varphi(x)\right\| \le \left\|\varphi(x_0)\right\| e^{k|x-x_0|}$$

Where $\left\|\varphi(x)\right\| = \left[\left|\varphi(x)\right|^2 + \left|\varphi'(x)\right|^2\right]^{\frac{1}{2}}$ and k = 1+ $|a_1|$ + $|a_2|$. **[5]**

b) Suppose a and b are continuous functions on an interval I. Let A be a function such that $A' = a$. Then prove that the function φ given by

$$\varphi(x) = e^{-A(x)} \int_{x0}^{x} e^{A(t)} b(t) \, dt, \text{where } x_0 \in I, \text{ is a solution of the equation}$$

$y' + a(x)y = b(x)$. **[5]**

c) Find the solution of the equation $y' + y = e^x$. **[4]**

Q2) Attempt the following.

a) If φ_1 and φ_2 are two solutions of $L(y) = y'' + ay' + by = 0$ on an interval I containing a point x_0, then prove that $W(\varphi_1, \varphi_2)(x) = W(\varphi_1, \varphi_2)(x_0)e^{-a(x-x_0)}$. **[5]**

b) If one solution of $y'' - \dfrac{2}{x^2} y = 0$ is $\varphi_1(x) = x^2$, find another solution by reduction of order method. **[5]**

c) Verify that a function φ given by $\varphi(x) = x^3$, $(x > 0)$ satisfy the equation $x^2 y'' - 7xy' + 15y = 0$. **[4]**

P.T.O.

Q3) Attempt the following.

    a)   Derive the Bessel function of zero order of second kind. **[5]**

    b)   Consider Euler equation $L(y) = x^2 y'' + ax y' + by = 0$ and the polynomial given by $q(r) = r(r-1) + ar + b$. Then prove that the basis for the solution of this equation on any interval not containing $x = 0$ is given by $\varphi_1(x) = |x|^{r_1}$, $\varphi_2(x) = |x|^{r_2}$ in case r_1 and r_2 are distinct where r_1 and r_2 are roots of polynomial $q(r)$. **[5]**

    c)   Find all solutions of the equation $y''' - 3y' + 2y = 0$. **[4]**

Q4) Attempt the following.

    a)   Find the solutions of second order Euler equation $x^2 y'' + xy' + y = 0$ for $x \neq 0$. **[5]**

    b)   Prove that two solutions φ_1 and φ_2 of $L(y) = y'' + ay' + by = 0$ are linearly independent on an interval I if, and only if, $W(\varphi_1, \varphi_2)(x) \neq 0$, $\forall x \in I$.**[5]**

    c)   Find the Wronskian of the functions $\varphi_1(x) = 1$, $\varphi_2(x) = x$, $\varphi_3(x) = x^3$ at a point $x = 0$. **[4]**

Q5) Attempt the following.

    a)   Find the solutions of $y'' - \dfrac{2}{x^2} y = x$, if $\varphi_1(x) = x^2, \varphi_2(x) = \dfrac{1}{x}$ are the solutions of corresponding homogeneous equation $y'' - \dfrac{2}{x^2} y = 0$. **[5]**

    b)   Find the solution of $L(y) = y'' - xy = 0$ by power series method. **[5]**

    c)   Find the singular points of $x^2 y'' + (x + x^2)y' - y = 0$ and determine those which are regular singular points. **[4]**

Q6) Attempt the following.

    a)   Prove that there exist n linearly independent solutions of the equation $L(y) = y^{(n)} + a_1 y^{(n-1)} + ... + a_n y = 0$. **[5]**

    b)   Prove that for y, z $\in \mathbb{C}_n$, **[5]**

        i) $|y + z| \leq |y| + |z|$

        ii) $||y| - |z|| \leq |y + z|$.

    c)   Show that y given by $y^2 = e^{2x} + c$ is a solution of the differential equation $y y' = e^{2x}$. **[4]**

Q7) Attempt the following.

a) Let M and N be two real valued functions which have continuous first partial derivation on some rectangle R: $|x - x_0| \le a, |y - y_0| \le b$. Prove that the equatives M(x, y) + N(x, y) y′ = 0 is exact if and only if

$$\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x} \text{ in R}.$$ **[5]**

b) Find first four approximations of the equation $y′ = xy$, $y(0) = 1$.   **[5]**

c) Compute the indicial polynomial of the equation $x^2 y″ + xe^x y′ + y = 0$ and show that its roots are $i, -i$.   **[4]**

Q8) Attempt the following.

a) Show that f defined by $f(x, y) = (3x + 2y_1, y_1 - y_2)$ for S : $|x| < \infty, |y| < \infty$ satisfy the Lipschitz condition on S.   **[5]**

b) Let g, h be continuous real valued functions for $a \le x \le b$, $c \le y \le d$ respectively, and consider the equation h(y) y′ = g (x). If G and H are any functions such that $G′ = g, H′ = h$, and c is any constant such that the relation H(y) = G(x) + c defines a real valued differential function φ for x in some interval l contained in $a \le x \le b$. Prove that φ is the solution of h (y) y′ = g (x) on l.   **[5]**

c) Find the solution of $y′ = \dfrac{3x^2 - 2xy}{x^2 - 2y}$.   **[4]**

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[6076]-412

S.Y. M.Sc. (Industrial Mathematics with Computer Applications)
MATHEMATICS
MIM - 402 : Statistical Methods
(2019 Pattern) (Semester - IV)

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

Instructions to the candidates :

  1) *Q.1 is compulsory.*
  2) *Attempt any five questions from Q.2 to Q.7.*
  3) *Figures to the right indicate full marks.*
  4) *Scientific calculators and statistical tables are allowed.*

Q1) Solve any five of the following (2 marks each) :   **[10]**

  a)   Define probability density function.

  b)   A card is selected from 52 playing cards. What is probability that the card is a red coloured face card?

  c)   What will be the sample space if one coin is tossed and one die is rolled simultaneously?

  d)   If $E(X) = 1.4$, then find $E(3x – 1)$.

  e)   How many different letter arrangement are there of the word MATHS?

  f)   Find the number of trials of a binomial distribution which has mean $= 20$ and S.D $= 1$.

  g)   Write down R-code if $X \rightarrow B(5,0.2)$. Find i) $P[X \leq 2]$ ii) $P[X \geq 1]$.

P.T.O.

Q2) a) 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

$$f(x) = \frac{x^2}{3}, \quad -1 < x < 2,$$
$$= 0, \quad \text{elsewhere}$$

i) Verify that $f(x)$ is a density function. ii) Find $P(0 < X \le 1)$ iii) Find F(x) iv) Find $P(X \le 1)$ **[7]**

b) Define correlation and its different types according to their range. **[5]**

Q3) a) Derive mean and variance for Uniform distribution on $[a, b]$. **[7]**

b) 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 defective. Now, suppose that a finished product is randomly selected. What is the probability that it is defective? **[5]**

Q4) a) 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] = μ and Variance = σ^2. **[7]**

b) If 2% of electric bulbs manufactured by a certain company are defective, find the probability distribution and probability that in a sample of 200 bulbs i) less than 2 bulbs are defective ii) more than 3 bulbs are defective. **[5]**

Q5) a) Describe two sample proportion test for small sample space. **[7]**

b) Find the regression coefficient Y on X. **[5]**

X	1	2	3	4	5	8	10
Y	9	8	10	12	14	16	15

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Q6) a) Genetic theory states that children having one parent of blood type A and the other of blood type B will always be of one the three types A, AB, B and that the proportions of these types will be on average 1:2:1. A report states that out of 300 children having one A parent and one B parent 30% were found to be of type A, 45% of type AB and remainder type B.

Test the hypothesis by χ^2 test. (Given $\chi_2^2 = 5.991$ at 5% level of significance) **[7]**

b) Define Variance and write down properties of Var[X]. **[5]**

Q7) a) Write a R-code for following problem:- **[6]**

For the following frequency distribution

X	1	2	3	4	5
F	7	11	9	8	3

Calculate arithmetic mean, geometric mean, harmonic mean, mode, median, upper quartile.

b) Fill the blanks in the following ANNOVA table for one way classification. **[6]**

Sources of Variation	d.f.	Sum of squares	Mean Sum of squares	F ratio
Between groups	k-1	SSB = ...	MSB	
Within groups	....	SSW = ...	MSW = ...	....
Total	N-1	....		

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

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:
  1) *Question 1 is compulsory.*
  2) *Attempt any five questions from Q.2 to Q.7.*
  3) *Figures to the right indicate full marks.*
  4) *Scientific calculators and statistical tables are allowed.*

Q1) Solve any five out of seven. **[10]**

  a) What is a recursive algorithm?

  b) Solve the recurrence relation. $T(n) = 2T(n/2) + n$, $T(1) = 1$.

  c) What is Convex Hull?

  d) Show that $2n^2 + 4n + 3 = O(n^2)$.

  e) Give time complexity of binary search in the worst case and best case.

  f) Define 0/1 knapsack problem.

  g) Write at least two characteristics of an algorithm.

Q2) a) Find the minimum spanning tree for following graph using Prim's and Kruskal's algorithm. **[7]**
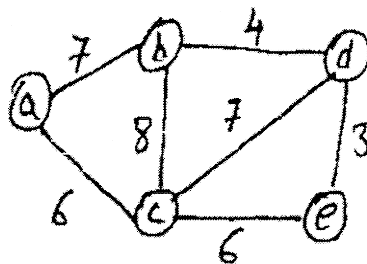
  b) Apply Merge Sort to sort the list (12, 5, 1, 10, 7, 9, 4, 2). **[5]**

Q3) a) What is the best way to multiply the chain of matrices with dimensions that are 5×10, 10×30, 30×5 and 5×15 using dynamic programming? **[7]**

  b) Find the Huffman code for the characters a, b, c, d, e and f having frequencies (In thousands) 35, 22, 45, 15, 29 and 20. **[5]**

Q4) a) What is the dominance rule? Find an optimal solution for 0/1 knapsack problem instance n = 4, m = 15, w = (2, 4, 6, 9) and p = (10, 10, 12, 18) using merge and purge method. **[7]**

b) Order the following functions by growth rate : $n\log(n)$, n, n^2, $n^2\log(n)$, 3^n. **[5]**

Q5) a) What is fractional knapsack problem? Find an optimal solution to the Knapsack instances n = 7, m = 15 (P1, P2, ..., P7) = (10, 5, 15, 7, 6, 18, 3) (w1, w2, ..., w7) = (2, 3, 5, 7, 1, 4, 1) (Use Greedy method). **[7]**

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

Q6) a) Write a note on single source shortest path. Apply Dijikstra's algorithm to find shortest path for following graph. **[7]**
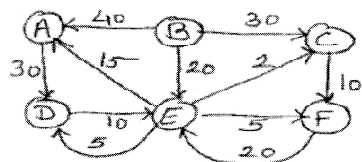
Source vertex is B.

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

Q7) Attempt any Two :

a) Write a note on Strassen's matrix multiplication. Give its recurrence relation and derive the time complexity. **[6]**

b) Give control abstraction for divide and conquer strategy. Write a note on Quick sort performance analysis. **[6]**

c) Write a note on sting editing. **[6]**

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[6076]-415

M.Sc. (Industrial Mathematics with Computer Applications)
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.*
3) *Neat diagrams must be drawn whenever necessary.*

Q1) **Attempt the following questions :**

    a) Explain service lifecycle in Android with diagram. **[5]**

    b) What are features of Android. **[5]**

    c) List the components included in Android SDK. **[2]**

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

Q2) **Attempt the following questions :**

    a) Explain Alarm and Toast with example. **[5]**

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

    c) Write any 2 uses of Intent? **[2]**

    d) What is mobile computing. **[2]**

Q3) **Attempt the following questions :**

    a) How mobile communication is useful in Vehicle and Stock information.**[5]**

    b) What is Thread? Explain runOnUiThread with example. **[5]**

    c) List any 4 mobile operating system. **[2]**

    d) List Types of communication devices. **[2]**

P.T.O.

Q4) **Attempt the following questions :**

a) Describe pros and cons of phoneGap. **[5]**

b) How wireless networks are useful for business purpose? **[5]**

c) What is manifest file? **[2]**

d) i) px = dp*(_____). ii) pt = _____ inch. **[2]**

Q5) **Attempt the following questions :**

a) Discuss various applications of mobile communication. **[5]**

b) What is Layout? Explain any 2 types of Layouts using suitable diagram.**[5]**

c) What is difference between JVM and Dalvik Virtual Machine? **[4]**

Q6) **Attempt the following questions :**

a) Explain Alarm and Toast with example. **[5]**

b) Explain different types of View Groups. **[5]**

c) Explain onStartCommand() and onBind() methods with respect to service in android. **[4]**

Q7) **Attempt the following questions :**

a) What are Adapters? Explain any 2 types of Adapters. **[5]**

b) What are services? Explain any 2 types of services with example. **[5]**

c) Write advantages and disadvantages of Swift. **[4]**

Q8) **Attempt the following questions :**

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

b) What is Xcode? What are Instruments? **[5]**

c) Explain any 2 data types in swift with example. **[4]**

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[6076]-512
T.Y. M.Sc.
(Industrial Mathematics with Computer Applications)
MIM - 502 : COMPUTATIONAL GEOMETRY
(2019 Pattern) (Semester - V)

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

Instructions to the candidates :
  1) *Q.1 is compulsory.*
  2) *Attempt any five questions from Q.2, Q.7.*
  3) *Figures to the right indicate full marks.*
  4) *Use of non programmable scientific calculators is allowed.*

Q1) **Attempt any five of the following :**   **[2 × 5 = 10]**

  a) Write the 3×3 transformation matrix for scaling in the x, y and z direction by 3, 1/4 and 5 units respectively.

  b) Write the transformation matrix for rotation about the origin through an angle of $60°$ in the clockwise direction.

  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 $\begin{pmatrix} -1 & 1 \\ 2 & 1 \end{pmatrix}$. Find the slope of A*B*.

  d) Write the transformation matrix which produces translations in x, y and z directions by the –3 , 2 and 4 units respectively.

  e) If a 2×2 transformation matrix $\begin{pmatrix} 1 & -1 \\ 5 & -2 \end{pmatrix}$ is applied to a circle of radius 5 units then find the area of the resulting figure.

  f) Determine if the transformation $\begin{pmatrix} -3/5 & 4/5 \\ -4/5 & -3/5 \end{pmatrix}$ is a solid body transformation.

  g) Write the transformation matrix for reflection through the $yz - plane$.

P.T.O.

Q2) a) Suppose a 2×2 transformation matrix $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ is used to transform a line segment PQ to P*Q*. Prove that if the slope of the line segment PQ is *m*, then the slope of the line segment P*Q* is

$$m^* = \frac{b + dm}{a + cm}.$$ **[7]**

b) $\triangle$ABG with vertices A[3, –1], B[4, 2], C[2, 1] is first rotated through $\theta = 90°$ about origin and reflected through *y*-axis. Find the vertices of the transformed triangle. **[5]**

Q3) a) Write an algorithm to reflect a point P[*a*, *b*] in the *xy* plane through an arbitrary line in the *xy*–plane. **[7]**

b) Show that the combined two dimensional transformation matrix, first reflection about *x*–axis and then about the line $y = -x$ is identical to rotation about the origin by an angle $\theta = 270°$. **[5]**

Q4) a) State any seven properties of Bezier curves. **[7]**

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

Q5) a) Obtain the transformation matrix for trimetric projection formed by rotation about the *y* axis through an angle 30° followed by rotation about *x* axis through an angle 35° followed by orthographic projection on $z = 0$ plane. Also determine the principal foreshortening factors. **[7]**

b) Derive the formula for generation of eleven points of the parabolic segment $y^2 = 4x$, $2 \le y \le 4$. **[5]**

Q6) a) Write an algorithm to generate uniformly spaced n points on an ellipse.**[7]**

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

b) Consider the Bezier curve determined by the control points $B_0[-3, -1]$, $B_1[2, 3]$, $B_2[6, 1]$ and hence find the position vector of the point corresponding to the parameter value $t = 0.2$. Also find first and second derivatives of the curve at the same point. **[5]**

Q7) a) Write a short note on perspective projections. **[6]**

b) Write a short note on oblique projections. **[6]**

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[6076]-513
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 of the following.*

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

Q1) Attempt All :

   a)   Give any five data types in Python.   **[5]**

   b)   Explain how recurssion is used in functions with example.   **[5]**

   c)   Write a note on back end used in full stack development.   **[2]**

   d)   What is the use of regex in pattern matching.   **[2]**

Q2) Attempt All :

   a)   Explain read() functions used in file handling.   **[5]**

   b)   Write a note on OOP features used in python.   **[5]**

   c)   What are the sequences?   **[2]**

   d)   How Django framework is used as server side programming in full stack development?   **[2]**

Q3) Attempt All :

   a)   Explain various array functions used in Python.   **[5]**

   b)   Write a Python program to fine GCD of two numbers.   **[5]**

   c)   Give any two features of Django framework.   **[2]**

   d)   How the objects can destroy in Python?   **[2]**

Q4) Attempt All :

a) Explain working of seek and tell operations in python with example. **[5]**

b) Give any five components used in full stack development. **[5]**

c) Write the connection string in Python. **[2]**

d) What are the built in class attributes? **[2]**

Q5) Attempt All :

a) Explain use of Matplotlib functions in Python with example. **[5]**

b) Write a note on import and export modules in python. **[5]**

c) Give any two features of Python in detail. **[4]**

Q6) Attempt All :

a) What are Pandas? How it is used in finding missing data? **[5]**

b) Explain identifiers are keywords with example. **[5]**

c) Explain use of lists as stacks with example. **[4]**

Q7) Attempt All :

a) Write a program to validate password using regular expression. **[5]**

b) Write a program to sort five numbers using functions in Numpy. **[5]**

c) List any four operations of dictionary. **[4]**

Q8) Attempt All :

a) Write a program to accept details of students and store in the SQLDB through python. **[5]**

b) Write a program to accept array and display its transpose matrix. **[5]**

c) Explain any two write functions in the file handling in python. **[4]**

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[6076]-514

T.Y. M.Sc. (IMCA)

MATHEMATICS

MIM-504 : Digital Image Processing

(2019 Pattern) (CBCS) (Semester - V)

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

Instructions to the candidates:

1) *Question 1 is compulsory.*
2) *Attempt any Five out of question 2 to question 7.*
3) *Question 2 to question 7 carry equal marks.*

Q1) Solve any five of the following.   **[10]**

a) What is Digital Image Processing?

b) Define the terms.

   i) Mean deviation.   ii) Standard deviation.

c) Give the equation of Inverse Discrete Fourier Transform.

d) What is texture?

e) Write the role of mathematics in image processing.

f) Give the acronym for.

   i) CCD   ii) MPEG

   iii) TIFF   iv) Pixel

Q2) Attempt the following :

a) Describe the method of image acquisition using single sensor and explain the basic relationships between pixels.   **[7]**

b) What is distance measures between two pixels? Find D_4 and D_8 distance for the pixel values $\begin{matrix} 0 & 1 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{matrix}$.   **[5]**
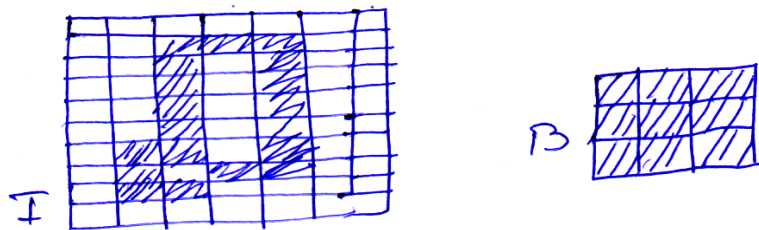
Q3) Attempt the following :

a) Explain power low transformation log transformation and piecewise linear transformation functions with suitable examples. **[7]**

b) What is histogram Matching? Explain various steps in histogram matching for the 3-bit image. **[5]**

Q4) Attempt the following :

a) Discuss the various steps for filitering in frequency domain. Also write order statistics filter. **[7]**

b) Apply hole filling on image 'I' with element 'B'. Draw step by step output. **[5]**

Q5) Attempt the following :

a) Explain the principle goal of image restoration techniques by giving a model of the image restoration process. Also explain the terms spatial filtering and frequency domain filtering. **[7]**

b) Discuss the method of removal of noise using geometric mean filter. **[5]**

Q6) Attempt the following :

a) Write in brief the Hit-or-Miss transformation. Explain boundary extraction. Give the extraction of connected components algorithm. **[7]**

b) What do you mean by opening and closing in image processing? Explain how both are duals of each other. **[5]**

Q7) Write short note on any two of the following : **[12]**

a) Chain codes for image representation.

b) Global thresholding.

c) Applications of Digital Image Processing in medical field and industrial area.

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[6076]-516
T.Y. 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 Eight questions given.*
2) *Figures to the right indicate full marks.*
3) *Neat diagrams must be drawn whenever necessary.*

Q1) **Attempt the following questions:**

    a)   Explain EPC global architecture.   **[5]**

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

    c)   Define the terms: i) H2M Communication. ii) M2M Communication. **[2]**

    d)   What are Sensor nodes?   **[2]**

Q2) **Attempt the following questions:**

    a)   Draw block diagram of RFID system. Discuss various components of RFID system.   **[5]**

    b)   Explain use of IOT in home appliances.   **[5]**

    c)   What are Sensors? Give any 2 uses of Sensor.   **[2]**

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

Q3) **Attempt the following questions:**

    a)   What is WSN? Explain history of WSN. Give one example of WSN. **[5]**

    b)   Explain characteristics of Internet of Things.   **[2]**

    c)   What is Sensor Technology?   **[2]**

    d)   What is Active Tag ? What is Passive Tag?   **[2]**

Q4) Attempt the following questions.
  a) Explain 4 stage IoT architecture with diagram.   **[5]**
  b) Explain working of RFID Tag using diagram.   **[5]**
  c) What is an RFID tag and RFID reader?   **[2]**
  d) What is use of Satellite technology?   **[2]**

Q5) Attempt the following questions:
  a) Explain the concept of web of things with example.   **[5]**
  b) Explain application of IOT for controlling vending and product machines.
                                                                         [5]
  c) Explain the concept of scalability in detail.   **[4]**

Q6) Attempt the following questions:
  a) Explain High level layered architecture of IOT with Diagram.   **[5]**
  b) Elaborate on how you will use IoT for remote healthcare.   **[5]**
  c) What is Scalability and Interoperability.   **[4]**

Q7) Attempt the following questions.
  a) Explain IoT Design Issues.   **[5]**
  b) What is clustering? Discuss clustering in IOT.   **[5]**
  c) Explain any 2 key IoT technologies.   **[4]**

Q8) Attempt the following questions :
  a) What is device identity? What are types of identities?   **[5]**
  b) Explain applications of Internet of Things in e-Health.   **[5]**
  c) Write a note on Connected Architectures with diagram.   **[4]**

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