Ref. No.: Ex/IT/BS/B/T/212/2024(S)

B.E. INFORMATION TECHNOLOGY SECOND YEAR, FIRST SEMESTER SUPPLEMENTARY EXAM 2024

Time: Three hours | MATHEMATICS FOR IT- I | Full Marks-100

CO1: Explain and illustrate sum and product of vectors with related applications

Attempt any **three (3)** questions. 3·5 = 15

1. Let **u,** and **v** be vectors and r is a scalar to prove that $r(\mathbf{u}+\mathbf{v}) = r\mathbf{u} + r\mathbf{v}$.
2. Prove that any four vectors are linearly dependent.
3. Let **a** and **b** be two vectors and **a.b** = 0 (scalar product of **a** and **b** is zero). Comments on **a** and **b**.
4. Let **P** and **Q** be diametrically opposite points and **R** any other point on the same circle. Show that **PR** and **QR** are at right angles.

CO2: Solve homogeneous, non-homogeneous linear ordinary differential equations of the 1st order and higher orders having constant and variable coefficients and system of linear differential equations

Attempt any **three (3)** questions 3·5=15

5. Obtain the differential equation associated with the primitive $Ax^2 + By^2=1$.
6. Solve $(2x^2 + 3y^2 - 7)\, x\, dx - (3x^2 + 2y^2 - 8)\, y\, dy = 0$.
7. Find the value of λ, for the differential equation $(xy^2 + \lambda x^2 y)\, dx + (x + y)\, x^2\, dy = 0$ is exact. Solve the equation for this value of λ.
8. Solve $(x + 1)\frac{dy}{dx} - y = e^x(x + 1)^2$.
9. Solve $(D^2 - 6D + 9)y = 6e^{3x} + 7e^{-2x} - log\ log\ 2$

CO3: Express a given real-world problem as a linear programming problem and use the simplex method to solve it

Attempt question **10** any **one (1)** from {11, 12} 10+5 = 15

10. Define the following terms related to the LPP:
    a. Solution
    b. Feasible solution
    c. Basic solution
    d. Basic feasible solution
    e. Non-degenerate basic feasible solution
    f. Degenerate basic feasible solution
    g. Optimal basic feasible solution
    h. Unbounded solution

11. A person wants to decide the constituents of a diet which will fulfil his daily requirements of proteins, fats and carbohydrates at the minimum cost. The choice is to be made from four different types of foods. The yields per unit of these foods are given in the following table. Formulate linear programming model for the problem.

Food type	*Yield per unit*			*Cost per unit* (₹)
	Proteins	*Fats*	*Carbohydrates*	
1	*3*	*2*	*6*	*45*
2	*4*	*2*	*4*	*40*
3	*8*	*7*	*7*	*85*
4	*6*	*5*	*4*	*65*
Minimum requirement	800	200	700	

[Turn over

12. Solve the following problem graphically.

Maximize $Z = 2x_1 + 3x_2$

Subject to

$$x_1 + x_2 \leq 30$$
$$x_2 \geq 3$$
$$x_2 \leq 12$$
$$x_1 - x_2 \geq 0$$
$$0 \leq x_1 \leq 20$$

Attempt any **two (2)** questions from {13, 14, 15} $2 \times 15 = 30$

13. Solve the following LPP by the Simplex method

Maximize $Z = 4x_1 + 7x_2$
Subject to $2x_1 + x_2 \leq 1000$
$10x_1 + 10x_2 \leq 6000$
$2x_1 + 4x_2 \leq 2000$
$x_1, x_2 \geq 0$

14. Solve the following LPP

Maximize $Z = 3x_1 - x_2$
Subject to
$2x_1 + x_2 \geq 2$
$x_1 + 3x_2 \leq 2$
$x_1 \leq 4$
$x_1, x_2 \geq 0$

15. Use duality to solve the LPP

Minimize $Z = 3x_1 + x_2$
Subject to
$2x_1 + 3x_2 \geq 2$
$x_1 + x_2 \geq 1$
$x_1, x_2 \geq 0$

CO4: Solve transportation problem using suitable methods and test for optimality

Attempt any **one (1)** question from {16, 17} 15

16. Formulate the mathematical model for the transportation problem given below. Find an optimal solution and corresponding cost of transportation problem.

Source	Destination			
	1	2	3	Supply
1	15	20	30	350
2	10	9	15	200
3	14	12	18	400
Demand	250	400	300	

17. Formulate the mathematical model for the transportation problem given below. Find an optimal solution and corresponding cost of transportation problem.

Source	Destination			Supply
	1	2	3	
1	25	45	10	200
2	30	65	15	100
3	15	40	55	400
Demand	200	100	300	

CO5: Solve assignment problem using suitable methods and examine for optimality

Attempt any **one (1)** question from {18, 19} 10

18. Solve the following assignment problem. Formulate the mathematical model for the problem.

Jobs		I	II	III	IV
Workers	A	10	12	19	11
	B	5	10	7	8
	C	12	14	13	11
	D	8	15	11	9

19. A company has 4 machines to do 3 jobs. Each job can be assigned to 1 and only 1 machine. The cost of each job on a machine is given to the following table. What are the job assignments which will minimize the cost? If multiple solutions exist, report all.

Machines		W	X	Y	Z
Jobs	A	18	24	28	32
	B	8	13	17	18
	C	10	15	19	22