Sub Code: BSM 212

B. Tech. (ME)
Year: II Semester: III
Minor Examination: 2025- 26
Title of Subject: Operations Research

Time: 2 Hrs. **Max Marks: 30**

Note: Answer all questions.

Q.1		Attempt any three of the following.	Marks	CO	BL	PO	PI Code
	a)	A company makes two kinds of leather belts; belt A and belt B. Belt A is a high-quality belt and belt B is of lower quality. The respective profits are Rs 4 and Rs 3 per belt. The production of each of type A requires twice as much time as a belt of type B, and if all belts were of type B, the company could make 1,000 belts per day. The supply of leather is sufficient for only 800 belts per day (both A and B combined). Belt A requires a fancy buckle and only 400 of these are available per day. There are only 700 buckles a day available for belt B. What should be the daily production of each type of belt? Formulate this problem as an LPP model and solve it using the simplex method.	4	1	3	1	1.1.1
	b)	Define slack and surplus variables in a linear programming problem. Also, explain the various steps of the simplex method involved in the computation of an optimum solution to a linear programming problem.	4	1	2	1	1.1.1
	c)	Explain the difference between a transportation problem and an assignment problem.	4	2	2	2	1.1.1
	d)	A project work consists of four major jobs for which an equal number of persons have submitted tenders. The tender amount quoted (in lakh of rupees) is given in the matrix.	4	2	3	2	1.1.1

		Job			
		a	b	c	d
Person	1	10	24	30	15
	2	16	22	28	12
	3	12	20	32	10
	4	9	26	34	16

Find the assignment which minimizes the total cost of the project when each contractor has to be assigned at least one job.

Q.2	**Attempt any three of the following.**						
a)	Use dual simplex method to solve the following LPP problem: $\text{Min}Z = 3x_1 + 6x_2$ subject to the constraints $x_1 + x_2 \geq 1$ $2x_1 + 3x_2 \geq 2$ with $x_1 \geq 0, x_2 \geq 0$.	3	1	3	2	1.1.1
b)	State the general rules for formulating a dual LPP problem from its primal. Write the dual to the following LPP problem. $\text{Max}Z = x_1 - x_2 + 3x_3$ subject to the constraints $x_1 + x_2 + x_3 \leq 10$ $2x_1 - x_3 \leq 2$ $2x_1 - 2x_2 + 3x_3 \leq 6$ with $x_1 \geq 0, x_2 \geq 0, x_3 \geq 0$.	3	1	3	2	1.1.1
c)	Use Big-M method to solve the following LPP problem: $\text{Min}Z = 5x_1 + 6x_2$ subject to the constraints $2x_1 + 5x_2 \geq 1500$ $3x_1 + x_2 \geq 1200$ with $x_1 \geq 0, x_2 \geq 0$.	3	1	3	2	1.1.1
d)	Use simplex method to solve the following LPP problem: $\text{Min}Z = x_1 - 3x_2 + 2x_3$ subject to the constraints $3x_1 - x_2 + 2x_3 \leq 7$ $-2x_1 + 4x_2 \leq 12$ $-4x_1 + 3x_2 + 8x_3 \leq 10$ with $x_1 \geq 0, x_2 \geq 0, x_3 \geq 0$.	3	1	3	2	1.1.1
Q.3	**Attempt any three of the following.**						
a)	Explain in brief three methods of initial feasible solution for transportation problem.	3	2	2	2	1.1.1
b)	Describe the computational procedure of the optimality test in a transportation problem. Apply MODI method to obtain the optimal solution of the given transportation problem.	3	2	3	2	1.1.1
c)	Describe the transportation problem with its general mathematical formulation.	3	2	2	1	1.1.1
d)	There are seven jobs, each of which has to go through the machines A and B in the order AB. Processing times in hours are as follows:	3	2	3	1	1.1.1

	W_1	W_2	W_3	Supply
F_1	2	7	4	5
F_2	3	3	1	8
F_3	5	4	7	7
F_4	1	6	2	14
Demand	7	9	18	34

Job	1	2	3	4	5	6	7
Machine A	3	12	15	6	10	11	9
Machine B	8	10	10	6	12	1	3

Determine a sequence of these jobs that will minimize the total elapsed time T. Also find T and idle time for machines A and B.

B. Tech. (ME)
Year: II, Semester: III
Major Examination: 2025- 26
Title of Subject: Operations Research

Time: 3 Hrs. Max Marks: 50

Note: Answer all questions.

Q.1	Attempt any five parts of the following:	Marks	CO	BL	PO	PI Code
a)	Solve the LPP using graphical method Max $z = 3x_1 + 2x_2$, subject to constraints $x_1 + x_2 \leq 4$, $x_1 - x_2 \leq 2$; $x_1 \geq 0, x_2 \geq 0$.	2	1	2	1	1.1.1
b)	Describe the advantages and disadvantages of operations research models.	2	1	2	1	1.1.1
c)	A furniture dealer deals in two items viz, tables and chairs. He has \$10,000 to invest and a space to store almost 60 pieces. A table costs him \$500 and a chair cost \$200. He can sell a table at a profit of \$50 and a chair at a profit of \$15. Assume that he can sell all the items that he buys. Formulate the problem as an LPP, so that he can maximize the profit.	2	1	2	1	1.1.1
d)	Explain unbalanced transportation problem with the help of suitable example.	2	2	2	2	1.1.1
e)	Explain the steps of least cost method for obtaining an initial basic solution of a transportation problem.	2	2	2	2	1.1.1
f)	Solve the following assignment problem:	2	2	3	2	1.1.1
g)	Describe the steps of the MODI method used in solving a transportation problem.	2	2	3	2	1.1.1
Q.2	**Attempt any two parts of the following:**					
a)	Use the graphical method for solving the following game and find the value of the game:	5	3	3	2	1.1.1

	P_1	P_2	P_3	P_4
J_1	1	4	6	3
J_2	9	7	10	9
J_3	4	5	11	7
J_4	8	7	8	5

Player B

Player A	B_1	B_2	B_3	B_4
A_1	2	2	3	-2
A_2	4	3	2	6

	b)	Solve the game whose payoff matrix is given below: Player B Player A | B_1 | B_2 | B_3 | B_4 A_1 | 3 | 2 | 4 | 0 A_2 | 3 | 4 | 2 | 4 A_3 | 4 | 2 | 4 | 0 A_4 | 0 | 4 | 0 | 8	5	3	3	2	1.
	c)	Explain the two-person zero-sum game, giving a suitable example.	5	3	3	2	1.1.1
Q.3		**Attempt any two parts of the following:**					
	a)	Explain the following terms in PERT/CPM: (i) Earliest time (ii) Latest time (iii) Total activity time (iv) Event slack and (v) Critical path.	5	3	3	2	1.1.1
	b)	Write short notes on (i) Total float (ii) Free float (iii) Independent float. Also, describe the inequality between these floats.	5	3	3	2	1.1.1
	c)	The table shows the necessary immediate predecessors for each activity. Activity | A | B | C | D | E | F | G | H | I | J Predecessor | – | A | A | B, C | A | D | C | E, F, G | H | H Duration (days) | 3 | 4 | 2 | 5 | 6 | 3 | 4 | 7 | 2 | 3 Determine the following: (i) An activity network (ii) The critical path (iii) Total float for activity B (iv) The latest start day for activity F (v) The earliest finish day for activity F.	5	3	3	2	1.1.1
Q.4		**Attempt any two parts of the following:**					
	a)	Explain the basic queuing process. What do you understand by (i) queue discipline (ii) arrival process (iii) service process?	5	4	3	2	1.1.1
	b)	A self-service store employs one cashier at the counter. Nine customers arrive on an average every 5 minutes while the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service time, find (i) Average number of customers in the system (ii) Average number of customers in the queue (or average queue length) (iii) Average time a customer spends in the system (iv) Average time a customer waits before being served.	5	4	4	2	1.1.1
	c)	A person repairing radios finds that the time spent on the radio set has an exponential distribution with a mean of 20 minutes. If the radios are repaired in the order in which they come in and their arrival is approximately Poisson with an average rate of 15 for an 8-hour day, what is the repairman's expected idle time each day? How many jobs are ahead of the average set just brought in?	5	4	4	2	1.1.1
Q.5		**Attempt any two parts of the following:**					
	a)	Explain, in brief, the main characteristics of the 'queuing system'.	5	4	3	2	1.1.1

b)	A branch of a bank has only one typist. Since the typing work varies in length, the typing rate is randomly distributed approximately in a Poisson distribution with a mean service rate of 8 letters per hour. The letters arrive at a rate of 5 per hour during the entire 8-hour workday. If the typist's time is valued at ₹1.50 per hour, determine (i) The percent time an arriving letter has to wait (ii) Average system time (iii) The total cost due to the typist's idle time per day.	5	4	4	2	1.1.1
c)	Trains arrive at the yard every 15 minutes, and the service time is 33 minutes. If the capacity of the yard is limited to 4 trains, calculate the following: (i) The probability that the yard is empty (ii) The average number of trains in the system.	5	4	3	2	1.1.1