BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

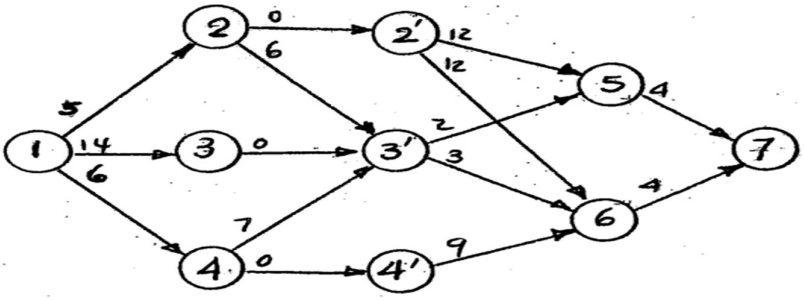
CLASS: IMSC **SEMESTER : VIII**
BRANCH: MATHS **SESSION : SP/2025**

SUBJECT: MA414 ADVANCED OPERATION RESEARCH

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	 A transportation network connects multiple cities as in figure, and it is required to determine the shortest path from City 1 to City 7. Using the backward recursion approach of DP define the stages and states of the problem and the optimal route (sequence of cities) to be followed	[10]	1	2
Q.2(a)	Find the optimal order quantity for a product when the annual demand for the product is 500 units, the cost of storage per unit per year is 10% of the unit cost and ordering cost per order is Rs 180. The unit costs are given below: $0 \le q_1 < 500$: ₹ 25.00 $500 \le q_2 < 1{,}500$: ₹ 24.80 $1{,}500 \le q_3 < 3{,}000$: ₹ 24.60 $3{,}000 \le q_4$: ₹ 24.40	[5]	2	3
Q.2(b)	The manager of a company manufacturing car parts has entered a contract for supplying 1000 numbers per day of a particular part to a car manufacturer. He finds that his plant has a capacity of producing 2000 numbers per day of the part. The cost of the part is Rs.50. Cost of holding stock is 12% per annum and set up cost per production run is Rs. 100. What should be run size for each production run and total optimum cost/month? How frequently should production runs be made? Shortage is not permissible.	[5]	2	2.5
Q.3(a)	A construction company is selecting a supplier for building materials. The decision is based on two criteria: Delivery Time (measured in weeks) and Cost (measured in dollars). The company considers Delivery Time twice as important as Cost with following options: Supplier M: Delivery Time = 4 weeks, Cost = $50,000 Supplier N: Delivery Time = 5 weeks, Cost = $45,000 Use the Analytic Hierarchy Process (AHP) to determine which supplier is the better choice.	[5]	3	2.5

PTO

Q.3(b)	Solve the following game graphically: $\begin{bmatrix} -6 & 0 & 6 & -3/2 \\ 7 & -3 & -8 & 2 \end{bmatrix}$	[5]	3	3
Q.4(a)	At a railway station only one train is handled at a time. The railway yard is sufficient only for two trains to wait while the other is given a signal to leave the station. Trains arrive at the station at an average rate of 6 per hour and the railway station can handle them at an average of 12 per hour. Assuming Poisson arrivals and exponential service distribution, find the steady state probabilities for the various number of trains in the system. Also find the average number of trains at the railway station and the average waiting time of a new train coming into the yard.	[5]	4	2
Q.4(b)	A library wants to improve its service facilities in terms of the waiting time of its borrowers. The library has two counters at present and borrowers arrive according to Poisson distribution with arrival rate 1 every 6 minutes and service time follows exponential distribution with a mean of 10 minutes. The library has relaxed its membership rules and a substantial increase in the number of borrowers is expected. Find the number of additional counters to be provided if the arrival rate is expected to be twice the present value and the average waiting time of the borrowers must be limited to half the present value.	[5]	4	2.5
Q.5	Minimize $f(x_1, x_2) = x_1^2 - x_1 x_2 + 3x_2^2$ using the steepest descent method. Take starting point (1, 2). Take tolerance € = 0.1.	[10]	5	2.5

::::::02/05/2025::::::E