

CS/B.TECH/ME/ODD SEM/SEM-7/ME-705C/2016-17



**MAULANA ABUL KALAM AZAD UNIVERSITY OF
TECHNOLOGY, WEST BENGAL**

Paper Code : ME-705C

OPERATIONS RESEARCH

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Graphs sheet(s) will be provided by the Institution on demand.

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following : 10 × 1 = 10

i) Hungarian method is applied for solutions of

- ☒ a) Assignment problems
- b) Decision theory related problems
- c) Queuing problems
- d) All of these.

ii) When customers move from one queue to another hoping to receive quicker service, it is termed as

- ☒ a) Reneging
- b) Balking
- ☒ c) Jockeying
- d) None of these.

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iii) The shortest path between any two nodes in a Network is determined by

- ☒ a) Dijkstra's Algorithm
- b) Poisson distribution
- c) Binomial distribution
- d) Exponential distribution.

iv) The assignment matrix is always a/an

- a) rectangular matrix
- ☒ b) square matrix
- c) identity matrix
- d) none of these.

v) If dual has unbounded solution, primal has

- ☒ a) no feasible solution
- b) unbounded solution
- c) feasible solution
- d) none of these.

vi) For a salesman who has to visit n cities which of the following is the way of his tour plan ?

- ☒ a) $n!$
- b) $(n + 1)!$
- c) $(n - 1)!$
- d) n .

vii) Laplace criteria is applicable for decision making under

- a) certainty
- ☒ b) uncertainty
- c) risk
- d) none of these.

viii) Degeneracy in transportation problems occurs when

- a) at optimality, the total cost is 0
- b) in finding an initial solution, a row and a column requirement are simultaneously satisfied
- c) there are two or more filled cells with the same smallest negative value in a closed path for an incoming basic variable
- d) total supply is greater than total demand
- e) total demand is great than the total supply.

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- ix) The common error(s) that occur(s) in a network construction is/are
 a) looping (cycling) b) dangling
 c) redundancy d) all of these.
- x) A pay-off, which is an outcome of all combinations of courses of action is
 a) positive b) negative
 c) zero d) all of these.
- xi) In Hurwicz alpha criterion the degree of optimism α varies between
 a) 1 and 2 b) 0 and 1
 c) 0 and 0.5 d) 0 and 2.
- xii) In a M/M/1 queue, the service rate is
 a) Poisson b) linear
 c) exponential d) none of these.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Explain how an assignment problem can be solved as a transportation problem.
3. Solve the following linear programming problem using graphical approach :

$$\begin{aligned} \text{Minimize} \quad & Z = 200x_1 + 300x_2 \\ \text{subject to,} \quad & 2x_1 + 3x_2 \geq 1200 \\ & x_1 + x_2 \leq 400 \\ & 2x_1 + 1.5x_2 \geq 900 \\ & x_1, x_2 \geq 0 \end{aligned}$$

4. Find the maximum value of $Z = 5x_1 + 7x_2$
 subject to,
 $x_1 + x_2 \leq 4$
 $3x_1 + 8x_2 \leq 24$
 $10x_1 + 7x_2 \leq 35$
 $x_1, x_2 \geq 0$

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5. A small ink manufacturer produces a certain type of ink at a total average cost of Rs. 3 per bottle and sells at a price of Rs. 5 per bottle. The ink is produced over the week-end and is sold during the following week. According to past experience the weekly demand has never been less than 78 or greater than 80 bottles in his place. Formulate the loss table.
6. A self service store employs one cashier at its 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.

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Solve the following all integer programming problem using branch and bound method :

$$\begin{aligned} \text{Maximize} \quad & Z = 6x_1 + 8x_2 \\ \text{subject to,} \quad & 4x_1 + 16x_2 \leq 32 \\ & 14x_1 + 4x_2 \leq 28 \\ & x_1, x_2 \geq 0 \end{aligned}$$

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- b) Four different jobs can be done on four different machines and the take-down time costs are prohibitively high for change over. The matrix below gives the cost in rupees for producing job i on the machine j .

Jobs	Machines			
	M_1	M_2	M_3	M_4
J_1	5	7	11	6
J_2	8	5	9	6
J_3	4	7	10	7
J_4	10	4	8	3

8. a) Use penalty method to solve the following L.P. Problem :

Minimize $Z = 6x + 4y$

subject to, $2x + 4y \leq 12$

$3x + 2y = 10$

$5x + 3y \geq 15$

$x, y \geq 0.$

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- b) Write down the dual of the following L.P. Problem :

Minimize $Z = 2x_1 + 5x_2 + x_3$

subject to, $2x_1 + x_2 - x_3 \leq 2$

$-3x_1 + 2x_2 - 5x_3 \geq -6$

$4x_1 + 3x_2 + x_3 \geq 10$

$x_1, x_2, x_3 \geq 0$

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9. a) Apply Vogel's approximation method to find the optimal transportation cost for the following problem :

		Destination				Supply
		D_1	D_2	D_3	D_4	
Factory	F_1	19	30	50	10	7
	F_2	70	30	40	60	9
	F_3	40	8	40	20	18
	Demand	5	8	7	14	34

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- b) Use the method of Lagrangian multipliers to solve the following non-linear programming problem :

Minimize : $Z = 2x_1^2 + x_2^2 + 3x_3^2 + 10x_1 + 8x_2 + 6x_3 - 100$

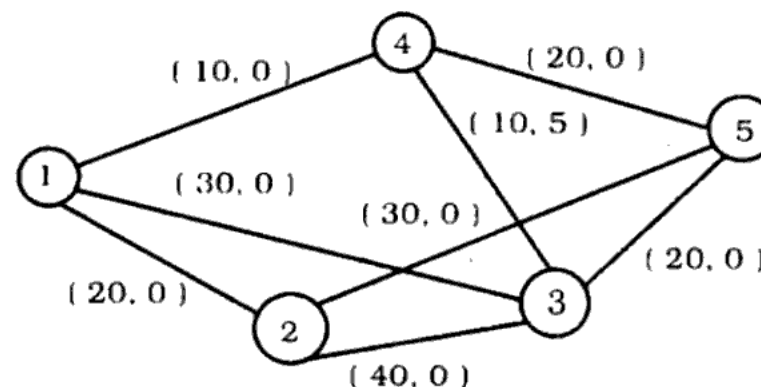
subject to $x_1 + x_2 + x_3 = 20$

$x_1, x_2, x_3 > 0.$

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10. a) Determine the maximal flow in the network shown below :

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- b) Mr. Sinha has to decide whether or not to drill a well on his farm. In his village, only 40% of the wells drilled were successful at 200 feet of depth. Some of the farmers who did not get water at 200 feet, drilled further upto 250 feet but only 20% struck water at 250 feet. Cost of drilling is Rs. 50 per foot. Mr. Sinha estimated that he would pay Rs. 18,000 during a 5-year period in the present value terms, if he continues to buy water from the neighbour rather than go for the well which would have a life of 5 years. Mr Sinha has three decisions to make :

- (i) Should be drill up to 200 feet and
- (ii) If no water is found at 200 feet, should he drill up to 250 feet ?
- (iii) Should he continue to buy water from his neighbour ?

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- *11. a) Under an employment promotion programme, it is proposed to allow sale of newspapers on the buses during off-peak hours. The vendor can purchase the newspapers at a special concessional rate of 25 paise per copy against the selling price of 40 paise. Any unsold copies are however a dead loss. A vendor has estimated the following probability distribution for the number of copies demanded :

Number of copies :	15	16	17	18	19	20
Probability :	0.04	0.19	0.33	0.26	0.11	0.07

- (i) How many copies should he order so that his expected profit will be maximum ?
- (ii) Compute EPPI

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- (iii) The vendor is thinking of spending on a small market survey to obtain additional information regarding the demand levels. How much should he be willing to spend on such a survey ?

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- b) Arrival rate of telephone calls at a telephone booth is according to Poisson distribution, with an average time of 9 minutes between two consecutive arrivals. The length of telephone call is assumed to be exponentially distributed, with mean 3 minutes.

- (i) Determine the probability that a person arriving at the booth will have to wait.
- (ii) Find the average queue length that is formed from time to time.
- (iii) The telephone company will instal a second booth when convinced that an arrival would expect to have to wait at least 4 minutes for the phone. Find the increase in flow rate of arrivals which will justify a second booth.
- (iv) What is the probability that an arrival will have to wait for more than 10 minutes before the phone is free ?

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