

CS/B.Tech/ME/Odd/Sem-7th/ME-705C/2015-16



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

ME-705C

OPERATIONS RESEARCH

Time Allotted: 3 Hours

Full Marks: 70

*The questions are of equal value.
The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.*

**GROUP A
(Multiple Choice Type Questions)**

I. Answer any *ten* questions. 10×1 = 10

(i) Which method is used to solve the LPP, if constraints having Artificial variables?

- (A) VAM (B) Big M-Method
(C) Simplex Method (D) Stepping stone Method

(ii) How many Artificial variables can be introduced in these equations?

$$2X_1 + X_2 = 4$$

$$4X_1 + 6X_2 \geq 6$$

$$X_1 + 6X_2 \leq 4$$

- (A) 0 (B) 1
(C) 2 (D) 3

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Turn Over

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(iii) Which method in Transportation problems gives the nearest optimal solution.

- (A) North-West corner rule (B) Least cost method
(C) Vogel's approximation method (D) Row minimum method

(iv) The number of Basic variables in a transportation problem is at most

- (A) $m + n - 1$ (B) $m + n + 1$
(C) $m - n + 1$ (D) $mn + 1$

(v) Hungarian method is a special type of

- (A) LPP (B) Simplex method
(C) Transportation problem (D) Inventory

(vi) The dual of the dual in a LPP will remain

- (A) dual (B) primal
(C) optimal (D) none of these

(vii) Critical path method (CPM) is

- (A) probabilistic (B) deterministic
(C) both (A) and (B) (D) none of these

(viii) PERT stands for

- (A) Performance Evaluation Report Technique
(B) Programme Evaluation Report Technique
(C) Programme Evaluation and Review Technique
(D) None of these

(ix) In balanced assignment problem the cost matrix must be

- (A) square (B) singular
(C) non singular (D) none of these

(x) In transportation problem demand and supply should be

- (A) same (B) not same
(C) both (A) and (B) (D) none of these

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- (xi) Queuing system comprising
- (A) the arrival and service pattern
 - (B) the queue discipline
 - (C) customer's behavior
 - (D) all of these
- (xii) in (M/M/1),(FCFS, r/r) queue system formula for expected number of customer in the system is
- (A) $\frac{1}{\mu - \lambda}$
 - (B) $\frac{\lambda}{\mu - \lambda}$
 - (C) $\frac{\lambda}{\mu(\mu - \lambda)}$
 - (D) none of these

4. Solve the Assignment problem.

	D1	D2	D3	D4
J1	8	26	17	11
J2	13	28	4	26
J3	28	19	18	15
J4	19	26	24	10

5. Show that $X = \{(x, y) / x^2 + y^2 \leq 4\}$ is a convex set.

6. In a Supermarket, the average arrival rate of customers is 10 every 30 minutes following poisson distribution. The average time taken by a cashier to list and calculate the customers purchase is 2.5 minutes, following exponential distribution. What is the probability that the queue length exceeds 7? What is the expected time spent by a customer in the system?

GROUP B
(Short Answer Type Questions)

Answer any three questions.

3 × 5 = 15

2. Four different metals namely Fe, Cu, Zn, Mn are required to produce three commodities A, B and C. To produce one unit of A 40 kg Fe, 30 kg Cu, 7 kg Zn, 4 kg Mn are needed. Similarly to produce one unit of B 70 kg Fe, 14 kg Cu, 9 kg Mn are required and for producing one unit of C 50 kg Fe, 18 kg Cu, 8 kg Zn are required. The total no. quantities of metals are 1 ton Fe, 5 Quintals Cu, 2 Quintals Zn and Mn each. The profits are Rs 300, Rs 200, and Rs 100 in selling per unit of A, B and C respectively. Formulate the Linear programming Problem.

3. Find the basic feasible solutions of the set of equations:
 $2x - y + 3z + t = 6; 4x - 2y - z + 2t = 16$

GROUP C
(Long Answer Type Questions)

Answer any three questions.

3 × 5 = 15

7. Solve the following LPP by simplex method
Maximize, $Z = 6X_1 + 8X_2$
Subject to : $30X_1 + 20X_2 \leq 300$
 $5X_1 + 10X_2 \leq 110$
 $X_1, X_2 \geq 0.$

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8. The warehouse capacities a_i , market demands b_j , and the unit cost of shipping c_{ij} are given in the following table

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	M ₁	M ₂	M ₃	M ₄	a _i
W ₁	2	2	2	1	3
W ₂	10	8	5	4	7
W ₃	7	6	6	8	5
b _j	4	3	4	4	15

Find the optimum solution for the problem.

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9. A company is producing a single product and is selling it through five agencies situated in different cities. All of a sudden, there is a demand for the product in another five cities not having any agency of the company. The company is faced with the problem of dealing on how to assign the existing agencies to dispatch the product to needy cities in such a way that the travelling distance is minimized (in kms) between the surplus and deficit cities. The details are given in the following distance matrix. 15

Deficit Cities Surplus Cities	I	II	III	IV	V
A	160	130	175	190	200
B	135	120	130	160	175
C	140	110	155	170	185
D	50	50	80	80	110
E	55	35	70	80	105

- 10.(a) A small maintenance project consist of the following jobs whose precedence relationship is given below: 3+2+3+2+2+1

Activity	Estimated duration (weeks)		
	Optimistic	Most likely	Pessimistic
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

- Draw the project network.
- Find the expected duration and variance of each activity.
- Calculate the early and late occurrence for each event and the expected project length.
- Calculate the variance and standard deviations of project length.
- What is the probability that the project will be completed –
 - 4 weeks earlier than expected?
 - not more than 4 weeks later than expected?
 If the project due date is 19 weeks, what is the probability of meeting the due date?

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11. Customers arrive at a one-window drive-in bank according to a Poisson distribution with mean 10 per hour. Service time per customer is exponential with mean 5 minutes. The space in front of the window, including that for the serviced car can accommodate a maximum of 3 cars. Other cars can wait outside this space. 3+4+4+4
- What is the probability that an arriving customer can drive directly to the space in front of the window?
 - What is the probability that an arriving customer will have to wait outside the indicated space?
 - How long is an arriving customer expected to wait before starting service?
 - How many spaces should be provided in front of the window so that all the arriving customers can wait in front of the window at least 20% of the time?