

Indian Maritime University
(A Central University, Govt of India)
End Semester Examinations – December 2023

Programme Name: B.Tech

Semester: VII

Subject Code: UG12E2704

Subject Name: Introduction to Operations Research

Date: 12.12.2023

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. If there are 'm' original variables and 'n' introduced variables, then there will be Columns in the simplex table. []
(a) $m + n$ (b) $m - n$ (c) $3 + m + n$ (d) $m + n - 1$
2. A basic feasible solution of a LPP is said to be..... if at least one of the basic variable is zero. []
(a) Degenerate (b) Non-degenerate (c) Infeasible
(d) Unbounded
3. For solving an assignment problem, which method is used? []
(a) Hungarian (b) American (c) German (d) All are incorrect
4. To make an unbalanced assignment problem balanced, what are added with all entries as zeroes? []
(a) Dummy rows (b) Dummy columns (c) both A and B (d) dummy entries

5. The stock of materials kept in the stores in anticipation of future demand is known as []
(a) Storage of materials (b) stock of materials (c) inventory (d) raw material.
6. We can reduce the materials cost by []
(a) using systematic inventory control techniques
(b) ordering the material as and when the need arises
(c) by ordering in bulk quantities
(d) ordering the material at fixed interval irrespective of need
7. The cost of providing service in a queuing system decreases with []
(a) decreased average waiting time in the queue
(b) decreased arrival rate
(c) increased arrival rate
(d) none of the above
8. The system of loading and unloading of goods usually follows: []
(a) LIFO
(b) FIFO
(c) SIRO
(d) SBP
9. A dummy activity is used in the network diagram when []
(a) two parallel activities have the same tail and head events
(b) delaying any activity affects project completion time
(c) that activity has not much importance on project completion
(d) none of these
10. Network models have advantage in terms of project []
(a) planning
(b) scheduling
(c) controlling
(d) all of these

Section B

Five Questions of 02 Marks each

11. Define the non-degenerate solution and basic solution?

12. Consider the Transportation problem shown below:

Plant		1	2	3	4	5	Supply
	1	10	2	16	14	10	300
	2	6	18	12	13	16	500
	3	8	4	14	12	10	825
	4	14	22	20	8	18	375
	Demand	350	400	250	150	400	

Find the initial basic feasible solution using Northwest corner method

13. Write a short note on ABC analysis?

14. What are the basic characteristics of a queuing system?

15. Construct a network for the project whose activities and precedence relationships are as given below:

A < C, D, I; B < G, F; D < G, F; F < H, K; G, H < J; I, J, K < E

Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. Use two-phase simplex method to solve, Maximize $Z = 5x_1 - 4x_2 + 3x_3$ subject to $2x_1 + x_2 - 6x_3 = 20$; $6x_1 + 5x_2 + 10x_3 \leq 76$; $8x_1 - 3x_2 + 6x_3 \leq 50$; $x_1, x_2, x_3 \geq 0$

17. A product is produced by 4 factories F_1, F_2, F_3 and F_4 . Their unit production costs are Rs: 2, 3, 1 and 5 respectively. Production capacity of the factories are 50, 70, 30 and 50 units respectively. The product is supplied to 4 stores S_1, S_2, S_3, S_4 , the requirements of which are 25, 35, 105 and 20 respectively. Unit costs of transportation are given below. Find the transportation plan such that the total production and transportation cost is minimum.

Factory	Destination				
		S1	S2	S3	S4
	F1	2	4	6	11
	F2	10	8	7	5
	F3	13	3	9	12
	F4	4	6	8	3

18. In a two-wheeler manufacturing company, pistons are being fed into the main assembly line from a product line situated in the next bay. The annual demand

for the pistons is 8000 units and the annual production capacity of the product line manufacturing the piston is 12,000 units. The set-up cost is Rs: 125 per set up and the carrying cost is Rs: 4 per piston per year. The shortage cost is Rs: 8 per piston per year. Find Q^* , Q_1^* , Q_2^* , t^* , t_1^* , t_2^* , t_3^* and t_4^*

19. Find the optimum order quantity for a product, the price breaks for which are as follows:

Quantity	Unit cost(Rs)
0-499	25
500-1499	24.80
1500-2999	24.60
Over 3000	24.40

Ordering cost is Rs: 180 per order, carrying cost is Rs: 0.10. Demand is 500 units per year. Also find the minimum inventory cost.

20. There is an automobile inspection site with three inspection stalls. Assume that cars wait in such a way that when a stall becomes vacant, the car at the head of the line pulls up to it. The station can accommodate four cars at the most, to be waiting (seven in station) at one time. The arrival pattern is Poisson with a mean of one car every minute during peak hours. The service time is exponential with mean six minutes. Find the average number of cars in the site during peak hours, the average waiting time and the average number of cars per hour that cannot enter the station because of full capacity.

21. Consider the following project.

Activity	Time estimate in weeks			Predecessor
	t_0	t_m	t_p	
A	3	6	9	None
B	2	5	8	None
C	2	4	6	A
D	2	3	10	B
E	1	3	11	B
F	4	6	8	C,D
G	1	5	15	E

Find the path and standard deviation. Also find the probability of completing the project by 18 weeks. (Area at $z=1.4556$ is 0.4265)

22. Explain degeneracy in a Transportation problem and how to resolve it.