

**IM.Sc. AIML Sem.-6 Examination
CC-311**

Operation Research

April-2025

Time : 2-30 Hours]

[Max. Marks : 70

Instructions: All questions are compulsory. Use of non-programmable scientific calculator is allowed.

Q.1 (a) Use Big-M method to Maximize $z = 6x + 4y$; (07)

Subject to the constrains $2x + 3y \leq 30$;

$3x + 2y \leq 24$;

$x + y \geq 3$, with $x, y \geq 0$

Give which variable enters into the basis and which leaves the basis at the end of second Simplex iterative table.

(b) Give solution up to first simplex iterative table (only) using simplex method to the following LPP (07)

Maximize $z = 30x_1 + 40x_2 + 20x_3$

Subject to the constrains: $100x_1 + 120x_2 + 70x_3 \leq 1,00,000$;

$7x_1 + 10x_2 + 8x_3 \leq 8,000$;

$x_1 + x_2 + x_3 \leq 1,000$, where $x_1, x_2, x_3 \geq 0$

OR

(a) A firm manufactures two products, A and B, from which the profits earned per unit are Rs. 10 and Rs. 9 respectively. Each product is processed on two machines, M_1 and M_2 . Product A requires three minutes of processing time on M_1 and 7 minutes on M_2 . While B requires 5 minutes on M_1 and 1 minute on M_2 . Machine M_1 is available for not more than 9 hours while machine M_2 is available for 10 hours during any working days. Find the number of units of products A and B to be manufactured to get maximum profit. Formulate the above as a linear programming problem to maximize the total profit. (07)

(b) Give dual of the given LPP: (07)

Maximize $z = -3x - 2y$;

Subject to the constrains $x + y \geq 1$;

$x + y \leq 7$;

$x + 2y \geq 10$;

$y \leq 3$, with $x, y \geq 0$.

Q.2 (a) A production company needs to ship goods from three warehouses to four destinations. The cost per unit between each warehouse and destination is given. (07)

Warehouses	Destinations				Supply
	D1	D2	D3	D4	
W1	3	1	7	4	250
W2	2	6	5	9	350
W3	8	3	3	2	400
Demand	200	300	350	150	

Use MODI Method to determine the optimal solution.

- (b) Solve the Assignment problem by using Hungarian Method. Assign the jobs for different machines to minimize the total cost. (07)

Jobs	Machines				
	A	B	C	D	E
1	13	8	16	18	19
2	9	15	24	9	12
3	12	9	4	4	4
4	6	12	10	8	19
5	15	17	18	12	20

OR

- (a) Solve the following Travelling Salesman Problem. Find the Path and minimum cost. (07)

	A	B	C	D	E
A	∞	2	5	7	1
B	6	∞	3	8	2
C	8	7	∞	4	7
D	12	4	6	∞	5
E	1	3	2	8	∞

- (b) What is the Transportation Problem? State its types? (07)
 A company has three plants (A, B, and C) with supplies of 40, 30, and 20 units respectively. It needs to supply four warehouses (W, X, Y, and Z) with demands of 25, 35, 20, and 10 units, respectively.

Factories	Warehouses			
	W	X	Y	Z
A	9	7	10	8
B	8	11	9	11
C	13	10	12	10

Solve for the initial basic feasible solution by using the Northwest Corner Method.

- Q.3 (a) Discuss in brief: The origin, use and applications of PERT and CPM. (07)
- (b) Listed in the table are the activities and sequencing requirements necessary for the completion of a research project. (07)

Activity	Description	Procedure	Duration (Week)
A	Literature search	-	6
B	Formulation of Hypothesis	-	5
C	Preliminary Feasibility study	B	2
D	Formal Disposal	C	2
E	Field analysis	A, D	2
F	Progress Report	D	1
G	Formal Research	A, D	6
H	Data collection	E	5
I	Data analysis	G, H	6
J	Conclusions	I	2
K	Rough draft	G	4
L	Final copy	J, K	3
M	Preparation of oral presentation	L	1

- I. Draw a network diagram for this project.
- II. Find the critical path and duration of the project.

OR

- (a) The following indicates the details of a project. The durations are in days; 'a' refers to optimistic time, 'm' refers to most likely time and 'b' refers to pessimistic time duration. (07)

Activity	1-2	1-3	1-4	2-4	2-5	3-4	4-5
a	2	3	4	8	6	2	2
m	4	4	5	9	8	3	5
b	5	6	6	11	12	4	7

- I. Draw the network.
- II. Find the critical path.

- (b) What is the primary objective of the Critical Path Method (CPM)? Explain the difference between total float and free float in CPM. (07)

Q.4 (a) State assumptions for economic order model and derive it when shortages are not allowed. (07)

- (b) A company has a demand of a product of 40 items per month. The purchase cost is Rs. 6 per item and the cost of ordering the material is Rs. 15 per order. The holding charge fraction is 20 % per annum. Find EOQ and total cost. (07)

OR

- (a) The cost of parameters and other factors for a production inventory system of paint color are given below. Find (a) optimal lot size, (b) number of shortages, and (c) manufacturing time and time between set-ups. (07)

Demand per year = 6000 units

Units cost = Rs 40

Set-up cost Rs 500

Production rate per year = 36000 units

Holding cost per year = Rs 8

Shortage cost per unit per year Rs 20

- (b) Derive inventory formula (only) for economic production inventory model when shortages are not allowed. (07)

Q.5 Attempt any SEVEN out of TWELVE: (14)

- (1) Consider the L.P. Problem

Minimize $z = 5x_2$

Subject to $x_1 = 4$, $x_2 = 7$, $x_1 \geq 0$, $x_2 \geq 0$ then, the solution to the given L.P.P. is

- A) Unbounded
 B) Infeasible
 C) Unique
 D) Multiple optimum solution.
- (2) If dual has unbounded solution, primal has
 A) No feasible solution.
 B) Unbounded solution.
 C) Feasible solution.
 D) None of the above.
- (3) If a primal LP problem has a finite solution, then the dual LP problem should have
 A) Finite solution.
 B) Infeasible solution
 C) Unbounded solution.
 D) None of the above.
- (4) When the total allocations in a transportation model of $m \times n$ size do not equal to $m + n - 1$ then the situation is known as
 A) Unbalanced situation
 B) Degeneracy
 C) Tie situation
 D) Optimum situation
- (5) In the optimum solution, more than one empty cell has their opportunity cost as zero, it indicates

- A) The solution is not optimal.
B) The problem has alternate solutions.
C) The problem will be a cycle.
D) Something wrong with the solution
- (6) The three probabilistic estimates about one activity analyzed under PERT have three-time estimates of 4, 5 and 6 days for the optimistic, normal, and pessimistic situation respectively. The expected time in days under PERT will be:
A) 5.167 days
B) 5 days
C) 9 days
D) 6 days
- (7) The activity that can be delayed without affecting the execution of the immediate succeeding activity is determined by
A) Total Float
B) Free Float
C) Independent Float
D) Dummy Float
- (8) In PERT/CPM, the merge event represents _____ of two or more events.
A) Splitting
B) Completion
C) Beginning
D) Joining
- (9) In an assignment problem involving 5 workers and 5 jobs, total number of assignments possible are _____.
A) 5!
B) 10
C) 25
D) 5
- (10) Which assumption is true for EOQ model with finite replenishment rate
A) Replenishment rate is finite at P units/time units with $P < R$
B) Replenishment rate is finite at P units/time units with $P > R$
C) Replenishment rate is finite at P units/time units with R/P
D) Replenishment rate is finite at P units/time units with P/R
- (11) Total cost of an inventory system when shortages are not allowed is sum of
A) Inventory holding cost
B) Shortage cost
C) Set up cost
D) both (A) and (C)
- (12) The ordering cost per order and average carrying cost are constant, and demand suddenly falls by 75%, then EOQ will
A) decrease by 50%.
B) not change.
C) increase by 50%.
D) decrease by 25%.
