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ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)
B.E- END SEMESTER EXAMINATIONS, May 2025
MINING ENGINEERING
IV-Semester
IE23C06 OPERATIONS RESEARCH (Regulation2023)

Time:3hrs Max.Marks: 100

To assess the following course outcomes and student learning level perspectives.

Co1: Convert an abstract real-world problem to an optimization model.
CO2: Perform sensitivity analysis for an optimization problem
CO3: Build and solve Transportation Models, Assignment Models, and TSP models
CO4: Handle issues in Project Management and other network problems.
CO5: Make decision under risk and uncertainty

K1 – Knowledge K3 - Application
K2 – Understanding K4 - Analysis

Answer All the Questions.
Part – A (10 x 2 = 20 Marks)

1.	State the limitation of the graphical method.	Co1 K1
2.	Name the assumptions of the linear programming problem	Co1 K2
3.	What is a simplex multiplier?	Co2 K1
4.	Define shadow price.	CO2 K1
5.	Write the differences between transportation and the Assignment	CO3 K2
6.	How to resolve degeneracy in transportation problems.	CO3 K1
7.	Write the differences between PERT and CPM.	CO4 K1
8.	Define flow augmenting path.	CO4 K1
9.	Define the theory of dominance.	CO5 K1
10.	What is a pure strategy in game theory?	CO5 K1

Part – B (5 x 13 = 65 Marks)

11a). Southern Oil Company produces two grades of gasoline regular and premium. The profit contributions are Rs 300 per gallon for regular gasoline and Rs 500 for premium per gallon. Each gallon of regular gasoline contains 0.3 gallons of grade A crude oil and each gallon of premium gasoline contains 0.6 gallons of grade A crude oil. For the next production period, southern has 18,000 gallons of grade crude oil available. The refinery used to produce the gasoline has a production capacity of 50,000 gallons for the next production period. Southern Oil's distributors have indicated that demand for the premium gasoline for the next production period will be at most 20,000 gallons. **(co1,k4)**

OR

11b) Solve the following LPP by the graphical method **(co1,k4)**

Max $Z = 3X_1 + 2X_2$
S.T
$-2X_1 + X_2 \leq 1$,
$X_1 \leq 2$,
$X_1+X_2 \leq 3$,
$X_1, X_2 \geq 0$

12a) Using the Simplex method, solve the given LPP: **(co2, K4)**
Maximize $Z = X_1 +X_2 +3X_3$
Subjected to the constraint
$3X_1 +2X_2 +X_3 \leq 3$
$2X_1 + X_2 + 2X_3 \leq 2$
$X_1, X_2, X_3 \geq 0$

OR

12 b). Solve the linear programming problem using the dual simplex algorithm. **(CO2,k4)**

Minimize $Z = 4X_1 + 7X_2$
S.T
$2X_1 + 3X_2 \geq 24$
$X_1 + 7X_2 \geq 9$
$X_1,X_2 \geq 0$

13 a) Find the optimal transportation cost for the following transportation table given below.

(CO3,k4)

	A	B	C	D	E	Available
P	8	2	4	12	18	100
Q	12	8	6	10	14	120
R	10	4	12	8	16	120
Demand	40	50	70	90	90	

OR

13 b) A sales manager has to assign a salesman to four territories. He has four candidates of varying experience and capabilities and assesses the possible profit for each salesman in each territory as given below. Find the assignment that maximizes the profit. **(CO3,k4)**

Salesman	Territory			
	A	B	C	D
1	35	27	28	37
2	28	34	29	40
3	35	24	32	38
4	24	32	25	28

14 a) A Project consists of 12 activities. The Immediate Predecessors and time estimates of the activities are summarized in the table given below. **(CO4,k4)**

(i) Draw the Network of the Project
(ii) Find the critical path and expected project completion time
(iii) What is the probability of completing the project on or before 30 weeks?

Table: Data of the activities

Activity	Immediate Predecessor (s)	Time Estimate (weeks)		
		Optimistic	Most Likely	Pessimistic
A	-	4	6	8
B	-	2	3	4
C	-	5	5	5
D	A	8	10	12
E	A	4	5	6
F	B, E	5	6	7
G	C	5	8	11
H	C	6	8	10
I	D	7	7	13
J	F, G	8	10	12
K	H	2	3	4
L	K	4	5	6

OR

14 b) A distance network consists of 11 nodes which are shown in the following table find the shortest path from node 1 to node 11 and the corresponding distance **(CO4,k4)**

Arc	1-2	1-3	1-4	2-5	3-5	3-6	3-7	4-7	5-8
Distance	8	7	1	5	9	2	8	10	12

Arc	5-9	6-9	7-9	7-10	8-11	9-11	10-11
Distance	7	9	6	13	4	2	15

15 a) Obtain the optimal strategies for both players and the value of the game. **(CO5,k4)**

		Player B	
		B1	**B2**
Player A	**A1**	-6	7
	A2	4	-5
	A3	-1	-2
	A4	-2	5
	A5	7	-6

OR

15 b) A finance manager is considering drilling a well. In the past, 70% of wells drilled were successful at 20 meters depth in that area. Moreover, on finding no water at 20 meters, some people in that area drilled further up to 25 meters but only 20% struck water at that level. The prevailing cost of drilling is Rs 500 per meter. The finance manager estimated that in case he does not get water in his well, he will have to pay Rs 15,000 to buy water from outside for the same period of getting water from the well. The following decisions are considered **(CO5,k4)**

i) Do not drill any well.

ii) Drill up to 20 meters and

iii) If no water is found at 20 meters, drill up to 25 meters

Draw on an appropriate decision tree and determine the finance Manager's optimal strategy

Part – C (1 x 15 = 15 Marks)

16 . Maximize $Z = 10X_1 + 6X_2 + 4X_3$ **(CO2,k4)**

ST

$X_1 + X_2 + X_3 \leq 100$ (Technical)

$10X_1 + 4X_2 + 5X_3 \leq 600$(Labour)

$2X_1 + 2X_2 + 6X_3 \leq 300$ (administration)

$X_1, X_2, X_3, \geq 0$

Basis	10	6	4	0	0	0	RHS
	X1	X2	X3	X4	X5	X6	
X2	0	1	5/6	10/6	-1/6	0	400/6
X1	1	0	1/6	-4/6	1/6	0	200/6
X6	0	0	4	-2	0	1	100
RP	0	0	-16/6	-20/6	-4/6	0	Z=4400/6

Using sensitivity analysis, answer the following concerning the above optimal tableau

a) What is the range on the profit of product 1 so that the current solution is still optimal?

b)Determine the shadow prices of all the resources.

c) What should be the profit of product 3 before it becomes worthwhile to manufacture?