JHARKHAND Rai University
RANCHI

PRACTICE SET

End Semester Examination, December 2025

Program: B.TECH (MINING)
Semester: V
Subject Code: 8PCCMiE402
Subject: Operation Research in Mining

Course Outcomes	Description
CO1	Formulate real-world problems as a linear programming model and describe the theoretical workings of the graphical and simplex method.
CO2	Formulate specialized linear programming problems, namely transportation and assignment problems and describe theoretical workings of the solution methods for transportation and assignment problems.
CO3	To develop the abilities in project evaluation techniques like PERT, CPM etc.
CO4	Apply the knowledge of game theory concepts to articulate real-world decision situations for identifying, analyzing, and practicing strategic decisions to counter the consequences.

UNIT-I

Section: I (1 Marks - MCQs) CO 1

1. Programming deals with the optimization of a function that is:

A) Quadratic B) Linear

C) Exponential D) Non-linear

2. The function to be maximized or minimized in LPP is called:

A) Constraint function B) Decision function

C) Objective function D) Optimal function

3. A solution that satisfies all constraints is called:

A) Basic solution B) Feasible solution C) Optimal solution D) Degenerate solution

4. The region satisfying all constraints of an LPP is called:

   A) Optimal region
   B) Unbounded region
   C) Feasible region
   D) Solution space

5. In graphical LPP, the optimum solution occurs:

   A) At the center of the feasible region
   B) At a corner (vertex) point
   C) On the interior boundary of the feasible region
   D) Everywhere in the feasible region

6. A constraint of the form $x1 + x2 \leq 10$ is:

   A) Greater-than constraint
   B) Equality constraint
   C) Less-than constraint
   D) Non-negativity constraint

7. Slack variable is added to convert:

   A) $\geq$ constraints to =
   B) $\leq$ constraints to =
   C) Equality constraints to inequality
   D) Unrestricted variables to non-negative

8. A Linear Programming Problem has infinite solutions when:

   A) Feasible region is a single point
   B) Feasible region is unbounded in the optimal direction
   C) The objective function is parallel to a constraint boundary
   D) There is no feasible region

9. The Simplex Method is used for solving:

   A) Two-variable LPP
   B) Graphical LPP
   C) Multi-variable LPP
   D) Non-linear optimization problems

10. When two or more basic variables take value zero at a basic feasible solution, it is called:

    A) Degeneracy
    B) Optimality

C) Unboundedness D) Multiple solutions

Section: II (10 Marks)

11. Solve graphically the given linear programming problem

Min $Z = 3X_1 + 5X_2$

Subject to

$-3X_1 + 4X_2 \leq 12$; $2X_1 - X_2 \geq -2$; $2X_1 + 3X_2 \geq 12$; $X_1 \leq 4$; $X_2 \geq 2$ and $X_1, X_2 \geq 0$ **CO1 Evaluate**

12. Solve the linear programming problem

Maximize $Z = 3X_1 + 5X_2 + 4X_3$

Subject to

$2X_1 + 3X_2 \leq 8$; $2X_2 + 5X_3 \leq 10$; $3X_1 + 2X_2 + 4X_3 \leq 15$ and $X_1, X_2, X_3 \geq 0$ **CO1 Evaluate**

13. Find optimum solution of given linear programming problem

Maximize $Z = X_1 + 2X_2 + 3X_3 - X_4$

Subject to

$X_1 + 2X_2 + 3X_3 = 15$; $2X_1 + X_2 + 5X_3 = 20$; $X_1 + 2X_2 + X_3 + X_4 = 10$ and $X_1, X_2, X_3, X_4 \geq 0$ **CO1 Evaluate**

14. Three grads of coal A, B and C contain phosphorus and ash as impurities. In a particular industrial process, fuel up to 100 ton (maximum) is required which should contain ash not more than 3% and phosphorus not more than 0.03%. It is desired to maximize the profit while satisfying these conditions. There is an unlimited supply of each grade. The percentage of impurities and the profits of grads are given below:

Coal	Phosphorus (%)	Ash (%)	Profits in Rs./ ton
A	0.02	3.0	12.00
B	0.04	2.0	15.00
C	0.03	5.0	14.00

15. Find the proportions in which the three grads be used. **CO1 Evaluate**

UNIT-II

Section: I (1 Marks - MCQs) CO 2

17. The main objective of a transportation problem is to:

a) Maximize cost
b) Minimize cost
c) Minimize transportation time only
d) Maximize transportation quantity

18. A transportation problem is said to be balanced if:

a) Total supply = Total demand
b) Total supply > Total demand
c) Total supply < Total demand
d) Demand is zero

19. Which method is used to find the initial basic feasible solution with the least total cost?

a) North-West Corner Rule
b) Least Cost Method
c) Vogel's Approximation Method
d) MODI Method

20. The number of basic variables in a transportation problem with m origins and n destinations:

a) m + n
b) m x n
c) m + n - 1
d) m – n + 1

21. The method used to check the optimality of a transportation solution is:

a) Least Cost Method
b) MODI (u-v) Method
c) North West Corner
d) Penalty Method

22. The main objective of an assignment problem is:

a) Assign maximum tasks to workers
b) Minimize cost or time
c) Maximize supply
d) Determine shortest route

23. Assignment problem is a special case of:

a) Transportation problem
b) Linear programming
c) Game theory
d) Network analysis

24. In an assignment problem, the number of rows and columns must be:

a) Different
b) Equal (balanced)

c) Always more rows d) Always more columns

25. Which method is used to solve assignment problems?

a) Simplex method b) Hungarian method

c) MODI method d) VAM

26. In assignment problems, each task is assigned to how many workers?

a) At least one b) More than one

c) Exactly one d) At most two

Section: II (10 Marks)

27. Five wagons are available at stations 1, 2, 3, 4 and 5. These are required at five stations I, II, III, IV and V. The mileages between various stations are given by the table below. How should the wagons be transported so as to minimize the total mileage covered? **CO2 Evaluate**

	I	II	III	IV	V
1	10	5	9	18	11
2	13	9	6	12	14
3	3	2	4	4	5
4	18	9	12	17	15
5	11	6	14	19	10

28. Find the initial solution to the following Transportation Problem using Vogel's Approximation Method (VAM) **CO 2 (Apply)**

Destination						
Factory		D1	D2	D3	D4	Supply
	F_1	3	3	4	1	100
	F_2	4	2	4	2	125
	F_3	1	5	3	2	75
	Demand	120	80	75	25	300

29. A company has 5 jobs to be done on five machines. Any job can be done on any machine. The cost of doing the jobs in different machines is given below. Assign the jobs for different machine so as to minimize the total cost. **CO 2 (Apply)**

Jobs	Machine				
	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	13
5	15	17	18	12	20

Section: III (20 Marks)

30. A small garment making unit has five tailors stitching five different types of garments. All the five tailors are capable of stitching all the five types of garments. The output per day per tailor and the profit (Rs.) for each type of garment are given below:

Garments						
Tailors		1	2	3	4	5
	A	7	9	4	8	6
	B	4	9	5	7	8
	C	8	5	2	9	8
	D	6	5	8	10	10
	E	7	8	10	9	9
Profit (Rs.) per garment		2	3	2	3	4

(i) Which type of garment should be assigned to which tailor in order to maximize profit assuming that there are no other constraints?

(ii) If tailor D is absent for a specified period and no other substitute tailor is available what should be the optimal assignment? **CO2 Analyze**

32. A company has four warehouses and six stores. The warehouses altogether have a surplus of 22 units of a given commodity, divided among them as follows:

Warehouses: 1 2 3 4

Surplus : 5 6 2 9

The six stores altogether need 22 units of the commodity. Individual requirements at stores 1, 2, 3, 4, 5 and 6 are 4, 4, 6, 2, 4 and 2 units respectively.

Cost of shipping one unit of commodity from warehouses i to j in rupees is given in the matrix below

	Stores						
		1	2	3	4	5	6
Warehouses	1	9	12	9	6	9	10
	2	7	3	7	7	5	5
	3	6	5	9	11	3	11
	4	6	8	11	2	2	10

(i) Formulate the mathematical model for the problem.

(ii) How should the products be shipped from the warehouses to the stores so that the transportation cost is minimum? **CO2 Analyze**

UNIT-III

Section: I (1 Marks - MCQs) CO 3

33. PERT stands for:

a. Programme Evaluation and Review Technique

b. Project Evaluation and Resource Technique

c. Process Evaluation and Review Technique

d. Programme Estimation and Resource Technique

34. CPM is mainly used for:

a. Probabilistic activity times b. Deterministic activity times

c. Marketing analysis d. Inventory control

35. In PERT, the time estimates used are:

a. One time estimate b. Two time estimates

c. Three time estimates d. No time estimate

36. Critical Path represents:

a. The longest path in the network b. The shortest path in the network

c. The path with minimum cost d. The path with float

37. Slack or Float of activities on the critical path is:

a. Always positive b. Negative

c. Zero d. Cannot be determined

38. The expected time (te) in PERT is given by:

a. (O + M + P)/3 b. (O + 4M + P)/6

c. (O + 2M + P)/4 d. (O + M + P)/2

39. Dummy activities in a PERT/CPM network are used to:

a. Consume time and resources b. Maintain logic of the network

c. Reduce the project duration d. Increase float

40. The main objective of CPM is:

a. Reduce cost of marketing b. Control time and cost of project

c. Reduce number of workers d. Improve product quality

41. Which of the following has probabilistic time estimates?

a. CPM b. PERT

c. Both CPM & PERT d. None

42. Crashing in CPM refers to:

a. Increasing project duration b. Decreasing float

c. Reducing activity time by adding resources d. Removing critical path

Section: II (10 Marks)

43. Draw a network to represent the project and the minimum time of completion of the project when time, in days of each task is as follows: **CO 3 (Apply)**

Activity	1 – 2	1 – 3	2 – 3	2 – 5	3 – 4	3 – 6	4 – 5	4 – 6	5 – 6	6 – 7
Duration (days)	15	15	3	5	8	12	1	14	3	14

44. Write rules for network construction. Consider table summarizing the details of a project involving 14 activities. CO 3 (Analyze)

Activity	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Predecessor	-	-	-	B	A	A	B	C,D	C,D	E	F,G,H	F,G,H	I	J,K

Duration	2	6	4	3	6	8	3	7	2	5	4	3	13	7

Section: III (20 Marks)

45. The following table shows the jobs of a network along with their time estimates. The time estimates an in day: CO 3 (Analyze)

Job	1 – 2	1 – 6	2 – 3	2 – 4	3 – 5	4 – 5	5 – 8	6 – 7	7 – 8
a	3	2	6	2	5	3	1	3	4
m	6	5	12	5	11	6	4	9	19
b	15	14	30	8	17	15	7	27	38

(a) Draw the project network.

(b) Find the critical path.

(c) Find the probability that the project is completed in 31 days.

46. For the given activities determine: **CO 3 (Apply)**

Job	1 – 2	1 – 3	2 – 4	3 – 4	3 – 5	2 – 6	4 – 6	5– 6
a	6	3	2	4	1	5	7	1
m	9	4	5	6	1.5	6	8	2
b	12	11	14	8	5	7	15	3

(a) Critical path using PERT

(b) Calculate variance and standard deviation for each activity.

(c) Calculate the probability of completing the project in 26 days.

UNIT-IV

Section: I (1 Marks MCQ) CO 4

47. Game theory primarily deals with:

a) Decision-making under risk b) Decision-making under conflict

c) Decision-making under certainty d) Inventory decisions

48. A two-person zero-sum game means:

a) Sum of gains is always positive
b) Sum of losses is zero
c) One player's gain is another player's loss
d) Both players always win

49. A saddle point in a game gives:

a) Mixed strategy
b) Pure strategy solution
c) No solution
d) Maximum regret

50. When a game has no saddle point, the solution is obtained by:

a) Dominance rule
b) Solving mixed strategies
c) Graphical method
d) Any of the above

51. The value of the game is:

a) Always positive
b) Expected payoff for both players
c) Sum of all payoffs
d) Difference of strategies

52. Dominance rule is used to:

a) Increase number of strategies
b) Delete inferior strategies
c) Find saddle point
d) Convert payoff matrix

53. A payoff matrix represents:

a) Payoff of one strategy
b) Payoffs of all players for all strategies
c) Only best strategy
d) Only worst strategy

54.In a maximization-minimization game, the row player tries to:

a) Minimize losses
b) Maximize his minimum gain
c) Maximize opponent's gain
d) Minimize opponent's gain

55. For a 2x2 game without saddle point, the mixed strategy is solved using:

a) Linear programming
b) Game tree
c) Probability equations
d) Simulation

56. The prisoner's dilemma is an example of:

a) Cooperative game
b) Strategic game

c) Zero-sum game d) Pure strategy game

Section: II (10 Marks)

57. Solve the following game by using the principle of dominance: CO 4 (Apply)

	I	II	III	IV	V	VI
1	4	2	0	2	1	1
2	4	3	1	3	2	2
3	4	3	7	-5	1	2
4	4	3	4	-1	2	2
5	4	3	3	-2	2	2

58. Solve the given game by graphical method CO4 (Apply)

Player A	Player B				
	-5	5	0	-1	8
	8	-4	-1	6	-5

59. Discuss principle of dominance. Players A and B play a game in which each player has three coins (20p, 25p, 50p). Each of them selects a coin without the knowledge of the other person. If the sum of the value of the coins is an even number, A win B's coin. If that sum is an odd number, B win A's coin. Develop a pay off matrix with respect to player A. Find the optimal strategies for the players. CO 4 (Apply)

Section: III (20 Marks)

60. Solve the given 2 X N game by the method of sub games. CO 4 (Apply)

Player A	Player B		
	1	3	11
	8	5	2

61. Discuss principle of dominance. Hence solve the following game: CO4 Apply

Player B					
Player A		I	II	III	IV
	I	3	2	4	0
	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

Summary Sheet:

CO Wise

CO	Q. No	Marks
CO1	1,2,3,4,5,6,7,8,9,10	95
CO2	11,12,13,14,15,16,17,18,19,20	95
CO3	21,22,23,24,25,26,27,28,29,30	95
CO4	31,32,33,34,35,36,37,38,39,40	95
Total		**380**

Unit Wise

Unit	Q. No	Marks
Unit 1	1,2,3,4,5,6,7,8,9,10	95
Unit 2	11,12,13,14,15,16,17,18,19,20	95
Unit 3	21,22,23,24,25,26,27,28,29,30	95
Unit 4	31,32,33,34,35,36,37,38,39,40	95
Total		**380**

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Blooms Taxonomy Level (BTL) Wise

BTL	Q. No	Marks
LOT	1,2,3,4,5,7,11,12,13,14,15,21,22,23,25,26,28,29,31,32,33,34,35	160
HOT	5,6,7,8,9,10,16,17,18,19,20,24,27,30,36,37,38,39,40	220
Total		**380**

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Disclaimer: - This is a Practice set. The Question in End term examination will differ from the Practice set. This Practice set is meant for practice only.