



INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR
Mid-Autumn Semester 2018-19

Date of Examination: 19/9/2018 Session: A/N Duration 2 hrs Full marks 60
Subject No: MI31007 Subject: Quantitative Decision making
Department/Center/School: Mining Engineering
Specific charts, graph paper, log book etc., required : Regular graph paper
Special Instructions (if any) : Answer all questions. Figures in margin indicate marks. Answer all the sections of question number 4 at the same place.

1. A company plans to manufacture and sell one or both of two products P1 and P2. These two products require the use of three different raw materials A, B and C which are available in limited quantities. The profits per units of products P1 and P2 are Rs. 400 and Rs. 1000 respectively. The other relevant data are given below:

Raw material	Units of raw material needed for making one unit of product		Total units of raw material available
	P1	P2	
A	10	5	2500
B	4	10	2000
C	1	1.5	450

- (i) Formulate the problem as a linear programming problem. (2)
(ii) Solve the problem by the graphical method. (8)
(iii) Show the feasible region on the graph and identify all the corner points. (2)
(iv) Is the optimal solution unique? Justify your answer. (1)
(v) If the optimal solution is not an unique optimal solution, then determine two other alternative optimal solutions. (2)
2. Consider the following linear programming problem: (15)

Maximize $Z = 4X_1 + 10X_2$
Subject to :

$$\begin{aligned} X_1 + 4X_2 &\leq 24 \\ 3X_1 + X_2 &\leq 21 \\ X_1 + X_2 &\leq 9 \end{aligned}$$

$$\text{and } X_1 \geq 0, X_2 \geq 0$$

Solve the problem by the simplex method. What is the optimal solution?

3. Find the maximum value of the following problem using the Big M method: (15)

$$Z = 5X_1 - 2X_2 + 3X_3$$

Subject to :

$$2X_1 + 2X_2 - X_3 \geq 2$$

$$3X_1 - 4X_2 \leq 3$$

$$X_2 + 3X_3 \leq 5$$

and $X_1 \geq 0, X_2 \geq 0, X_3 \geq 0$

4. a) Explain the importance of project optimization with relevance to mining projects and briefly describe the two widely used approaches for the same. (3)
- b) The details of a project are shown below for two cases of time considerations (viz., Case A and Case B). The activities are linked to each other in the manner depicted for executing some portion of mining project. For each of the two cases:

SI No.	Activity	Immediate Predecessor Activity(ies)	Time Duration (in Months)	
			Case A	Case B
1	A	-	3	7
2	B	-	6	5
3	C	-	5	6
4	D	B	6	5
5	E	A	8	10
6	F	A	4	3
7	G	B	4	3
8	H	C, D	7	6
9	I	C, D	3	6
10	J	E	6	4
11	K	F, G, H	5	3
12	L	F, G, H	4	2
13	M	I	13	11
14	N	J, K	9	7

- (i) Construct the corresponding CPM networks (2 x 2)
- (ii) Determine the corresponding critical paths and project completion times (2 x 2)
- (iii) Compute the total floats and free floats for the non-critical activities. (2 x 2)