

B. E. Part-II, 6th Semester Final Examination, 2013
Optimization Techniques in Mineral Industry (MN 602)

Time: 3 hours

Full Marks: 70

Answer any FIVE questions.

Marks are given at right side of questions.

1. a) An opencast project is composed of eleven activities whose predecessors and time estimates are listed in the following table:

<u>Activities</u>	<u>Predecessors</u>	<u>Estimated duration (in weeks)</u>		
		<u>Optimistic</u>	<u>Pessimistic</u>	<u>Most likely</u>
A ₁	none	2	5	3
A ₂	none	8	11	8
A ₃	A ₁	7	11	9
A ₄	A ₂	6	9	7
A ₅	A ₃	9	11	10
A ₆	A ₃	10	18	14
A ₇	A ₃ , A ₄	11	11	11
A ₈	A ₆ , A ₇	6	14	10
A ₉	A ₅	4	6	5
A ₁₀	A ₉	3	5	4
A ₁₁	A ₈	1	2	1

I. Draw the PERT network.

II. Compute the slack for each activity and determine the critical path.

- b) How the probability of completion of a project in a given date is calculated?

(5×2+4)

2. a) Define and derive EOQ. Find out the expression of total optimal inventory cost.

b) A Mining Workshop purchases 12,000 parts of a machine for its annual requirements, ordering one month usage at a time. Each part costs Rs. 20. The ordering cost per order is Rs 15 and the carrying charges are 15% of the average inventory. You have been assigned to suggest a more economical purchasing policy for the company. What advice would you offer and how much would it save the company per year?

(7+7)

3. a) Patients arrive at the local hospital for emergency service at the rate of one every hour. Currently, only one emergency case can be handled at a time. Patients spend an average of 20 min receiving emergency care. How much would be the average service time need to be decreased to keep the average time in the system (waiting and receiving service) less than 25 min?

b) A departmental secretary receives an average of 8 jobs/hr. Many are short jobs, while others are quite long. Assume, however, that the time to perform a job has an

exponential distribution with a mean of 6 min. What is the average elapsed time from the time the secretary receives a job until it is completed? Calculate the probabilities that a job will be completed in less than two hours and probability that more than five jobs in the system?

(7+7)

4. a) In a post office 3 clerks are assigning to process incoming mail. The first clerk B_1 processes 40%, the second clerk B_2 processes 35% and third clerk B_3 processes 25% of the mail. The first clerk has an error rate of 0.04, the second clerk has an error rate of 0.06 and the third clerk is 0.03. A mail selected at random from the days output is found to have an error. The postmaster wishes to know the probability that was processed by first, second and third clerk respectively having an error.

b) Three coins are tossed together. Find the probability to get more than one head and at least one head.

(8+6)

5. a) A and B throw alternatively with a pair of ordinary dice. A wins if he throws 7, before B throws 6 and B wins if he throws 6 before A throws 7. If A begins the game, then show that his chance of winning is $36/61$.

b) Three mines A, B and C which supply coal to four power plants W, X, Y and Z. The daily coal production schedules from the mines are 7, 13 and 11 thousand tonne respectively and the daily coal requirements for the power plants are 6, 10, 6 and 9 thousand tonne respectively. The unit cost of transportation from each mine to power plants are given by the following cost matrix.

Mines \ Power plants	W	X	Y	Z
	A	9	22	10
B	15	20	12	8
C	20	12	10	16

Develop the initial basic feasible solution by VAM.

(7+7)

6. A firm has divided its marketing area into three zones. The amount of sales depends upon the number of salesman in each zone. The firm has been collecting the data regarding sales and salesmen in each area over a number of past years. The information is summarized below. The firm is interested to identify the maximum profit and its allocations in different zones with 7, 8 and 9 salesmen for the next year.

No. of Salesmen	Profit in thousands of rupees		
	Zone-1	Zone-2	Zone-3
0	30	45	42
1	45	45	54
2	60	52	60
3	70	64	70
4	79	72	82
5	90	82	95
6	98	93	102
7	105	98	110
8	100	100	110
9	90	100	110

(14)

7. a) Find the optimal assignment for a problem with the following cost matrix.

	M1	M2	M3	M4	M5
J1	8	4	2	6	1
J2	0	9	5	5	4
J3	3	8	9	2	6
J4	4	3	1	0	3
J5	9	5	8	9	5

b) Write short note on artificial variable & slack variable.

(8+6)

8. a) Given the LPP

$$\begin{aligned} &\text{Maximize } Z = 2x_1 - 6x_2 \\ &\text{Subject to } x_1 - 3x_3 \leq 6 \\ &\quad 2x_1 + 4x_2 \geq 8 \\ &\quad -x_1 + 3x_2 \geq 6 \\ &\quad x_1, x_2, x_3 \geq 0 \end{aligned}$$

Formulate the dual of the above primal problem.

b) Solve the following LPP

$$\begin{aligned} &\text{Maximize } Z = -2x_1 + x_2 + 3x_3 \\ &\text{Subject to } x_1 - 2x_2 + 3x_3 = 2 \\ &\quad 3x_1 + 2x_2 + 4x_3 = 1 \\ &\quad x_1, x_2, x_3 \geq 0 \end{aligned}$$

(5+9)