

**MASTER OF PRODUCTION ENGINEERING EXAMINATION, 2017**  
(1<sup>st</sup> Semester)

**THEORY OF OPTIMIZATION**

Time: Three hours

Full marks: 100

**Answer any THREE questions from GROUP A and any TWO questions from GROUP B.**

**GROUP A**

1.(a) Two firms A and B have, for years, been selling a competing product that forms a part of both firms' total sales. The marketing executive of firm A raised the question: 'What should be the firm's strategies in terms of advertising for the product in question.' The market research team of firm A developed the following data for varying degree of advertising: (14)

(i) No advertising, medium advertising and large advertising for both firms will result in equal market shares.

(ii) Firm A with no advertising: 40% of the market with medium advertising by firm B and 28% of the market share with large advertising by firm B.

(iii) Firm A using medium advertising: 70% of the market with no advertising by firm B and 45% of the market share with large advertising by firm B.

(iv) Firm A using large advertising: 75% of the market with no advertising by firm B and 45% of the market share with medium advertising by firm B.

Based on the above information, answer the marketing executive's questions.

(b) Player A is paid Rs. 8 if two coins turn heads at the same time and Rs. 10 if two coins turn tails at the same time. Player B is paid Rs. 3 when the two coins do not match. Given the choice of being player A, what would be your optimal strategy? (6)

2. (a) The cost of fuel for running a train is proportional to the cube of the speed generated in km per hour. When the speed is 12 km per hour, the cost of fuel is Rs. 64 per hour. If other charges are fixed, i.e. Rs. 2000 per hour, find the most economical speed of the train for running a distance of 100 km. (6)

(b) Find the optimal solution of the following constrained multi-variable problem using the method of direct substitution: (14)

$$\text{Minimize } Z = x_1^2 + (x_2 + 2)^2 + (x_3 - 3)^2$$

Subject to the constraint

$$x_1 + 5x_2 - 3x_3 = 8$$

$$x_1, x_2, x_3 \geq 0$$

3.(a) A radio manufacturer finds that he can sell  $x$  radios per week at Rs.  $p$  each, where  $p = 2(100 - (x/4))$ . His cost of production of  $x$  radios per week is Rs.  $(120x + (x^2/2))$ . Show that his profit is maximum when the production is 40 radios per week. Also find his maximum profit per week. (8)

(b) Solve the following problems by geometric programming: (12)

$$\text{Minimize } Z = 3x_1^2 x_2^{-3} + 5x_1^{-3} x_2 + 2x_1 x_2, \quad x_1, x_2 > 0$$

4. A manufacturing firm produces a product A. the firm has the contract to supply 60 units at the end of the first, second and third months. The cost of producing  $x$  units of A in any month is given by  $x^2$ . The firm can produce more units of A in any month and carry them to a subsequent month. However, a carrying cost of Rs. 25 per unit is charged for carrying units of A from one month to the next. Assuming that there is no initial inventory, determine the number of units of A to be produced in each month so as to minimum the total cost. (20)

5. A manufacturing company has a certain piece of equipment that is inspected at the end of each day and classified as just overhauled, good, fair or inoperative. If the item is inoperative, it is overhauled, a procedure that takes one day. Let us denote the four classifications as states 1, 2, 3 and 4 respectively. Assume that the working condition of the equipment follows a Markov chain with the following transition matrix:

Today	Tomorrow			
	1	2	3	4
1	0	$\frac{3}{4}$	$\frac{1}{4}$	0
2	0	$\frac{1}{2}$	$\frac{1}{2}$	0
3	0	0	$\frac{1}{2}$	$\frac{1}{2}$
4	1	0	0	0

If it costs Rs. 125 to overhaul a machine (including lost time) on the average and Rs. 75 as production lost if the machine is found inoperative, then using the steady-state probabilities, compute the expected per day cost of maintenance. (20)

**M. PROD. E. EXAMINATION, 2017**(1<sup>ST</sup> Semester)**SUBJECT: THEORY OF OPTIMISATION**

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**Group-B***(Use separate answer script for each group)*

6. a) Explain with the help of graphical presentation the following solutions : 6
- (i) Unbounded Solution;
- (ii) Alternative Optimal Solution.

- b) An advertising company wants to determine how to obtain the most audience exposure from its current advertising budget. The four media which are available are television, radio, magazines and newspapers. A market research team has obtained the data, given in the table: 14

Particulars	T.V.	Radio	Newspaper	Magazine
Cost / Advertising Unit	Rs.60,000/-	Rs.25,000/-	Rs.20,000/-	Rs.12,000/-
No. Of Male Customers Reached / Unit	2,00,000	1,10,000	80,000	50,000
No. Of Female Customers Reached / Unit	1,50,000	1,20,000	85,000	70,000

The company does not wish to spend more than Rs.7,00,000/- on advertising. Other requirements are:

- a) At least 18,00,000 males must be reached.
- b) At least 15,00,000 females must be reached.
- c) At least 4 units must be bought on television.
- d) Not more than 10 units must be bought in magazines.
- e) The number of units on radio and newspapers must each be between 2 and 15.

If the company wants to determine how many units to spend in each media in order to maximise the total number of customers reached, formulate the problems one in linear programming.

7. Solve the following LPP by Two-Phase Method: 20

Maximize  $Z = 40x_1 + 24x_2$

Subject to

$$20x_1 + 50x_2 \geq 4800$$

$$80x_1 + 50x_2 \geq 7200$$

Where,  $x_1, x_2, \geq 0$

- 8 Maximise  $Z = x_1 + 2x_2 - x_3$  20

Subject to

$$2x_1 + x_2 + x_3 \leq 14$$

$$4x_1 + 2x_2 + 3x_3 \leq 28$$

$$2x_1 + 5x_2 + 5x_3 \leq 30$$

Where,  $x_1, x_2, x_3 \geq 0$