

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

CLASS: BE
BRANCH: PROD.

SEMESTER : VII
SESSION : MO/19

SUBJECT: PE7019 ADVANCED OPERATION RESEARCH

TIME: 3:00 HOURS

FULL MARKS: 60

INSTRUCTIONS:

1. The question paper contains 7 questions each of 12 marks and total 84 marks.
 2. Candidates may attempt any 5 questions maximum of 60 marks.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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Q.1 Use revised simplex method to solve the following problem: [12]

Maximize $Z = 3x_1 + 2x_2$ (Objective function); Subject to

$$x_1 + x_2 \leq 4$$

$$x_1 - x_2 \leq 2$$

Where, $x_1, x_2 \geq 0$

Also, find the range of the value of the coefficient of the variable x_1 in the objective function such that the current optimal solution remains optimal. Also find the range of the value of the coefficient of the variable x_2 in the objective function such that the current optimal solution remains optimal.

Q.2(a) The Data collected in running a machine whose purchase cost is Rs 60000 are given below: [6]

Year	1	2	3	4	5
Resale value (Rs)	42000	30000	20400	14400	9650
Cost of spares (Rs)	4000	4270	4880	6000	7000
Cost of Labour (Rs)	14000	16000	18000	25000	30000

Determine the optimum period of replacement of the machine.

Q.2(b) The initial price of the equipment is Rs 5000. The running cost varies as shown below: [6]

Year	1	2	3	4	5	6	7
Running Cost in Rs.	400	500	700	1000	1300	1700	2100

Take a discount rate of 9%. Find out the optimum replacement interval.

Q.3(a) Mr. Sethi has Rs 10000.00 to invest in one of three options: A, B, and C. The return on investment depends on whether the economy experiences inflation, recession or no change at all. The possible return under each economic condition are given below in the following table: [6]

Strategies	States of nature		
	Inflation	Recession	No Change
	Rs.	Rs.	Rs.
A	2000	1200	1500
B	3000	800	1000
C	2500	1000	1800

Identify the decision taken under the following approaches: (i) Pessimistic, (ii) Optimistic, (iii) Equal probability, (iv) Hurwicz criterion. The decision maker's degree of optimism (α) being 0.7

Q.3(b) Amar company is currently working with a process which after paying for materials labour etc. brings a profit of Rs 12000. The following alternatives are made available to the company: [6]

- (i) The company can conduct research R1, which is expected to cost Rs 10000 having 90% chance of success. If it proves to be successful, the company earns a profit of Rs 25000.
- (ii) The company can conduct research R2, which is expected to cost Rs 8000 having a probability of 60%, the gross income will be Rs 25000
- (iii) The company can pay Rs 6000 as royalty for a new process which will bring a gross income Rs 20000.
- (iv) The company continues the current process.

Because of limited resources, it is assumed that only one of the two types of research can be conducted at a time. Use decision tree analysis to locate the optimal strategy for the company.

Q.4(a) Find the optimum strategies A and B and value of the game for the payoff matrix given below: [6]

		B		
		Strategies	I	II
A	I	1	13	11
	II	8	5	2

Q.4(b) Consider the following payoff matrix to find the optimum strategies for A and B. Also find the value of the game. [6]

		B	
		Strategies	I
A	I	-2	4
	II	8	3
	III	9	0

Q.5(a) On the average 96 patients per 24-hour day require the service of an emergency clinic. Also, on average, a patient requires 10 minutes of active attention. Assume that the facility can handle only one emergency at a time. Suppose that it costs the clinic Rs 100 per patient treated to obtain an average servicing time of 10 minute, and that each minute of decrease in this average time would cost the clinic Rs 10 per patient treated. How much would have to be budgeted by the clinic to decrease the average size of the queue from $1\frac{1}{3}$ patients to $\frac{1}{2}$ patient. [8]

Q.5(b) Trains arrive at the yard every 15 minutes and the service time is 33 minutes. If the line capacity of the yard is limited to 4 trains, find (a) the probability that the yard is empty and (b) The average number of trains in the system. [4]

Q.6 A departmental store purchases Christmas trees which can be ordered only in lots of 100. Each tree costs Rs 25 and sells at Rs 40 each. Unsold trees, however, have no salvage value. The probability distribution obtained from analysis of past sales data is given below: [12]

Trees sold	Probability
100	0.2
200	0.35
300	0.25
400	0.15
500	0.05
Total	1

Simulate for 10 days demand and suggest how many units of tress should the store order?
The sequence of random number to be used are 3, 27, 45, 57, 85, 23, 9, 44, 97, 96

Q.7(a) A member of a certain political party is making plans for an upcoming presidential election. He has received the services of six volunteer workers for precinct work and he wishes to assign them to three precincts in such a way as to maximize their effectiveness. He feels that it would be inefficient to assign worker to more than one precinct if they can accomplish more in other precincts. The following table gives the estimate increase in popularity of the party's candidate if it were allocated various number of workers. [8]

No. of workers	0	1	2	3	4	5	6
Precinct 1	0	25	42	55	63	69	74
Precinct 2	0	22	33	54	65	73	80
Precinct 3	0	33	43	47	50	42	53

Q.7(b) Using Dynamic Programming to determine the value of u_1 , u_2 , and u_3 so as to: [4]
Minimize $Z = u_1 + u_2 + u_3$
Subject to the constraints: $u_1 u_2 u_3 = 27$ and, $u_1, u_2, u_3 \geq 0$