

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

CLASS: BE
BRANCH: PROD.

SEMESTER : VII/ADD
SESSION : MO/18

SUBJECT: PE7019-ADVANCED OPERATION RESEARCH

TIME: 03:00 HRS.

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 revised simplex method to solve the following problem: [12]

Maximize $Z = 10x_1 + 4x_2$ (Objective function)

Subject to

$$20x_1 + 10x_2 \leq 1200$$

$$40x_1 + 10x_2 \leq 1600$$

Where, $x_1, x_2 \geq 0$

Q.2(a) A fleet owner finds from his past records that the cost per year of running a truck and resale values whose purchase price is Rs. 8000.00 are given as under. At what stage the replacement is due? [6]

Year:	1	2	3	4	5	6	7	8
Running cost in Rs.	1000	1200	1400	1800	2300	2800	3400	4000
Resale value in Rs.	3000	1500	750	375	200	200	200	200

(b) The cost of a new machine is Rs 5000. The maintenance cost of the n^{th} year is given by $R_n = 500(n-1)$; $n = 1, 2, 3, \dots$ Suppose that the discount rate per year is 0.05. After how many years will it be economical to replace the machine with a new one? [6]

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]

Startegies	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.

(b) The Indian yacht company has developed a new cabin cruiser which they have earmarked for the medium to large boat market. A market analysis has 30% probability of annual sales being 5000 boats, a 40% probability of annual sales being 4000, and 30% probability of annual sales being 3000. This company go for limited production, where variable costs are Rs 10000 per boats and fixed costs are Rs 800000 annually. Alternately, they can go into full scale production, where variable costs are Rs 9000 per boats and fixed costs are Rs 500000 annually. If new boats are sold for Rs 11000, should the company go into limited or full-scale production when their objective is to maximize the expected profits. [6]

Q.4 The management of ABC company is considering the question of marketing a new product. The fixed cost required in the project is Rs 4000. Three independent and uncertain factors are; the selling price, variable cost and the annual sales volume. The product has a life of 1 year only. The management has the data on these three factors as under [12]

Selling Price (Rs)	Prob	Variable costs (Rs)	Prob	Sales volume (Units)	Prob
3	0.2	1	0.3	2000	0.3
4	0.5	2	0.6	3000	0.3
5	0.3	3	0.1	5000	0.4

Considering the sequence of thirty random numbers: 81, 32, 60, 04, 46, 31, 67, 25, 24, 10, 40, 02, 39, 68, 08, 59, 66, 90, 12, 64, 79, 31, 86, 68, 82, 89, 25, 11, 98, 16
 Using the sequence (first 3 random numbers for the first trials and so on) simulate the average profit for the above project on the basis of 10 trials.

- Q.5(a) Two players P and Q play a game. Each of them has to choose one of three colours, white (W), blue (B) and red (R) independently of the other. The complete payoff matrix is given below. Find the optimum strategies for P and Q and the value of the game. [6]

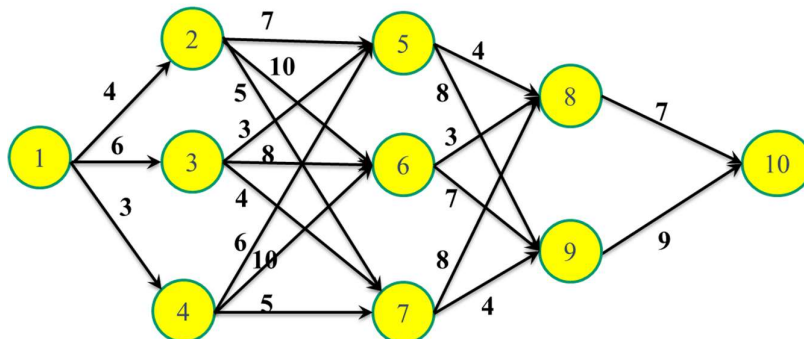
		Q		
		W	B	R
P	W	0	-2	7
	B	2	5	6
	R	3	-3	8

- (b) Determine the solution of the game for the payoff matrix given below, using sub games [6]

		B		
		I	II	III
A	I	1	3	11
	II	8	5	2

- Q.6(a) A warehouse has only one loading dock manned by three person crew. Trucks arrive at the loading dock at an average rate of 4 trucks per hour and the arrival rate is Poisson distributed. The loading of a truck takes 10 minutes on an average and can be assumed to be exponentially distributed. The operating cost of a truck is Rs 20 per hour and the members of the loading crew are paid Rs 6 each per hour. Would you advise the truck owner to add another crew of three persons? [6]
- (b) Trains arrive at the yard every 20 minutes and the service time is 30 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. [6]

- Q.7(a) A salesman located in a city A decided to travel to city B. He knew the distances of the alternative routes from city A to city B. He then drew a highway network map as shown in figure. The city of origin A is city 1. The destination city is city 10. Other cities through which the salesman passes are numbered 2 to 9. The arrow representing the routes between cities and distances in kilometers are indicated on each route. The salesman problem is to find the shortest route. [6]



- (b) Using Dynamic Programming determine the value of u_1 , u_2 , and u_3 so as to: [6]

$$\text{Minimize } Z = u_1^2 + u_2^2 + u_3^2$$

Subject to the constraints:

$$u_1 + u_2 + u_3 = 10 \text{ and } u_1, u_2, u_3 \geq 0$$