[This question paper contains 4 printed pages.]

4243 *Your Roll No. .....*

MBA (FT) **A**

Paper F – 3404 – OPERATIONS RESEARCH

(Admissions of 1998 and onwards)

Time : 3 hours *Maximum Marks : 70*

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any **four** *questions.* **All** *questions carry equal marks.*

1. (a) Discuss why simulation has been an preferred tool for analyzing complex decision making situations like for example queueing systems.

(b) A small fast food outlet has only one service counter. The service is done on a first-come-first-served basis. The arrival of customers at the counter and their service times are both random. Based on past records following distributions for inter-arrival and service times have been obtained.

Inter-arrival time (minutes)	Probability
1	0.2
2	0.3
3	0.35
4	0.15

Service time (minutes)	Probability
2	0.55
3	0.35
4	0.1

It costs ₹100 per hour to man the service counter and a customer's waiting time is estimated at a cost of ₹130 per hour. Using simulation, find out whether it would be economical to add another service counter at the outlet.

You may use the following sequences of random numbers:
Sequence 1: 29, 94, 93, 30, 30, 74, 12, 21, 7, 57.
Sequence 2: 1, 62, 14, 92, 17, 98, 30, 9, 15, 43.

P.T.O.

2. (a) 'Monitoring and Updating' are two vital project management activities. Discuss how 'PERT/COST' can be a useful tool in conducting these activities.

(b) A financial service company *Smart Invest Co.* has to decide on how to divide available funds among three classes of investment: Stocks, Bonds and Mutual funds. Based on the past data the average annual rates of returns for the three options are: 15%, 8% and 11% respectively and the covariance table is as follows

	Stocks	Bonds	Mutual Funds
Stocks	0.66	3	2
Bonds	3	1	0.5
Mutual Funds	2	0.5	0.5

A 10% rate of return is acceptable. Optimize the investment decision of *Smart Invest* that minimizes the investment risk.

3. (a) Describe how 'Time minimizing transportation problems' are useful for the dairy industry?
(b) Formulate a 'Time minimizing transportation problems' as an optimization model.

(c) *XYZ company* collects milk from villagers every day and supplies them to three processing plants in Ghaziabad, Faridabad and Sonepat. Milk is collected in vans, from three village cooperatives starting at 4.00 am in the morning. The time required (in hours) to transport the milk from the three supply points to the processing plants are given in the following table. To keep the calculations simple the unit of measure is assumed as the number of vans.

Village Cooperatives	**Ghaziabad**	**Faridabad**	**Sonepat**	**Supply (Vans)**
A	5	7	8	15
B	6	5	5	20
C	5	8	7	30
Requirement (Vans)	20	20	15	

Find the optimal transportation plan.

4. A company plans to schedule its annual advertising campaign. The total advertising budget is set at ₹1,0,000,000. The firm can purchase local radio spots at ₹20,000 per spot, local television sports at ₹1,20,000 per spot or magazine advertising at ₹40,000 per insertion. The payoff from each advertising medium is a function of its audience size and audience characteristics. Let this payoff be defined as audience points. Audience points for the three advertising vehicles are :

Radio	50 points per spot
Television	250 points per spot
Magazine	200 points per insertion

The advertising Manager of the firm has established the following goals for the advertising campaign, listed in the order of importance:

i) The total budget should not exceed ₹1,00,00,000.
ii) The contract with the radio and television station requires that the firm spend at least ₹30,00,000 for television and radio ads.
iii) The company does not wish to spend more that₹20,00,000 for magazine ads.
iv) Audience points from the advertising campaign should be maximized.

Formulae and solve (up to three iterations only) this problem as a goal programming problem by the simplex method.

5 (a) "Dynamic programming is a mathematical programming technique which solves for a series of sequential decisions" Discuss and elaborate the statement.

(b) A man is engaged in buying and selling identical items. He operates from warehouse having a capacity of 500 items. Each month he can sell any quantity that he chooses up to the stock at the beginning of the months. Each month, he can buy as much he wishes for delivery at the end of the month for long as his stock does not exceed 500 items. For the next four months he has the following error-free forecasts of cost and sales prices (in ₹):

Month n	**1**	**2**	**3**	**4**
Cost, c_n	27	24	26	28
Sales price, p_n	28	25	25	27

If he currently has a stock of 200 units, what quantities should he sell and buy in the next four months to maximize profit? Find the solution using dynamic programming.

6. (a) A mechanic repairs four machines. The mean time between service requirements is 5 hours for each machine and forms an exponential distribution. The mean repair time is one hour and also follows the same distribution pattern. Machine downtime costs ₹ 25 per hour and the mechanic costs ₹55 per hour. Determine the following:

i) Probability that the service facility will be idle,
ii) Expected number of machines waiting to be repaired,
iii) Total expected cost per hour.

(b) A cycle dealer finds that the cost of holding a cycle in stock for a week is ₹25 Customers who cannot obtain a new cycle immediately tend to go to other dealers, and he estimates that for every customer who cannot get immediate delivery losses an average of ₹200. For one particular model of cycle the probabilities of a demand of 0, 1, 2, 3, 4 and 5 cycles in a week are 0.05, 0.10, 0.20, 0.30, 0.20 and 0.15, respectively. How many cycles should the dealer keep in stock per week? (Assume that there is no time lag between ordering and delivery).