[This question paper contains 6 printed pages.]

4202 *Your Roll No. .....*

MBA (FT) **A**

Paper MBAFT–6202 – MANAGEMENT SCIENCE

(Admissions of 2010 and onwards)

Time : 3 Hours *Maximum Marks : 50*

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

Attempt any **five** *questions. Marks are indicated against each question.*

1. (a) The *ABC fertilizer Company* produces three types of fertilizer – *Supergro*, *Dynaplant* and *Soilsaver*. The company has the capacity to produce a maximum of 2000 tons of fertilizer in a week. It cost Rs.8.000 to produce a ton of *Supergro*, Rs.15.000 for *Dynaplant* and Rs.20.000 for *Soilsaver*. The production process requires 10 hours of labour for a ton a *Supergro*, 12 hours for a ton of *Dynaplant*, and 18 hours for a ton of *Soilsaver*. The company has 800 hours of normal production labour available each week. Each week the company can expect a demand for 800 tons of *Supergro*, 900 tons of *Dynaplant*, and 1100 tons of *Soilsaver*. The company has established following goals in order of their priority:

(i) The company does not want to spend over Rs. 2.00.000 per week on production if possible.

(ii) The company would like to limit overtime of 100 hours per week.

(iii) The company wants to meet the demand for all three fertilizers. However it is twice as important to meet the demand for *Supergo* as it is to meet the demand for *Dynaplant*, and it is twice as important to meet the demand for *Dynaplant* as it is to meet the demand for *Soilsaver*.

(iv) It is desirable to avoid producing under capacity, if possible.

(v) Because of union agreement the company wants to avoid under utilization of labour.

Formulate a goal programming model for determining the number of tons of each brand of fertilizer to produce in order to satisfy the goals. (5)

(b) The PQR company produces two kinds of paper: newsprint and white wrapping paper. It requires five minutes to produce a meter of newsprint and eight minutes to produce a meter of wrapping paper. The company has 4800 minutes of normal production capacity available each week. The profit is Rs.2 for a meter of newsprint, and Rs.2.40 for a meter of wrapping paper. The weekly demand is for 500 meters of newsprint and 400 meters of wrapping paper. The company has established the following goals in order of priority.

(i) Limit overtime to 480 minutes.

(ii) Achieve a profit of Rs.3000 or more each week.

(iii) Fulfill the demand for the products (attach appropriate weight)

(iv) Avoid underutilization of production capacity

(a) Formulate a goal programming model for determining the number of meters of each type of paper to produce weekly in order to satisfy the various goals.

(b) Solve this model. (5)

P.T.O.

2.(a) What is queueing theory; in what areas of management can it be applied successfully? Discuss. (5)

(b) The *XYZ bank* presently has one outside drive-up teller. It takes the teller an average of four minutes to serve a bank customer. Customers arrive at the drive-up window at the rate of 12 per hour. The bank operations officer is currently analyzing the possibility of adding a second drive-up window at an annual cost of Rs.2.00.000. It is assumed that arriving cars will be equally divided between both windows. The operations officer estimates that each minutes deduction in customer waiting time would increase the bank's revenue by Rs.20,000 annually. Should the second drive-up window be installed? Assume that the distribution of number of arrivals is Poisson and the service time distribution is exponential. (5)

3. *PM computers* is an international manufacturer of computer equipment and software. It is going to introduce a number of new products in the coming year and it wants to develop marketing programs to accompany the product introductions. The marketing program includes the preparation of printed materials distributed directly by the company and used by the company's marketing personnel, vendors and representatives; print advertising in regular magazines, trade journals, and news papers; and television commercials. The program also includes extensive training programs for marketing personnel, vendors, and representatives about the new products. A project management team with members from the marketing department and manufacturing areas has developed the following list of activities for the development of the marketing program. Construct the network for this project and determine the activity schedule. Identify the critical path and determine the expected project duration time and variance. What is the probability that the program can be completed within six months?

Activity	Description	Predecessors	Time estimate (days)		
			Minimum	Likely	Maximum
a	Preliminary budget and plan approval	-	10	15	20
b	Select marketing personnel for training	-	5	9	12
c	Develop overall media plan	*a*	15	25	30
d	Prepare separate media plans	*c*	12	20	25
e	Develop training plan	*c*	5	8	12
f	Design training course	*e*	6	14	20
g	Train marketing personnel	*b, f*	16	20	25
h	Plan TV commercials with agency	*d*	15	25	35
i	Draft in-house print materials	*d*	8	15	20
j	Develop print advertising layout with agency	*d*	16	23	30

k	Review print advertising layouts	*j*	4	9	12
l	Review TV commercials	*h*	3	7	12
m	Review and print in-house materials	*i*	3	5	7
n	Release advertising to print media	*g, i, k*	2	4	8
o	Release TV commercials to networks	*l*	4	7	10
p	Final marketing personnel review	*g, i, k*	4	5	9
q	Run media, advertising, mailings	*m, n, o*	15	20	30

(10)

4.(a) "ABC analysis is a selective inventory control technique but has some limitations". Explain how these limitations may be overcome by incorporating some other selective control techniques.

(5)

(b) *American Bottle Company* (*ABC*) produces several types of glass containers. They have recently reduced capacity at several of their plants. Glass manufacturing involves large, expensive machines (including ovens), several of which are turned off in the capacity reduction. The machines were hard to shut down and to start up. In the evnt of a surge in demand, they wanted to know how quickly they could start one. How quickly can they start a new oven using normal times? What is the fastest time in which a new oven can be started, and how much additional cost is involved? (5)

Cost (Rs.) per unit time (hour) reduction	**Activity**	**Normal Time**	**Crash Time**	**Predecessors**
-	A. Preheat glass	8	8	C
-	B. Preheat oven	12	12	D
400	C. Obtain materials	4	2	-
200	D. Check valves	4	2	-
200	E. Check pressure seals	2	1	B
-	F. Add glass to oven	2	2	A, E
500	G. Prepare bottle-maker	6	3	E
-	H. Run test production	4	4	F, G
500	I. Examine test quantity and make adjustments	4	2	H
-	J. Refill oven with glass	2	2	H

P.T.O.

5. The *Super Motor Company* has two plants where it can manufacture large trucks for the construction industry. The production costs are same at the two plants, and the cost (in thousands of Rupees) of shipping each truck, is shown below for each combination of plant and distribution center.

	Distribution center		
Plant	**1**	**2**	**3**
A	9	8	5
B	7	9	6

A total of 60 trucks are produced and shipped per week. Each plant can produce any amount up to a maximum of 50 trucks per week, so there is considerable flexibility on how to divide the total production between the two plants so as to reduce shipping costs. Each distribution center may receive any quantity between 10 to 30 trucks per week, provided that the total shipped to all distribution centers must still equal 60 trucks per week. **Formulate** as a linear programming problem, the Management's problem of determining how many trucks should be produced each week at each plant, and what the overall shipping pattern should be to minimize the total shipping cost.

Solve the above problem for the situation when each distribution center must receive exactly 20 trucks per week. (10)

6.(a) At a small but growing airport, the local airline company is purchasing a new tractor for a tractor-trailer train to bring luggage to and from the airplanes. A new mechanised luggage system will be installed in three years, so the tractor will not be needed after that. However, because it will receive heavy use, so that the running and maintenance costs will increase rapidly as it ages, it may still be more economical to replace the tractor after one or two years. The following table gives the total net discounted cost associated with purchasing a tractor (purchase price minus trade-in allowance, plus running and maintenance costs) at the end of year i and trading it in at the end of year j (where end of year 0 is now).

	j		
i	1	2	3
0	Rs. 8,000	Rs. 18,000	Rs. 31,000
1		Rs. 10,000	Rs. 21,000
2			Rs. 12,000

Management wishes to determine at what times (if any) the tractor should be replaced to minimize the total cost for the tractor(s) over three years. Formulate a network model for this problem as a shortest path problem and solve. (5)

(b) A forest consists of two types of trees: those that are 0-5 feet and those that are taller than 5 feet. Each year, 40% of all 0-5 feet tall tree die, 10% are sold for Rs.2,000 each, 30% stay between 0 and 5 feet, and 20% grow to be more than 5 feet. Each year, 50% of all trees taller than 5 feet are sold for Rs.5,000, 20% are sold for Rs.3,000, and 30% remain in the forest.

(i) What is the probability that a 0-5 feet tall tree will die before being sold?

(ii) If a tree (less than 5 feet) is planted, what is the expected revenue earned from that tree?

(5)

7. Vivian is the manager of new-accounts at the *Pro-Money bank*. She is currently faced with the question of whether to extend a Rs. 10,00,000 loan to a potential new customer, an exporter in textile. Vivian has three categories for the creditworthiness of a company – poor risk, average risk, high risk, but she doesn't know which category fits this potential customer. Experience indicates that 20 percent of companies similar to this textile exporter are poor risks, 50 percent are average risks, and 30 percent are good risks. If credit is extended, the profit for poor risk is -Rs.1,50,000 (i.e. a loss), for average risk Rs.1,00,000, and for high risks Rs.2,00,000. If loan is not given, the textile exporter will turn to another bank. Vivian is able to consult a credit-rating organization for a fee of Rs.50,000 per company evaluated. For companies whose actual credit records with the bank turn out to fall into each of the three categories, the following table shows the percentage that were given each of the three possible credit evaluations by credit-rating organization.

	Actual credit record		
Credit evaluation	**Poor**	**Average**	**Good**
Poor	50%	40%	20%
Average	40%	50%	40%
Good	10%	10%	40%

(i) Develop a decision analysis formulation for this problem by identifying the decision alternatives, the state of nature, and the pay-off table when the credit-rating organization is not used.

(ii) Find the expected value of perfect information. Does this answer indicate that consideration should be given to using credit-rating organization?

(iii) Draw the decision tree for this entire problem. Use this decision tree to determine Vivian's optimal policy.

(10)

8.(a) A and B are two television channels popular among young adults. The channels are battling for share of viewership. Channel A has an advantage in reality shows. If it runs a reality show during primetime, it gets a higher viewership than if it runs another type of program. Channel B has an advantage in game shows. If it runs a game show during primetime, it gets a higher viewership than if it runs a reality show. Based on extensive survey, a market research company recommends the following viewership for Channel A and Channel B during primetime, for various combination of programs:

		Channel B	
		Reality show	**Game show**
Channel A	**Reality show**	80%, 20%	50%, 50%
	Game show	50%, 50%	30%, 70%

If both the channels have to simultaneously decide their program during primetime, what should be their optimal strategies? (5)

(b) The *Pro-Money bank* will be soon connecting computer terminals at each of its branch offices to the Central Sever computer at its main office using special fiber optic cable lines. The line from a branch office need not be connected directly to the main office. It can be connected indirectly by being connected to another branch office that is connected (directly or indirectly) to main office. The only requirement is that every branch office be connected by some route to the main office. The cost for fiber optic cable lines is Rs.10,000 times the length in (kilometers) involved. The distance between every pair of branch offices is as follows:

	Distance (in km) between pair of branch offices					
	Main Office	**Branch 1**	**Branch 2**	**Branch 3**	**Branch 4**	**Branch 5**
Main Office	-	210	90	135	290	180
Branch 1	210	-	120	130	235	70
Branch 2	90	120	-	160	140	240
Branch 3	135	130	160	-	195	100
Branch 4	290	235	140	195	-	330
Branch 5	180	70	240	100	330	-

The management of *Pro-Money bank* wishes to determine which pairs of offices should be directly connected by special phone lines in order to connect every branch office (directly or indirectly) to main office at a minimum total cost. Solve the problem. (5)

(200)****