

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

MCA - SEMESTER-IV • EXAMINATION – WINTER • 2014

Subject Code: 2640003

Date: 02-12-2014

Subject Name: Operations Research

Time: 10:30 am - 01:00 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1**
- (a) Define Operations Research. State any four application of Operations Research. **04**
- (b) What is Float? Discuss in brief (i) Total Float and (ii) Free Float **03**
- (c) A company produces two types of leather belts, say A and B. Belt A is of superior quality and B is inferior. Profit on the two is 40 and 30 rupees per belt respectively. Each belt of type A requires twice as much time as required by a belt of type B. If all the belts were of type B, the company could produce 1,000 belts per day. Belt A requires a Fancy buckle and only 400 of them are available per day. For belt B only 700 Buckles are available per day. The supply of leather is sufficient only for 800 belts per day. How should the company manufacture the two types of belts in order to have a maximum overall profit? Solve it using Graphical Method. **07**
- Q.2**
- (a) Solve the following problem using Simplex Method **07**
- $\text{Max } Z = 30X_1 + 40X_2 + 20X_3$
- Subject to Constraints
- $10X_1 + 12X_2 + 7X_3 \leq 10,000$
- $7X_1 + 10X_2 + 8X_3 \leq 8,000$
- $X_1 + X_2 + X_3 \leq 1,000$
- $X_1, X_2, X_3 \geq 0$
- (b) (i) Write the dual of the following Primal LP problems **04**
- $\text{Max } Z = 2X_1 + 6X_2 + 9X_3$
- Subject to Constraints
- $2X_1 + 3X_2 + 5X_3 \geq 2$
- $3X_1 + X_2 + 7X_3 = 3$
- $X_1 + 4X_2 + 6X_3 \leq 5$
- and $X_1, X_2 \geq 0, X_3$ is unrestricted
- (ii) Explain the importance of Artificial Variable in Big- M method. **03**
- OR**
- (b) Solve the following LPP by Big – M Method **07**
- $\text{Max } Z = 2X_1 + 3X_2 + 4X_3$
- Subject to Constraints
- $3X_1 + X_2 + 4X_3 \leq 600$
- $2X_1 + 4X_2 + 2X_3 \geq 480$
- $2X_1 + 3X_2 + 3X_3 = 540$
- $X_1, X_2, X_3 \geq 0$
- Q.3**
- (a) Define Simulation. Why is Simulation used? Give one application area when this technique is used in practice. **04**
- (b) Explain the difference between pure strategy and mixed strategy used in game theory. **03**
- (c) A manufacturing company has three plants X, Y and Z, which supply to the distributors located at A, B, C, D and E. Monthly plant capacities are 80, 50, and 90 units respectively. Monthly requirements of distributors are 40,40,50,40 **07**

and 80 units respectively. Unit transportation cost are given below in rupees:

From	To				
	A	B	C	D	E
X	5	8	6	6	3
Y	4	7	7	6	6
Z	8	4	6	6	3

Determine an optimal distribution for the company in order to minimize the total transportation cost.

OR

- Q.3 (a)** Two competitors are competing for the market share of the similar product. The payoff matrix in terms of their advertising plan is shown below: **04**

Competitor A	Competitor B		
	No Advertising	Medium Advertising	Heavy Advertising
No Advertising	10	5	-2
Medium Advertising	13	12	13
Heavy Advertising	16	11	10

Suggest optimal strategies for the two firms and value of the game.

- (b)** What is a queuing problem? What are the components of a queuing system? **03**
(c) A large oil company operating a number of drilling platforms in the North Sea is forming a high speed rescue unit in order to cope with emergency situations that may occur. The rescue unit comprises 6 personnel who, for reasons of flexibility, undergo the same comprehensive training program. The Six personnel are assessed as to their suitability for various specialist tasks and the marks they received in the training program are given in the following table: **07**

Specialist Task	Trainee Number					
	I	II	III	IV	V	VI
Unit Leader	21	5	21	15	15	28
Helicopter Pilot	30	11	16	8	16	4
First Aid	28	2	11	16	25	25
Drilling Technology	19	16	17	15	19	8
Firefighting	26	21	22	28	29	24
Communications	3	21	21	11	26	26

Based on the marks awarded, what role should each of the trainees be given in the rescue unit?

- Q.4 (a)** Consider a self-service store with one cashier. Assume Poisson arrivals and exponential service times. Suppose that on average nine customers arrive every 5 minutes and that the cashier can serve 10 in 5 minutes. Find: **07**
 (a) Average number of customers in the system.
 (b) Average number of customers queuing for service.
 (c) Average waiting time of customer in the system.
 (d) Average waiting time of customers in the queue.
 (e) Probability of no customers in the system.
(b) What is Replacement? Describe some important Replacement situations. **03**
(c) Ram Industry needs 5400 units/year of a bought-out component which will be used in its main product. The ordering cost is Rs. 250 per order and the carrying cost per unit per year is Rs. 30. Find the Economic Order Quantity, the number of orders per year and the time between successive orders. **04**

OR

- Q.4 (a)** What are Inventory Models? Clearly explain with suitable examples the different costs that are involved in the inventory problem. **07**
(b) A large cricket stadium has four giant light stands, which together have 1,000 bulbs of a certain type. From the past data, it was observed that the failure rates **07**

of these special bulbs are shown in the following table

End of Week	1	2	3	4	5
Cumulative probability of failure	0.15	0.30	0.5	0.7	1.0

The cost of replacing an individual bulb is Rs. 6, while the cost of replacing the entire lot of bulbs is Rs. 3 per bulb. Assuming that the individual replacements can be carried out at any time whereas the group replacement can be carried out only at the end of the week, determine the optimal interval between group replacements. If the policy of individual replacement is considered, would it be beneficial?

Q.5 (a) (1.) Define General Sequencing Problem. Explain no passing rule in a sequencing problem. **03**

(2.) Five Jobs are performed, first on machine X and then on machine Y. The time taken, in hours by each job on each machine is given below: **04**

Job	A	B	C	D	E
Time on Machine X	12	4	20	14	22
Time on Machine Y	6	14	16	18	10

Determine the optimum sequence of jobs that minimizes the total elapsed time to complete the jobs. Also compute the minimum time.

(b) The following maintenance job has to be performed periodically on the heat exchanges in a refinery: **07**

Task	Description	Immediate Predecessor	Time (days)
A	Dismantle pipe connections	---	14
B	Dismantle header, closure and floating head front	A	22
C	Remove tube bundle	B	10
D	Clean bolts	B	16
E	Clean header and floating head front	B	12
F	Clean tube bundle	C	10
G	Clean shell	C	6
H	Replace tube bundle	F,G	8
I	Prepare shell pressure test	D,E,H	24
J	Prepare tube pressure test and make the final reassembly	I	16

- Draw a network diagram of activities for the project.
- Identify the critical path. What is its length?
- Find the total float and free float for each non-critical activities.

OR

Q.5 (a) A project consists of eight activities with the following relevant information: **07**

Activity	Predecessors	Estimated duration(days)		
		Optimistic	Most	Pessimistic
A	---	1	1	7
B	---	1	4	7
C	---	2	2	8
D	A	1	1	1
E	B	2	5	14
F	C	2	5	8
G	D, E	3	6	15
H	F, G	1	2	3

- Draw the PERT network and find out the expected project

completion time.

- (ii) What duration will have 95% confidence for project completion?

- (b) A manufacturing firm works 80 hours a week and has a capacity of overtime work to the extent of 40 hours in a week. It has received seven orders to be processed on three machines A, B and C, in the order ABC to be delivered in a week's time from now. The process times are recorded in the given table:

07

Jobs	1	2	3	4	5	6	7
Machine A	14	16	12	12	14	16	10
Machine B	4	4	2	6	6	4	8
Machine C	12	10	8	8	4	2	10

The manager, who, in fairness, insists on performing the jobs in the sequence in which they are received, is refusing to accept an eighth order, which requires 14, 4 and 10 hours respectively on A, B and C machines, because, according to him, the eighth jobs would require a total of 122 hours for processing, which exceeds the firm's capacity. Advise him.
