

GUJARAT TECHNOLOGICAL UNIVERSITY**SEMESTER- 4 EXAMINATION – WINTER 2012****Subject code: 640003****Date: 09/01/2013****Subject Name: Operations Research****Time: 10:30 – 13:00****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)** A manufacturer produces two different models, X and Y of the same product. **07**
 The raw materials R_1 and R_2 are required for production. At least 18 kg of R_1 and 12 kg of R_2 are must be used daily. Also at most 34 hours of labour are to be utilized. 2 kg of R_1 are needed for each model X and 1 kg of R_1 for each model Y. For each model of X and Y, 1 kg of R_2 is required. It takes 3 hours to manufacture a model X and 2 hours to manufacture a model Y. The profit is Rs. 50 for each model X and Rs. 30 for each model Y. How many units of each model should be produced to maximize the profit? Formulate this problem as an LP model and solve it graphically.

(b) Answer the following

- 1 What is Operations Research (OR)? What are the significant features of OR? **04**
 State any four application of OR.
- 2 Explain the following terms: **03**
 Loop and dangling, merge and burst events, float and slack.

Q.2 (a) Answer the following

- 1 Explain the difference between pure strategy and mixed strategy used in game theory. **03**
- 2 What is a queuing problem? What are the components of a queuing system? **04**

(b) Use penalty (Big-M) method to solve the following LPP **07**

$$\text{Maximize } Z = 2x_1 + 4x_2$$

$$\text{subject to } 2x_1 + x_2 \leq 18$$

$$3x_1 + 2x_2 \geq 30$$

$$x_1 + 2x_2 = 26$$

$$x_1, x_2 \geq 0$$

OR**(b)** Attempt the following

- 1 For what value of λ , the game with following pay-off matrix is strictly determinable? **03**

Player A	Player B		
	B_1	B_2	B_3
A_1	λ	6	2
A_2	-1	λ	-7
A_3	-2	4	λ

- 2 Arrivals at a telephone booth are considered to be Poisson, with an average time of 10 minutes between one arrival and the next. The length of a phone call is assumed to be distributed exponentially, with mean 3 minutes. Find: **04**
 1. The probability that an arrival finds that four persons are waiting for their turn.
 2. The average number of persons waiting and making telephone calls.
 3. The average length of the queue that is formed time to time.

4. The probability that a waiting time of a person in queue shall be more than 2 minutes?

Q.3 (a) Answer the following

- 1 Which are the different methods (other than Hungarian method) available for solving an assignment problem? Explain why it is not practical to use these methods. **04**
- 2 What are the components of an LPP? What does the non-negativity restriction mean? **03**

(b) A cement factory manager is considering the best way to transport cement from his three manufacturing centers P, Q, R to depots A, B, C, D and E. The weekly production and demands along with transportation cost per ton are given below: **07**

Centre	Depot						Tons
		A	B	C	D	E	
	P	4	1	3	4	4	60
	Q	2	3	2	2	3	35
	R	3	5	2	4	4	40
	Tons	22	45	20	18	30	

What should be distribution program that minimize the transportation cost?

OR

Q.3 (a) Answer the following

- 1 Describe the transportation problem and give its mathematical model. **03**
- 2 What is simulation? What are the advantages and disadvantages of simulation? **04**

(b) A solicitor's firm employs typists on hourly piece-rate basis for their daily work. There are five typists and their charges and speed are different. According to an earlier understanding, only one job is given to one typist and the typist is paid for a full hour even when he works for a fraction of an hour. Find the least cost allocation for the following data: **07**

Typist	Rate/hour (Rs.)	No. of pages typed/hour	Job	No. of pages
A	5	12	P	199
B	6	14	Q	175
C	3	8	R	145
D	4	10	S	298
E	4	11	T	178

Q.4 (a) XYZ Electronic Co. supplies microcomputer circuitry that incorporated microprocessors into refrigerators and other home appliances. One of the components has an annual demand of 250 units, and this is constant throughout the year. Carrying cost is estimated to be Rs.1 per unit per year, and the ordering cost is Rs.20 per order. **07**

- (1) To minimize cost, how many units should be ordered each time an order is places?
- (2) How many orders per year are needed with the optimal policy?
- (3) What is the average inventory if costs are minimized?
- (4) Suppose the ordering cost is not Rs.20, and the company has been ordering 150 units each time an order is placed. For this order policy to be optimal, what would the ordering cost have to be?

(b) The initial cost of a machine is Rs. 30,000 and running or operating expenditure which increases with age of the machine is given below: **07**

Year	1	2	3	4	5	6	7
Running cost (Rs.)	5,000	6,000	8,000	10,000	13,000	16,000	20,000

What is the replacement policy? When this machine should be replaced? It is

given that the rate of interest is 10% and scrap value is nil.

OR

Q.4 (a) Answer the following

1 ABC co. buys in lots of 500 boxes which is a 3 month supply. The cost per box is Rs. 125 and the ordering cost is Rs. 150. The inventory carrying cost is estimated at 20% of unit value. What is the total cost of existing inventory policy? How much money could be saved by employing the economic order quantity? **04**

2 Discuss, in detail, the various types of inventories. **03**

(b) The data collected in running a machine, the cost of which is Rs. 60,000 are given below: **07**

Year	1	2	3	4	5
Resale value (Rs)	42,000	30,000	20,400	14,400	9,650
Cost of spares (Rs.)	4,000	4,270	4,880	5,700	6,800
Cost of labour (Rs.)	14,000	16,000	18,000	21,000	25,000

Determine the optimum period of replacement of the machine.

Q.5 (a) Given the following data regarding the processing times of some jobs on three machines M_1 , M_2 and M_3 . The order of processing is $M_1 - M_2 - M_3$. Determine the sequence that minimizes the total elapsed time required to complete the following jobs. Also evaluate idle time for each machine. **07**

Machine s	Jobs						
	A	B	C	D	E	F	G
M_1	30	80	70	40	90	80	70
M_2	40	30	20	50	10	40	30
M_3	60	70	50	110	50	60	120

(b) The precedence relationships of the activities, and activity time estimates (in weeks) of a project is as follows: **07**

Task	A	B	C	D	E	F	G	H	I
Precedence	-	-	A	A	C	D	B	E,F	G
Optimistic	4	1	6	2	5	3	3	1	4
Likely	7	5	12	5	11	6	9	4	19
Pessimistic	16	15	30	8	17	15	27	7	28

1. Draw the network of the project.
2. Find Critical path and critical activities and expected completion time.
3. Find the probability that the project will be completed between 35 and 40 weeks.
4. If the project manager wishes to be 95% sure that the project is completed on time, when should he start the project work?

Given:

$$[P(0 < Z < 0.6) = 0.2257], [P(0 < Z < 0.4) = 0.1554], Z_{0.95} = 1.64.$$

OR

Q.5 (a) A firm works 40 hours a week and has a capacity of overtime work to extend of 20 hours in a week. It has received seven orders to be processed on three machines A, B and C in the order A, B, C to be delivered in a week's time from now. The process times (in hours) are recorded in the following table. **07**

Job	1	2	3	4	5	6	7
Machine A	7	8	6	6	7	8	5
Machine B	2	2	1	3	3	2	4
Machine C	6	5	4	4	2	1	5

The manager, who, in fairness, insist on performing the jobs in the sequence in which they are received, is refusing to accept an eighth order, which require 7, 2 and 5 hours respectively on A, B and C machines, because, according to him,

the eight job would require a total of 62 hours for processing, which exceeds the firm's capacity. What would you advise him? What is the total idle time on each machine?

- (b) The precedence relationships of the activities, and activity time estimates (in weeks) of a project is as follows: **07**

Task	A	B	C	D	E	F	G	H	I	J
Precedence	-	A	-	C	B,C	C	F	D,E,G	D,E	H,I
Time	10	5	15	11	10	5	5	10	10	15

1. Draw the network of the project.
2. Find Critical path and critical activities and expected completion time.
3. Obtain the total, free and independent float values for non-critical activities.
