

GUJARAT TECHNOLOGICAL UNIVERSITY**BE – SEMESTER V • EXAMINATION – WINTER - 2012****Subject code: 152005****Date: 23-01-2013****Subject Name: Quantitative Techniques in Management****Time: 02:30 pm to 05:00 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) Solve the following LP problem by using the two phase simplex method. **07**

$$\text{Minimize } Z = x_1 - 2x_2 - 3x_3$$

Subject to the constraints:

$$-2x_1 + x_2 + 3x_3 = 2$$

$$2x_1 + 3x_2 + 4x_3 = 1$$

$$x_1, x_2, x_3 \geq 0$$

- (b)** A company engaged in producing tinned food has 300 trained employees on its rolls, each of whom can produce one can of food in a week. Due to the developing taste of public for this kind of food, the company plans to add to existing labour force, by employing 150 people, in a phased manner, over the next five weeks. The newcomers would have to undergo a two week training programme before being put to work. The training is to be given by employees from among the existing ones and it is a known fact that one employee can train three trainees. Assuming that there would be no production from the trainers and trainees during training period, as the training is off-the-job. However, the trainees would be remunerated at the rate of Rs 300 per week, the same rate would applied as for the trainers. The company has booked the following orders to supply during the next five weeks: **07**

Week	1	2	3	4	5
No.of cans	280	298	305	360	400

Assume that the production in any week would not be more than the number of cans ordered for so that every delivery of the food would be 'fresh'.

Formulate this problem as an LP model to develop a training schedule that minimizes the labour cost over five week period.

- Q:2 (a)** A company manufacturing air coolers has two plants located at Mumbai and Kolkata with a capacity of 200 units and 100 units per week respectively. The company supplies the air-coolers to its four show rooms situated at Ranchi, Delhi, Lucknow and Kanpur which have a maximum demand of 75, 100, 100 **07**

and 30 units respectively. Due to differences in raw material cost and transportation cost, the profit per unit in Rupees differs which is shown in the table below.

	Ranchi	Delhi	Lucknow	Kanpur
Mumbai	90	90	100	110
Kolkata	50	70	130	85

Plan the production programme so as to maximize the profit. The company may have its production capacity at both plants partly or wholly unused.

- (b) Find the basic feasible solution of the following transportation problem by North-west corner rule. Also find the optimal transportation plan. **07**

	1	2	3	4	5	Available
A	4	3	1	2	6	80
B	5	2	3	4	5	60
C	3	5	6	3	2	40
D	2	4	4	5	3	20
Required	60	60	30	40	10	

OR

- (b) A product is produced by four factories A, B, C and D. The unit production cost are Rs. 2, Rs. 3, Rs. 1 and Rs. 5 respectively. Their production capacities are factory A – 50 units, B – 70 units, C – 30 units and D – 50 units. These factories supply the product to four stores, demands of which are 25, 35, 105 and 20 units respectively. Unit transportation cost in rupees from each factory to each store is given in the table below. **07**

Factories	Stores				
		1	2	3	4
	A	2	4	6	11
	B	10	8	7	5
	C	13	3	9	12
	D	4	6	8	3

Determine the extent of deliveries from each of the factory to each of the stores so that the total production and transportation cost is minimum.

- Q:3 (a)** A construction project is composed of 7 activities, whose time estimates are listed in the table below. Activities are identified by their beginning (i) and ending (j) node numbers. **07**

Activity (i – j)	Estimated duration (weeks)		
	Optimistic	Most likely	Pessimistic
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

- (a) Draw the network diagram of the activities in the projects.
 (b) Find the expected duration and variance for each activity. What is the expected project length.

(b) Estimated times for the jobs of a project are given below:

07

Job	A	B	C	D	E	F	G	H	I	J	K	L
Time (weeks)	13	5	8	10	9	7	7	12	8	9	4	17

The constraint governing the jobs are as follows:

A and B are start jobs; A controls C, D and E; B controls F and J; G depends upon C; H depends on D; E and F controls I and L, K follows J; L is also controlled by K; G, H, I and L are the last jobs. Draw the network diagram, determine the total project time and critical path.

OR

Q:3 (a) Find the sequence that minimizes the total elapsed time required (T) in completing the following jobs. Each job is processed in the order ABC. Also calculate T. **07**

Job	1	2	3	4	5	6	7
Machine A	10	8	12	6	9	11	9
Machine B	6	4	6	5	3	4	2
Machine C	8	7	5	9	10	6	5

(b) A large steel manufacturing company has three options with regard to production : (1) produce commercially (2) built pilot plant (3) stop producing steel. The management has estimated that their pilot plant, if built, has 0.8 chances of high yield and 0.2 chance of low yield. If the pilot plant shows the high yield, management assigns a probability of 0.75 that the commercial plant will also have a high yield. If the pilot plant shows a low yield, there is only a 0.1 chance that the commercial plant will show a high yield. Finally, management's best assessment of the yield on the commercial size plant without building a pilot plant first has 0.6 chance of high yield. A pilot plant will cost Rs. 3,00,000. The profits earned under high and low yield conditions are Rs. 1,20,00,000 and –Rs. 12,00,000 respectively. Find the optimum decision for company by using the decision tree. **07**

Q:4 (a) A group of process plants in an oil refinery are fitted with valves. Over a period of time, the failure pattern of these 400 valves has been observed and it is as follows: **07**

Month	1	2	3	4	5	6	7	8
Number of valve failing	8	20	48	104	120	56	32	12

It costs Rs. 100 to replace each valve individually. If all the valves are replaced at a time, it costs Rs. 50 per valve. The maintenance department is considering following replacement policies:

1. To replace all valves simultaneously at fixed intervals, in addition to replacing valves as and when they fail.
2. To replace valves as and when they fail.

Suggest an optimal replacement policy.

(b) Arrival at telephone booth is considered to be Poisson with an average time of 10 minutes between one arrival and the next. The length of phone calls is estimated to be distributed exponentially, with mean of 3 minutes. **07**

- (a) What is probability that a person arriving at the booth will have to wait?
- (b) The telephone department will install a second booth when convinced that an arrival would expect waiting for at least 3 minutes for a

phone call. By how much should the flow of the arrivals increases in order to justify a second booth?

(c) What is the average length of the queue that forms time to time?

OR

Q:4 (a) A firm has machine whose purchase price is Rs. 20,000. Its maintenance cost and resale price at the end of different years are as given below **07**

Year	1	2	3	4	5	6
Maintenance cost (Rs.)	1500	1700	2000	2500	3500	5500
Resale price (Rs.)	17000	15300	14000	12000	8000	3000

1. Obtain the economic life of the machine and the minimum average cost.
2. The firm has obtained a contract to supply the goods produces by the machine, for a period of 5 years from now. After this time period, the firm does not intend to use the machine. If the firm has a machine of this type that is one year old, what replacement policy should it adopt if it intends to replace the machine not more than once?

(b) A branch of SBI has only one typist. Since the typing work varies in length (number of pages to be typed), the typing rate is randomly distributed approximating a Poisson distribution with mean service rate of 8 letters per hour. The letters arrive at a rate of 5 per hour during the entire 8 – hour work day. If the type writer is valued at a Rs. 1.50 per hour, determine: **07**

1. Equipment utilization.
2. The per cent time that an arriving letter has to wait.
3. Average system time.
4. Average cost due to waiting on the part of the typewriter.

Q:5 (a) Determine the optimal sequence of performing 5 jobs on 4 machines. The machining of each job is required in the order ABCD and the process timings are as follows: **07**

Jobs	Machine			
	A	B	C	D
1	8	3	4	7
2	9	2	5	5
3	6	4	5	8
4	12	5	1	9
5	7	1	2	3

(b) A small garment making unit has five tailors stitching five different types of garments. All the five tailors are capable of stitching all the five types of garments. The output per day per tailor and the profit (Rs.) for each type of garment are given below: **07**

Tailors	Garments				
	1	2	3	4	5
A	7	9	4	8	6
B	4	9	5	7	8
C	8	5	2	9	8
D	6	5	8	10	10
E	7	8	10	9	9
Profit per garment (Rs)	2	3	2	3	4

Which type of garment should be assigned to which tailor in order to maximize the profit, assuming that there are no other constraints?

OR

- Q:5 (a)** A businessman has two independent investment portfolios A and B, available to him but he lacks the capital to undertake both of them simultaneously. He can either choose A first and then stop, or if A is not successful, then take B or vice versa. The probability of success of A is 0.6, while for B it is 0.4. both investment scheme require an initial capital outlay of Rs. 10,000 and both return nothing if the venture proves to be unsuccessful. Successful completion of A will return Rs. 20,000 (over cost) and successful completion of B will return Rs 24,000 (over cost). Draw a decision tree in order to determine the best strategy. **07**
- (b)** The captain of the cricket team has to allot five middle batting positions to five batsmen. The average runs scored by each batsman at these positions are as follows: **07**

Batsman	Batting position				
	1	2	3	4	5
P	40	40	35	25	50
Q	42	30	16	25	27
R	50	48	40	60	50
S	20	19	20	18	25
T	58	60	59	55	53

Find the assignment to positions which would give the maximum number of runs.
