Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

MCA Sem-4th Regular Examination May 2011

Subject code:640003 **Subject Name: Operations Research**

Date: 21/05/2011 **Time : 02.30 P.M. – 05.00 P.M.**

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)** What is Linear Programming? Explain the basic components of an LP model. Also state its assumptions. **07**

(b) A tape recorder company manufactures models A, B and C, which have profit contributions per unit of Rs 15, Rs 40 and Rs 60, respectively. The weekly minimum production requirements are 25 units for model A, 130 units for model B and 55 units for model C. Each type of recorder requires a certain amount of time for the manufacturing of the component parts, for assembling and for packing. Specifically, a dozen units of model A require 4 hours for manufacturing, 3 hours for assembling and 1 hour for packaging. The corresponding figures for a dozen units of model B are 2.5, 4 and 2 and for a dozen units of model C are 6, 9 and 4. During the forthcoming week, the company has available 130 hours of manufacturing, 170 hours of assembling and 52 hours of packaging time. Formulate this problem as an LP model so as to maximize the total profit to the company (Do not solve). **07**

Q.2 **(a)** Solve the following LP problem using Graphical method: **07**

Maximize $Z = 10x_1 + 15x_2$

subject to the constraints $2x_1 + x_2 \le 26$

$2x_1 + 4x_2 \le 56$

$-x_1 + x_2 \le 5$

and $x_1, x_2 \ge 0$.

(b) Solve the following LP problem using Simplex method: **07**

Maximize $Z = x_1 - x_2 + 3x_3$

subject to the constraints $x_1 + x_2 + x_3 \le 10$

$2x_1 - x_3 \le 2$

$2x_1 - 2x_2 + 3x_3 \le 0$

and $x_1, x_2, x_3 \ge 0$.

OR

(b) Solve the following LP problem using Big-M method: **07**

Maximize $Z = 2x_1 + x_2 + 3x_3$

subject to the constraints

$x_1 + x_2 + 2x_3 \le 5$

$2x_1 + 3x_2 + 4x_3 = 12$

and $x_1, x_2, x_3 \ge 0$.

Q.3 **(a)** Find the optimal solution to the following Transportation problem: **07**

	D_1	D_2	D_3	D_4	Availability
S_1	23	27	16	18	30
S_2	12	17	20	51	40
S_3	22	28	12	32	53
Requirement	22	35	25	41	123

The cell entries are unit transportation costs.

(b) Obtain the dual of the following primal LP problem. **07**

Maximize $Z = 4x_1 + 2x_2$

subject to the constraints $x_1 - 2x_2 \geq 2$

$x_1 + 2x_2 = 8$

$x_1 - x_2 \leq 10$

and $x_1 \geq 0$, x_2 unrestricted in sign.

OR

Q.3 **(a)** There are five jobs to be assigned to five machines. Costs of completion of the jobs on the respective machine are given in the table below: **07**

		Machine				
		M_1	M_2	M_3	M_4	M_5
Job	J_1	65	40	90	80	90
	J_2	60	35	100	85	85
	J_3	60	38	105	90	95
	J_4	70	45	120	90	100
	J_5	65	40	105	87	90

Find the optimal assignment of jobs to the machines so as to minimize the total cost of all the jobs.

(b) (1) Explain: Errors and Dummies in PERT/CPM network. **04**

(2) Given the following pay-off matrix of a two-person zero-sum game, determine the optimal strategies for the players and the value of the game. Is the game strictly determinable? Is it fair? **03**

Player A's strategy	Player B's strategy				
	B_1	B_2	B_3	B_4	B_5
A_1	8	10	–3	–8	–12
A_2	3	6	0	6	12
A_3	7	5	–2	–8	17
A_4	–11	12	–10	10	20
A_5	–7	0	0	6	2

Q.4 **(a)** Describe the characteristics of calling population (input source) of a queuing system. What do you understand by Queue discipline? **07**

(b) Given the following information: **07**

Activity	Duration (in days)	Activity	Duration (in days)
0–1	2	3–4	3
1–2	8	3–6	7
1–3	10	4–7	5
2–4	6	5–7	2
2–5	3	6–7	8

(a) Draw the arrow diagram.

(b) Identify the critical path and find the total project duration.

(c) Calculate total, free and independent floats.

OR

Q.4 **(a)** Four jobs 1, 2, 3 and 4 are to be processed on each of the five machines A, B, C, D and E in the order ABCDE. Find the total minimum elapsed time if no passing of jobs is permitted. Also calculate idle time for each machine. **07**

Jobs:	1	2	3	4
Machine A:	7	6	5	8
Machine B:	5	6	4	3
Machine C:	2	4	5	3
Machine D:	3	5	6	2
Machine E:	9	10	8	6

(b) (1) Define the word 'Inventory'. What are the main reasons for carrying inventory? **04**
(2) State advantages and disadvantages of Simulation. **03**

Q.5 **(a)** Customers arrive at a clinic at the rate of 8 per hour (Poisson arrival) and the doctor can serve at the rate of 9 per hour (exponential). **07**
(1) What is the probability that a customer does not join the queue and walks into the doctor's room?
(2) What is the probability that there is no queue?
(3) What is the probability that there are 10 customers in the system?
(4) What is the expected number in the system?
(5) What is the expected waiting time in the queue?

(b) The initial cost of a machine is Rs 15,000 and maintenance or running costs which increases with age of the machine are given below: **07**

Year	Running cost (in Rs)
1	2,500
2	3,000
3	4,000
4	5,000
5	6,500
6	8,000
7	10,000

What is the optimal replacement policy if the capital is worth 10% and there is no salvage value?

OR

Q.5 **(a)** Assume that goods trains are coming in a yard at the rate of 30 trains per day and suppose that the interarrival times follow an exponential distribution. The service time for each train is assumed to be exponential with an average of 36 minutes. If the yard can admit 9 trains at a time (there being 10 lines, one of which is reserved for shunting purpose), calculate the probability that the yard is empty and the average queue length. **07**

(b) The data on the operating cost per year and resale price of equipment A whose purchase price is Rs 10,000 are given below: **07**

Year	Operating cost(Rs)	Resale value (Rs)
1	1500	5000
2	1900	2500
3	2300	1250
4	2900	600
5	3600	400
6	4500	400
7	5500	400

(1) What is the optimum period for replacement?
(2) When equipment A is 2 years old, equipment B, which is a new model for the same usage, is available. The optimum period for replacement is 4 years with an average cost of Rs 3600. Should equipment A be replaced by equipment B? If so, when?

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