Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

MCA - SEMESTER–VI • EXAMINATION – WINTER 2013

Subject Code: 640003 Date: 11-12-2013

Subject Name: Operations Research (OR)

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)** Fill in the blanks: **07**

(i) In a linear programming, all relationships among decision variables are _____.

(ii) A _____ variable represents amount by which solution values exceed a resource.

(iii) Network is the graphical display of a project that contains both _____ and _____.

(iv) When inventory reaches a specific level called _____ enough inventory is available to cover expected demand during the lead time.

(v) Customers from a queue are selected for service according to certain rules known as _____.

(vi)_____ occurs when no value of the variable is able to satisfy all the constraints in linear programming problem simultaneously.

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

Maximize $Z = 2x_1 + x_2$

subject to the constraints

$$x_1 + 5x_2 \leq 10$$
$$x_1 + 3x_2 \geq 6$$
$$2x_1 + 2x_2 \leq 8$$

and $x_2 \geq 0$, x_1 unrestricted.

Q.2 **(a)** An electronic company is engaged in the production of two components C_1 and C_2 that are used in radio sets. Each unit of C_1 costs the company Rs. 5 in wages and Rs. 5 in material, while each of C_2 costs the company Rs. 25 in wages and Rs. 15 in material. The company sells both products on one-period credit terms, but the company's labour and material expenses must be paid in cash. The selling price of C_1 is Rs. 30 per unit and of C_2 it is Rs. 70 per unit. Because of the company's strong monopoly in these components, it is assumed that the company can sell, at the prevailing prices, as many units as it produces. The company's production capacity is, however, limited by two considerations. First, at the beginning of period 1, the company has an initial balance of Rs. 4000. Second, the company has available in each period 2000 hours of machine time and 1400 hours of assembly time. The production of each C_1 requires 3 hours of machine time and 2 hours of assembly time, whereas, the production of each C_2 requires 2 hours of machine time and 3 hours of assembly time. Formulate this problem as an LP model so as to maximize the total profit to the company.(DO NOT SOLVE) **07**

(b) What is Linear Programming? State and explain the basic components of LP model. **07**

OR

(b) Solve the following LP problem graphically: **07**

Maximize $Z = x_1 - 3x_2$

subject to the constraints

$$x_1 + x_2 \leq 300$$
$$x_1 - 2x_2 \leq 200$$
$$2x_1 + x_2 \geq 100$$
$$x_2 \leq 200$$

and $x_1, x_2 \geq 0$.

Q.3 **(a)** Define: Two-person zero-sum game, Saddle point. **07**

For the game with payoff matrix:

Player A	Player B			
	B_1	B_2	B_3	B_4
A_1	3	–5	0	6
A_2	–4	–2	1	2
A_3	5	4	2	3

Determine the best strategies for players A and B and the value of the game. Is this game (i) fair? (ii) strictly determinable?

(b) Solve the following LPP using Big M method: **07**

Maximize $Z = 3x_1 + 5x_2$

subject to the constraints

$$x_1 - 2x_2 \leq 6$$
$$x_1 \leq 10$$
$$x_2 \geq 1$$

and $x_1, x_2 \geq 0$.

OR

Q.3 **(a)** A project has following activities and other characteristics: **07**

Activity	Preceding Activity	Time estimates in weeks		
		Optimistic	Most Likely	Pessimistic
A	—	4	7	16
B	—	1	5	15
C	A	6	12	30
D	A	2	5	8
E	C	5	11	17
F	D	3	6	15
G	B	3	9	27
H	E, F	1	4	7
I	G	4	19	28

Draw the PERT network diagram, identify the critical path and find the project completion time.

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

Maximize $Z = 5x_1 + 3x_2$

subject to the constraints

$$x_1 + x_2 \leq 2$$
$$5x_1 + 2x_2 \leq 10$$
$$3x_1 + 8x_2 \leq 12$$

and $x_1, x_2 \geq 0$.

Q.4 **(a)** Determine an initial basic feasible solution to the following transportation problem using (i) Least Cost Method and (ii) Vogel's Approximation Method: **07**

Origins	Destinations				Availability
	D_1	D_2	D_3	D_4	
O_1	5	3	6	2	19
O_2	4	7	9	1	37
O_3	3	4	7	5	34
Demand	16	18	31	25	90

(b) An engineering company is offered a material handling equipment A. It is priced at Rs. 60,000 including cost of installation. The costs for operation and maintenance are estimated to be Rs. 10,000 for each of the first five years, increasing every year by Rs. 3,000 in the sixth and subsequent years. The company expects a return of 10% on all its investment. What is the optimal replacement period? **07**

OR

Q.4 **(a)** Define: Simulation. State the advantages and disadvantages of simulation. **07**

(b) Solve the following assignment problem: **07**

	1	2	3	4	5
A	41	72	39	52	25
B	22	29	49	65	81
C	27	39	60	51	40
D	45	50	48	52	37
E	29	40	45	26	30

Q.5 **(a)** Explain the following terms: Size of calling population, Queue discipline, Transient state and steady state. **07**

(b) A machine operator has to perform three operations, turning, threading and knurling on a number of different jobs. The time required to perform these operations (in minutes) for each job is known and is given below: **07**

Job	Time for turning	Time for threading	Time for knurling
1	3	8	13
2	12	6	14
3	5	4	9
4	2	6	12
5	9	3	8
6	11	1	13

Determine the order in which the jobs should be processed in order to minimize the total time required to turn out all the jobs.

OR

Q.5 **(a)** The arrival rate of a customer at a service window of a cinema hall follows a Poisson probability distribution with a mean rate of 45 per hour. The service rate of the clerk follows exponential distribution with a mean of 60 per hour. **07**

(i) What is the probability of having no customer in the system?

(ii) What is the probability of having five customers in the system?

(iii) Find Ls, Lq, Ws and Wq.

(b) A purchase manager places order for a lot of 500 units of a particular item. **07**
From the available data the following results are obtained:
Inventory carrying cost = 40 percent
Ordering cost per order = Rs. 600
Cost per unit = Rs 50
Annual demand = 1000 units
Find out the loss to the organization due to his ordering policy.

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