

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY
MCA Integrated – SEMESTER IV – EXAMINATION – SUMMER-2015

Subject Code: 4440602

Date: 13/05/2015

Subject Name: Operations Research

Time: 10:30 am to 1:00 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 LPP using Simplex Method. **07**

Maximize $Z = x_1 - x_2 + 3x_3$

Subject to the constraints $x_1 + x_2 + x_3 \leq 10$

$2x_1 - x_3 \leq 2$

$2x_1 - 2x_2 + 3x_3 \leq 0$ and

$x_1, x_2, x_3 \geq 0$

(b) A department of a company has five employees with five jobs to be performed. The time (in hours) that each man takes to perform each job is given in the effectiveness matrix. **07**

		Employees				
		I	II	III	IV	V
Jobs	A	10	5	13	15	16
	B	3	9	18	13	6
	C	10	7	2	2	2
	D	7	11	9	7	12
	E	7	9	10	4	12

How should the job be allotted, one per employee, so as to minimize the total man-hours using Hungarian method?

Q.2 (a) i. Define two person zero-sum game and value of the game. **02**

ii. A company management and the labour union are negotiating a new three year settlement. Each of these has 4 strategies: **05**

I: Hard and aggressive bargaining II: Reasoning and logical approach

III: Legalistic strategy IV: Conciliatory approach

The costs to the company are given for every pair of strategy choice

Company Strategies				
Union strategies	I	II	III	IV
I	20	15	12	35
II	25	14	8	10
III	40	2	10	5
IV	-5	4	11	0

What strategy will the two sides adopt? Also determine the value of the game.

(b) i. Write any one definition of Operations Research. **02**

- ii. Use the Graphical method to solve the following LP problem. 05
 Minimize $Z = -x_1 + 2x_2$
 Subject to the constraints (i) $-x_1 + 3x_2 \leq 10$,
 (ii) $x_1 + x_2 \leq 6$,
 (iii) $x_1 - x_2 \leq 2$ and
 $x_1, x_2 \geq 0$

OR

- (b) i. Write the advantages of Operations Research. 03
 ii. Write the Dual of the following primal LP problems 04
 Minimize $Z_x = 2x_1 + 3x_2 + 4x_3$
 Subject to the constraints (i) $2x_1 + 3x_2 + 5x_3 \geq 2$
 (ii) $3x_1 + x_2 + 7x_3 = 3$
 (iii) $x_1 + 4x_2 + 6x_3 \leq 5$ and
 $x_1, x_2 \geq 0, x_3$ is unrestricted in sign.

- Q.3 (a)** Find the initial basic feasible solution for the following transportation problem using (i) Least Cost Method and (ii) Vogel's method. 07

	D1	D2	D3	D4	Supply
S1	19	30	50	10	7
S2	70	30	40	60	9
S3	40	8	70	20	18
Demand	5	8	7	14	

- (b) i. What is Queuing system? Define Balking, Reneging and Jockeying with suitable example. 04
 ii. Define the term: Simulation. Give its advantages and disadvantages. 03

OR

- Q.3 (a)** A company has Factories at F_1 , F_2 and F_3 that supply products to warehouses at W_1 , W_2 and W_3 . The weekly capacities of the factories are 200, 160 and 90 units, respectively. The unit shipping costs (in rupees) are as follows: 07

	W_1	W_2	W_3	Supply
F_1	16	20	12	200
F_2	14	8	18	160
F_3	26	24	16	90
Demand	180	120	150	

Determine the initial feasible solution using North-West Corner method. Also determine optimal basic feasible solution using Modi's method.

- (b) Use penalty (Big-M) method to solve the following LP problem. 07
 Minimize $Z = 5x_1 + 3x_2$
 Subject to the constraints (i) $2x_1 + 4x_2 \leq 12$,
 (ii) $2x_1 + 2x_2 = 10$,
 (iii) $5x_1 + 2x_2 \geq 10$ and
 $x_1, x_2 \geq 0$.

- Q.4 (a) i.** Define: (i) Purchase Cost (ii) Holding cost (iii) ordering cost (iv) Total inventory Cost. 04

- ii. The production department of a company requires 3,600 kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of placing an order is Rs 36 and the cost of carrying inventory is 25 per cent of the investment in the inventories. The price is Rs 10 per kg. Help the purchase manager to determine an ordering policy for raw material. **03**

- (b) Machine A costs Rs 45,000 and its operating costs are estimated to be Rs 1,000 for the first year increasing by Rs 10,000 per year in second and subsequent years. Machine B costs Rs 50,000 and operating costs are Rs 2,000 for the first year, increasing by Rs 4,000 in the second and subsequent years. If at present we have a machine of type A, should we replace it with B? If so when? Assume that both machines have no resale value and their future costs are not discounted **07**

OR

- Q.4 (a)** Each unit of an item costs a company Rs 40. Annual holding costs are Rs 18 per cent of unit cost of the item due to miscellaneous changes: 1 per cent for insurance, 2 per cent allowances for obsolescence, Rs 2 for building overheads, Rs 1.50 for damage and loss, and Rs 4 miscellaneous costs. The annual demand for the item is constant at 1,000 units. Placing each order costs the company Rs 100. **07**

- Calculate EOQ and the total costs associated with stocking the item.
- If the supplier of the item will only deliver batches of 250 units, how are the stock holding costs affected?
- If the supplier relaxes his order size requirement, but the company has limited warehouse space and can stock a maximum of 100 units at any time, what would be the optimal ordering policy and associated costs?

- (b) A computer contains 10,000 resistors. When any resistor fails, it is replaced. The cost of replacing a resistor individually is Re 1 only. If all the resistors are replaced at the same time, the cost per resistor would be reduced to 35 paisa. The percentage of surviving resistors say $S(t)$ at the end of month t and the probability of failure $P(t)$ during the month t are as follows: **07**

t	0	1	2	3	4	5	6
S(t):	100	97	90	70	30	15	0
P(t):	-	0.03	0.07	0.20	0.40	0.15	0.15

What is the optimal replacement plan?

- Q.5 (a)** A research and development department is developing a new power supply for a console television set. It has broken the job down into the following: **07**

Job	Description	Immediate Predecessors	Time(days)
A	Determine output voltages	-----	5
B	Determine whether to use solid state rectifiers	A	7
C	Choose rectifier	B	2
D	Choose filters	B	3
E	Choose transformer	C	1
F	Choose chassis	D	2
G	Choose rectifier mounting	C	1
H	Layout chassis	E,F	3
I	Build and test	G,H	10

Draw the network diagram of activities involved in the project and indicate the critical path.

- (b) A book binder has one printing press, one binding machine and manuscripts of 7 different books. The times required for performing printing and binding operations for different books are shown below: **07**

Book:	1	2	3	4	5	6	7
Printing time (hours):	20	90	80	20	120	15	65

Binding time (hours):	25	60	75	30	90	35	50
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Decide the optimum sequence of processing of books in order to minimize the total time required to bring out all the books.

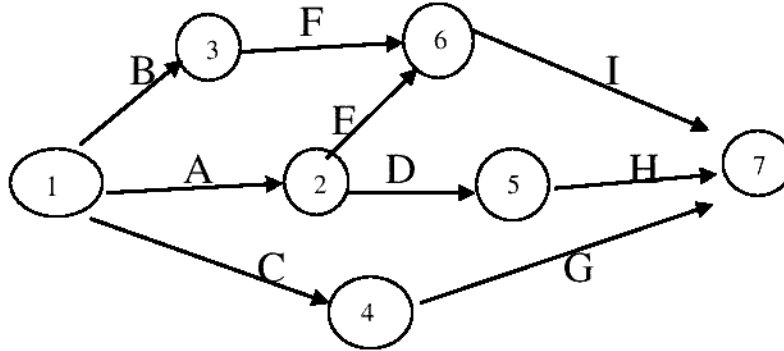
OR

Q.5 (a)

The following network diagram represents activities associated with a project:

07

Activities	A	B	C	D	E	F	G	H	I
Optimistic time t_o	5	18	26	16	15	6	7	7	3
Pessimistic time t_p	10	22	40	20	25	12	12	9	5
Most likely time t_m	8	20	33	18	20	9	10	8	4



- Expected completion time and variance of each activity.
- The earliest and latest expected completion times of each event.
- The critical path
- The probability of expected completion time of the project if the original scheduled time of completing the project is 41.5 weeks.
($\Phi(0.52) = 0.3048$)

(b)

Find an optimal sequence for the following sequencing problems of four jobs and five machines, when passing is not allowed. Its processing time(in hours) is given below:

07

Job	Machine				
	M ₁	M ₂	M ₃	M ₄	M ₅
A	7	5	2	3	9
B	6	6	4	5	10
C	5	4	5	6	8
D	8	3	3	2	6

Also find the total elapsed time.
