



Name :
Roll No. :
Invigilator's Signature :

CS/B.Tech (CHE)/SEM-8/CHE-804B/2013

2013

OPERATIONS RESEARCH

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Graph sheet(s) will be supplied by the Institute on demand.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$$10 \times 1 = 10$$

- i) Gantt chart is helpful in
 - a) efficient utilization of manpower and machines
 - b) preparing production schedule
 - c) efficient dispatching of products
 - d) inventory control.
- ii) If we convert the inequation $x_1 + 5x_2 \leq 7$ into the equation $x_1 + 5x_2 = 7$, then x_3 is a
 - a) slack variable
 - b) surplus variable
 - c) artificial variable
 - d) both artificial and surplus variables.



- iii) A feasible solution to an LPP
 - a) must satisfy all the constraints
 - b) must be a corner point of the feasible region
 - c) need not satisfy all the constraints
 - d) must optimize the value of the objective function.
- iv) If dual has an unbounded solution, primal has
 - a) an unbounded solution
 - b) an infeasible solution
 - c) a feasible solution
 - d) none of these.
- v) In a system of m simultaneous linear equations of n unknowns ($m < n$), the number of basic variables will be
 - a) $m + n$
 - b) m
 - c) $m + n - 1$
 - d) n .
- vi) The latest allowable occurrence time (T_L^i) for predecessor event is calculated by
 - a) $T_L^i = \text{minimum of } (T_L^j - t_E^{ij})$
 - b) $T_L^i = \text{maximum of } (T_L^j - t_E^{ij})$
 - c) $T_L^i = \text{minimum of } (T_L^j + t_E^{ij})$
 - d) $T_L^i = \text{maximum of } (T_L^j + t_E^{ij})$.
- vii) In time-cost read-off analysis
 - a) cost at normal time is zero
 - b) cost increases linearly as time increases
 - c) cost decreases linearly as time increases
 - d) none of these.

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**GROUP – B****(Short Answer Type Questions)**Answer any *three* of the following. $3 \times 5 = 15$

2. State any *five* applications of operations research.
3. Draw a network for the project whose activities and their predecessor activities are given below :

Activity	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>	<i>I</i>	<i>J</i>	<i>L</i>
Preceded by	–	–	–	A	B	B	C	D	E	H,I	F,G

4. Make a graphical representation of the set of constraints in the following L.P.P. Find the extreme points of the feasible region. Find also the maximum value of the objective function.

$$\text{Maximize } Z = 6x_1 + 4x_2$$

$$\text{subject to } 5x_1 + 7x_2 \leq 35,$$

$$7x_1 + 5x_2 \leq 35,$$

$$4x_1 + 3x_2 \geq 12,$$

$$3x_1 + x_2 \geq 3$$

$$\text{and } x \geq 0, \geq 0.$$

5. A company manufactures two products *A* and *B*. Each unit of *B* takes twice as long to produce as one unit of *A* and if the company were to produce only *A* it would have time to produce 2000 units per day. The availability of the raw material is sufficient to produce 1500 units per day of both *A* and *B* combined. Product *B* requires a special ingredient only 600 units can be made per day. If *A* fetches a profit of Rs. 2 per unit and *B* a profit of Rs. 4 per unit, formulate the L.P.P. to maximize the profit of the company.



6. What is meant by inventory ? What are the main objectives of an inventory model ?

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Define crashing of network and cost slope of an activity. 3
- b) The following table gives the activities of a construction project and other relevant information.

Activity <i>i-j</i>	Normal duration (days)	Crash duration (days)	Cost of crashing (Rs./day)
1 - 2	9	6	20
1 - 3	8	5	25
1 - 4	15	10	30
2 - 4	5	3	10
3 - 4	10	6	15
4 - 5	2	1	40

Overhead of the project is Rs. 60 per day.

What are the normal project length and the minimum project length ? What is the optimal project schedule ?

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8. a) Obtain the *dual* problem of the following *primal* problem. 5

Minimize $Z = x_1 - 3x_2 - 2x_3$

subject to $3x_1 - x_2 + 2x_3 \leq 7,$

$2x_1 - 4x_2 \geq 12,$

$-4x_1 + 3x_2 + 8x_3 = 10,$

$x_1, x_2 \geq 0$ and x_3 is unrestricted.



- b) Solve the L.P.P. by simplex method.

$$\text{Minimize } Z = 3x_1 + 5x_2$$

$$\text{subject to } x_1 + 2x_2 \geq 8,$$

$$3x_1 + 2x_2 \geq 12,$$

$$5x_1 + 6x_2 \leq 60$$

$$\text{and } x_1, x_2 \geq 0.$$

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9. a) Find out the optimal transportation schedule using Vogel's Approximation Method (VAM). 9

	W1	W2	W3	W4	a_i
F1	19	30	50	10	7
F2	70	30	40	60	9
F3	40	8	70	20	18
b_j	5	8	7	14	

- b) Find the minimum cost solution for the assignment whose cost coefficients are given below. 6

	I	II	III	IV
1	4	5	3	2
2	1	4	-2	3
3	4	2	1	-5

10. a) An automobile company manufactures around 150 scooters. The daily production varies from 146 to 154 depending upon the availability of raw materials and other working conditions :

Production (Per day)	146	147	148	149	150	151	152	153	154
Probability	0.04	0.09	0.12	0.14	0.11	0.10	0.20	0.12	0.08



The finished scooters are transported in a specially arranged truck accommodating 150 scooters.

Using the following random numbers –

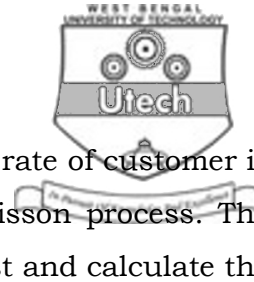
80, 81, 76, 75, 64, 43, 18, 26, 10, 12, 65, 68, 69, 61, 57,

simulate the process to find out :

- i) what will be the average number of scooters waiting in the factory ? 8
- ii) what will be the average number of empty space on the truck ? 8
- b) A salesman has to visit five cities A, B, C, D and E. The distances (in hundred kilometres) between the five cities are as follows. Which route should be selected so that the total distance travelled is minimum. 7

	A	B	C	D	E
A	–	4	7	3	4
B	4	–	6	3	4
C	7	6	–	7	5
D	3	3	7	–	7
E	4	4	5	7	–

11. a) The demand rate of a particular item is 12000 units per year. The set-up cost per run is Rs. 350 and the holding cost is Rs. 0.02 per unit per month. If no shortages are allowed and the replacement is instantaneous, determine –
 - i) the optimum lot size
 - ii) the optimum scheduling period
 - iii) minimum total expected annual cost. 8



- b) In a supermarket, the average arrival rate of customer is 10 in every 30 minutes following Poisson process. The average time taking by a cashier to list and calculate the customers' purchase is 2.5 minutes following exponential distribution. What is the probability that the queue length exceeds 6 ? What is the expected time spent by a customer in the system ? 7

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