

Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech (CHE-New)/SEM-8/CHE-804B/2010

2010

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 provided by the Institution.

GROUP – A

(Multiple Choice Type Questions)

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

10 × 1 = 10

- i) Operations Research is
 - a) applied decision theory
 - b) a scientific knowledge
 - c) a scientific approach to problem solving for executive management
 - d) all of these.
- ii) If we convert the inequation $2x_1 + 3x_2 \geq 4$ into the equation $2x_1 + 3x_2 + x_3 = 4$, then x_3 is a/an
 - a) slack variable
 - b) surplus variable
 - c) artificial variable
 - d) both artificial and surplus variable.



- 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 to 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 equation in 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 tread-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	A	B	C	D	E	F	G	H	I	J	K
Preceded by	—	—	—	A	B	B	C	D	E	H,I	F,

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.

$$\begin{aligned}
 &\text{Maximize} && Z = 6x_1 + 4x_2 \\
 &\text{subject to} && 5x_1 + 7x_2 \leq 35, \\
 &&& 7x_1 + 5x_2 \leq 35, \\
 &&& 4x_1 + 3x_2 \geq 12, \\
 &&& 3x_1 + x_2 \geq 3 \\
 &\text{and} && x \geq 0, y \geq 0.
 \end{aligned}$$

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 materials is sufficient to produce 1500 units per day of both A and B combined. Product B requiring 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)

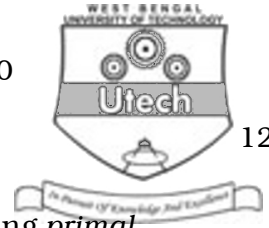
Answer any *three* of the following. $3 \times 15 = 45$

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 is 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 :

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

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

$2x_1 - 5x_2 \geq 12,$

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

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

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

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Minimize, $Z = 3x_1 + 5x_2$

subject to $x_1 + 2x_2 \geq 8,$

$3x_1 + 2x_2 \geq 12,$

$5x_1 + 6x_2 \leq 60$

and $x_1, x_2 \geq 0.$

9. a) Find out the optimal transportation schedule using

Vogel's approximation method :

	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 :

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

10. a) A 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.



- 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 ?

	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	–

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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 Re. 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 every 30 minutes following Poisson process. The average time taken by a cashier to list and calculate the customer's purchase is 2.5 minutes following exponential distribution. What is the probability that

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the queue length exceeds 6 ? What is the expected time spent by a customer in the system.



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