

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.

8365

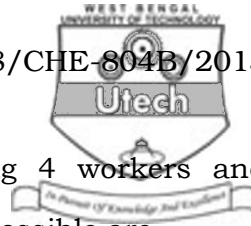
[ Turn over

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



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

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



- viii) In an assignment problem involving 4 workers and 3 jobs, total number of assignments possible are
- a) 4
  - b) 3
  - c) 7
  - d) 12.
- ix) In the unit cost rises, optimum order quantity will
- a) increase
  - b) decrease
  - c) either increase or decrease
  - d) none of these.
- x) Multiple servers of queue may be
- a) in parallel
  - b) in series
  - c) in combination of parallel and series
  - d) all of these.
- xi) As simulation is not an analytical model, therefore, result of simulation must be viewed as
- a) approximation
  - b) exact
  - c) unrealistic
  - d) simplified.
- xii) In Monte-Carlo simulation
- a) randomness is the key requirement
  - b) the model is of deterministic nature
  - c) both (a) and (b)
  - d) none of these.

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

**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 :

<b>Activity</b>	<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>
<b>Preceded by</b>	–	–	–	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.

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



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.

<b>Activity <i>i-j</i></b>	<b>Normal duration (days)</b>	<b>Crash duration (days)</b>	<b>Cost of crashing (Rs./day)</b>
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 ?

12

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.

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



- b) Solve the L.P.P. by simplex method. 10

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

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

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

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

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

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	

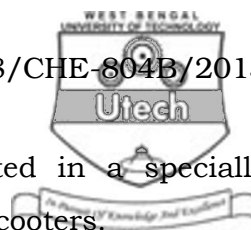
- b) Find the minimum cost solution for the assignment whose cost coefficients are given below. 6

	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

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



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,

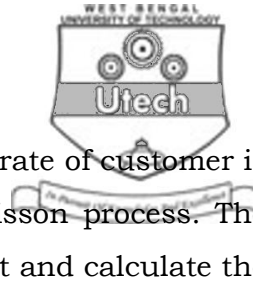
simulate the process to find out :

- 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

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



- 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

---