

Paper ID & Roll No. to be filled in your Answer Book

Roll No. 

1	1	0	5	2	0	1	0	4	0	1
---	---	---	---	---	---	---	---	---	---	---

B. TECH. (MECHANICAL ENGINEERING) (SEM.VI)

**UTU (END SEM.) EXAMINATION, 2013-14**

**OPERATIONS RESEARCH**

*Time: 3.00 Hours*

*[Total Marks: 100*

**Note:** Attempt all questions, the marks assigned to each question is indicated at question itself.

Q1. Attempt any four of the following: (5 X 4)

- (a) Discuss the significance and scope of Operations Research in scientific management.
- (b) What are the characteristics and limitations of a linear programming problem?
- (c) "OR is the art of winning wars without actually fighting them". Justify.
- (d) Explain the difference between Transportation and an Assignment problem.
- (e) What is two 'person zero sum game'? What are the advantages and limitations of game theory?
- (f) Explain the following with reference to queuing models:
  - (i) M/M/1
  - (ii) Service discipline
  - (iii) Kendal's notation

Q2. Attempt any four of the following: (5 X 4)

- (a) The standard weight of a special purpose brick is 5 kg and it contains two basic ingredients B1 and B2. B1 costs Rs 5/kg and B2 costs Rs 8/kg. Strength considerations dictate that the brick contains not more than 4 kg of B1 and a minimum of 2 kg of B2. Since the demand for the product is likely to be related to the price of the brick, formulate the linear programming problem.
- (b) For what value of  $\lambda$ , the game with following payoff matrix is strictly determinable?

		Player B		
		B1	B2	B3
Player A	A1	$\lambda$	6	2
	A2	-1	$\lambda$	-7
	A3	-2	4	$\lambda$

- (c) Discuss the similarities and differences between CPM and PERT.

- (d) What is degeneracy in transportation problems? How is it resolved?
- (e) Show that the assignment model is a special case of the transportation model.
- (f) Define:
  - (i) Total Float
  - (ii) Free Float
  - (iii) Independent Float

Q3. Attempt any two of the following: (10 X 2)

- (a) Food X contains 6 units of vitamin A per gram and 7 units of vitamin B per gram and costs 12 paise per gram. Food Y contains 8 units of vitamin A per gram and 12 units of vitamin B per gram and costs 20 paise per gram. The daily minimum requirement of vitamin A and vitamin B is 100 units and 120 units respectively. Find the minimum cost of product mix by the simplex method.
- (b) A product is produced by four factories A, B, C and D. The unit production costs are Rs 2, Rs 3, Re 1 and Rs 5 respectively. Their production capacities are: factory A- 50 units, B- 70 units, C-30 units and D-50 units. These factories supply the product to four stores demand of which are 25, 35, 105 and 20 units respectively. Unit transport cost in rupees from each factory to each store is given in the table below:

		Store			
		1	2	3	4
Factories	A	2	4	6	11
	B	10	8	7	5
	C	13	3	9	12
	D	4	6	8	3

Determine the extent of deliveries from each of the factories to each of the stores so that the total production and transportation cost is minimum.

- (c) A company has one surplus truck in each of the cities A, B, C, D and E and one deficit truck in each of the cities 1, 2, 3, 4, 5 and 6. The distance between the cities in kilometers is shown in the matrix below. Find the assignment of trucks from cities in surplus to cities in deficit so that the total distance covered by vehicles is minimum.

	1	2	3	4	5	6
A	12	10	15	22	18	8
B	10	18	25	15	16	12
C	11	10	3	8	5	9
D	6	14	10	13	13	12
E	8	12	11	7	13	10

Q4. Attempt any two of the following: (10 X 2)

(a) Reduce the following game by dominance and find the game value:

		Player B			
		I	II	III	IV
Player A	I	3	2	4	0
	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

(b) A Project schedule has the following characteristics:

Activity	Times (Weeks)	Activity	Times (Week)
1-2	4	5-6	4
1-3	1	5-7	8
2-4	1	6-8	1
3-4	1	7-8	2
3-5	6	8-10	5
4-9	5	9-10	7

- (i) Construct the network.
- (ii) Compute Earliest Occurrence Time and Late Occurrence Time for each event
- (iii) Find the critical path.

- (c) The time estimates (in weeks) for the activities of a PERT network are given below.

Activity	$t_o$	$t_m$	$t_p$
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

- (i) Draw the project network.
- (ii) Determine the expected project length
- (iii) If the project due date is 19 weeks, what is the probability of not meeting the due date.
- (iv) The probability that the project will be completed at least four weeks earlier than expected time.

Q5. Attempt any two of the following: (10 X 2)

- (a) A branch of Punjab National Bank has only one typist. Since the typist work varies in length (number of pages to be typed), the typing rate is randomly distributed approximating a Poisson distribution which mean service rate of 8 letters per hour. The letter arrives at the rate of 5 per hour during the entire 8 hours work day. If the type writer is valued at rupees 1.50 per hour. Determine :

- (i) Equipment utilization
  - (ii) The percent time that an arriving letter has to wait
  - (iii) Average system time
  - (iv) Average cost due to waiting on the part of type writer  
i.e. it remaining idle
- (b) Prove that the probability of  $n$  customers in the system at any time in case of Poisson arrivals and exponential service times is given by

$$P_n = \left(\frac{\lambda}{\mu}\right)^n \cdot \left(1 - \frac{\lambda}{\mu}\right)$$

- (c) Write the short notes on the following:
- (i) Degeneracy in Linear Programming Problems
  - (ii) Balanced and Unbalanced Transportation Problems
  - (iii) Earliest Start Time, Late Start Time, Earliest Finish Time
  - (iv) Looping and Dangling in network diagram

x-x+x