

## Seventh Semester B.E. Degree Examination, June 2012

### Operations Research

Time: 3 hrs.

Max. Marks:100

**Note: 1. Answer FIVE full questions, selecting at least TWO questions from each part.**  
**2. Use of normal distribution tables is permitted.**

#### PART – A

- 1 a. Define operations research and briefly explain the phases of OR. (05 Marks)  
 b. ABC company owns a paint factory that produces both exterior and interior paints for wholesale distribution. The basic raw materials A and B are used to manufacture the paints. The maximum availability of A is 6 tonne/day and that of B is 8 tonne/day. The requirements of raw materials/tonne of interior and exterior paints are given below :

Raw material	Exterior paint	Interior paint
A	1	2
B	2	1

Market survey has established that the daily demand for interior paint cannot exceed that of exterior paint by more than 1 tonne. The survey also shows that max demand for interior paint is limited to 2 tonnes/day. The wholesale price/tonne is Rs.3000 for exterior and Rs.2000 for interior paint. How much interior and exterior paint the company should produce to maximize the gross income. Formulate the above data as a LPP and solve graphically. (15 Marks)

- 2 a. Explain the condition of inconsistency and redundancy in LPP. (05 Marks)  
 b. Show that both the Primal and the dual of the following LPP have the same optimal 'Z' and the solution can be read from the Primal solution :

$$\text{Maximize } Z = 2x_1 + x_2$$

$$\text{Subject to constraint } x_1 + 5x_2 \leq 10; \quad x_1 + 3x_2 \leq 6; \quad 2x_1 + 2x_2 \leq 8, \quad x_1, x_2 \geq 0 \quad (15 \text{ Marks})$$

- 3 a. Differentiate between transportation and assignment models. (05 Marks)  
 b. Goods are to be shipped from three warehouses  $W_1, W_2$  and  $W_3$  to six customers  $C_1, C_2, C_3, \dots, C_6$ . The availabilities at the warehouses are 100, 120 and 150 units respectively while the demands of customers are 50, 40, 50, 90, 60 and 80 respectively. The unit costs of transportation are as given in the following table. Is it possible to have more than one optimal solution? (15 Marks)

		Customers					
		$C_1$	$C_2$	$C_3$	$C_4$	$C_5$	$C_6$
Warehouses	$W_1$	15	25	18	35	40	23
	$W_2$	22	36	40	60	50	38
	$W_3$	26	38	45	52	45	48

- 4 a. A bookbinder has one printing machine, one binding machine and one finishing machine. The time in minutes required for printing, binding and finishing operations for each book are known. Determine the order in which the books should be processed in order to minimize the total time required to process all the jobs. Also find the total elapsed time and idle time.

Book	1	2	3	4	5
Printing time	40	90	80	60	50
Binding time	50	60	20	30	40
Finishing time	80	100	60	70	110

(10 Marks)

- 4 b. Determine the minimum elapsed time for completing following two jobs. Details of processing times and the sequence of operations are given below :
- Job 1 : A – 4 to C – 2 to D – 6 to E – 3 to B – 2
- Job 2 : C – 8 to A – 3 to D – 4 to B – 2 to E – 3
- Also determine the sequence of jobs on each machine. (10 Marks)

**PART – B**

- 5 a. List the basic characteristics of queue. (05 Marks)
- b. A public telephone booth is in a post office. The arrivals are considered to be Poisson’s with an average inter arrival time of 12 minutes. The length of the phone call is assumed to be exponentially distributed with an average of 4 minutes, calculate the following :
- i) What is the probability that fresh arrival will not have to wait for the phone?
  - ii) What is the probability that an arrival will have to wait more than 10 minutes before the phone is free?
  - iii) What is the average length of the queue that forms time to time?
  - iv) What is the probability of finding more than 5 customers in the system? (15 Marks)

- 6 a. A project consists of the following activities with their precedence relationship and duration in days:
- i) Draw the network of the project
  - ii) Identify the critical path and project duration
  - iii) Calculate EST, EFT, LST, LFT, TF, FF and IF for each activity.

Activity	A	B	C	D	E	F	G	H
Precedence	-	A	A	B	B	BC	BC	DF
Duration (in days)	10	8	7	9	6	10	4	12

(10 Marks)

- b. A project is composed of 7 jobs whose time estimations are given below :

Activity	1-2	1-3	1-4	2-5	3-5	4-6	5-6
Most likely time	7	16	7	9	20	14	2
Optimistic time	8	18	9	10	24	16	3
Pessimistic time	9	20	11	11	28	18	4

- i) Draw the network and calculate the length and variance along the critical path
- ii) Find the probability of completing the project one day earlier and 2 days later. (10 Marks)

- 7 a. Solve the following ( 2 × 4 ) game by graphical method, table Q7(a) (08 Marks)

		Player B			
		I	II	III	IV
Player A	I	2	1	0	-2
	II	1	0	3	2

Table.Q7(a)

		Player B			
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>
Player A	A <sub>1</sub>	3	2	4	0
	A <sub>2</sub>	3	4	2	4
	A <sub>3</sub>	4	2	4	0
	A <sub>4</sub>	0	4	0	8

Table.Q7(b)

- b. Solve the game by principle of dominance, table Q7(b). (08 Marks)
- c. Define the following : (04 Marks)
  - i) Saddle point
  - ii) Pure strategy
  - iii) Mixed strategy
  - iv) Two persons zero sum game

- 8 a. Explain the methods used in integer programming problems. (04 Marks)

- b. Solve the following integer programming problem by Gomory technique :
- Maximize  $Z = x_1 + x_2$
- Subject to constraints  $3x_1 + 2x_2 \leq 12, x_2 \leq 2, x_1, x_2 \geq 0$  and integers. (16 Marks)