Faculty of Engineering and Technology

B.E. Semester—VI (Mechanical Engg.) (C.B.S.) Examination

OPERATIONS RESEARCH

Time : Three Hours]   [Maximum Marks : 80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Solve Question No. **1 OR** Question No. **2**.

(3) Solve Question No. **3 OR** Question No. **4**.

(4) Solve Question No. **5 OR** Question No. **6**.

(5) Solve Question No. **7 OR** Question No. **8**.

(6) Solve Question No. **9 OR** Question No. **10**.

(7) Solve Question No. **11 OR** Question No. **12**.

(8) Due credit will be given to neatness and adequate dimensions.

(9) Assume suitable data wherever necessary.

(10) Illustrate your answers wherever necessary with the help of neat sketches.

(11) Use of non-programmable calculator is permitted.

(12) Any Other instructions : Use of Normal Distribution chart / table permitted.

MVM—45003

1. (a) Define OR. Explain characteristics and scope of operations research. 5

   (b) A manufacturer wishes to determine how to produce two products A and B so as to get maximum total profit from the sale of products. Both the products are made in two processes I and II. It takes 7 hours in process I and 4 hours in process II to manufacture 100 units of product A. It requires 6 hours in process I and 2 hours in process II to manufacture 100 units of product B. Process I can handle 84 hours of work and process II can take 32 hours of work in the scheduled period. If the profit is Rs. 4 per 100 units of product B and Rs. 11 per 100 units of product A, how many of each products A and B should be manufactured to realise the maximum profit ? Solve by Graphical method. 8

   OR

2. (a) Solve by simplex method :

   maximize $Z = 2x_1 + 3x_2 + 4x_3$

   subject to $3x_1 + x_2 + 4x_3 \leq 600$

   $2x_1 + 4x_2 + 2x_3 \geq 480$

   $2x_1 + 3x_2 + 3x_3 = 540$

   $x_1, x_2, x_3 \geq 0$ 10

MVM—45003 2 (Contd.)

(b) Construct the dual to the primal problem :

Maximize $Z = 3x_1 + 5x_2$

subject to $\quad 2x_1 + 6x_2 \leq 50$

$\quad 3x_1 + 2x_2 \leq 35$

$\quad 5x_1 - 3x_2 \leq 10$

$\quad x_2 \leq 20$

$\quad x_1 \geq 0 \quad x_2 \geq 0$ 3

3. Find the optimum solution to the following transportation problem in which the cells contain the transportation cost in rupees :

WAREHOUSE

	W1	W2	W3	W4	W5	Available
F1	7	6	4	5	9	40
F2	8	5	6	7	8	30
F3	6	8	9	6	5	20
F4	5	7	7	8	6	10
Required	30	30	15	20	5	

FACTORY

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OR

MVM—45003 3 (Contd.)

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4. Find the least cost for the travelling salesman problem shown below :

	P	Q	R	S	T
P	∞	12	15	17	11
Q	16	∞	13	18	12
R	18	17	∞	14	17
S	22	14	16	∞	15
T	11	13	12	18	∞

14

5. (a) What is game theory ? Explain the terms :

   (i) Pure strategy

   (ii) Mixed strategy

   (iii) Saddle point.   5

   (b) There are seven jobs, each of which has to go through the machines A and B in the order AB. Processing times in hours are given as :

Job	Machine A	Machine B
1	3	8
2	12	10
3	15	10
4	6	6
5	10	12
6	11	1
7	9	3

Determine a sequence of these jobs that will minimize the total elapsed time T. Also find T and idle time for machines A and B.   8

OR

6. (a) Define :

   (i) Carrying cost

   (ii) Shortage costs

   (iii) Ordering cost.   5

   (b) A stockist has to supply 400 units of a product every Monday to his customers. He gets the product at Rs. 50 per unit from the manufacturer. The cost of ordering and transportation from the manufacturer is Rs. 75 per order. The cost of carrying inventory is 7.5 % per year of the cost of product.

   Find :

   (i) The economic lot size

   (ii) The total optimal cost (including the capital cost)

(iii) The total weekly profit if the item is sold for Rs. 55 per unit. 8

7. A project has the following activities and other characteristics :

Activity	Preceding Activity	Time in weeks		
		t_o	t_m	t_p
A	—	4	7	16
B	—	1	5	15
C	A	6	12	30
D	A	2	5	8
E	C	5	11	17
F	D	3	6	15
G	B	3	9	27
H	E,F	1	4	7
I	G	4	19	28

(i) Draw the Pert network and identify critical path and project completion time.

(ii) Find the probability that the project is completed in 36 weeks.

(iii) If the project manager wishes to be 99 % sure that the project is completed on June 30, 2004, when should he start the project work ? 14

OR

8. Table below shows jobs, their normal time and cost and crash time and cost estimates for a project :

Job	Normal time (days)	Normal cost (Rs.)	Crash time (days)	Crash cost (Rs.)
1—2	6	1400	4	1900
1—3	8	2000	5	2800
2—3	4	1100	2	1500
2—4	3	800	2	1400
3—4	Dummy	—	—	—
3—5	6	900	3	1600
4—6	10	2500	6	3500
5—6	3	500	2	800

Indirect cost for the project is Rs. 300 per day.

(i) Draw the network of project.

(ii) What is the normal duration and cost of project ?

(iii) Find the optimal duration and minimum project cost. 14

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9. A manufacturer is offered two machines A and B. A has cost price of Rs. 2500, its running cost is Rs. 400 for each of the first 5 years and increases by Rs. 100 every subsequent year. Machine B, having the same capacity as A. cost Rs. 1250, has running cost of Rs. 600 for 6 years increasing by Rs. 100 per year thereafter. If money is worth 10 % per year, which machine should be purchased ? Scrap value of both machines is negligibly small.   13

OR

10. The following mortality rates have been observed for a certain type of light bulbs :

Week	Percent failing by the end of week
1	10
2	25
3	50
4	80
5	100

There are 1000 bulbs in use and it costs Rs. 1 to replace an individual bulb which has burnt out. If all bulbs were replaced simultaneously it would cost 25 paise per bulb. It is proposed to replace all bulbs at fixed intervals whether or not they have burnt out and to continue replacing burnt out bulbs as they fail. At what intervals should all the bulbs be replaced ?   13

11. (a) Explain structure of waiting line model.   4

(b) Auto vehicles arrive at a petrol pump, having one petrol unit, in Poisson fashion with an average of 10 units per hour. The service time is distributed exponentially with a mean of 3 minutes. Find the following :

(i) Average number of units in the system.

(ii) Average waiting time for customer.

(iii) Average length of queue.

(iv) Probability that a customer arriving at the pump will have to wait.

(v) The utilization factor for pump unit.

(vi) Probability that the number of customers in the system is 2.   9

OR

12. A company trading motor car spares wishes to determine the level of stock it should carry for the item in its range. Demand is not certain and there is lead time for stock replenishment. For one item, the following information is obtained :

Demand (Units/Day)	Probability
3	0.1
4	0.2
5	0.3
6	0.3
7	0.1