Reg.No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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VII SEMESTER B.TECH (BIOMEDICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: **OPERATIONS RESEARCH** [BME 433] ELECTIVE - IV

REVISED CREDIT SYSTEM

Time duration: 3 Hours. Thursday, 26th November 2015 Max. Marks; 100

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.

1A. Explain with an example an Unbounded L.P. problem and how it is reflected in the final simplex tableau. Suggest managerial action to resolve it. **04**

1B. Give an account of information requirements and assumptions to formulate waiting line models. **06**

1C. A company has excess capacity in two production areas. Area 1 has 20 hours of unused time and Area 2 has 30 hours of unused time. The firm is introducing two new products to use this slack capacity. Each unit of product A requires 1 hour in production Area 1 and each unit of product B requires ½ hour of time in production Area 2. At least 30 units of product B must be produced. The total combined output of the proposed products must equal 50 units. Product A contributes $5 to profit and B will contribute $6 to profit. Formulate LP problem. Do not solve. However draw the first simplex tableau and interpret the numbers in the $C_j - Z_j$ row. **10**

2A. Explain with example Travelling salesman Problem and to what extent it is identical with Assignment Problem. **04**

2B. Write a note on three time estimates used in PERT models and how to arrive at expected time of each activity. **06**

2C. Following is the transportation problem from 4 warehouses A, B, C, D to 3 customers 1,2,3. The capacities at the warehouses, the demands of the customers, unit transportation costs are given below: **10**

i) Find the optimal transportation schedule.

ii) Find the alternate optimal solution, if any.

	Customers			
	1	2	3	Supply
A	5	9	13	10
B	20	5	9	10
C	13	17	22	10
D	9	13	17	10
Demand	9	17	9	

3A. A T.V. manufacturer must decide how many B & W (Black & White) sets and how many colour sets he should produce for each day's sale so as to maximise his daily profit. The LPP has been formulated as **10**

$$MaxZ = 60x_1 + 150x_2 \qquad \text{(Total profit in \$)}$$

$$S.t.$$

$$x_1 + x_2 \le 24 \qquad \text{(Max. no. of chasis available)}$$

$$5x_1 + 10x_2 \le 160 \qquad \text{(Max. production hours)}$$

$$x_2 \le 10 \qquad \text{(Max. no. of colour tubes)}$$

$$x_1, x_2 \ge 0$$

Where x_1 and x_2 represent number of B & W sets and colour sets to be produced. The optimal simplex tableau is shown below:

		C_j	60	150	0	0	0
		Q	x_1	x_2	s_1	s_2	s_3
0	s_1	2	0	0	1	-1/5	1
60	x_1	12	1	0	0	1/5	-2
150	x_2	10	0	1	0	0	1
	Z_j =2220		60	150	0	12	30
	$C_j - Z_j$		0	0	0	-12	-30

(i) Explain to the management the optimum production plan and status of each resource.

(ii) Conduct sensitivity analysis with respect to profit coefficients.

3B. Refer to the above simplex tableau in Q.No.3A and answer the following questions: **10**

(i) What is the unit worth of each resource it? Find the range over which this value is valid?

(ii) Management can secure additional units of only one of the three sources. Recommend which resource can be increased and to what extent. What will be the additional profit?

4A. In designing a production facility it is important to locate the work centres so as to minimise the material handling cost. 3 work centres are required to manufacture, assemble and package a product. 4 locations are available within the plant. The material handling cost at each location for the work centres is given by the following cost Matrix. Determine the location of work centres that minimises the total material handling cost. Use Assignment Algorithm. **10**

Location	**1**	**2**	**3**	**4**
Manufacturing	18	15	16	13
Assembly	16	11	--	15
Packaging	9	10	12	8

4B. A Pharma Co. performs tests on samples of a particular drug. There is only one chemist in the laboratory. The probability distribution of the time to process one sample is given below: **10**

Process time (hours):	1	2	3	4	5
Probability	0.20	0.35	0.30	0.10	0.05

The sample arrives every one hour,(i.e. the inter arrival time of 1 hour is constant for every sample). Conduct a simulation experiment for ten samples using following random numbers for processing time: 28, 10, 99, 00, 27, 12, 73, 73, 99, 12

From the simulated data, determine i) The percentage of time the chemist is busy.

(ii) Mean number of samples waiting in the queue. (iii) Mean system time.

5A. A truck can carry a total of 10 tons. Three types of products are available for shipment. Their weights and values are tabulated. At least one unit of each type must be shipped. Determine the loading that will maximise the total value. Use Dynamic Programming. **10**

Type	Unit value	Unit weight (tons)
A	$ 20	1
B	$ 50	2
C	$ 60	2

5B. **10**

Two companies A and B are competing to secure a very lucrative business contract. Each company has 3 strategies (Low bid, Medium bid, and High bid). Their respective payoffs are reflected in the form of a 2 person zero sum game as given below:

		Company B		
		B1	**B2**	**B3**
Company A	**A1**	2	5	7
	A2	-1	2	4
	A3	6	1	9

i) Recommend the optimal strategies for each company and find the value of the game.

ii) If companies deviate from your recommendation and A chooses the strategy based on Maximin criteria and B chooses the strategy based on Minimax criteria, what will be the loss for each company.

6A. Write a note on application and limitations of Simulation Models. **04**

6B. A Company retains service crew to repair machine break downs that occur on average of 3 per day in Poisson fashion. The crew can service on average 8 machines per day. The repair time distribution follows Exponential distribution. **06**

Determine: (a) Utilization rate of service system. (b) Expected number of machines in the system (c) Probability that more than two machines are down and waiting to be repaired.

6C. A project is divided into seven activities whose time duration (days) are given below. **10**

Activity	**1 – 2**	**2 – 3**	**2 – 4**	**3 – 4**	**3 – 5**	**4 – 5**	**5 – 6**
Duration (days)	2	7	9	4	10	5	4

i) Construct the network incorporating above information. Calculate the event times.

ii) Identify the critical path. Calculate four activity times.

iii) If the duration of activity 3 – 5 can be reduced by 3 days, what will be project completion time?