Mechanical Engineering Department
Motilal Nehru National Institute of Technology, Allahabad

End Semester Examination 2016-17
Operations Research ME1505
B.Tech. (PIE) - V Semester

Time: 3 hours

Maximum Marks: 60
Assume any missing data and mention it neatly.

Ques 1: A and B play a game in which each has three coins a 5p, a 10p and a 20p. Each player selects a coin without the knowledge of the other's choice. If the sum of the coins is an odd amount, A wins B's coin; if the sum is even, B win's A's Coin. Find the best strategy for each player and the value of the game. **5 marks**

8 marks

Ques 2: Estimate times for the jobs of a project are given below:

Job	A	B	C	D	E	F	G	H	I	J	K	L
Time (in weeks)	13	5	8	10	9	7	7	12	8	9	4	17

The constraints governing the jobs are as follows:
A and B are start jobs
A controls C, D and E
B controls F and J
G depends upon C
H depends on D
E and F control I and L
K follows J
L is also controlled by K
G, H, I and L are the last jobs.

Draw the network and determine float for each activity, project duration and the critical path.

Ques 3: Four jobs 1, 2, 3 and 4 are to be processed on each of the five machines: A, B, C, D and E in the order ABCDE. Find the total minimum elapsed time if no passing of jobs is permitted. Also determine idle time for each machine. **6 marks**

Machine / Job	A	B	C	D	E
1	7	5	2	3	9
2	6	6	4	5	10
3	5	4	5	6	8
4	8	3	3	2	6

Ques 4: Four new machines M_1, M_2, M_3 and M_4 are to be installed in a machine shop. There are five vacant places A, B, C, D and E available. Because of limited space, machine M_2 cannot be placed at C and M_3 cannot be placed at A. The assignment cost of machine from i to place j is shown below. Find the optimal assignment schedule. **6 marks**

	A	B	C	D	E
M_1	4	6	10	5	6
M_2	7	4	--	5	4
M_3	--	6	9	6	2
M_4	9	3	7	2	3

Ques 5: A company has three factories manufacturing the same products and five sale agencies in different parts of the country. Production costs differ from factory to factory and the sales prices from agency to agency. The shipping cost per unit product from each factory to each agency is known. Given the following data, find the production and distribution schedules most profitable to the company. **8 marks**

	Factory cost/ unit (Rs.)	Max. capacity (no of units)
1	18	140
2	20	190
3	16	115

Agency →

Factory ↓	1	2	3	4	5
1	2	2	6	10	5
2	10	8	9	4	7
3	5	6	4	3	8
Demand	74	94	69	39	119
Sales Price	35	37	36	39	34

Ques 6: Maximize the following LPP with the help of ***Big M Method*** **15 marks**

Maximize $Z = x_1 + 2x_2 + 3x_3 - x_4$

Subject to: $x_1 + 2x_2 + 3x_3 = 15$

$2x_1 + x_2 + 5x_3 = 20$

$x_1 + 2x_2 + x_3 + x_4 = 10$

$x_1, x_2, x_3, x_4 \geq 0$

Ques 7: Write short notes on (any FOUR): **3 X 4 = 12 marks**

I. Minimum spanning tree problem
II. Maximal flow problem
III. Crashing of project network
IV. Assumptions made in Break Even Analysis
V. PERT
VI. Two Phase method in LPP

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