National Institute of Technology Hamirpur
Department of Mechanical Engineering
End Semester Examination

B. Tech. VII Semester

Max. Marks: 50
Time: 3:00 Hrs

Sub.: Operations Research (ME-411)

Instructions: All questions are compulsory; weightages of marks are mentioned against the questions.

Question No	Question Statement	Marks
Q1	An Air Force is experimenting with three types of bombs P, Q and R in which three kinds of explosives, viz. A, B and C will be used. Taking the various factors into account, it has been decided to use at the maximum 600 kg of explosive A, at least 480 kg of explosive B and exactly 540 kg of explosive C. Bomb P requires 3, 2, 2 kg; bomb Q requires 1, 4, 3 kg and bomb R requires 4, 2, 3 kg of explosives A, B, C respectively. Bomb P is estimated to give the equivalent of a 2 ton explosion, bomb Q, a 3 ton explosion and bomb R, a 4 ton explosion respectively. Under what production schedule can the Air Force make the biggest bang?	**[10]**
Q2	A company has factories at four different places, which supply warehouses A, B, C, D and E. Monthly factory capacities are 200, 175, 150 and 325 units respectively. Monthly warehouse requirements are 110, 90, 120, 230 and 160 units respectively. Unit shipping costs are given in below table. The costs are in rupees. Shipment from 1 to B and from 4 to D is not possible. Determine the optimum distribution to minimize shipping costs.	**[10]**

From \ To	A	B	C	D	E
1	13	--	31	8	20
2	14	9	17	6	10
3	25	11	12	17	15
4	10	21	13	--	17

Question No	Question Statement	Marks
Q3	A company has a team of four salesmen and there are four districts where the company wants to start its business. After taking into account the capabilities of salesmen and the nature of district, the company estimates that the profit per day in rupees for each salesman in each district is as given below	**[10]**

	District			
	1	2	3	4
A	16	10	14	11
B	14	11	15	15
C	15	15	13	12
D	13	12	14	15

Salesman

Find the assignment of salesmen to various district which will yield maximum profit.

Q4   A company currently involved in negotiations with its union on the upcoming wage **[10]** contract. Positive signs in below table represent wage increase while negative sign represents wage reduction.

Conditional costs to the company (₹ in lakhs)
Union strategies

		U_1	U_2	U_3	U_4
	C_1	+ 0.25	+ 0.27	+ 0.35	− 0.02
Company	C_2	+ 0.20	+ 0.16	+ 0.08	+ 0.08
strategies	C_3	+ 0.14	+ 0.12	+ 0.15	+ 0.13
	C_4	+ 0.30	+ 0.14	+ 0.19	+ 0.00

What are the optimal strategies for the company as well as the union? What is the game value?

Q5.   A project schedule has the following characteristics: **[10]**

Activity	Time (weeks)	Activity	Times (weeks)
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

Construct the network diagram and find the critical path. Show the earlies start time, latest finish time and total float in tabular form for the given project.

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