ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

There are 6 (Six) questions. Answer all of them. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the right column. Assume reasonable values if required.

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1. a. Solve the game theory problem as provided in the payoff table below using linear programming method. Here, player A and player B could use three strategies, namely strategy X, Y and Z. **[20] CO2, PO2**

Player A		Player B		
		Strategy X	Strategy Y	Strategy Z
	Strategy X	1	-1	3
	Strategy Y	3	5	-3
	Strategy Z	6	2	-2

   b. A maintenance staff finds that the time spent on his jobs has an exponential distribution with a mean of 30 minutes. If he repairs the sets in the order in which they came in, and if the arrival of sets follows a Poisson distribution with an approximate average rate of 10 per 8-hour day, (i) determine the maintenance staff's expected idle time each day, and (ii) calculate the no of sets in the queue including those being served. **[5] CO2, PO2**

2. A product is manufactured by four factories A, B, C, and D. The production capacities are 50,70,30, and 50 units respectively. These factories supply the products to four stores, say X, Y, Z, and R, that have demand 25, 35, 105, and 20 units respectively. Unit transportation cost from each factory to each store in BDT is given below. Determine the extent of deliveries from these factories to the stores so that transportation cost is minimum. **[25] CO2, PO2**

Factory/ Store	X	Y	Z	R	*Supply*
A	2	4	6	11	*50*
B	10	8	7	5	*70*
C	13	3	9	12	30
D	4	6	8	3	50
Demand	25	35	105	20	

3. In the modification of a plant layout of a factory four new machines P, Q, R and S 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 Q cannot be placed at C and machine R cannot be placed at A. The cost of locating a machine at a place (in US$) is provided in the table. Find the optimal assignment schedule. **[25] CO2, PO2**

Machine/ Place	A	B	C	D	E
P	4	6	10	5	6
Q	7	4	--	5	4
R	--	6	9	6	2
S	9	3	7	2	3

4. Use graphical method to solve the following LP problem: [25]
   Maximize $z = 3x_1 + 5x_2$ CO3,
   Subject to the constraints PO3
   $3x_1 + 2x_2 \le 18$
   $x_1 \le 4$
   $x_2 \le 6$
   $x_1, x_2 \ge 0$
   Then perform sensitivity analysis and discuss the findings in your own words.

5. A generator manufacturing plant sets two criteria for the selecting a truck for their factory. [25]
   These two criteria are: Reliability(R), and Maintenance (M). Two trucks, one is called X CO2,
   and the other is Y, are suggested by a vendor. The Chief Engineer of the company prefers PO2
   R five times more important than M. Furthermore, pertaining to R, she prefers X two times
   more than Y. Pertaining to M, she prefers Y three times more than X. Using Analytical
   Hierarchy Process (AHP), determine which truck the engineer should select.

6. A salesman located in a city A decided to travel to city B. He knew the distances of [25]
   alternative routes from city A to city B. He then drew a highway network map as shown CO2,
   below. The city of origin A, is city 1. The destination city B, is city 10. Other cities through PO2
   which the salesman will have to pass through are numbered 2 to 9 as shown in the figure.
   The arrow representing routes between cities and distances in kilometers are indicated on
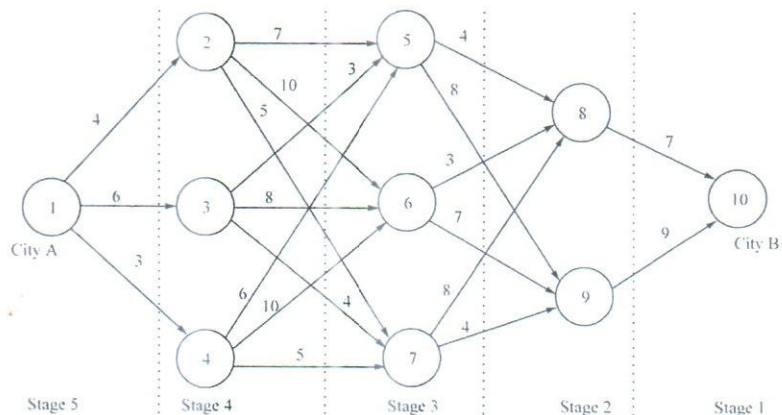   each route. Using dynamic programming, find the shortest route that covers all the selected
   cities from A to B.

Fig: Highway Network Map
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