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BSc. Eng. (IPE)
Semester: 6th Semester

Date: 14 May 2024
Time: 10:00 am – 01:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester-Final Examination
Course No IPE 4611
Course Title: Operations Research

Summer Semester, A. Y. 2022-23
Time: 3 Hours
Full Marks: 150

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. Two car manufacturers denoted by X and Y are in a price war. Firm X has the choice of increasing the price, leaving it unchanged, or lowering it. Firm Y has the same three options. Firm X's gross sales in the event of each of the pairs of choices are shown as the value of each element in the payoff table. Assuming firm X as the maximizing one, formulate and solve the problem as a linear programming problem. [20] CO2, PO2

		Firm Y		
Firm X		Providing free registration	Do not change	Reduce price
	Providing free registration	1	-1	3
	Do not change	3	5	-3
	Reduce price	6	5	-2

b. The KP Automobile has only two staff members. Customers arrive according to a Poisson process with a mean rate of 10 per hour. The service for each customer is exponential with mean of 4 minutes. On the basis of this information, find the probability of not having to wait for service aka probability of zero customer in the queue and the probability to atleast wait sometime. Also determine the expected percentage of idle time for each staff member. [5] CO2, PO2

2. A company has four production plants P, Q, R, and S. From these plants, products are to be shipped to five warehouses E, F, G, H, and K. The transportation costs (in BDT) per unit between factories to warehouses along with supply and demand information are given in the table below: [25] CO2, PO2

Plant/ Warehouse	E	F	G	H	K	*Supply*
P	10	2	3	15	9	*35*
Q	5	10	15	2	4	*40*
R	15	5	14	7	15	20
S	20	15	13	25	8	30
Demand	*20*	*20*	*40*	*10*	35	

Here inside the table unit transportation cost is provided for each specific cell according to plant-to -warehouse transportation applicable for that cell. Find the optimal solution for the above mentioned transportation problem. Use the Least Cost Method for initial solution and later UV method considering degeneracy.

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. Solve the following linear programming problem using Dual Simplex method [25] CO2, PO2

Minimize $z = 81x_1 + 103x_2$

Subject to:

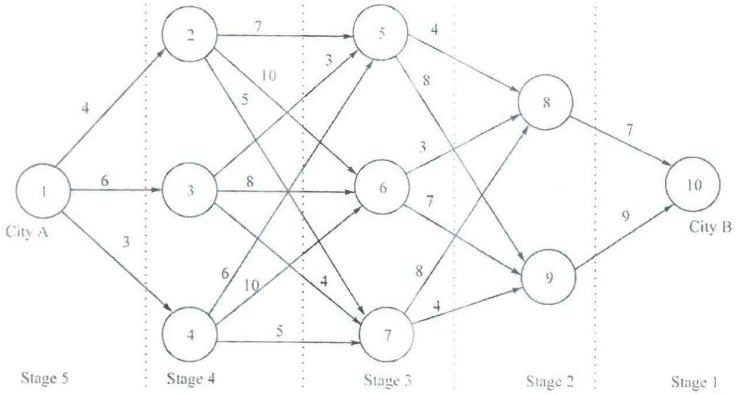
$80x_1 + 61x_2 \geq 1502$

$20x_1 + 90x_2 \geq 1200$

$x_1, x_2 \geq 0$

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

6. A salesman located in a city A decided to travel to city B. He knew the distances of alternative routes from city A to city B. He then drew a highway network map as shown below. The city of origin A, is city 1. The destination city B, is city 10. Other cities through which the salesman will have to pass through are numbered 2 to 9. 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. [25] CO3, PO3



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Formula:

$$\frac{1}{P_0} = \sum_{n=0}^{c-1} \frac{(\frac{\delta}{\mu})^n}{n!} + \frac{(\frac{\delta}{\mu})^c}{c!(1-\rho)}$$