Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, July 2020

Programme Name: M.Tech. Automation & Robotics Engineering **Semester : II**
Course Name : Optimization Techniques **Time : 03 hrs**
Course Code : ECEG 7010 **Max. Marks : 100**
Nos. of page(s) : 03

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Instructions: Attempt all questions. Answers should be attempted in blank white sheets (hand written) with all the details like programme, semester, course name, course code, name of the student, Sapid at the top (as in the format) and signature at the bottom (right hand side bottom corner).

SECTION A (4× 5 = 20 Marks)

S. No.		Marks	CO
Q1.	For the following minimization type transportation problem, obtain the initial basic feasible solutions by adopting North-West corner method and Least cost method, and find out which solution is better. <table><tr><td></td><td>W_1</td><td>W_2</td><td>W_3</td><td>a_i</td></tr><tr><td>P_1</td><td>5</td><td>1</td><td>8</td><td>12</td></tr><tr><td>P_2</td><td>2</td><td>4</td><td>0</td><td>14</td></tr><tr><td>P_3</td><td>3</td><td>6</td><td>7</td><td>4</td></tr><tr><td>b_j</td><td>9</td><td>10</td><td>11</td><td></td></tr></table>	**[5]**	**CO2**
Q2.	Perform one iteration of steepest descent algorithm to minimize the function $f(x_1, x_2) = 25x_1^2 + x_2^2$ starting at $X_0 = \begin{pmatrix}1\\3\end{pmatrix}$.	**[5]**	**CO3**
Q3.	Formulate the dual of the following problem. $\max z = 2x_1 + 3x_2 + x_3$ subject to $4x_1 + 3x_2 + x_3 = 6$ $x_1 + 2x_2 + 5x_3 = 4$ $x_1, x_2, x_3 \geq 0.$	**[5]**	**CO1**
Q4.	Using Hessian matrix check the following function is convex or not. $f(x_1, x_2) = x_1^2 - 2x_1x_2 + 2x_2^2 - 4x_1.$	**[5]**	**CO4**

SECTION B (4 × 10 = 40 Marks)

Q5.	Using Big-M method show that the following linear programming problem has no feasible solution. $\max z = -2x_1 + x_2 + 3x_3$ subject to $x_1 - 2x_2 + 3x_3 = 2$ $3x_1 + 2x_2 + 4x_3 = 1$ $x_1, x_2, x_3 \geq 0.$	**[10]**	**CO1**

Q6.	A transportation company ships truckloads of grain from three silos to four mills. The supply (in truckloads), the demand (also in truckloads) and the unit transportation costs (in hundreds of rupees) per truckloads on the different routes are summarized below. The company has an initial shipping schedule: $x_{11} = 5, x_{14} = 2, x_{23} = 7, x_{24} = 2, x_{32} = 8$ and $x_{34} = 10$. Check optimality of the schedule by modified distribution (MODI) method. If not optimal, find the optimal shipping schedule between the silos and mills, and minimum transportation cost by Stepping stone algorithm.	[10]	CO2

Mills

		I	II	III	IV	Supply
Silos	A	19	30	50	10	7
	B	70	30	40	60	9
	C	40	8	70	20	18
	Demands	5	8	7	14	

Q7.	The head of the department of an IT sector has five jobs A, B, C, D, E and five sub-ordinates X, Y, Z, W, U. The following table gives the number of minutes each man would take to perform each job. How would be the jobs be allocated, one per sub-ordinate, to minimize the total time?	[10]	CO2

	X	Y	Z	W	U
A	85	75	65	125	75
B	90	78	66	132	78
C	75	66	57	114	69
D	80	72	60	120	72
E	76	64	56	112	68

Q8.	Solve the following Network problem (shortest path problem) using dynamic programming technique.	[10]	CO4

Activities	Weights	Activities	Weights
A→B	7	C→F	7
A→C	6	C→G	7
A→D	5	D→F	10
B→E	3	D→G	10
B→F	4	E→H	9
C→E	6	E→I	8

<table>
<tr><th colspan="4">SECTION C ($2 \times 20 = 40$ Marks)</th></tr>
<tr><td>Q9A.</td><td>A medical representative has to five stations A, B, C, D and E, starting from A. The cost of going one station to another are given in the following table. He does not want to visit any station twice before completing his tour of all stations and wishes to return to the starting station. Solve the travelling salesman problem to determine the route he should select so that total travelling cost is minimum.
<table>
<tr><td></td><td></td><td colspan="5">To</td></tr>
<tr><td></td><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td></tr>
<tr><td rowspan="5">From</td><td>A</td><td>--</td><td>2</td><td>5</td><td>7</td><td>1</td></tr>
<tr><td>B</td><td>6</td><td>--</td><td>3</td><td>8</td><td>2</td></tr>
<tr><td>C</td><td>8</td><td>7</td><td>--</td><td>4</td><td>7</td></tr>
<tr><td>D</td><td>12</td><td>4</td><td>6</td><td>--</td><td>5</td></tr>
<tr><td>E</td><td>1</td><td>3</td><td>2</td><td>8</td><td>--</td></tr>
</table></td><td>[10]</td><td>CO2</td></tr>
<tr><td>Q9B.</td><td>Take the following problem. Reduce the size of interval [0,3] containing the minimizer to less or equal to 0.30 by Golden section method.
$$\min 0.65 - \frac{0.75}{1+x^2} - 0.65x\tan^{-1}\left(\frac{1}{x}\right), x \in [0,3].$$</td><td>[10]</td><td>CO3</td></tr>
<tr><td>Q10A.</td><td>Compute Karush-Kuhn-Tucker (KKT) optimality conditions for the following convex programming problem.
$$\min_{x_1, x_2 \geq 0} -4x_1 + x_1^2 - 2x_1x_2 + 2x_2^2$$
$$\text{subject to} \quad 2x_1 + x_2 \leq 6$$
$$x_1 - 4x_2 \leq 0.$$</td><td>[10]</td><td>CO3</td></tr>
<tr><td>Q10B.</td><td>Solve the following linear problem by dynamic programming technique.
$$\max_{x_1, x_2 \geq 0} 8x_1 + 7x_2$$
$$\text{subject to} \quad 2x_1 + x_2 \leq 8$$
$$5x_1 + 2x_2 \leq 15$$</td><td>[10]</td><td>CO4</td></tr>
</table>

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