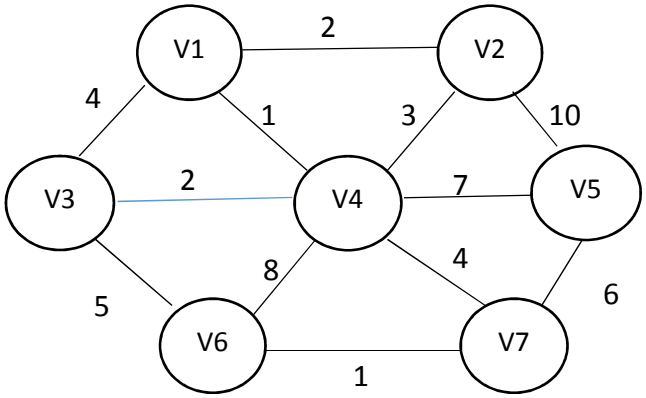
Total No of Questions: [8]		***SEAT NO. :***	
			[Total No. of Pages :3]
		Solution set :	
		T.E. (Robotics and Automation)-2019 course	
		Artificial Intelligence for Robotics (311509-A)	
		(Semester - II)	
Time: 2 Hours			***Max. Marks : 70***

Instructions to the candidates:

1) ***Neat diagrams must be drawn wherever necessary.***
2) ***Figures to the right side indicate full marks.***
3) ***Use of Calculator is allowed.***
4) ***Assume Suitable data if necessary***

Q1)	a)	Determine the minimum path length for following graph using greedy search method.	**[9]**
	b)	Using a simulated annealing algorithm to solve minimization problem, function value of 20 is updated to new value of 30 at temperature 55°C. What is the probability of accepting the new solution?	**[8]**
		OR	



V1-V4 : 1, V1-V2: 2, V4-V3: 2, V4-V7: 4, V7-V1: 1, V7-V5: 6, Total Length: 16

$$\Pr = e^{-\Delta C'/T} = e^{-10/55} = 83.37\ \%$$

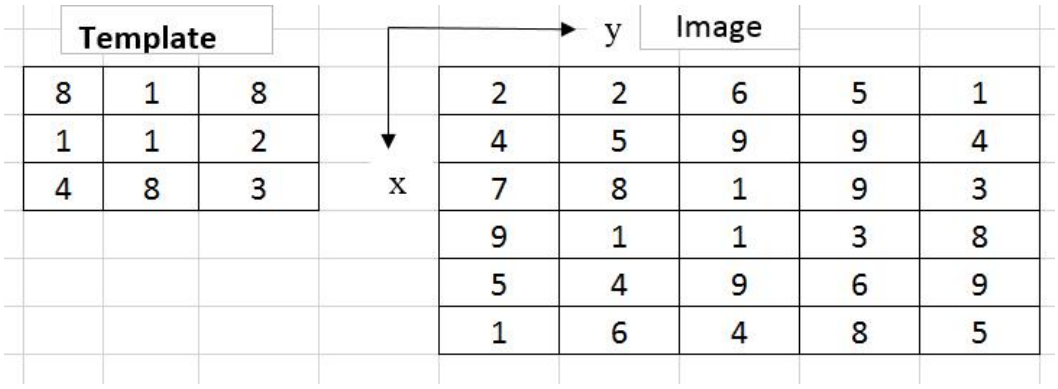
Q2) a) Ant colony optimization is used to solve a travelling salesmen problem with 5 stations. The distance matrix is given below. Considering starting station as A, what is the % probability that an ant will choose the path 1 to 3? Assume initial pheromone deposition level as 1. **[10]**

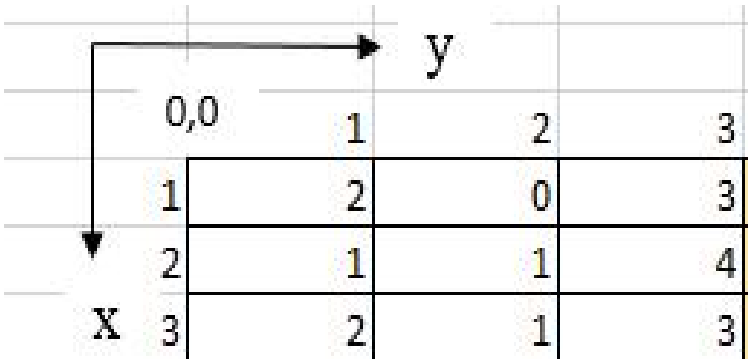
	1	2	3	4	5
1	0	14	16	19	12
2	14	0	15	13	10
3	16	15	0	11	17
4	19	13	11	0	21
5	12	10	17	21	0

DISTANCE MATRIX(d)							PHEROMEN DEPOSIT (τ)				
	A	B	C	D	E		A	B	C	D	E
A	0	14	16	19	12	1	1	1	1	1	1
B	14	0	15	13	10	2	1	1	1	1	1
C	16	15	0	11	17	3	1	1	1	1	1
D	19	13	11	0	21	4	1	1	1	1	1
E	12	10	17	21	0	5	1	1	1	1	1
			η					Probability from Ant 1 from City 1			
	1	2	3	4	5		B	C	D	E	Total
1	0.0000	0.0714	0.0625	0.0526	0.0833		0.0051	0.0039	0.0028	0.0069	0.0187
2	0.0714	0.0000	0.0667	0.0769	0.1000						
3	0.0625	0.0667	0.0000	0.0909	0.0588		0.2725	**0.2086**	0.1480	0.3709	
4	0.0526	0.0769	0.0909	0.0000	0.0476						
5	0.0833	0.1000	0.0588	0.0476	0.0000						

b) Explain the steps of real coded genetic algorithm. **[7]**

Q3) a) For the image and template shown in Figure, determine the correlation factor for translation (1, 1) using normalized cross correlation method. **[10]**



		Avg. Intensity of image 5 9 9 — 25 81 81 8 1 9 — 64 1 81 1 1 3 — 1 1 9 18.547 40 9 72 8 1 18 4 8 9 Avg. Intensity of Template 64 1 64 1 1 4 16 64 9 14.96663 $\Sigma T\text{-}I$ = 169 σ = 0.609	
	b)	Determine the centroid of the grayscale image shown in Fig. below.  m00 = 8, m10=35, m01=39, xc=m10/m00=4.375, yc=m01/m00=4.875	**[7]**
		OR	
Q4)	a)	Determine the gradient of intensity of a pixel having intensity 2 in the image given below. Use Prewitt operator. 5 8 4 6 2 3 4 6 1	**[8]**

		Mx	*My*	Image
		-1 0 1	-1 -1 -1	5 8 4
		-1 0 1	0 0 0	6 2 3
		-1 0 1	1 1 1	4 6 1
		M1	*M2*	
		-5 0 4	-5 -8 -4	
		-6 0 3	0 0 0	
		-4 0 1	4 6 1	
		Fx 2.333	Fy 2	
		∇F 3.073		
	b)	For a certain binary image, following data operates. Determine the compression ratio using run length encoding.	**[9]**

Run	Bit Value	Length
1	1	12
2	0	18
3	1	7
4	0	17
5	1	10

Length	Bit	Total
01100	1	6
10010	0	6
00111	1	6
10001	0	6
01010	1	6
		30

Compression ratio = (64-30)/64=0.53 = 53%

Q5)	a)	Explain the application of any one metaheuristics algorithm for robot motion planning.	**[10]**
	b)	Write note on visibility graph method for robot path planning.	**[8]**
		OR	
Q6)	a)	Explain route optimization for AS/RS systems	**[8]**

	b)	With suitable examples, the bug 0 and bug 1 strategies for obstacle avoidance in mobile robot navigation.	**[10]**
Q7)	a)	Use A* algorithm to determine the shortest path for an automated guided vehicle while moving from work station at (4, 6) to workstation at (1, 1) shown in Fig. below. The obstacles are in the form of tool storage racks at locations (3, 3), (1, 4) and (4, 2).	**[9]**

(1,1)	(2,1)	(3,1)	(4,1)
(1,2)	(2,2)	(3,2)	(4,2)
(1,3)	(2, 3)	(3,3)	(4,3)
(1,4)	(2, 4)	(3,4)	(4,4)
(1, 5)	(2,5)	(3, 5)	(4,5)
(1,6)	(2,6)	(3,6)	(4,6)

	1	2	3	4
1	(1,1)	(2,1)	(3,1)	(4,1)
2	(1,2)	(2,2)	(3,2)	(4,2)
3	(1,3)	(2, 3)	(3,3)	(4,3)
4	(1,4)	(2, 4)	(3,4)	(4,4)
5	(1, 5)	(2,5)	(3, 5)	(4,5)
6	(1,6)	(2,6)	(3,6)	(4,6)

	g	h	Total
4,5	1	7	8
3, 6	1	7	8
3, 5	2	6	8
4, 4	2	6	8
3,4	3	5	8
3,6	0	7	7
2,5	3	5	8

	b)	Write note on: Real time scheduling in flexible environment	**[9]**
		OR	
Q8)	a)	Explain with suitable example techniques for automatic tool path generation.	**[9]**
	b)	Write note on: Applications of artificial intelligent techniques in flexible manufacturing systems.	**[9]**