Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV 2019

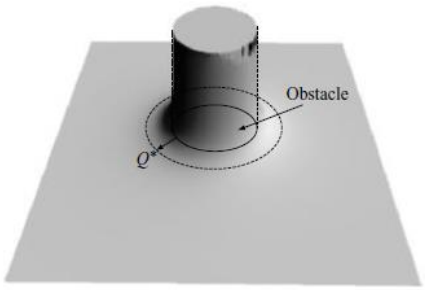
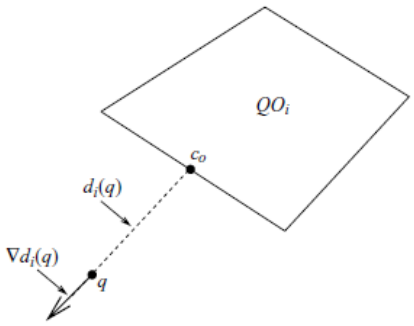
SUBJECT: ROBOT PATH PLANNING [MTE 4008]

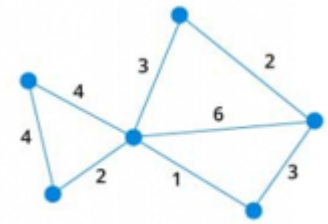
(28/11/2019, 2:00 PM-5:00 PM)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed

1A.	Explain the definitions of configuration space and workspace by taking an example of two-joint arm manipulator.	**3**	**CO1**
1B.	Write the class of approaches that addresses the problem of gradient descent method.	**2**	**CO1**
1C.	Construct the equations of U_{att} and U_{rep} with proper explanations by making use of Fig. 1C(a) and Fig. 1C(b) given below  Fig. 1C (a): Repulsive gradient operating in a domain near the obstacles.  Fig. 1C(b): The gradient is a unit vector pointing away from the nearest point.	**5**	**CO1**
2A.	Interpret the Hessian matrix for a real-valued function in an artificial potential functions.	**3**	**CO1**
2B.	Construct a Dijkstra's algorithm for Fig. 2B by choosing a starting vertex and assigning infinity path values to all the other vertices.	**4**	**CO2**

	 Fig. 2B: Graph for Dijkstra's algorithm.		
2C.	Construct the state space matrix for a third-order polynomial trajectory planning.	**3**	**CO4**
3A.	Illustrate that one-dimensional deformation retracts are roadmaps.	**3**	**CO3**
3B.	State the pre-image theorem with a proper example and critical points in the properties of GVD roadmap.	**5**	**CO3**
3C.	Interpret Morse cell decomposition definition with a neat sketch.	**2**	**CO3**
4A.	Design a control law using Lyapunov stability for a GVG edge tracing with two obstacles.	**5**	**CO3**
4B.	Analyze and design a complexity based coverage path with proper boundary conditions for Fig. 4B.  Fig. 4B: Δ is the diameter of the minimal disk that fully contains the space.	**5**	**CO3**
5A.	Give an outline on the pseudocode of the Rapidly Exploring Random Trees with an example.	**5**	**CO3**
5B.	Explain on the steps of the time-scaling algorithm in a decoupled trajectory planning with proper diagram.	**5**	**CO4**