



**University of Tehran**  
**School of Electrical and Computer Engineering**

<b>Course:</b>	Advanced Robotics		
<b>Course type:</b>	Elective	AI & Robotic	Credit: 3
<b>Level:</b>	Graduate		
<b>Co-requisite(s):</b>			
<b>Prerequisite(s):</b>	Robotics or with the instructor's permission.		
<b>Prerequisite by topic:</b>			
<b>Textbook(s):</b>	<ul style="list-style-type: none"> <li>- Probabilistic Robotics, S. Thrun et. al.</li> <li>- PRM: Selected papers</li> </ul>		
<b>Coordinator:</b>	Hadi Moradi.		
<b>Goals:</b>	<ul style="list-style-type: none"> <li>- To teach the students the basic concepts of probabilistic approaches in robotics</li> <li>- To make the students capable of using probabilistic approaches in motion planning of high degree of freedom robots</li> <li>- To teach the students the basics of filtering approaches such as KF, EKF, UKF and Particle Filtering</li> <li>- To teach the students the motion and sensor models, the localization and mapping algorithms</li> </ul>		
<b>Outcome:</b>	<p>Upon successful completion of the course, students would be able to:</p> <ol style="list-style-type: none"> <li>1. Describe the importance of randomized/probabilistic approaches in robotics</li> <li>2. Use PRM for motion planning of high DOF robots</li> <li>3. Determine the motion model and the sensor model of a given robot</li> <li>4. Use Kalman filtering and Particle filtering for localization of mobile robots</li> <li>5. Describe the Simultaneous Localization and Mapping concept and apply it.</li> </ol>		
<b>Topics:</b>	<ul style="list-style-type: none"> <li>• Motion planning for high degree of freedom robots</li> <li>• Probabilistic Roadmaps</li> <li>• Use of PRM/RRT in other field such as animation and protein folding</li> <li>• Basics of Kalman, Extended Kalman, Unscented Kalman, and Particle filters</li> </ul>		

	<ul style="list-style-type: none"> <li>• Sensor and motion models</li> <li>• Localization of robots</li> <li>• Mapping in robotics</li> <li>• Simultaneous Localization and Mapping</li> </ul>
<b>Computer usage:</b>	- Students would do computer assignments using PRM and Localization
<b>Assignments:</b>	<ul style="list-style-type: none"> <li>- Homework 1: Motion planning</li> <li>- Homework 2: Probability and filtering</li> <li>- Homework 3: Sensor and Motion models</li> <li>- Homework 4: Localization and mapping</li> </ul>
<b>Projects:</b>	<ul style="list-style-type: none"> <li>- Project 1: Motion planning of a High DOF</li> <li>- Project 2: Localization in a maze</li> </ul>
<b>Grading:</b>	<ul style="list-style-type: none"> <li>- Homework: 15%</li> <li>- Project 1: 15%</li> <li>- Midterm: 10%</li> <li>- Final project (as part time final exam in the form of take home exam): 40%</li> <li>- Final exam: 20%</li> </ul>
<b>Further readings:</b>	- Papers given in the class
<b>Prepared by:</b>	Hadi Moradi.
<b>Date:</b>	16.10.1392