

**Kinematic Analysis and Synthesis of Mechanisms**  
**(MEC 567)- Spring 2019**  
**COURSE OUTLINE**

**Instructor:** J. Rastegar  
**Office:** H. E. 108  
**Office Hours:** M 10:00 AM–3:00 PM  
**Lectures:** Mondays 4:00-6:50 pm HUMANITIES 2045  
**Text:** *Mechanism Design – Analysis and Synthesis – Volume II*, By A. Erdman and G. Sandor, Prentice Hall.

**Reference:**

1. *Mechanism Design – Analysis and Synthesis – Volume I* – By A. Erdman and G. Sandor, 3<sup>rd</sup> Edition, Prentice Hall.
2. *Introduction to Robotics, Mechanics and Control* - By J. Craig, 2nd Ed., Addison-Wesley, 1989 (or another similar robotics text).
3. Instructor provided material and lecture.

The following topics will be covered from the above text and references:

<u>Topic</u>	<u>Text</u>
1 Introduction (1 week) (history of mechanisms and robotic manipulators, analysis and synthesis methods and terminology, research areas)	Chap. 1 (Ref. 1-3)
2 Kinematics Analysis of Linkage Mechanisms. (1 1/2 weeks) (d-o-f, review of displacement, velocity and acceleration analysis, branching, force/motion transmission).	Chap. 3-4 (Ref. 3)
3 Kinematics of Robot Manipulators. (direct and inverse kinematics, open-loop and parallel configurations, d-o-f, redundancy, number of configurations, service/approach angle, path and trajectory synthesis) - (2 weeks)	(Ref. 2, Chap. 2-3 and Ref. 3)
4 Kinematics Issues in Robot Manipulators. (workspace analysis and synthesis with and without joint motion constraints, motion and force transmissibility, dexterity and related workspaces) - (1 1/2 weeks)	Ref. 3
<b>1st Midterm</b>	
5 Position Analysis of Serial and Parallel Manipulators. (1 week)	(Refs. 2 and 3)
6 Kinematics Analysis of Spatial Linkage Mechanisms. (1/2 week)	(Ref. 3)
7 Kinematics Synthesis of Planar Linkage Mechanisms. (type synthesis, dimensional synthesis: graphical motion generation, path generation) – (1 1/2 weeks)	Chap. 8 (8.1-11) Ref. 1
8 Kinematics Synthesis of Planar Linkage mechanisms. (dimensional synthesis: analytical methods for motion, path and function generation) – (1 1/2 weeks)	Chap. 8 (8.12-24) Ref. 1
<b>2st Midterm</b>	
9 Dynamics of Serial Manipulators (1 week)	Ref. 2

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| 10 | Robot Manipulator Control and Related Issues (1 week) | Refs. 2 and 3 |
| 11 | Course Review and Project Presentation (1/2 week)     |               |

During the semester, each student will select a mechanism or manipulator analysis and synthesis project. A short statement of the project is due following the first midterm exam. Each student is expected to discuss the project with the instructor for approval before the due date. The projects will involve the identification of the function(s) that the mechanism or manipulator is intended to perform, formulation of appropriate method(s) to estimate the level of performance of the device and solution method(s), followed by the formulation of an appropriate method to synthesize the device to achieve a prescribed or optimal performance. A final ppt presentation as well as a written report is due by the last day of classes. Oral presentation will be required during the last day of classes.

No late homework will be accepted.

### **GRADING**

- 1- Homework (15 points).
- 2- Two midterms (15 points each).
- 3- Final exam (40 points).
- 4- Project (proposal, presentation and final report) - (15 points).

### **DISABILITY SUPPORT SERVICES (DSS) STATEMENT (must be the following language)**

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room128, (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

*[In addition, this statement on emergency evacuation is often included, but not required:*

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information go to the following website: <http://www.stonybrook.edu/ehs/fire/disabilities> ]

### **ACADEMIC INTEGRITY STATEMENT (must be the following language as approved by the undergrad council):**

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at <http://www.stonybrook.edu/uaa/academicjudiciary/>

### **CRITICAL INCIDENT MANAGEMENT (must be the following language as approved by the undergrad council):**

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.