MEC 310 (Introduction to Machine Design): 3 Credits Fall 2024

Course Administration

INSTRUCTOR:	Nilanjan Chakraborty, 212 Heavy Engineering, (631) 632 9327. E-mail: nilanjan.chakraborty@stonybrook.edu
LECTURE HOURS:	Monday and Wednesday (3:30 PM – 4:50 PM) (Light Engineering 102).
OFFICE HOURS:	Monday: 1:45 PM – 3:15 PM; Wednesday: 1:45 PM – 3:15 PM or by appointment (212 Heavy Engineering).
REQUIRED TEXT:	**Design of Machinery: An introduction to the synthesis and analysis of mechanisms and machines**, Robert Norton, 6th Edition, McGraw-Hill. (5th Edition will also work)
PREREQUISITES:	MEC 262, MEC102; CO-REQUISITE: MEC 203.
HOMEWORK:	A total of up to 8 problem sheets will be given as homework over the whole semester. Homework will not be graded. The purpose of the homework is to complement the material in class and show you how the material taught in class can be used to solve aspects of a design problem. The solutions will be posted one week after it is assigned.
PROJECT:	Two design projects will be given. It will be due four weeks following its assignment unless otherwise stated. A written report is required for the design project.
EXAMS:	3 Midterms and 1 Final Exam. **Exam # 1: Wednesday 10/02/2024.** **Exam # 2: Wednesday 11/06/2024.** **Exam # 3: Wednesday 12/04/2024.** **Final Exam: Monday 12/16/2024, 5:30 PM – 8:00 PM.** • All midterm exams will be scheduled in class. • No makeup exam unless arranged prior to the exam.
GRADING:	Semester letter grade is based upon your performance in the following: 2 Projects @ 10% each 20% 3 Exams @ 15% each 45% Final (comprehensive) 35%
GRADING SCALE	Not a curve – accumulation of your course work, as follows: A (100-94) A- (93-90) B+ (89-87) B (86-82) B- (81-79) C+ (78-76) C (75-72) C- (71-68) D+ (67-64) D (63-60) F (59 or below). **Note that you need to get a minimum of 60% on each Design project to pass.**

STUDENT OUTCOMES

(a) Ability to apply knowledge of mathematics, science, and engineering.

(e) Ability to identify, formulate, and solve engineering problems.

(m) Ability to model, analyze, design, and realize physical systems, components, or processes.

(n) Ability to work professionally in both thermal and mechanical systems areas.

COURSE LEARNING OBJECTIVES	**ASSESSMENT TOOLS**
Know how to determine the mobility of a mechanism	Exam questions
Know how to synthesize a linkage by using graphical methods	Exam questions
Know how to analyze the movement of a linkage using loop closure equations	Exam questions
Know how to analyze the velocity and acceleration of a linkage using vector equations	Exam questions
Know how to design a cam profile from a given displacement curve graphically	Exam questions
Know how to analyze a compound gear train	Exam questions
Know how to analyze an epicyclic gear train	Exam questions
Know how to formulate and solve a mechanism design problem	Rubrics of evaluation on design report

Course Overview

Application of graphical and analytical methods to the analysis and synthesis of mechanism. Covers concepts of degrees of freedom, graphical and analytical linkage synthesis, position, velocity, acceleration, and force analysis of linkage mechanisms. Introduces principles behind the operation of various machine elements such as gears and gear trains, cams, flywheels and their design, and analysis techniques.

The above topics are fundamental to the broader subject of machine design. The prerequisites for the present course are MEC 102 (Engineering Computing and Problem Solving II) and Engineering Dynamics (MEC 262). MEC 203 (Engineering Graphics and CAD) is a co-requisite. The kinematic and dynamic analyses (velocity, acceleration, and force analyses) of machinery are essentially applications of the fundamentals presented in MEC 262. The results of these analysis, i.e., forces acting on each machine component, are important for a following course, Mechanical Design (MEC 410), in which the students will learn how to size or design machine components to prevent mechanical failure.

Tentative Schedule

WEEK	MATERIAL COVERED	Text Chapters
1	Introduction and Kinematics Fundamentals Mechanisms and machines, Engineering design process, Degrees of freedom, The Grashof condition, Linkage inversion, Practical considerations.	Ch.1, 2
2,3	Graphical Linkage Synthesis Classification of kinematic synthesis problems, Dimensional synthesis involving 2 and 3 positions, quick return mechanisms.	Ch. 3
4,5,6	Linkage Analysis Loop closure equations for four-bar linkages and slider-crank linkages, Transmission angles, toggle positions. Velocity and acceleration analysis.	Ch. 4,6,7
7,8,9	Analytical Linkage Synthesis 2 and 3 position synthesis, comparison of analytical and graphical synthesis	Ch. 5
10-12	Cam Design Various mechanisms, Cam classification, Cam motion programs, Graphical design and analytical design of cams.	Ch. 8
13	Gears and Gear Trains The Fundamental Law of Gearing, Interference and undercutting, Design of gear trains.	Ch. 9
14	Static and Dynamic Force Analysis of Mechanisms	Ch. 11
15	Balance of Machinery	Ch. 12
16	Wrap-up and Review	

December 9, last day of class.
Final Exam (comprehensive): December 16 (Monday), 5:30 PM – 8:00 PM.

Resources: Video lectures from a previous version of the class.
https://www.youtube.com/playlist?list=PLk8N362Zei8ky8sQt6SNkB8ZWIb-mW2Cs

Brightspace: All homework assignments and solutions will be posted on the Brightspace course account. I will use email and Brightspace exclusively to communicate with you off class. It is your responsibility to make sure that your email id is a current one on the Brightspace system. I suggest that you use a university email id for this class; it is free and official. I am not

responsible for the emails not delivered to your commercially available email accounts. To learn more and for SUNY Online helpdesk information, visit: https://brightspace.stonybrook.edu.

Academic Integrity Statement: 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 is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Professions, 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/commcms/academic_integrity/index.html.

Academic dishonesty is an extremely serious offense and will not be tolerated in any form. Academic dishonesty in general is the presentation of intellectual work that is not originally yours. Examples include, *but are not limited to*, copying or plagiarizing class assignments including homework, reports, designs, computer programs, graphics, and other submitted materials; copying or otherwise communicating answers on exams with other students; bringing unapproved aids, either in physical (written) or electronic form to an exam; obtaining copies of an exam prior to its administration, etc. Academic dishonesty violates both the ethical and moral standards of the Engineering profession and all infractions related to academic dishonesty will be prosecuted to the fullest via the CEAS CASA committee.

Student Accessibility Support: If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center. For procedures and information go to the following website: https://ehs.stonybrook.edu//programs/fire-safety/emergency-evacuation/evacuation-guide-disabilities and search Fire Safety and Evacuation and Disabilities.

Critical Incident Management: Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards 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. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.