Degree Program:

□ ECE-Electrical & Computer Engineering,

■ **ME - Mechanical Engineering**

□ General Courses for Both ECE & ME Degree Programs

Course Name: **Design and Manufacturing II**
Course Code: VM350
Course Credits: 4
Course Category: ■ Required □ Elective

Terms Offered:

□ Fall _____

□ Spring _____

■ Summer_____2017_____

Course Pre/Co-requisites: VM250

Textbooks:

- R.L. Norton, **Design of Machinery** – An Introduction of the Synthesis and Analysis of Mechanisms and Machines, 5th Edition, McGraw-Hill, 2012, ISBN: 978-0-07-352935-6
- R. G. Budynas, J. K. Nisbett, **Shigley's Mechanical Engineering Design**, 10th Edition, McGraw-Hill, 2014, ISBN: 978-0-070-339820-4
- J. Donnell, S. Jeter, C. MacDougall, J. Snedeker, **Writing Style and Standards in Undergraduate Reports**, 3rd Edition, College Publishing, 2016, ISBN:978-1-932780-09-3

Other supplementary course materials may be available during the lecture and posted at course Canvas site.

Instructor:

Prof. Jaehyung "Joshua" Ju
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Office: JI Bldg. 210
Office Hour: Tuesday/Thursday 5:00 - 6:00 pm.

Teaching Assistants (TAs):

Mr. Zhihao Yuan Email: myindex@sjtu.edu.cn Office: JI Bldg.109 Office hour: Tuesday 7:00-9:00pm	Mr. Shenlin Chen Email: forest-chen@sjtu.edu.cn Office: JI Building 3rd floor YLM Center Office hour: Wednesday 7:00-9:00pm

Grading Policy:

Exam I	20%
Exam II	20%
Exam III (final exam)	20%
Homework assignments on the lectures (~11 best out of all assigned)	10%
Lab assignemtns	5%
Project report I (virtual prototyping, proposal presentation)	10%
Project report II (game competition, final report)	15%

Attendance may be checked in a random basis. A maximum 10 points will be given to the final exam as a bonus if a student keeps a good record of attendance for lectures as well as lab work; you may be given pop-up quizzes during the class.

Policy for Late Submission

Every homework should be submitted to the instructor or TAs by the beginning of the class on the due day. Failure to submit homework on time will get 25% deduction per day.

If a student miss an exam due to an "excused absence", the percentage missed will be added to the next exam with 15% deduction. (Note: an excused absence is the one that follows the University guidelines and is approved by the instructor.) While absences from the class are discouraged, sometimes circumstances arise that require missing a class. If a student does miss a class, it is the student's responsibility to contact someone in the class or the instructor to determine the material that was covered. Please note that the instructor can assist the student in identifying the material that he (or she) has missed, but that a detailed synopsis of the missed lecture will not be given.

Review of the grading: If a student feels that there is a problem on grading, he (or she) could re-submit the homework (or exam) to the TA or instructor for review. However, the review will be conducted by both instructor and TA at the certain extra time.

Course materials, assignments, and examples will be distributed through the Canvas system. Important notices will also be circulated through the email system in Canvas. ***It is students' responsibility to check the posted information in Canvas and check the course-related emails from their registered email addresses.***

Academic Integrity:

Assignments for lecture and lab (computer) are to be completed on your own unless specified as group assignments. This means:

- Students are not allowed to sit together and work out the details of the problems with anyone.
- Students are not authorized to discuss the problem set with previous class members, nor anyone else who has significant knowledge of the details of the problems set.

- Nor should you compare your written solutions, whether in scrap paper form or your final work product, with other students (and vice versa).
- You are also not allowed to possess, look at, use, or in any way derive advantage from the existence of solutions prepared in previous years.

Violation of this policy is considered as a violation of the honor code and is grounds for the Instructor(s) to initiate an action that may lead to grade reduction, course withdrawal, University suspension or expulsion.

For your information, the UM-STJU JI has a nationally recognized Honor Code of Academic Integrity. This Code sets standards for academic integrity for all students. As a student, you are responsible for upholding these standards. For more information on the Honor Code at UM-SJTU Joint Institute, please visit http://umji.sjtu.edu.cn/academics/academic-integrity/honor-code/. To further exhibit your commitment to academic integrity, after each examination, students must sign their names on the Honor Pledge on the test paper. The Honor Pledge is as follows: "I have neither given nor received unauthorized aid on this examination, nor have I concealed any violations of the Honor Code." Instructors are not required to grade tests in which the signed Honor Pledge does not appear. The Honor Code remains enforced whether or not the student signs the Pledge.

Lecture: (classroom: Dong Zhong Yuan E4-505)

Monday **4:00 – 5:40PM**
Thursday **8:00 - 9:40 AM**
Friday **8:00 - 9:40 AM (Weeks 1, 3, 5, 7, 9, 11)**

Lab:

Notice: Anyone who is taking VM350 should pass VM250 in the previous semester. For those who do not or cannot due to special reasons, please see the instructor at the starting of the semester.

The schedule of lab sections will be posted on Canvas. There are two Lab parts.

- **Engineering graphics**
  - **CAD drawing using Unigraphics NX.**
  - **Place: JI computer room (in YLM Student Center)**
  - **Time: (Week 2- Week 6)**
    - **Tuesday 4:00 – 5:40 PM (Section 1)**
    - **Thursday 6:20 – 8:00 PM (Section 2)**

- **Manufacturing :**
  - **Design and Manufacturing of Project**
  - **Place: Design and Manufacturing Lab (4th floor of JI building)**
  - **Time:**
    - **flexible**

Students are required to attend the lab sessions. TA will collect the lab assignments with an attendance sheet after lab sessions.
Students may start their projects earlier (even Week 1) at Design and Manufacturing lab.

Course objective:

The goal of the course is to understand basic engineering principles behaind common mechanical systems, as well as how to utilize the enigninering knowledge to both synthesize and analyze simple mechanical systems & components. At the end of this course, student shoulid be able to obtain the following outcomes:

1. Design (synthesize) basic mechanical systems (including components such as linkage, cams, bearing, and gears) and mechatronics systems (which integrate electronic control and mechanical components) to satisfy given motion requirements.
2. Perform analyses of the underlying kinematics of a mechanicaal system to predict behavior and evaluate key mechanical quntities (trajecttory, velocity, acceleration, force, etc.)
3. Apply approriate selection criteria to choose standard mechanical compoentns such as gears, bearing and springs.
4. Virtual prototyping of mechanical systems using one or more commercial CAD programs - e.g., Unigraphics, SolidWorks, ProEngineer or AutoCAD for checking performance.
5. Test and evaluate the physical prototypes of simple machine systems and components for performance and benchmarks.
6. Critique and redesign mechanical systems and components for enhanced performance and reliability.

Course Topics:

1. Review of the design process and relevant design principles.
2. Basic kinematic analysis of mechanisms such as four bar linkages and cams.
3. Application of basic materials and mechanics to mechanical design.
4. Analysis and synthesis with focus on the selection methods for basic components which may include gears, bearings, springs, power screws, fasteners.
5. Introduction of common mechatronic components; selection and application of motors based upon predictive models and motion curves.
6. Design of mechanical or mechatronic systems for given requirements, such as motions, trajectories, power ratings, etc.
7. Analysis of load and power flow through transmission systems such as gears, linkages, cams.
8. Preparation of engineering instructions (tolerance drawing and text) by selecting the appropriate materials and manufacturing processes based upon geometry, loading and tolerances.
9. Build and assemble mechanical systems using standard machine shop tools (manual/CNC mill, lathe, drill and laser cutter) and advanced manufacturing tools; e.g., 3D printing.
10. Test and evaluate simple machine systems and components for performance and failure behavior using physical and virtual prototypes.
11. Introduction to teamwork

Homework:

There will be about **12** homework assignments from the lecture and five from the lab work. The 11 best of homework assignments on lecture will be accounted for grading.

Project:

Coursework will also consist of one semester-long group project. Your team members will be chosen ***by the instructor*** based on some criteria. There are two design reviews before the final presentation. Preliminay project presentations including virtual design of the project with CAD are on **June 30**. The final report with competition is due on **July 28**.

Exams:

There will be three exams in this course, each of which accounts for 20% in the final grade. The content covered in each exam will be specified during the lecture. Exam I, II, and III are tentatively scheduled on **June 16, July 14**, and **August 7**, respectively.

Peer evaluation:

Since the collaborative activity is an essential part of this course, each member will be asked to submit a peer evaluation sheet at the end of the semester, to evaluate the participation of each team member (including yourself) to project activities. A peer evaluation form is available on the course Canvas site under "Final Project."

Lecture Schedule: (tentative)[1]

Week #	Date	Lec. #	Topic	Reading assignment	HW
1	M 5/15	1	Course Overview, Project		
	Th 5/18	2	Introduction to design	Norton (Ch1)	
	Fr 5/19	3	Kinematic fundamentals: Kinematic pairs, Mobility	Norton (Ch2)	
2	M 5/22	4	Kinematic fundamentals: Number synthesis, Isomers	Norton (Ch2)	HW1
	Th 5/25	5	Kinematic fundamentals; Grashof condition	Norton (Ch2)	HW2
	Sa 5/27	6	Kinematic fundamentals; Compliant mechanism, MEMS	Norton (Ch2)	HW 3
3	M 5/29		No class (substituted to 5/27)		
	Th 6/1	7	Graphical linkage synthesis	Norton (Ch3)	
	Fr 6/2	8	Graphical linkage synthesis	Norton (Ch3)	HW 4
4	M 6/5	9	Graphical linkage synthesis	Norton (Ch3)	
	Th 6/8	10	Graphical linkage synthesis	Norton (Ch3)	HW 5
5	M 6/12	11	Position analysis	Norton (Ch4)	
	Th 6/15	12	Position analysis	Norton (Ch4)	HW 6
	Fr 6/16		Exam I		
6	M 6/19	13	Technical presentation (engineering communication)	Donnell (p256)	

[1] green – kinematics, blue- machine element design, orange – engineering communication, red – mechatronics

	Th 6/22	14	Analytical linkage synthesis	Norton (Ch5)	HW 6
7	M 6/26	15	Velocity analysis	Norton (Ch6)	
	Th 6/29	16	Cam design	Norton (Ch8)	HW 7
	Fr 6/30		Project report I - virtual prototyping with presentation	Slide	
8	M 7/3	17	Cam design	Norton (Ch8)	
	Th 7/6	18	Gear trains	Norton (Ch9)	HW 8
9	M 7/10	19	Gear trains	Norton (Ch9)	
	Th 7/13	20	Introduction to mechatronics		HW9
	Fr 7/14		Exam II		
10	M 7/17	21	Technical reports (engineering communication)	Donnell (p231)	
	Th 7/20	22	Gear mechanics (force/strength)	Shigley(Ch13)	HW10
11	M 7/24	23	Screws, Fasteners	Shigley (Ch8)	
	Th 7/27	24	Belts and chains	Shigley(Ch17)	HW11
	Fr 7/28		Project report II – Game day	Report	
12	M 7/31	25	Shafts	Shigley(Ch7)	
	Th 8/3	26	Bearings	Shigley(Ch11)	HW12
13	Fr 8/7		Exam III (Final exam)		

Lab Schedule: (tentative)

Week	Engineering graphics - JI Computer room (3F)	Manufacturing - Design & Manuf. Lab (4F)	Lab assignment (Engineering Graphics)
1			
2	Modeling, Assembling and Animation / Global joint 1	Open shop for project	Assignment 1
3	No lab (Dragon boat festival)		
4	Global joint 2	Open shop for project	Assignment 2
5	Geneva device	Open shop for project	Assignment 3
6	Walking machine leg	Open shop for project	Assignment 4
7	Flywheel system	Open shop for project	Assignment 5
8		Open shop for project	
9		Open shop for project	
10		Open shop for project	