ENGR 293: Project Management & Design Course Outline

Course: ENGR 293 – Project Management & Design 2020W
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Course Description & Learning Outcomes

This course covers mechanical design, including design methodology, synthesis and analysis. The design projects will represent both mechanical mechanism design and thermo-fluid systems.

Offered: Winter Semester (Jan – Apr)
Credit: 3
In-Class Workload: 3 hours – 2 Team Meetings (1.5 hour each) per week

Open only to students in the Camosun Engineering Bridge program to UBC.

Upon successful completion of this course a student will be able to:

- Describe the engineering design process and related tools;
- Apply the design process and related tools to solve unstructured open-ended problems with specific goals but multiple potential solutions;
- Demonstrate practical applications of key engineering concepts from technology programs in fluids, thermodynamics, solid mechanics and dynamics;
- Demonstrate effective and professional communication skills through oral presentations and written documents;
- Work effectively in a group and apply strategies to improve group dynamics;
- Describe the role of an engineer as a professional in society.

ENGR 293 is equivalent to the course MECH 223 of UBC “Introduction to the Mechanical Design Process" at UBC. The teaching material of ENGR 293 is mainly based on those of MECH 223. Therefore, the credit of ENGR 293 earned from Camosun can be transferred to their UBC credits when students in the Camosun Engineering Bridge program starts their third year of Mechanical Engineering at UBC.

Textbook

The Engineering Design Process: An Introduction for mechanical engineers. Third Edition, (2018) – by P. Ostafichuk, etc.

This edition is recommended, but previous versions of the textbook will also suffice for the course. Please note: The course is taught using Team Based Learning (TBL) and you will need the textbook to complete reading assignments prior to class. By the end of the course, you will have covered the entire text. This textbook is required for MECH 223 of UBC. It is also used as a reference in MECH 328, MECH 454, 457, 458 and 459 of UBC so be sure to hang onto it after ENGR 293.

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Evaluation & Grading System

Unlike the other courses, ENGR 293 focuses heavily on Team-Based Learning. Many of the activities will be evaluated with a single mark assigned per team but each student will still be individually responsible for the material. The nominal course grades are shown below. Please note, the instructor reserves the right to adjust the course grading at any time, as the instructor feels necessary.

Mark Components				
Item		Number	Weight (%)	Individual (I) or Team (T)
Module RAPs		6	5	I
		6	5	T
Final RAP		1	7	I
		1	8	T
Project	Logbook	10	10	I
	Project Milestone Documents	12	15	T*
	Milestone Presentations	3	15	T*
	Prototype	1	10	T*
	Final Presentation (including the Poster)	1	10	T*
	Final Project Report	1	15	T*

NOTE: The team component (T*) of your grade will be subject to a peer assessment which is designed to recognize individual contributions to the team's achievements.

Project Milestone Documents (subject to modification, if necessary)			
No.	Item	Number	Weight (%)
1	Team Charter	1	0.75%
2	Project Proposal (including a list of possible projects)	1	1.5%
3	Requirements List	1	0.75%
4	Concept Matrix	1	0.75%
5	CPM	1	0.75%
6	Gantt Chart	1	1.5%
7	Stakeholder Engagement	1	0.75%
8	Risk Mitigation Plan	1	0.75%
9	Budget Plan - Financials, Resources (human and Capital), Marketing, Promotion, etc.	1	0.75%
10	Fabrication & Production Plan - Procurement, Manufacturing, Material Sourcing, etc.	1	1.5%
11	Drawings – Parts, Assembly and 3D models etc.	A few	4.5%
12	Team Assessments	A few	0.75%

Participation and Attendance

The time of arrival information will be recorded for each individual for each lecture in a table in the logbook. There are no direct penalties applied to individuals or teams for late arrival or absence, so this mainly serves as a record of when people arrive. If one member is routinely late, think about how that impacts the team – both in terms of marks and team cohesiveness – and consider discussing the situation with them. Professional behavior, including arriving to scheduled team activities on time, is also one of the criteria in the peer reviews. Lastly, at the end of the course, timely arrival to lectures and meetings will be considered as one piece of evidence for whether to "promote" students just below a grade boundary (i.e. students with grades 49%, 59%, 64%, 69%, 72%, 76%, 79%, 84%, and 89%).

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Course Schedule and Timeline (subject to modification, if necessary)

Wk	Date	Topic	Content	Activity
1	Jan.06 Jan.08	Module 1: Design Process and Ideation	• Team Formation – Team Structure • Design process • Project Management • Generating Ideas	• Team Formation: Charter, Assessment, Project Ideas, Name • Project Management: CPM, Gantt Chart • Identify Needs and Research • Camosun Library • Team Meeting
2	Jan.13 Jan.15		• Evaluation and decision making • RAP 1 (Jan.15)	• Winnowing Process • Concept Ranking – Pugh Charts, • Concept Scoring – WDM, Value Equation etc. • Team Meeting • Guest Speaker?
3	Jan.20 Jan.22	Module 4: Specification and Design Tools	• Design Process • Uncertainty analysis • Engineering economics • Formal design methods	• Team Meeting
4	Jan.27 Jan.29		• RAP 2 (Jan.29)	• TRIZ • Statistical Basics • Team Meeting • Team Presentation 1 (Jan.27): Project Proposal Presentation (informal)
5	Feb.03 Feb.05	Module 2: Implementation	• Minimum constraint design • Estimating performance • Material selection	• Team Meeting • Guest Speaker?
6	Feb.10 Feb.12		• RAP 3 (Feb.12)	• Team Meeting
7	Feb.17 Feb.19	Family Day - Reading Week - No Class		

ENGR 293: Project Management & Design Course Outline

Wk	Date	Topic	Content	Activity
8	Feb.24 Feb.26	Module 5: Detailed Design	• Optimization • Mitigating failure • Design for manufacture, assembly, and usability	• Team Presentation 2 (Feb.24): Project Design Presentation (informal) • Estimation • Standards and Codes • Prototyping – Cardboard, SolidWorks • Team Meeting
9	Mar.02 Mar.04		• RAP 4 (Mar.04)	• Team Meeting • Guest Speaker?
10	Mar.09 Mar.11	Module 3: Mechanical Components and Mechanisms	• Mechanisms • Making parts • Material selection	• Team Meeting • Team Presentation 3 (Mar.11): Project Fabrication Plan Presentation (informal)
11	Mar.16 Mar.18		• RAP 5 (Mar.18)	• OpenBOM • McMaster-Carr • 3D Printing • Camosun Innovates • Team Meeting • Guest Speaker?
12	Mar.23 Mar.25	Module 6: Broad Context of Design	• Societal context • Patents and bringing ideas to market • RAP 6 (Mar.25)	• Social Responsibility – TBL • Engineering Ethics • IP, and IP Protection • Team Meeting • Guest Speaker?
13	Mar.30 Apr.01	Final Presentation Preparations	• Poster (One-pager) • PPT	• Individual reflections • Team Assessments • Team Meeting
14	Apr.06 Apr.08	**Final Showcase**	• RAP Final (Apr.06) • Final Presentation (Apr.08)	• Team Meeting • Team Presentation 4 (Apr.08): Final Project Presentation (formal)

NOTE: The Guest Speakers are subject to their availability.

ENGR 293: Project Management & Design Course Outline

Class Activities (subject to modification, if necessary)

Activity	Description
Content Acquisition	Design is as much art as science. As such, there is generally no single right answer, but a range of better or worse responses to a design need. Our goal is to help you develop good insight into design problems, and judgment and wisdom in assessing potential solutions. The technical content in this course will be given to you largely in the form of readings and other resources that you will be expected to go through in advance of the classes. In the classes, you will work with your team to discuss and apply the knowledge you have gained through your readings in order to develop your ability to weigh different approaches and justify the approaches you choose to take. Engineering design is also about making informed tradeoffs under time and resource constraints – can you tell when it is time to say enough is enough? This also is a skill you will work on in the classes through discussing questions with your team, presenting the results of your team's discussion to the class, and engaging in broader class discussions.
Team meetings	Two Weekly team meetings are dedicated to design meetings during which you will be presenting progress reports to the instructor. Your logbook will be signed-off during this meeting. While the instructor is available for guidance, please be aware that this time is shared among all teams. Two Weekly team meetings are also dedicated to tutorial sessions during which you will have instructor support (including invited guest speakers) to work on problems and give recommendation, advice or feedback of the project development. You are expected to work in teams during these periods
Computer Lab & Workshop	There are no dedicated computer lab or workshop sessions for this class. However, each student is expected to practice class techniques using software available on college computers to do calculation, analysis, simulation and 3D modeling etc. and using the Workshop (including 3D printers) to build the prototypes. Although collaboration with your team and/or other classmates is expected, each student must complete their individual and unique analysis. Yes, markers are able to identify exactly replicated language.

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Team-Based Learning (TBL)

ENGR 293 uses a Team-Based Learning (TBL) approach for the projects and classes. In the TBL method, basic familiarity with course material is gained through readings prior to class and class time is used to focus on application and high-level learning. In contrast, conventional approaches to teaching see class time spent to deliver the basic material and you would be left on your own to figure out the high-level learning out of class. The six sections of the course (as listed in the Course Topics above) will each follow the format:

1. Out-of-class reading
2. In-class Readiness Assurance Process (RAP)
3. In-class group work
4. In-class discussion
5. Application to project

Theory of Knowledge: Acquisition, Application, Judgment

We generally view learning in design as progressing through three different stages: first knowledge, then application, and finally judgment. As shown in the table below, the TBL approach involves the instructor at the higher-level stages rather than leaving you to figure those out on your own. The following table is from UBC MECH 223 syllabus:

Level of Learning	Examples of the types of things you do with this level of learning	Traditional Teaching Approach	TBL Approach
Knowledge: learn basic course material (low-level)	Describe methods, list elements, identify parts, compare features	The class is used for the instructor to convey knowledge while students take notes or listen; readings are often assigned but rarely completed by students	On their own, students can obtain most of the basic knowledge needed by completing readings; the first class of a module is used to test understanding and provide feedback
Application: learn to use the course material (mid-level)	Solve problems, construct models, analyze components, explain observations	Some examples are done in class by instructors and in tutorials by TAs; students spend out-of-class time practicing application on their own	Class time and tutorial time is largely used to work through exercises. Projects and team assignments extend these opportunities out of class but results are discussed in class.
Judgment: learn to think critically and extend the course material (high-level)	Invent new approaches, formulate conclusions, judge feasibility, justify arguments	There is very little or no formal high-level instruction; students grapple with this on their own, outside of class; there is no feedback provided by instructors	A significant portion of class time is used to discuss judgment and other high-level learning. The instructor facilitates discussions and is actively involved in providing feedback.

Readiness Assurance Process (RAP)

The Readiness Assurance Process (RAP) is a technique in Team-Based Learning[1]. It is used to ensure that students are familiar with background information on a topic so that class time can be used more effectively. In particular, students are responsible for learning simple concepts through assigned readings before coming to class so that more time is available for high-level learning guided by instructors. (That is, instead of using the class time to convey basic knowledge, the RAP process allows faculty to spend that time discussing and practicing how to use that knowledge). The steps in the RAP in class are:

1. Individual RAP quiz: an individual multiple-choice test based on a general understanding of material from assigned readings.
2. Team RAP quiz: the same multiple-choice test that was conducted individually, but this time taken as a team.
3. Instructor feedback: immediate feedback by instructors to ensure all students understand the material before proceeding with more advanced topics

RAPs	Scope	Tentative Date (subject to modification, if necessary)
RAP 1	Module 1 Design Process & Ideation	Jan.15, 2020
RAP 2	Module 4 Specification & Design Tools	Jan.29, 2020
RAP 3	Module 2 Implementation	Feb.12, 2020
RAP 4	Module 5 Detailed Design	Mar.04, 2020
RAP 5	Module 3 Mechanical Components & Mechanisms	Mar.18, 2020
RAP 6	Module 6 Broad Context	Mar.25, 2020
RAP Final	Modules 1 – 6 RAPs 1 – 6 + Practice Problems of the text book	Apr.06, 2020

[1] Michaelsen, Larry K., Arletta Bauman Knight & L. Dee Fink. "Team-Based Learning." Stylus Publishing, Sterling, 2004.

Team Formation

Each student is assigned to a team to work with throughout ENGR 293. Each team comprise of no more than 4 or 5 students. A team is not just a group of people working together. A team is a cohesive unit working towards a common goal. Teams play an important role both in class and in the design projects. To increase the team diversity, it is encouraged that each team is formed from students drawn from different colleges. It is also desirable that each team is formed to have roughly equal average GPA and ability in team skills, hands-on skills, and communication skills etc. In addition, the Myers-Briggs type indicator can be used as team member personality assessment tool to help the team formation process.

Team Projects

After the team formation, each team can choose their projects under the supervisor of the instructor. The idea of the team project is wide open, no limits. However, since it is a course project, there are some restrictions:

- Team Project is aiming to solve a very practical and specific issue with an engineering approach
- Team Project has to be small enough to make sure it can be finished in a semester
- Team Project also has to be large enough to cover all the major milestones and can result in meaning deliverables, including engineering docs and prototype.
- Team Project budget has to be very reasonable to make it affordable and feasible

College Supports, Services and Policies

Immediate, Urgent, or Emergency Support
If you or someone you know requires immediate, urgent, or emergency support (e.g. illness, injury, thoughts of suicide, sexual assault, etc.), **SEEK HELP**. Resource contacts @ http://camosun.ca/about/mental-health/emergency.html or http://camosun.ca/services/sexual-violence/get- support.html#urgent

College Services
Camosun offers a variety of health and academic support services, including counselling, dental, disability resource centre, help centre, learning skills, sexual violence support & education, library, and writing centre. For more information on each of these services, visit the **ST UDE NT S ERV IC E S** link on the College website at http://camosun.ca/

College Policies
Camosun strives to provide clear, transparent, and easily accessible policies that exemplify the college's commitment to life-changing learning. It is the student's responsibility to become familiar with the content of College policies. Policies are available on the College website at http://camosun.ca/about/policies/.
Education and academic policies include, but are not limited to, Academic Progress, Admission, Course Withdrawals, Standards for Awarding Credentials, Involuntary Health and Safety Leave of Absence, Prior Learning Assessment, Medical/Compassionate Withdrawal, Sexual Violence and Misconduct, Student Ancillary Fees, Student Appeals, Student Conduct, and Student Penalties and Fines.

A. Grading Systems *http://camosun.ca/about/policies/index.html*

The following two grading systems are used at Camosun College:

1. Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
90-100	A+		9
85-89	A		8
80-84	A-		7
77-79	B+		6
73-76	B		5
70-72	B-		4
65-69	C+		3
60-64	C		2
50-59	D		1
0-49	F	Minimum level has not been achieved.	0

2. Competency Based Grading System (Non GPA)

This grading system is based on satisfactory acquisition of defined skills or successful completion of the course learning outcomes

Grade	Description
COM	The student has met the goals, criteria, or competencies established for this course, practicum or field placement.
DST	The student has met and exceeded, above and beyond expectation, the goals, criteria, or competencies established for this course, practicum or field placement.
NC	The student has not met the goals, criteria or competencies established for this course, practicum or field placement.

B. Temporary Grades

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy at http://camosun.ca/about/policies/index.html for information on conversion to final grades, and for additional information on student record and transcript notations.

Temporary Grade	Description
I	*Incomplete*: A temporary grade assigned when the requirements of a course have not yet been completed due to hardship or extenuating circumstances, such as illness or death in the family.
IP	*In progress*: A temporary grade assigned for courses that are designed to have an anticipated enrollment that extends beyond one term. No more than two IP grades will be assigned for the same course.
CW	*Compulsory Withdrawal*: A temporary grade assigned by a Dean when an instructor, after documenting the prescriptive strategies applied and consulting with peers, deems that a student is unsafe to self or others and must be removed from the lab, practicum, worksite, or field placement.