COURSE OUTLINE : ENGR 298
D Credit – Degree Applicable
COURSE ID 010196
Cyclical Review: August 2020

COURSE DISCIPLINE : ENGR

COURSE NUMBER : 298

COURSE TITLE (FULL) : Undergraduate Research in Engineering I

COURSE TITLE (SHORT) : Undergraduate Research in Engr I

CATALOG DESCRIPTION

ENGR 298 is a research and design course where diverse groups of students collaborate professionally to research and design an engineering product or process solving a real-world engineering problem tied to contemporary societal needs. Emphasis is placed on projects that help people by engaging multidisciplinary topics such as robotics, biomedical, and environmental engineering and sustainability. Typically, students learn technical and collaborative communication skills and publish academic papers or posters at local conferences.

Total Lecture Units: 1.50

Total Laboratory Units: 1.50

Total Course Units: 3.00

Total Lecture Hours: 27.00

Total Laboratory Hours: 81.00

Total Laboratory Hours To Be Arranged: 0.00

Total Contact Hours: 108.00

Total Out-of-Class Hours: 54.00

Prerequisite: ENGR 122, ENGR 125, ENGR 133, ENGR 140, ENGR 152, ENGR 156, or ENGR 111, or equivalent.

ENTRY STANDARDS

	Subject	Number	Title	Description	Include
1	ENGR	122	Engineering Graphics	Apply the principles of orthographic projection to create complete multi-view engineering drawings;	Yes
2	ENGR	122	Engineering Graphics	use computer aided design software to create 3D models, assemblies, exploded views and engineering drawings;	Yes
3	ENGR	122	Engineering Graphics	apply the engineering design process and demonstrate its steps in a design project.	Yes
4	ENGR	125	Programming Concepts and Methodologies for Engineers	integrate software and hardware components in order to respond to physical phenomena and manipulate physical devices and objects;	Yes
5	ENGR	125	Programming Concepts and Methodologies for Engineers	demonstrate the interaction between software and the physical world;	Yes
6	ENGR	125	Programming Concepts and Methodologies for Engineers	demonstrate awareness of industry standards for quality assurance and software life cycle such as ISO 9000 and IEEE.	Yes
7	ENGR	156	Programming and Problem-Solving in MATLAB	write M-files with “while” and “for” loops and user defined functions;	Yes
8	ENGR	156	Programming and Problem-Solving in MATLAB	write simple graphical user interfaces;	Yes
9	ENGR	133	Introduction to Engineering Design	interpret customer requirements, design need, purpose or mission of an engineering design problem;	Yes
10	ENGR	133	Introduction to Engineering Design	explain importance of measurements and tolerancing to account for fitting;	Yes
11	ENGR	133	Introduction to Engineering Design	demonstrate ability to function in a team.	Yes
12	ENGR	140	Materials Science and Engineering	apply knowledge of materials to engineering design decisions;	Yes
13	ENGR	140	Materials Science and Engineering	compare the strengths and weaknesses of different types of engineering materials;	Yes
14	ENGR	152	Engineering Mechanics - Statics	determine the forces that act on rigid bodies which may include externally applied forces, weight, normal forces, distributed loads, friction and reactions at structural supports;	Yes

15	ENGR	152	Engineering Mechanics - Statics	analyze two dimensional and three dimensional forces that act on rigid bodies in static equilibrium;	Yes
16	ENGR	152	Engineering Mechanics - Statics	create force, shear and bending moment diagrams to determine the location and magnitude of the largest forces and moments;	Yes
17	ENGR	111	Computer Aided Design SOLIDWORKS I	complete a series of problems demonstrating basic knowledge and skills in utilizing a computer aided drafting system;	Yes
18	ENGR	111	Computer Aided Design SOLIDWORKS I	practices standard drawing procedures and content such as number of views, type of views, appropriate dimensions to call out in views, details in title block, and basic geometric tolerancing.	Yes

EXIT STANDARDS

1 Communicate effectively in an interdisciplinary, team-based environment;
2 interface with interdisciplinary sub-teams with varying specialties;
3 develop innovative design concepts to solve a problem or task;
4 create and test a prototype to assess the viability of a design concept;
5 create and present a design proposal to an audience of peers, professors, and industry professionals;
6 create and present a technical design plan to an audience of peers, professors, and industry professionals;
7 simulate the performance of designs with computer software before a physical product is available for testing;
8 evaluate, analyze, and critique the designs of peers and apply those insights to the creation of his or her own designs;
9 read and analyze technical documentation and specification sheets;
10 utilize proper laboratory safety protocols;
11 design a system to complete a specific task, and produce design data necessary to manufacture that system;
12 demonstrate fair and effective team building that includes support for team member cultural, racial, gender and disability differences that contribute to effective research and design;
13 apply knowledge of computer simulation techniques to evaluate the effectiveness of design concepts.

STUDENT LEARNING OUTCOMES

1 demonstrate effective teamwork to solve technical engineering design problems;
2 create conceptual designs to solve a task or problem and evaluate their viability through the construction of prototypes;
3 communicate technical results of engineering research and/or design to a broad audience through the effective use of media.

COURSE CONTENT WITH INSTRUCTIONAL HOURS

	Description	Lecture	Lab	Total Hours
1	Introduction to the Engineering Design Process • Mission statement, customer need or problem definition • Background research, trade studies, or benchmarking • Definition of requirements • Brainstorm, evaluate, choose potential solutions • Calculations and analyses • Develop prototype • Testing • Communication and iteration as necessary • Communicate results • The role of failure in engineering design	3	8	11
2	Engineering Tools and Safety • Tools of engineering; software, hardware • Computer aided design (mechanical parts, electronics, etc.) • Design calculations and computer aided performance simulation • Laboratory safety and equipment usage • Hand tools for prototyping • Manufacturing processes; additive (3D printing) and subtractive (machining) • Testing equipment • Testbed design	4	13	17
3	Team Building and Team Dynamics • Elements of effective design teams • Discrimination in the engineering workplace • Gender and racial/ethnic microaggressions that hinder engineering teamwork • Vouching for and supporting underrepresented or marginalized colleagues • Harnessing all skills and experiences for excellence in engineering design • Environmental sustainability, safety and engineering ethics	4	13	17

4	Engineering Calculations and Analyses • Hand calculations • Computer calculations • Simulations • Reality checks of calculations • Errors and omissions and corrections • Engineering software and programming tools • Algorithms and programming • Finite element analysis (FEA) • Computational fluid dynamics (CFD) • Printed circuit boards (PCB) • Introduction to control theory and microcontrollers	4	13	17
5	Technical Communication • Types of technical communication used in engineering • Importance of accurate and consistent communication and estimates • Writing for engineering in private industry vs academia • Lab reports, test reports, graphs, simulation results • Respectful attitudes in engineering communications	4	13	17
6	Engineering Management • Introduction to project engineering and engineering management • Careers in project and engineering management • Design reviews • Reporting to managers and clients • Ethics in engineering and project engineering	4	13	17

7	Publication of Results • Importance of communicating design results effectively • Publishing in conferences and journals • Writing technical memos, reports, academic papers and posters • Student vs. professional publications • Final Design Review	4	8	12
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OUT OF CLASS ASSIGNMENTS

1 data collection (e.g. conduct a trade study or benchmarking of infant car seats);
2 analysis (e.g. stress calculation on a wheel support beam);
3 project proposals (e.g. a proposal for a design project including deliverables, budget, and timeframe);
4 group project (e.g. conceptual design of an autonomous robot that can climb stairs);
5 technical publication submission (e.g. engineering research poster submitted to a local conference such as the Society of Women Engineers (SWE).

METHODS OF EVALUATION

1 peer assessments (e.g. each team member anonymously evaluates themselves and their team members similar to industry practice);
2 individual skills demonstration (e.g. student demonstrates a computer based stress calculation);
3 instructor evaluation of in-class presentations (e.g. evaluation of preliminary design review, PDR);
4 final project (e.g. team presentation of their engineering design).

METHODS OF INSTRUCTION

- [x] Lecture
- [x] Laboratory
- [ ] Studio
- [x] Discussion
- [x] Multimedia
- [ ] Tutorial
- [ ] Independent Study
- [x] Collaboratory Learning
- [x] Demonstration
- [ ] Field Activities (Trips)
- [x] Guest Speakers
- [x] Presentations

TEXTBOOKS

Title	Type	Publisher	Edition	Medium	Author	IBSN	Date
Introduction to Engineering Research	Required	Morgan & Claypool Publishers	1	Print	Wendy C. Crone	9781681737997	2020