ENGT M38: CAPSTONE PROJECT IN MECHATRONICS ENGINEERING TECHNOLOGY

Originator
srelle

College
Moorpark College

Attach Support Documentation (as needed)
1- Advisory Committee Board Meeting.pdf

Discipline (CB01A)
ENGT - Engineering Technology

Course Number (CB01B)
M38

Course Title (CB02)
Capstone Project in Mechatronics Engineering Technology

Banner/Short Title
Capstone Project in Mecha ENGT

Credit Type
Credit

Honors
No

Start Term
Fall 2022

Catalog Course Description
Provides engineering design experience by integrating the knowledge gained in previous coursework related to mechatronics engineering technology. Incorporates the engineering design process, problem solving and troubleshooting, teamwork, project management, technical writing, and project presentation skills.

Taxonomy of Programs (TOP) Code (CB03)
0935.00 - *Electro-Mechanical Technology

Course Credit Status (CB04)
D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)
B (Transferable to CSU only)

Course Basic Skills Status (CB08)
N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)
B - Advanced Occupational

Course Cooperative Work Experience Education Status (CB10)
N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)
Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)
N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)
Y - Not Applicable

Course Noncredit Category (CB22)
Y - Credit Course

Funding Agency Category (CB23)
A - Primarily Developed Using Economic Development Funds

Course Program Status (CB24)
1 - Program Applicable

General Education Status (CB25)
Y - Not Applicable

Support Course Status (CB26)
N - Course is not a support course

Field trips
May be required

Faculty notes on field trips; include possible destinations or other pertinent information
Naval Base in Point Mugu or in Port Hueneme; or local engineering companies.
(Alternative assignments may be substituted for the field trip)

Grading method
(L) Letter Graded

Alternate grading methods
(O) Student Option- Letter/Pass
(P) Pass/No Pass Grading

Does this course require an instructional materials fee?
No

Repeatable for Credit
No

Is this course part of a family?
No

Units and Hours

Carnegie Unit Override
No

In-Class

Lecture

Activity

Laboratory
Minimum Contact/In-Class Laboratory Hours
105
Maximum Contact/In-Class Laboratory Hours
105

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
105
Total Maximum Contact/In-Class Hours
105

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
0
Maximum Outside-of-Class Hours
0

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
105
Total Maximum Student Learning Hours
105

Minimum Units (CB07)
2
Maximum Units (CB06)
2

Prerequisites
ENGT M02; ENGT M04; ENGT M06; ENGT M30; ENGT M32

Entrance Skills

Entrance Skills
ENGT M02

Prerequisite Course Objectives
ENGT M02-demonstrate the operation of electronic lab equipment to test components and circuits by properly connecting and operating the following standard test equipment: power supplies, function generators, ammeters, voltmeters, ohmmeters, digital multimeters, and oscilloscopes.
ENGT M02-explain the operation of digital logic gates.
ENGT M02-identify the more commonly used integrated circuit families used in digital equipment and discuss their operation and characteristics.
ENGT M02-use Boolean algebra to express logic operations and minimize logic circuits in design.
ENGT M02-discuss the operation and application of counters, shift registers, and other combinational and sequential logic circuits.

Entrance Skills
ENGT M04

Prerequisite Course Objectives

ENGT M04-solve basic electronic problems related to direct current involving resistance, current, voltage, and power applied to both simple and complex combinations of series and parallel circuit components, comprised of resistors, capacitors and coils, in a given network configuration.
ENGT M04-diagram and discuss the relationship between electricity and magnetism as related to a direct current permanent magnet motor, a solenoid or an electromechanical relay.
ENGT M04-describe and contrast the construction, operation, and purpose of resistors, potentiometers, switches, fuses, relays, and batteries.
ENGT M04-explain the basic principles of sinusoidal sources of alternating current (AC) and solve AC network circuit problems involving resistors, capacitors, inductors and transformers.
ENGT M04-discuss the purpose and effects of resistors, capacitors, inductors and/or transformers in a given AC network problem, analyze it and diagram the solution to a posed problem by using J-Factors (complex numbers) appropriately and accurately.

Entrance Skills

ENGT M06

Prerequisite Course Objectives

ENGT M06-explain the basic functions, operations, and architecture of microprocessors and microcontrollers.
ENGT M06-analyze the behavior of particular microprocessors and microcontrollers studied in class according to fundamental laws and formulas.
ENGT M06-develop a flowchart to define a problem and map a solution based on analytical and experimental techniques learned in class. Write a program that implements this flowchart for a microprocessor/microcontroller-based function.
ENGT M06-design, construct, and evaluate the efficacy of a microprocessor/microcontroller-based circuit or system according to a given set of requirements and constraints including, but not limited to, power consumption, speed, and cost.

Entrance Skills

ENGT M30

Prerequisite Course Objectives

ENGT M30-explain the basic functions, operations, and architecture of PLCs.
ENGT M30-discuss the advantages and the disadvantages of using PLCs.
ENGT M30-describe and demonstrate how the parts of the PLC system are connected electrically.
ENGT M30-analyze problems representative of control system environments using PLCs.
ENGT M30-demonstrate the installation, maintenance, and troubleshooting of PLCs and PLC modules.

Entrance Skills

ENGT M32

Prerequisite Course Objectives

ENGT M32-explain the basic functions, operations, and architecture of various sensors, actuators, and power transmission components.
ENGT M32-incorporate various sensors, actuators, and power transmission components into a working electromechanical system.
ENGT M32-explain the basic functions, operations, and architecture of microcomputers and Input/Output devices.
ENGT M32-program microcomputers and Input/Output devices for a specified application.
ENGT M32-demonstrate knowledge of design and control of robotics devices as electromechanical systems.
ENGT M32-demonstrate knowledge in shielding and grounding of various electromechanical systems and creating feedback loops.
ENGT M32-troubleshoot a malfunctioning electromechanical component or system.

Requisite Justification

Requisite Type

Prerequisite

Requisite

ENGT M02

Requisite Description

Course in a sequence

Level of Scrutiny/Justification
Content review

Requisite Type
Prerequisite

Requisite
ENGT M04

Requisite Description
Course in a sequence

Level of Scrutiny/Justification
Content review

Requisite Type
Prerequisite

Requisite
ENGT M06

Requisite Description
Course in a sequence

Level of Scrutiny/Justification
Content review

Requisite Type
Prerequisite

Requisite
ENGT M30

Requisite Description
Course in a sequence

Level of Scrutiny/Justification
Content review

Requisite Type
Prerequisite

Requisite
ENGT M32

Requisite Description
Course in a sequence

Level of Scrutiny/Justification
Content review

Student Learning Outcomes (CSLOs)

	Upon satisfactory completion of the course, students will be able to:
1	plan and manage a large scale engineering design project which has an emphasis on topics related to mechatronics engineering technology.

2	integrate the knowledge acquired in the mechatronics engineering technology program to provide effective solutions for problems related to electromechanical systems or components.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	use an engineering project management software such as Microsoft Project to plan and manage a large-scale capstone project.
2	implement the seven steps of the systems engineering approach to develop, manage, and implement a large scale capstone project.
3	manage a project timeline effectively, making adjustments as necessary, while ensuring adherence to project requirements and safety.
4	demonstrate the ability to use team-oriented problem solving techniques to arrive at an optimal solution for large scale engineering projects.
5	document properly their progress on the design project on a day-to-day basis including any problems encountered and their resolution by applying critical and analytical thinking and problem solving skills.
6	present and defend a proposal for an engineering design project in spoken and written formats.

Course Content

Lecture/Course Content

Not Applicable.

Laboratory or Activity Content

- **5% - Introduction to the Capstone Project**
- **15% - Planning the Project Part I**
  - Review of key technical concepts such as DC/AC circuits, electronic and electrical devices, mechanical devices, Programmable Logic Controllers (PLCs), digital circuits, microprocessors and microcontrollers
  - Project documentation using software such as Microsoft Project Professional
  - Process of establishing task responsibility
  - Process of creating milestones on the Gantt chart
  - Using computer software such as Excel to record bills of material
- **15% - Planning the Project Part II**
  - Project reporting process
  - Work breakdown structure
  - Project schedule and budgeting lead times using software such as Microsoft Project Professional
  - Resource allocation and resolving resource conflicts using software such as Microsoft Project Professional
  - Resource cost estimations
- **40% - Project Prototyping**
  - Hardware sourcing
  - Hardware simulation
  - Test scripts to ensure system functionality
  - Designing and building a prototype
  - Documenting prototype performance against the original design specifications
  - Determining appropriate troubleshooting techniques for designed systems
  - Determining how to modify the design to counteract difficulties including resources, time, technology
- **20% - Prototype Demonstration, Final Project Assembly and Test**
- **5% - Coordination and Preparation Among Team Members to Present the Project in Written and Spoken Format**

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):

Written expression
Problem solving exercises
Skills demonstrations

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Computational homework

Group projects
Individual projects
Laboratory activities
Laboratory reports
Oral presentations
Reports/papers
Simulations
Skills demonstrations
Skills tests or practical examinations

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Case studies
Class activities
Class discussions
Collaborative group work
Computer-aided presentations
Demonstrations
Field trips
Group discussions
Guest speakers
Instructor-guided interpretation and analysis
Instructor-guided use of technology
Internet research
Laboratory activities
Lecture
Practica
Small group activities

Describe specific examples of the methods the instructor will use:

The instructor will use PowerPoint presentations, problem solving exercises, and demonstrations to explain the design concepts and the engineering project management concepts of the course. Occasionally guest speakers may be invited to share their engineering design experiences with the students and to critique the students' design ideas and/or the functionality of the students' design prototype.

Representative Course Assignments

Writing Assignments

1. Answer questions regarding project planning, management, schedules, design, prototyping, and troubleshooting. An example would be: Fill in a flowchart showing the project management steps and use a Gantt chart to show project schedules and timelines.

2. Provide written progress reports on the mechatronics engineering capstone design project. For example: Prepare weekly progress reports documenting the project goals for the week, the role and the success of each team member in completing their assigned tasks, problems encountered, solutions attempted, and the results.

3. Write a technical report documenting the design of a system that uses robotics technology. For example: Provide a technical report on the use of robots in medicine or agriculture, specifying all software and hardware components, their use and interconnections.

Critical Thinking Assignments

1. Design and construct an electromechanical system that can perform a specified function. Select the most suitable electronic, electrical and mechanical devices, microprocessors, and microcontrollers, and justify your selection. Specify all hardware components and their connections including any software and programming languages used. An example would be the design of a robot that can detect, collect, and analyze polluted waters.

2. Troubleshoot by locating and identifying a faulty component in a given malfunctioning electromechanical system having specific symptoms using analytical and experimental techniques learned in class. An example would be to troubleshoot a robotic arm that sporadically speeds up during its lifting operation.

Reading Assignments

1. Read scholarly publications such as the *Journal of Mechatronics and Robotics* to find relevant information and some insight into the assigned mechatronics engineering design project.

2. Read scientific and technical journal articles relevant to advances in electromechanical systems to expand understanding of their use in research and industry.

Skills Demonstrations

1. Illustrate the ability to construct and test the functionality of an electrical or a mechanical system in the lab using the materials provided.
2. Illustrate the ability to troubleshoot a faulty electromechanical system that is malfunctioning using the appropriate testing tools.

Outside Assignments

Representative Outside Assignments

N/A

District General Education

A. Natural Sciences

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

Course is CSU transferable

Yes

CSU Baccalaureate List effective term:

Fall 2022

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

Area C: Arts and Humanities

Area D: Social Sciences

Area E: Lifelong Learning and Self-Development

Area F: Ethnic Studies

CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

IGETC

Area 1: English Communication

Area 2A: Mathematical Concepts & Quantitative Reasoning

Area 3: Arts and Humanities

Area 4: Social and Behavioral Sciences

Area 5: Physical and Biological Sciences

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type

Periodical

Description

The journal of ***Mechatronics, The Science of Intelligent Machines*** is a refereed journal that publishes articles that report advances in the state-of-the-art in Mechatronics and Robotics.

Resource Type

Periodical

Description

The ***Journal of Mechatronics and Robotics (JMR)*** publishes original and innovative research and practical developments in the field of mechatronics and robotics. The journal covers a wide range of application areas, such as robotic-assisted manufacturing; advanced mechanisms and robotics; systems modelling and analysis; instrumentation and device control; automation systems; intelligent sensing and control; medical robotics; bio inspired robots; autonomous and complex systems; micro/nano manipulators and systems; robotic-assisted surgery; simulation robotics and mechanisms; sensor design, sensor-fusion and sensor-based control; teleoperation and telerobotics; aerospace systems. The Journal of Mechatronics and Robotics (JMR) publishes original research papers, review papers, case studies, and patent alerts on the latest innovations in methodologies, technologies, and products within the fields of mechatronics and robotics.

Resource Type

Other Instructional Materials

Description

Handouts developed on-site by the instructor for the assigned design project.

Resource Type

Textbook

Classic Textbook
No

Description
Heldman, Kim. *Project Management JumpStart*. 4th ed., Wiley, 2018.

Resource Type
Periodical

Description
The ***International Journal of Mechatronics and Automation, (IJMA)*** is a fully refereed international journal that presents state-of-the-art research in the area of mechatronics and industrial automation. The intention of *IJMA* is to provide an international forum to report latest developments from interdisciplinary theoretical studies, computational algorithm development and practical applications. It particularly welcomes those emerging methodologies and techniques which bridge theoretical studies and applications and have significant potential for real-world applications.

Library Resources

Assignments requiring library resources
Mechatronics engineering capstone design project.

Sufficient Library Resources exist
Yes

Example of Assignments Requiring Library Resources
Research using the Library's print and online resources to find scholarly publications that can provide useful information on and innovative approaches to human-computer interactions and human-robot interactions.

Primary Minimum Qualification
ENGINEERING TECHNOLOGY

Review and Approval Dates

Department Chair
01/20/2022

Dean
01/20/2022

Technical Review
02/03/2022

Curriculum Committee
02/15/2022

DTRW-I
03/10/2022

Curriculum Committee
MM/DD/YYYY

Board
04/12/2022

CCCCO
MM/DD/YYYY

DOE/accreditation approval date
MM/DD/YYYY