Mt. San Jacinto College
Integrated Course Outline of Record

Form B

Submitted by: James Bae **Date:** 11/12/2020

Department	Subject	Course Number	Title
Engineering: Technologies	Engineering: Technologies ENGR	125	Engineering Design and Development

Units/Hours

Each lecture unit requires 1 hour per week of class time, and 2 hours per week of study outside of class.
Each laboratory unit requires 3 hours per week of class time.
Each activity unit requires 2 hours per week of class time and 1 hour per week of study outside of class.

Lecture Units	Lab Units	Total Units
2.00	1.00	3.00
Lecture Contact Hours	**Lab Contact Hours**	**Total Contact Hours**
32.00 - 36.00	48.00 - 54.00	80.00 - 90.00
Lecture Homework Hours	**Lab Homework Hours**	
64.00 - 72.00	0	

Stand Alone:

Program Applicable

AA/AS Degree General Ed Breadth Area(s):

-none-

General Education Justification:

Maximum Enrollment: 32

Maximum Enrollment Justification:

Course requires significant individualized instruction or assessment â€“ check all that apply:

* Course requires graded class discussion and graded class participation.
* Course requires 3 or more oral presentations by each student per semester.
* Course relies on small group dynamics as a means of instruction or assessment.

*** Course requires that each student be evaluated individually on a set of skills more than twice per semester.**

Justification: Computer programs are used. Specialized equipment is used. The course is heavily project and skill based. The course has group and individual projects that are presented orally in class, individual skill based demonstrations are performed and graded in class.

Grading Method: Letter Grade or P/NP

TOP code: 0924.00*

Can be Taken 1 **time(s) for credit** (max 4)

- ☐ - Visual or Performing Arts course that is required to meet major requirements for UC/CSU
- ☐ - Intercollegiate athletics course
- ☐ - Academic/vocational competition course

Catalog Description:

(Please do not refer to transferability or degree, certificate, or employment concentration applicability. Please only describe the course).
(**75 words** or less in gray box below).

This course is a capstone course. Teams of students will work together to design and construct solutions to engineering problems. Emphasis will be placed on research methods, design problem statements, continuous improvement, cost analysis, prototyping, testing methods, project construction, and project presentation.

Schedule Description:

(Please do not refer to transferability or degree, certificate, or employment concentration applicability. Please only describe the course).
(**25 words** or less in gray box below).

This capstone course emphasizes the application of engineering design and construction. Students work in teams to solve engineering problems, using appropriate methods of engineering.

Need for the course:

This course provides the new Engineering student with foundational skills to be immediately able to join an engineering company at an entry level or to pursue further opportunities in Engineering including more advanced job-skills training or pursuit of transfer pathways to a 4-year institution. It is one course of a series of courses required for a student to be awarded an Engineering Technologist Support Certificate. The Center of Excellence for Labor Market Research (California Community Colleges) estimates that entry-level Engineering Technology jobs (Civil, Electrical, Industrial, Mechanical, amongst other Technicians) will continue to grow in the Inland Empire/San Bernardino area from 2018-2023 by 3%, while offering positions earning above estimated â€œliving wageâ€ rates. This estimated 300 annual jobs outpaced the awards given at the time by local community colleges. This indicates a major opportunity for MSJC to continue to provide entry level Engineering job training, while growing the program to more advanced training to support professional training in the future. This course supports and is attached to: ENGR - Engineering Technologist Support - Certificate ENGR - Engineering Technologist Support - Certificate

Prerequisite(s):

Prerequisites go through a separate approval process. See Forms E1-E6 for details.
(For further clarification, contact the Prerequisite Subcommittee)

- ENGR 122 with a Grade of C or better. and
- ENGR 523 with a Grade of C or better. and
- ENGR 124 with a Grade of C or better.

Corequisite(s):

Corequisites go through a separate approval process. See Forms E1-E6 for details.

-none-

Recommend Preparation:

Recommended Preparation goes through a separate approval process. See Forms E1-E6 for details.

-none-

Other Enrollment Criteria:

-none-

Learning Objectives:

(please number each objective and express in behavioral terms)

Upon the completion of the course the student will be able to do the following:

1. Choose resources for research, using the internet and the library.
2. Investigate availability of U.S. Patent for an original design.
3. Create, simulate and test basic designs using industry standard computers and software.
4. Evaluate test results and other data for validity.
5. Interpret sketches, designs, and drawings for technical content.
6. Research, design, manufacture, test and evaluate mechanical, electronic or electromechanical assemblies.
7. Prepare portfolios to organize, display, and present information.
8. Create presentations using media such as overhead transparencies, 35mm slides, digital images, PowerPoint, and video.

Course Content:

(please number the outline of main topics and subtopics)

1. Researching a Problem - Problem Identification, Justification and Defining Solution Requirements
    1. Project Organization and Documentation
        1. Project management - planning, organizing, motivating, utilizing resources to achieve specific goals
        2. Open ended design process - identify justifiable problem and developing an original solution that attempts to solve it
        3. Project Documentation
            1. Technical writing principles, practices, and techniques
            2. Engineering design process including "Intellectual Property" research and protection
            3. Project Proposal presentation and communication skills
    2. Project Research - using research and data to drive topic selection
        1. Impacts on Society
        2. Stakeholder engagement and feedback
            1. Consulting other professionals - experts with specific knowledge in an area of interest
            1. Peer Review
        3. Effective market research focuses on potential users and buyers to support project investment
        4. Research and analysis of past solutions

3. Project Definition - creating a well developed and accurately written problem statement identifying a need
    1. Guides development of measureable and objective design requirements
    2. Focuses an engineering design process
2. Designing a Solution - Generating and Defending an Original Solution
    1. Identification of design goals - specifications, constraints, parameters, desired features, fundamental design
    2. Inclusion of inputs and stakeholders
        1. Relevant principles and practices of Science, Technology, Engineering, and Mathematics (STEM) should be used to inform and justify design choices should be evident and well documented in an engineering design process
        2. Peer review process (Preliminary Design Review) to
            1. Evaluate design solutions, provide feedback, and implement necessary revisions or modifications
            2. Predict the viability of the final design proposed
        3. Creating effective design teams with diversity and inclusion
        4. Ethical responsibilities to clients, peers, their profession, and the general public
        5. Involving additional stakeholders in an open ended engineering design process
    3. Solution identification and selection
        1. Multiple design possibilities should be explored
        2. Using a decision matrix to compare preliminary design solutions and determine a solution path
        3. Considering other consequences in product development
    4. Solution Testing
        1. Prototype should be created that can be tested qualitatively and quantitatively
        2. Virtual solutions - to plan, test, and prepare for building a prototype
    5. Assessing a product's lifecycle
        1. identifying potential improvements in the process
        2. provides a method for evaluating the product's degree of success.
    6. Forms of technical visual communication
        1. technical drawings, circuit diagrams, process or flow charts
        2. Drawings and sketches are used to organize, record, and communicate ideas
3. Prototype Creation and Testing
    1. Safety in the workplace
    2. Purpose of prototyping and testing
    3. Cost analysis before construction - Material, tools, and equipment requirements
    4. Preparation for prototype testing
        1. Determining what to test - what aspect or specification
            1. Identifying pass/fail or evaluative criteria
        2. Consideration of strength and weight of materials and fastening procedures
        3. Data collection during assembly and test - quantitative vs qualitative data
        4. Assembly instructions for fabricators
        5. Testing and measurement process and procedures
            1. Subsystems for problem isolation and incremental testing
            2. Data collection methods and procedures
    5. Evaluating the results of prototype testing to refine design and improve the design solution
        1. Data analysis vs requirements
        2. A Critical Design Review determines the quality and functionality of the final prototype
        3. Stakeholders Review for recommendations of modifications or improvements
4. Evaluation and Reflection on the Design Process - Evaluation, Reflection, and Designer Recommendations
    1. Engineering design process is typically non-linear
        1. may need to re-visit steps in the process
        2. may take next steps based on feedback from previous steps
    2. Engineering design process is a guide, a series of waypoints for effective problem solving, and a tool for self-evaluation

3. The ability to communicate as a professional is a critical skill for engineers.
4. Engineering design projects are peer reviewed throughout process
5. Stakeholder feedback and design reviews critical in guiding engineers through the design process

5. Presentation of the Design Process - Final Presentation and Documentation
    1. Presentation of this design process and project findings are critical to the engineering design process
    2. Presentations and displays of work provide the means to effectively promote and justify the implementation of a project
    3. A well-done presentation can enhance the perception of the quality of work completed for a team project
    4. The use of presentation software allows designers to present visual aids and project information in a professional manner
    5. The media format used for a presentation is chosen in order to effectively communicate the design solution process to a target audience

Lab Content:

(please number the outline of main topics and subtopics)

1. Orientation and Safety
    1. Safety, reliability, and cost effectiveness
2. Research Methods
    1. Problem statement
    2. Formal research
    3. Library resources
    4. Computer-based research
    5. Guided research
    6. Independent research
    7. Contacting experts
    8. Expectations and time management
3. Patent searches
    1. Patent search exercise
4. Prototype Development
    1. Design
    2. Simulation
    3. Rapid-prototyping
    4. Construction
    5. Testing and evaluation
5. Capstone Engineering Project
    1. Documentation exercise
    2. Reliability exercise
    3. Teamwork and delegation
6. Capstone Project Construction
    1. Component construction
    2. Construction and Tool use exercises
    3. Project assembly
    4. Testing and evaluation
7. Project Presentation & Demonstration
    1. Protocols for writing the formal report
    2. Sketches, models and drawings
    3. Model simulation data and project photos
    4. Daily engineering journals
    5. PowerPoint
    6. Digital images

Methods of Instruction:

Methods of instruction may include, but are not limited to the following:

- **Method:** Lecture
  Integration: Multimedia presentations and computer simulations will explain how engineers work in researching a problem, designing a solution, creating a prototype, and presenting the design process.
- **Method:** Observation and Demonstration
  Integration: Observation and Demonstration with supporting visual materials and computer programs will reinforce topics such as visualization and design analysis, presentation principles, principles and elements of design, technical sketching and drawing, and prototype construction, testing and evaluation.
- **Method:** Projects
  Integration: Projects will engage students in the analysis and description of the design process, including research, data collection, protocols for writing the formal report and preparation of final presentation. Projects are conducted within a group.
- **Method:** Directed Study
  Integration: Directed study will expose students to computational and non-computational problem solving exercises including the topics of research methods, design problem statements, continuous improvement, cost analysis, prototyping, and testing methods.

Methods of Evaluation:

A student's grade shall be determined by the instructor using multiple measures of performance related to the course objectives. Methods of evaluation may include but are not limited to the following:

- **Method:** Class Participation
  Integration: Students will participate in topical discussions, problem solving activities and demonstrations (computational or non-computational), and simulated exercises within the design process. Evaluation will be based on level of participation, reasoning processes, demonstrated skill set and accuracy of results.
- **Method:** Exams/Tests
  Integration: Tests and quizzes will be given which show student understanding of terminology, and knowledge of subject matter. The format may include multiple choice, short answer/essay, and diagram identification.
- **Method:** Group Projects
  Integration: Group oral presentations of problem solving exercises will be made regarding analysis and description of the design process, including research, data collection, prototyping, and the peer review process. This is evident by clarity, organization, thoroughness of content, the appropriate application of course material and demonstration of effective communication.
- **Method:** Capstone Project
  Integration: Teams of students will work together to design and construct a solution to a real engineering problem. Emphasis will be placed on research methods, design problem statements, continuous improvement, cost analysis, prototyping, testing methods, project construction, and project presentation. Evaluation will be based on clarity, organization, thoroughness of content, with appropriate application of course material including research and data driven decisions, proper documentation, and the demonstration of relevant principles and practices of Science, Technology, Engineering and Mathematics.
- **Method:** Oral Presentation
  Integration: Capstone projects will be demonstrated and presented orally to the class and will be graded on skill assessment, appropriate mechanistic choice, organization and thoroughness.

Examples of Assignments:

Students will be expected to understand and critique college level texts or the equivalent. Reading and writing, as well as out of class assignments are required. These assignments may include but are not limited to the following:

1. Create a Standard Tessellation Language "STL" file in a scale within the capacity of the rapid prototype (RP) machine for the first solid model object created for your capstone project. Transmit the file to the RP machine and confirm the machine settings with your instructor before starting the

part creation process. Submit the finished RP part for evaluation.

2. Access the United States Government Patent and Trademark Office website at www.uspto.gov and determine if there is a patent for a concept similar to the idea you have chosen for your capstone project. If you find a patent for a concept similar to your idea, write a one page report which specifies the differences between your idea and the patent. If you did not find a patent for a concept similar to your idea, write a one page report which addresses the diligence you exercised in researching patents. Include the report in the appendix of your project portfolio and submit the report.
3. Using a minimum of three detail models for your project, create a mechanism assembly model with necessary linkages. Using the Inventor software simulation feature, perform a kinematic analysis on this model. Evaluate the results of the analysis to determine if design changes are required. Obtain screen plots of the analysis and submit for evaluation.

Textbooks:

- Project Management Institute (2017). *A Guide to the Project Management Body of Knowledge (PMBOKÂ® Guide)â€“Sixth Edition* Project Management Institute. ISBN: 9781628251845
- Kerzner, Harold (2017). *Project Management: A Systems Approach to Planning, Scheduling, and Controlling 12th Edition* Wiley. ISBN: 9781119165354
- Larson, E., Clifford Gray (2017). *Project Management: The Managerial Process* McGraw Hill. ISBN: 1259666093

Other Resources:

Minimum Qualification

- Engineering (Masters Required) **or**
- Engineering Support **or**
- Engineering Technology (Masters Required)