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	523	Computer Integrated Manufacturing (formerly ENGR-123)

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: 0956.00*

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 explores the integration of engineering technology principles and automation in manufacturing environments. Topics include 3-D design and modeling, CNC programming and production, rapid prototyping, robotics and manufacturing systems.

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 course covers topics such as design and modeling, CNC machining, rapid prototyping, robotics and manufacturing systems.

Need for the course:

This course provides the new to 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 as well as the Engineering: Drafting Technology degree and 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.

Prerequisite(s):

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

- ENGR 120 with a Grade of C or better. and
- ENGR 121 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. Identify components of a typical manufacturing system.
2. Describe how input and output devices are part of an open and closed loop system.
3. Explain direct and indirect costs of manufacturing a product.
4. Analyze how adequate product fulfills a function.
5. Explain the difference between primary and secondary manufacturing processes.
6. Create machine code to manufacture a product using Computer Aided Manufacturing program.
7. Distinguish between accuracy and repeatability.
8. Compare and contrast common CIM systems.
9. Evaluate the effectiveness of a system to accomplish a goal.

Course Content:

(please number the outline of main topics and subtopics)

1. Principles of Manufacturing
    1. Orientation and Lab Safety
    2. Careers in Manufacturing Engineering
    3. History of Manufacturing
        1. Functional groups contributing to manufacturing and production management
        2. Manufacturing and economics
        3. Processes used in the manufacture of products
    4. Control Systems
        1. Use of control systems to manage everyday products
        2. Open and Closed loop systems and inout/output devices
        3. Use of flowcharting and pseudocode in manufacturing
        4. Design and development processes
    5. Cost of Manufacturing
        1. Control system design, cost and safety
        2. Factors for calculating production costs
        3. Skilled workforce calculations
        4. Long term planning and investments
2. Manufacturing Process
    1. Designing for Manufacturability
        1. Designing to systematically solve problems

2. Considerations for manufacturing a quality part
3. Engineering Code of Ethics or Conduct - Ethical responsibilities for safety
4. Manufacturing performance
5. Manufacturing as part of a supply chain

2. How things are made
    1. Prototyping to evaluate and refine the design
    2. Industrial manufacturing processes and machines
    3. Newer technologies for enhancing accuracy and efficiency
3. Primary Versus Secondary Manufacturing Processes
4. Product Development
    1. Machines/Technology in the manufacturing process
    2. CAM/CIM programming tools and CAD programs
    3. Machine operation variables
    4. Error-proofing, jigs and fixtures

3. Elements of Automation
    1. Introduction to Robotic Automation
        1. The evolution of automation
        2. Industrial robotics
        3. Robot and machine communication and coordination
    2. Elements of Automation Power
        1. Production and transmission of power - electrical, hydraulic, pneumatic
        2. Sensor feedback to control systems
    3. Robotic Programming and Usage
        1. Microcontrollers
        2. Diverse environments and functions of robots
        3. Unique programming languages used in manufacturing
        4. Variable declaration, loops and debugging
        5. Work parameters - space, capacity and safety
4. Manufacturing System Integration
    1. CIM Systems
        1. Manufacturing Archetypes - Mass production, Workcells and flexible manufacturing
        2. Process flow and flowcharting
    2. Integration of Manufacturing Elements
        1. Overall production time and product profit
        2. Overall system process flow and subsystems
        3. Sequencing of automated operations
        4. Sensors to ensure high quality part production

Lab Content:

(please number the outline of main topics and subtopics)

1. Orientation and Safety
2. Safety, reliability, and cost effectiveness
3. Research Methods
    1. Problem statement
    2. Formal research - Guided and Independent
    3. Information sources - library, internet, experts, others
    4. Expectations and time management
4. Prototype Development
    1. Design
    2. Simulation
    3. Rapid-prototyping
    4. Construction
    5. Testing and evaluation

5. Engineering Project
    1. Documentation exercise
    2. Reliability exercise
    3. Teamwork and delegation
6. Project Construction
    1. Component construction
    2. Construction and Tool use exercises
    3. Project assembly
    4. Testing and evaluation
7. Project Presentation & Demonstration
    1. Formal reports and presentations - formats and software
    2. Inclusion of multimedia -
        1. Sketches, models and drawings
        2. Model simulation data and charts
        3. Project photos, digital images
    3. Daily engineering journals

Methods of Instruction:

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

- **Method:** Lecture
  Integration: Multimedia presentation and computer simulations introducing control systems, manufacturing costs, processes, production, automation, power, robots, CIM and related manufacturing course topics/material.
- **Method:** Observation and Demonstration
  Integration: Demonstration and supporting visual materials and computer programs, introducing topics such as measuring tools, machine tools, computer aided design programs, power systems, automation and robotic systems.
- **Method:** Projects
  Integration: Analysis and description of the computer integrated manufacturing process including research and data collection, with the findings presented to the class. Conducted individually and within a group.
- **Method:** Directed Study
  Integration: Problem solving design projects in individual and team exercises regarding manufacturing processes, material selection, cutting tools, quality assurance, safety and design.

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: Participation in topical discussions, problem solving activities and demonstrations (computational and non-computational), and simulated exercises within the design and production process.
- **Method:** Exams/Tests
  Integration: Quizzes will be periodic short objective tests of course related concepts. A mid-term and final exam will be given to demonstrate understanding of course learning outcomes. Format may include multiple choice, short answer/essay and diagram identification.
- **Method:** Group Projects
  Integration: Group oral presentations of problem solving exercises regarding computer integrated manufacturing and the selection of operations, machine tools, cutting tools, materials and procedures.
- **Method:** Oral Presentation
  Integration: Presentation to the class of a CIM research topic that includes a written report on a student chosen and instructor approved topic in a specified format. Individual projects will demonstrated and presented orally to the class and will be graded on skill assessment, appropriate mechanistic choice, organization and thoroughness.
- **Method:** Projects

Integration: Project based learning will be evaluated on an individual basis through problem solving activities that produce a finished product within specified tolerances and surface finish requirements.

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. Design a 4" x 6" picture frame that incorporates 3/4" thick plastic stock. The frame must exhibit a rabbit in the back, and a milled pocket to enable hanging. Submit your work to the instructor for evaluation.
2. Create a 3D model of a prototype sample for the wheel spindle using reverse engineering techniques. Save the model and convert the geometry to CNC tool motion using CAM software. Submit your toolpath code to the instructor for evaluation.
3. Reverse engineer an assigned child's toy that has a minimum of two linkage moving parts. Re-engineer the moving parts so that they can be produced by CNC milling and/or turning processes. Create a solid model of your new design. Submit your work to the instructor for evaluation.

Textbooks:

- Groovner, M. (2018). *Automation, Production Systems, and Computer-Integrated Manufacturing, 5th edition* Pearson. ISBN: 9780134605463

Other Resources:

Minimum Qualification

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