San Jose State University
Charles W. Davidson College of Engineering
Department of Aviation and Technology

Tech 149 Computer Integrated Manufacturing (CIM) Systems

Course Syllabus

Semester and Year:	Spring, 2017
Course Sections & Codes:	1 & 11 (21618 & 21619)
Class days & Times:	M: 1:00- 2:45 PM; W: 1:00-3:45 PM
Class Locations:	M: ENG 101, 103; W: ENG 101 & 103, IS 119 & 122
Instructor:	Dr. Samuel C. Obi
Office Room:	IS 105
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Catalog Description

Integration of all aspects of a manufacturing enterprise using computer-integrated manufacturing (CIM) technologies. Design, development and implementation of manufacturing systems using project management techniques and team work.
Prerequisites: Tech 145, Tech 147. (2 hrs lecture, 3 hrs lab. units.)

Course Description

This course emphasizes the integration of manufacturing enterprise using computer-integrated manufacturing (CIM) technologies. It employs CAD/CAM interface and other CIM sub-systems, database management, facility layout, product documentation, process planning, production planning and control, group technology, teamwork, and manufacturing operations and management to bring about a student-designed, CIM-oriented enterprise. Tech 149 is divided into five instructional units, each with its associated objectives. Each unit has associated laboratory activities designed to augment those objectives.

Required Textbook and Other Materials

1. Groover, M. K. (2014). Automation, Production Systems, and Computer-Integrated Manufacturing (4th Edition). (**Required for course**).
   a) Available at Spartan Bookstore.
   b) Available Online (Amazon etc.).
   c) Also available at Course Reserves of King's Library for student check out.
2. Student Edition of 2015-2016 SolidWorks CAD software, available at any of the following sites (**Required for course**):
   a) Available on all 30 workstations in the class and some selected college labs.
   b) http://www.novedge.com/products/2928

c) Spartan Bookstore's website: http://www.creationengine.com/html/ss_spartan.html

3. Rehg, James A. & Kraebber, Henry W. (2005). Computer-Integrated Manufacturing. (3rd Ed.) Prentice-Hall: Englewood Cliffs, N.J. (**Recommended)**
4. Obi, Samuel C. (2013). Introduction to Manufacturing Systems. Available at Spartan Bookstore and from: http://www.amazon.com/Introduction-Manufacturing-Systems-Dr-Samuel/dp/1481701118/ref=sr_1_2?s=books&ie=UTF8&qid=1453148300&sr=1-2&keywords=introduction+to+manufacturing+systems (**Recommended**)
5. Kalpakjian, S. & Schmid, S. R. (2013). Manufacturing Engineering and Technology. (7th. Edition) Upper Saddle River, NJ: Pearson Prentice Hall. (**Recommended**)
6. SolidProfessor CAMWorks Online Training Videos available (by purchases only) at: http://www.solidprofessor.com/training-plans/camworks/ (**Highly recommended**)
7. Other readings and handouts as assigned.
8. A minimum of 4g flash drive (8g recommended)
9. Laptop/notebook computer with ample memory and speed (**highly recommended**)
10. Scientific hand calculator with trig and square root functions
11. Safety goggles
12. Digital calipers
13. Email address and Internet access
14. Some processing materials as may be needed by teams

Course Objectives

After taking this course, the student should be able to:

1. Demonstrate knowledge of classical and state-of-the-art production systems, control systems, management technology, cost systems, and evaluation of system justification techniques.
2. Describe computer integrated manufacturing (CIM) and its impact on productivity, product cost, and quality.
3. Describe computer technologies including computers, database and data collection, networks, machine control, etcetera, as they apply to factory management and factory floor operations.
4. Describe the integration of manufacturing activities into a complete system
5. Demonstrate sensitivity to human-factors related issues as they affect decision making in the factory environment.

Outline of Course Content and Unit objectives

Unit 1: Introduction to CIM Technology

Objectives:

a) Review definitions of manufacturing
b) Review history of modern manufacturing
c) Describe manufacturing automation
d) Review manufacturing economics

e) Determine rationale for computer integrated manufacturing
f) Describe components of computer integrated manufacturing

Reading List for Unit 1:
1. Groover: Chapters 1, 2, 3 & 4
2. Handouts for Unit 1
3. Class and lab activity materials
4. Video on Computer-Integrated Manufacturing (contingent upon time availability)

Unit 2: CAD/CAM

Objectives:
a) Review the design process and CAD system capabilities and components
b) Review basic tasks in computer-aided manufacturing
c) Describe the relationships of the two major CIM sub-systems: CAD and CAM
d) Describe the concept of computer numerical control programming as part of CIM
e) Generate and edit part programs using latest CAM software
f) Determine the nature of enabling technologies behind CAD and CAM

Reading List for Unit 2
1. Groover: Chapters 7, 13 & 23
2. Handouts for Unit 2
3. Class and lab activity materials
4. Video on Computer-Integrated Manufacturing (contingent upon time availability)

Unit 3: Production Engineering and Other CIM Subsystems

Objectives:
a) Develop the concepts of the following CIM subsystems:
    1) Computer-aided engineering (CAE)
    2) Computer-aided process planning (CAPP)
    3) Flexible manufacturing systems (FMS)
    4) Group Technology (GT)
    5) Sales and Marketing
    6) Material Handling Systems (MHS)
    7) Processing Machines etc.
b) Describe tasks and activities performed in the following CIM subsystems:
    1) Computer-aided engineering CAE
    2) Computer-aided process planning CAPP
    3) Flexible manufacturing systems FMS
    4) Group Technology Group Technology
    5) Sales and Marketing
    6) Material Handling Systems (MHS)
    7) Processing Machines etc.

Reading List for Unit 3
1. Groover: Chapters 14, 18, 19 & 24
2. Handouts for Unit 3

3. Class and lab activity materials

Unit 4: Network Systems, Quality Systems, Manufacturing Planning, Control and Scheduling in CIM Environment

Objectives:

a) Describe the various levels of computer integrated manufacturing
b) Develop a general understanding of various networking systems, communications, connectivity and activities of entities in a CIM environment
c) Explore the functions and position of programmable logic controllers in a CIM environment
d) Describe quality systems and techniques in a CIM environment
e) Explore the role of manufacturing planning and control systems in a CIM environment
f) Employ scheduling strategies employed in a CIM enterprise

Reading List for Unit 4

1. Groover: Chapters 9, 20 & 25
2. Handouts for Unit 4
3. Class and lab activity materials

Unit 5: Automated Manufacturing

Objectives:

a) Understand the various types of automated machines and systems used in production environment
b) Describe the connectivity of industrial controls, programmable logic controllers, and industrial robots in a CIM environment
c) Understand the roles of production support machines, automated material handling, automatic guided vehicles (AGV), automated storage and retrieval systems (AS/RS) and automated machine tools and tooling in CIM
d) Describe inspection systems in CIM environment
e) Understand the fundamentals of automated production lines
f) Integrate commonly used industrial control devices, including CAD/CAM, computer-assisted numerical control programming, computer-assisted quality control, and automatic identification

Reading List for Unit 5

1. Groover: Chapters 8, 10, 11, 16 & 22
2. Handouts for Unit 5
3. Class and lab activity materials
4. Manufacturing Insight: Material Handling (TU0954A) (video)

Course Requirements

Reading Assignments

All textbook reading assignments must be completed according to the activity schedule, and students must be prepared for discussion of weekly reading topics in class. In

addition, students will undertake outside readings of articles and texts from current literature relevant to topics being discussed and studied in class.

Class Assignments (100)
There will be five class assignments designed to help students understand the various aspects of Computer-Integrated-Manufacturing. These assignments will be issued in class at various times in the semester during and after class discussions. The administration of four of these assignments will be scheduled in the course schedule. Each of the four assignments is worth 20 points and is due as scheduled. The fifth assignment will be issued in four separate unscheduled and unannounced modules of 5 points apiece. Students' cumulative scores on these will generate their total scores out of the 20 points that the fifth assignment is worth.

Laboratory Exercises: Refresher Project (50 points)
Students will complete one individual project involving selected short laboratory exercises that include the use of computer and machine technology in basic CAD/CAM, CNC programming, material handling, machining, machine control, and other topics selected by the instructor.

A written report, including graphics and printouts will be required describing the experiences and activities of the exercise in relation to a CIM environment. A detailed description of the project will be provided at the scheduled date during the semester.

Team Project (120 points)
You will, in a small group, develop a product proposal involving a product and manufacturing technologies required to produce it. Each team will design a different and approved product, which consists of six or more parts (eight or more parts for an approved four-member team). Teams should identify a product that requires a flexible manufacturing system (FMS) made up of at least the following sub-systems: machines/machining centers, MHS, measurement/inspection, loading/unloading station, part washing station, and labor. The project is expected to include some aspect of product design, documentation, web design and management, scheduling, process planning, CNC programming, tool design, facility design and layout, simulation, written and oral presentations.

Students will obtain written approval for their topics and the proposal must be completed for presentation on the due date (see course semester schedule).
A title and outline (schedule) for the class project is due no later than the second week of team's formation. The completed project documentation is due on date scheduled (see class semester activity schedule). A detailed description of the project will be provided at the scheduled date during the semester. A comprehensive **oral presentation** of the project with appropriate visual aids will be required. The purpose is to give you experience in analyzing, organizing, writing, and presenting information on current manufacturing methods.

Term Paper (40 points)
Separate from the term project, which is product-centered, a term paper is required from each student. Students may propose any manufacturing-related topic with an

approved written outline. A tentative term paper outline and title are due as scheduled (see class semester activity schedule provided). The topic should be on a detailed description of any of the many CIM sub-systems discussed in class, but should be based on outside materials other than the course textbooks. Your paper must conform to the APA format. A more detailed format for this paper will be provided. The completed paper is also due on the scheduled date. The term paper report shall be from 4 to 8 pages, not including appendices and illustrations, and shall conform to specified class format.

Course Examinations (150 points)
There will be one midterm and one final examination, covering reading assignments, lectures, classroom discussions, field trips, and laboratory exercises. The midterm and final will be announced at least one week in advance, and will occur close to the dates scheduled for the course.

Pop Quizzes (30 points)
Three pop quizzes will take place occasionally during the semester.

Certified Manufacturing Specialist (CMS) and/or Certified Manufacturing Technologist (CMfgT) Examinations

This course encourages each student to take one of two professional exams. The selected exam serves several functions:

1) As soon-to-graduate seniors in manufacturing program, it gives students an opportunity to earn this certification for their future career growth, because earning the certification demonstrates your competence in the fundamentals of manufacturing,
2) As a result, it helps to improve your resumes by informing potential employers that you are well prepared for a manufacturing career,
3) It helps manufacturing students to assess and prepare themselves professionally for their future career goals because it helps them to know what are expected of them in the field, and
4) It helps the department to improve program assessment of manufacturing program, which is necessary for program upgrading, accreditation and other university requirements.

A) Association of Technology, Management and Applied Engineering's (ATMAE's) Certification Exam
The Certified Manufacturing Specialist (CMS) program is geared toward programs with a strong manufacturing emphasis and the exam was developed with help from ATMAE members working in such programs. The exam is an open book, 180-question, multiple choice examination with questions on 16 content areas of manufacturing, including: joining, casting, forming, machining, nontraditional machining, materials, quality, CIM, production planning, wood technology, metrology, supervision/management, technical drafting and electronics. The ATMAE certification program recognizes individual certified members who have met certain professional standards to become certified and to maintain their certification. A study guide with sample practice questions can be found at: http://www.atmae.org/?page=CertificationProgram. The **Department of Aviation and Technology will pay for this exam**.

B) Society of Manufacturing Engineers' (SME's) Certification Examination.
The Certified Manufacturing Technologist (CMfgT) exam takes three hours and consists of 130 multiple choice questions covering subjects including math, applied science, design, materials, manufacturing processes, manufacturing management, manufacturing economics, quality control, computer applications, and automation. All of the SME exams are meant to be taken as "open book" exams. Students are allowed to bring reference books and text books into the exam along with a non-programmable calculator. Resource material is available at SME's web site at: http://www.sme.org/cmfgt/. **This exam may be taken and paid for by interested students.**

Exam and Assignment Notes:

1. **At least one week's notice will be given of announcements and/or changes in forthcoming exams.**
2. **No make-up of examinations shall be given, except if an emergency arises. Such situations must be documented immediately.**
3. **All assignments are due as scheduled and must be typewritten or they will not be accepted.**
4. **NO PAPERS WILL BE ACCEPTED LATE UNLESS PROPER AND APPROVED WRITTEN PERMISSION HAS BEEN OBTAINED BEFORE THE DUE DATE.**
5. **Assignments are due at the BEGINNING of the class period on the designated due date or when the instructor asks for them.**

Class Participation

Class participation is critical for the success of the class as a whole and for your learning. You are expected to arrive at class meetings on time and stay for the entire period. If you need to do work elsewhere, you must inform your instructor of the details before leaving the class. If you miss periods at which your group is working it will affect your participation grade significantly.

Grading	**# Assigned**		**Points Each**		**Totals**
Class assignments	5	x	20	=	100
Refresher lab exercises (as project 1)	1	x	50	=	50
Quizzes	3	x	10	=	30
Team project & documentation	1	x	120	=	120
Term paper	1	x	40	=	40
Midterm exam	1	x	50	=	50
Final exam	1	x	100	=	100
Total					**495**

Grades will be computed from the ratio of total points achieved to total points possible: 97+% = A+, 93-96 = A, 90-92 = A-; 87+% = B+, 83-86 = B, 80-82 = B-; etcetera.

Course Delivery

The course provides for about five hours per week of class time. One to two hours will

be used for lectures, exams, discussions, and presentations. Three hours will be provided for laboratory exercises (after the second week), and field trips (when possible) will take place at either time.

University Policy Information

a) Academic integrity statement (from Office of Student Conduct and Ethical Development):

Your own commitment to learning, as evidenced by your enrollment at San José State University, and the University's Academic Integrity Policy requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the Office of Student Conduct and Ethical Development. The policy on academic integrity can be found at (http://www.sjsu.edu/studentconduct/).

b) Campus policy in compliance with the Americans with Disabilities Act:

If you need course adaptations or accommodations because of a disability, or if you need special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with DRC to establish a record of their disability.

Computers and Other Laboratories

Most of the lab work for this class will take place in the advanced manufacturing systems lab, E101 and its adjoining lab E 103. Industrial Studies rooms 119 and 122 may also be used but have no computers. E 390 may also be available for limited work.

- For labs in which this class does not have priority (i.e. scheduled), request permission to work in the lab ahead of time, and announce yourself to the instructor in charge each time you arrive.
- Obey lab rules, clean up your work area and return the system or machine to the condition and state (on/off, cleaned, covered, etcetera) it was in when you arrived.

If you are found working in a lab without instructor permission, you will lose lab privileges altogether.

- No copying of software will be tolerated IN ANY LAB, and
- Storage devices which have program files on them may not be used.
- You are not permitted to load ANY programs on ANY computer without express permission from the lab director.
- Do not unplug, move or reconfigure any workstation from its status.
- Lab time is to be used only for class projects, not for papers or work for other classes.
- No drinking is allowed in computer rooms. Do not leave soda cans and drinking cups sitting by your workstation. Spillage may occur.
- Students who abuse their laboratory privileges will lose those privileges.
- Read the handout provided on specific safety rules on using CNC and conventional machine tools

Course Schedule (Schedule subject to change with notice)

Wk	Week of:	Topic (lecture content)	Recommended Readings and

			Assignment Due Dates
	Class meets _____	When there is no lecture specified, you are expected to be working on your projects and/or assignments.	All assignments due as scheduled unless stated otherwise.
1	Jan. 30	• **Orientation to the class.** • Overview of methods and expectations. • **Assignment 1 issued**	• **Buy class text & materials.** • **Readings are from the required text:** 1. Groover, M. K. (2014). Automation, Production Systems, and Computer-Integrated Manufacturing (4th Edition). **2.** Outside Materials provided in class
2	Feb. 6	• Unit 1: Introduction to CIM • Lab: Description of lab activities and policies. • **Refresher project issued** • Assignment 1 continues	• Groover: Chapters 1, 2, 3 & 4 • Outside materials
3	Feb. 13	• Unit 1: Introduction to CIM • **Refresher project continues**	• Groover: Chapters 1, 2, 3 & 4 • **Assignment 1 Due**
4	Feb. 20	• Unit 2: CAD/CAM • **Refresher project continues** • Assignment 2 issued	• Groover: Chapters 7, 13 & 23
5	Feb. 27	• Unit 2: CAD/CAM • Work on assignment 2	• Groover: Chapters 7, 13 & 23 • **Refresher Project Due**
6	March 6	• Unit 3: Production Engineering and Other CIM Subsystems • **Team project begins**	• Groover: Chapters 14, 18, 19 & 24 • Outside materials • **Assignment 2 Due**
7	March 13	• Unit 3: Production Engineering and Other CIM Subsystems • Team project continues • Dynamics of team work • **Assignment 3 issued**	• Groover: Chapters 14, 18, 19 & 24 • Outside materials
8	March 20	• **Mid-Term Exam** • Team project continues • Work on assignment 3 • **Research paper introduced/begins**	• Outside materials
9	March ~~27 & 29~~	• **Spring Recess - no classes**	• **Spring Recess - no classes**
10	April 3	• Unit 4: Network Systems, Quality Systems, Manufacturing Planning, Control and Scheduling in CIM Environment	• Groover: Chapters 9, 20 & 25 • Outside materials • **Assignment 3 Due**

11	April 10	• Unit 4: Network Systems, Quality Systems, Manufacturing Planning, Control and Scheduling in CIM Environment • **Assignment 4 issued**	• Groover: Chapters 9, 20 & 25 • Outside materials
12	April 17	• Unit 5: Automated Manufacturing • Team project continues • Work on assignment 4	• Groover: Chapters 8, 10, 11, 16 & 22 • Outside materials
13	April 24	• Unit 5: Automated Manufacturing • Team project continues • Class review	• Groover: Chapters 8, 10, 11, 16 & 22 • Outside materials • **Assignment 4 Due**
14	May 1	• Team project continues • Class review	• Outside materials.
15	May 8	• **Research Presentation** • Team project continues	• **Research Report Due** • **Research Presentation Due**
16	May 15	• **Team project presentations** • **Lab Clean-up** • **Last Day of Class** • **Final exam review**	• Attendance mandatory • **Team project portfolio due** • **Team project presentations due**
Final exam is Thursday, May 18, 12:15 PM – 2:30 PM			

This schedule is subject to changes depending on circumstances in the course of the semester.

All assignments are due on Wednesdays unless changed by instructor.

Monday – Friday (March 27 – March 31) is Spring Recess - no classes
Friday March 31 is Cesar Chavez Day - Campus will be closed.