

MARION TECHNICAL COLLEGE
COURSE SYLLABUS STANDARD TEMPLATE

COURSE NUMBER & NAME: MFT1050 / 21 Semiconductor 101
TERM/YEAR: Spring 2024
DAY/TIME: T/Th 5-6:50PM
DEPARTMENT NAME: Engineering Technologies
TAG/OTM/OT36/CT2/CTAG¹
COURSE #:
(if applicable)
DELIVERY METHOD: Traditional
CREDIT HOURS: 4
COURSE REQUIREMENT(s):

INSTRUCTOR INFORMATION

INSTRUCTOR(s):
EMAIL/OTHER CONTACT INFO:
TELEPHONE:
BLDG/OFFICE NO:
OFFICE HOURS: *(for student support)*
IN CASE OF EMERGENCY: Dial 9-911 from any office or courtesy phone on-campus.

COURSE DESCRIPTION

In this course, a student will explore career opportunities within the semiconductor industry and learn how people effectively work in a cleanroom environment and adhere to chemical safety best practices. Students will be introduced to how semiconductor wafers are manufactured and processed to become an integrated circuit used in a variety of industries. Students will demonstrate problem-solving, critical thinking and communication skills while learning how the microelectronic manufacturing environment focuses on punctual delivery of products and tasks, according to the Standard Operating Procedure (SOP)/checklist.

COURSE MATERIALS

TEXTBOOK:
AUTHOR(s):
PUBLISHER:
YEAR/EDITION:
OTHER RESOURCES/ TEXTBOOK:

MAJOR COURSE LEARNING OBJECTIVES

Upon successful completion of this course, students will be able to:

¹ Approved TAG and OT36 courses carry the guarantee that the courses and their credits will transfer and apply toward the major at any of Ohio's public institutions of higher education, provided they were taken when the courses were equivalent. Additional Ohio transfer information may be obtained at <https://www.ohiohighered.org/>

1. Demonstrate the capability of working safely in a cleanroom environment by donning, wearing, and doffing a cleanroom suit (bunny suit).
2. Articulate how a semiconductor wafer is manufactured and processed to become an integrated circuit.
3. Explore career opportunities in the semiconductor industry and work efficiently and safely in a microelectronic manufacturing environment with a focus on on-time delivery of products and completion of tasks in a digital checklist or procedure.
4. Articulate chemistry and safety awareness in semiconductor manufacturing including gases used in plasma, gases used in thin film deposition, and chemistry used to clean silicon wafers.

COURSE OUTLINE

<u>INSTRUCTIONAL WEEKS</u>	<u>CHAPTER</u>	<u>TOPIC/ASSIGNMENT</u>
Week 1		Introduction to the Semiconductor Industry -Describe semiconductor processing. -Explore career opportunities and identify local semiconductor organizations. -Explain the purpose of a cleanroom in the semiconductor industry.
Week 2		Introduction to Cleanrooms Part A -Interpret a Safety Data Sheet and National Fire Protective Agency Diamond. -Explain appropriate use of PPE for handling and storing chemicals and responding to spills/exposure. -Describe gowning protocol safety and typical visual and audio safety indicators.
Week 3		Introduction to Cleanrooms Part B -Explain purpose and use of bunny suit in a cleanroom environment. -Describe process for donning and doffing PPE and test that it is functioning (operating) correctly. -Describe maintenance processes associated with a cleanroom as well as overall cleanliness of the technician.
Week 4		Nanotechnology, Semiconductor History and Fabrication Process Overview, Part A -Identify the basic processes, tools and chemistry involved in semiconductor manufacturing. -Explain the history of integrated circuit technology with a focus on function, size, power usage, and application. -Articulate a high-level broad overview of semiconductor manufacturing.
Week 5		Nanotechnology, Semiconductor History and Fabrication Process Overview, Part B -Describe a semiconductor product, such as a silicon wafer, and how becomes part of other products/technologies. -Complete a non-quantitative introduction to electricity.

<u>INSTRUCTIONAL WEEKS</u>	<u>CHAPTER</u>	<u>TOPIC/ASSIGNMENT</u>
		-Describe industrial chemicals and gases in use in the semiconductor industry.
Week 6		Semiconductor Materials Science -Identify the basic processes, tools and chemistry involved in semiconductor manufacturing. -Describe the concept of sizes used in the semiconductor processing industry. -Review the Neil Bohr model atom and the relation to electricity. -Describe how a wafer is made. -Demonstrate effective use of equipment and/or tools in the cleanroom environment. -Describe the typical work environment of semiconductor manufacturing technicians. -Describe industrial chemicals and gases.
Week 7		Semiconductor Devices- Ingot and Wafer Fabrication -Describe integrated circuit (IC) devices contain dopants of both n and p type. -Articulate the Czochralski process of going from sand to ingot to silicon. -Describe the size of wafers used in Integrated Circuits (IC) and MEMS devices. -Differentiate processes performed at a semiconductor fabrication facility from a foundry used in the manufacturing of integrated circuits (IC).
Week 8		Wafer Cleaning and Thin film Sputtering Part A -Describe the thin film sputtering process including a broad introduction to DC sputtering, RF sputtering, and ion beam sputtering/assisting. -Describe chemistry used in manufacturing processes to etch and clean semiconductors.
Week 9		Wafer Cleaning and Thin film Sputtering Part B -Describe/demonstrate removal of water and skin oils from wafer processing. -Describe the application of a spin rinse drier to silicon wafers. -Describe chemistry used in thin film deposition. -Describe/demonstrate high-level overview of thin film processing.
Week 10		Lithography -Describe a mask is and scale of the artwork on the mask -Describe a fiducial is and how it's used for alignment. -Describe the maintenance on photolithography systems. -Describe chemistry used to etch & clean semiconductors. -Describe photolithography and purpose of the "photoresist." -Explain the concept and safety of wavelengths of light. -Explain chemistry used in photoresist. -Describe the photoresist process.

<u>INSTRUCTIONAL WEEKS</u>	<u>CHAPTER</u>	<u>TOPIC/ASSIGNMENT</u>	
Week 11		Wet Etching -Explain photolithography processing, exposure, and development. -Describe oxidation both wet and dry. -Describe etching and how etching works with photolithography. -Explain wet chemical etching and chemical safety. -Differentiate Anisotropic and Isotropic etches.	
Week 12		Dry Etching -Identify the basic processes, tools and chemistry involved in semiconductor manufacturing dry etching. -Describe how plasma is used to clean or dry-etch a wafer and the overall process that uses vacuums. -Describe cleaning processes and maintenance processes around plasma RIE systems and their associated vacuum systems.	
Week 13		Diffusion Process -Differentiate historic methods of diffusion from newer processes of diffusion. -Explain the process of ion implantation. -Explain maintenance processes around diffusion systems and associated vacuum systems. -Describe chemistry used in semiconductor diffusion.	
Week 14		Thin Film Deposition-PVD and CVD -Describe Plasma Enhanced Chemical Vapor Deposition. -Explain materials processed using PECVD. -Describe atomic layer deposition. -Describe thin film sputtering. -Describe thin film evaporation using thermal and electron beam (e-beam) processing. -Explain maintenance required on vacuum systems. -Explain safety practices for major gases and chemicals used in PECVD.	
Week 15		Multi-Layer IC and Backend Process -Describe how cleaning, thin film deposition, etching, and photolithography are used to create multiple layers that constitute the fabrication of an integrated circuit (IC). -Explain the typical timeline of creating a multi-layer integrated circuit. -Describe the final steps in the wafers IC process. -Describe how the wafer is diced. -Describe packaging and the backend process.	
<u>EXAM WEEK*</u>	<u>DAY</u>	<u>TIME</u>	<u>LOCATION/ROOM</u>
Week 16*			
<p><i>*Exams <u>must</u> be held during exam week (the 16th week of the term), except for 8-week half session courses or the summer terms where exams are held on the last day the class meets for that term.</i></p>			

NOTE: This is a tentative schedule and subject to change at the discretion of the instructor.

ADDITIONAL INFORMATION:

Eating and drinking are not permitted in any computer classroom or lab. All copyright laws will be observed. It is illegal to copy software.

EVALUATION & GRADING PROCEDURES

ATTENDANCE AND PARTICIPATION:

Consistent with College Policy #520 – Class Attendance and as stated on Page 339 of the *MTC Policy Book*, <https://www.mtc.edu/about/pdfs/MTCPolicyBook.pdf>, the student is responsible for attending every class and for the material presented. If a student will not be attending a class, he or she is responsible to contact the instructor and to make sure all assignments are completed, prior to the scheduled class. Some departments have special provisions regarding missed work and absences. Please contact your instructor for additional information.

ONLINE CLASS ATTENDANCE:

GRADING PROCEDURES:

EXAMPLE: Three exams will be given. Each exam will consist of an objective section and a practical section. Each exam will be graded on the basis of 100 points and a total of 30 points for homework.

GRADING SCALE:

90 -100 = A
80 - 89 = B
70 - 79 = C
60 - 69 = D
0 - 59 = F

FINAL GRADE CRITERIA:

Quizzes----- 35%
Mid-----30%
Final-----35%

MAKE-UP AND LATE POLICY:

Make-up exams will be given only for excused absences as determined by the instructor. The instructor must be notified of the prospective absence prior to the time scheduled for the examination. The make-up exam may be a different exam than the exam given during the scheduled exam time.

CREDIT HOUR DEFINITION

Credit Hour: Marion Technical College subscribes to the federal definition of the “credit hour” endorsed by the Higher Learning Commission that typically requires students to work on out-of-class assignments a *minimum of twice the amount of time* as the amount of formalized instruction.

Examples:

Minimum Homework Hours Per Week for 3 Credit Course (16-Week Term)	
Delivery Format	Homework Per Week
Traditional	6 hours
Blended	6.75 – 8.25 hours
Online	9 hours

Minimum Homework Hours Per Week for 3 Credit Course (8-Week Term)	
Delivery Format	Homework Per Week
Traditional	12 hours
Blended	13.5 – 16.5 hours
Online	18 hours

COLLEGE GRADUATE COMPETENCIES

Assessment begins with a clear understanding of what students are expected to learn. College Graduate Competencies (CGC’s) are common to all areas of study and apply to all students. The individual sub-skills defined in each CGC are taught, reinforced, and/or periodically measured in various courses throughout the curriculum. The six CGC areas and statements are:

1. **Communications:** Communicate effectively both written and orally.
2. **Mathematics:** Solve problems using mathematics.
3. **Problem-Solving:** Solve problems through analysis, creativity, and synthesis to make informed decisions.
4. **Professionalism:** Demonstrate good work habits, effective interpersonal and teamwork skills, and a high level of professionalism.
5. **Technology:** Use technology tools efficiently and effectively to perform personal and professional tasks.
6. **Diversity:** Exhibit respect and sensitivity for individual and institutional differences.

COMMUNICATIONS DEVICE USAGE

All personal communication devices, including cell phones, must be set to vibrate or off while in classrooms, labs and participating in other class-related activities, unless the use of such a device is specified in the official course syllabus. Infractions will result in warnings and, eventually, grade-related penalties. Exceptions must be approved in writing by the instructor.

Additionally, all personal communication devices, including cell phones, must be deactivated (turned completely off) during exams, quizzes or other evaluations. Any student found to be using a communication device during an exam will be given a grade of zero for the exam.

EQUIPMENT REQUIREMENTS

Marion Technical College requires all students to obtain a computer with the following minimum specifications per program of study. Laptops are used in the classroom, outside of class using our learning management system, and Microsoft Office 365. Marion Technical College does not provide support of student-owned laptops.

Engineering Programs

Processor: i7 or better (note: Intel processor required)

RAM: 16 GB

SSD: 256 GB

Minimum Screen Size: 15.6"

Video Card for SolidWorks

Windows Operating System

Internet Connection

Webcam

Information Technology Programs

Processor: i7 or better (note: Intel processor required)

RAM: 16 GB

SSD: 256 GB

Minimum Screen Size: 15.6"

Windows Operating System

Internet Connection

Webcam

All Other Programs

Processor: i5/Ryzen 5

RAM: 8 GB (4 GB would also work – 8 GB gives flexibility if requirements change)

SSD: 256 GB

Minimum Screen Size: 15.6"

Windows Operating System

Internet Connection

Webcam

Frequently Used Software

Marion Technical College utilizes Microsoft Office 365. As such students get free access to Microsoft Office 365.

Note: Tablets, iPads, MacBooks, and Chromebooks will not meet the laptop requirements as they are unable to run Microsoft 365 ProPlus.

ACADEMIC MISCONDUCT

Examples of dishonest or unacceptable scholarly practice at Marion Technical College include but are not limited to:

- A. Work copied verbatim from an original author; work copied practically verbatim with some words altered from the original without proper credit, i.e., reference citations, being given; a copyright explanation and more information is available at www.copyright.com.
- B. Copying answers [and/or electronic data] from another's test paper, quizzes, notes, book, etc.
- C. Evidence of a deliberate and calculated plan to engage in a dishonest academic practice, such as gaining access to examinations prior to the time the exam was to be given or the extraction of information regarding an examination from other students.
- D. Falsification of clinical, practicum, or laboratory records.
- E. Plagiarism – using someone else's ideas or words as your own. In an educational setting you can avoid plagiarism by providing appropriate source documentation. For more information on plagiarism, visit www.plagiarism.org.
- F. Unauthorized collaboration with others or use of prior work (e.g., submitted for another assignment in a different course) without permission or citation (if previously published).

It is important to note that if AI tools like chatGPT are permitted to be used for an assignment, then they should be used with caution and proper citation. AI is not a replacement for your own thinking and research.

Turnitin Disclaimer

Marion Technical College has partnered with the third-party application Turnitin to help maintain our standards of excellence in academic integrity. Turnitin is a suite of tools that provide instructors with information about the authenticity of submitted work and facilitates the process of grading for instructors. Submitted files are compared against an extensive database of content. Turnitin produces a similarity report and a similarity score, which is the percentage of a document that is similar to content held within the database. A similarity report gives the instructor more information about any potential matches and their sources. Turnitin does not determine if an instance of plagiarism has occurred. Instead, it gives instructors the information they need to determine the authenticity of work as a part of a larger process. All submissions to this course may be checked using Turnitin.

Note: Please also see the Academic Misconduct section in the ***Student Handbook*** on the college website at <http://www.mtc.edu/>

FINANCIAL AID ATTENDANCE REPORTING

Marion Technical College is required by federal law to verify the enrollment of students who participate in Federal Title IV student aid programs (Federal grants and student loans) and/or who receive educational benefits through the Department of Veterans Affairs. It is the responsibility of the College to identify students who do not commence attendance or who stop attendance in any course for which they are registered and paid. Non-attendance is reported by each instructor, and can result in a student being administratively withdrawn from the class section. Please contact the Financial Aid Office for information regarding the impact of course withdrawals on financial aid eligibility.

BELONGING AND EQUITY

Marion Technical College is committed to providing equal opportunities for all students, and does not discriminate on the basis of age, ancestry, color, disability, ethnicity, gender, gender identity and expression, genetic information, medical status, military status, national origin, nursing parent status, pregnancy, race, religion, sex, sexual orientation, parent and foster parent status, protected veteran status, or any other bases under the law. As a community, we celebrate difference and value the worth of every individual. To report any form of discrimination or harassment, follow the link to the online [Student Complaint Form](#).

ACCOMMODATIONS FOR DISABILITIES

If a student has any kind of visible or non-visible disability -- learning, emotional, physical, health, or cognitive - - and needs possible accommodations to fully participate in all aspects of this course, they should contact the Office of Student Disability Services as early as possible to discuss reasonable accommodations for their access needs. The Office of Student Disability Services is located in BR176; the phone number for the Office of Student Disability Services is 740.386.4222, or email Jenifer Montag, Director of the Office of Disability Services, at montagj@mtc.edu or DS@mtc.edu. If students already have a diagnosis, Disability Services can help them document their needs and create an accommodation plan. By making a plan through Disability Services, students can facilitate appropriate accommodations without disclosing their condition or diagnosis to their course instructor(s). If students don't have a diagnosis, please contact DS to see what would be needed from the student to support the request for accommodations.

RELIGIOUS AND SPIRITUAL ACCOMMODATIONS

Students may request up to three absences per academic term to observe holidays or organized activities that align with their religion, faith, or spiritual belief system ("sincerely held religious belief"). In accordance with state law (Ohio Revised Code 3345.026), students must submit written notice to their instructor(s) of the expected dates of absence within the first 14 calendar days of the course(s). Instructors will provide appropriate academic accommodations if an absence for a sincerely held religious belief coincides with coursework, quizzes, exams, etc. The College's complete policy can be found on the College website and in the student handbook. Questions about this accommodation process can be directed to woughterl@mtc.edu.

TITLE IX NON-DISCRIMINATION FOR STUDENTS

No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any educational program or activity receiving Federal financial assistance.

- Sexual harassment and acts of sexual violence such as rape, sexual assault, sexual exploitation, dating violence, domestic violence, are forms of sex discrimination prohibited.
- Also non-discrimination for students experiencing pregnancy/childbirth/parenting impacts on their education.

Report any discrimination, or ask questions of the Title IX Coordinator.

- Title IX Coordinator: Cretia Johnson (johnsonc@mtc.edu; (740) 386-4195)
- Pregnancy/Childbirth/Parenting adjustments or concerns – contact Jenifer Montag, Director MTC Disability Services (montagj@mtc.edu; (740) 386-4222)

ADDITIONAL RESOURCES

The following information is provided to help make students more aware of resources which may aid in their academic success such as tutoring, disability services, academic advising, financial aid, emergency procedures, etc.

Academic Advising:

All students at MTC are assigned to an academic advisor. Your advisor is available to guide you in course selection and registration, assist you with career and academic planning, discuss your academic difficulties and personal goals, and refer you to campus and community resources to support your success. If you are not sure of your advisor's name or contact information, log-in to My Plan through My MTC. You can also check with your academic department secretary or the Center for Student Success and Engagement (BR 176).

Tutoring:

MTC offers free one-on-one, small group, and online tutoring services for many of the classes you take at MTC. If you are having difficulties in a course, it is very important to seek out assistance as soon as possible so you do not fall behind. For more information about tutoring, please contact David Richman at TUTORING@mtc.edu or 740-386-1193 or stop by BR 193.

Your instructors want to see you succeed and are also available to answer questions before, during, and after class as well as during weekly office hours (office hours are designated times set aside to meet with students each week).

Drug/Alcohol & Mental Health Concerns:

MTC has a licensed mental health counselor on staff to help you with personal matters that may impact your studies and academic performance. Contact Mike Stuckey at stuckeym@mtc.edu or 740-386-4171 if you believe a counselor can be of assistance regarding topics such as depression, anxiety, feeling overwhelmed, managing stress, difficulties making decisions, or substance abuse.

Student Assistance Program (SAP):

This new resource provides you and members of your household with confidential mental health support, resources, and information for personal and school-life balance issues. This includes short-term clinical counseling (up to 5 sessions free), legal support, financial information, and online resources through GuidanceResources 24/7/365. To access your benefits, call 833-955-3384 or visit www.guidanceresources.com and enter School ID: MTC Student.

MTC Connections Center:

MTC recognizes that students often face challenges outside of the classroom which impact their academic success. Any student who is experiencing food insecurity (limited/lack of food), housing insecurity or homelessness, transportation issues, limited access to childcare, or any other concern is encouraged to reach out to the MTC Student Resource Navigator. You can reach the Connections Center at CONNECTIONSCENTER@mtc.edu or visit the Connections Center in Bryson Hall 143.

The Marion Campus Food Pantry and Fresh Express Market (free fresh produce are available to all students, regardless of income, to address food insecurity and hunger) has two locations – one in the Alber Student Center and one in the Connections Center (BR 143). You must present your student ID. Hours vary by term. Please check your MTC email, campus signage, or visit the Connections Center for more information.

Financial Aid:

Regularly attending class is critical in achieving academic success. If you receive some form of financial aid, such as the Pell Grant and/or the Federal Direct Student Loan, federal regulations require you to attend classes. In part, this is why your instructor records attendance. Maintaining satisfactory academic progress (SAP) is important in preserving your future eligibility for financial resources. If you ever have questions or concerns, please contact the Office of Financial Aid.

Emergency Procedures

MTC is committed to providing a safe and secure environment for students. We want you to have the resources and knowledge that aid your response to emergency situations in an appropriate and confident manner. MTC shares Public Safety Services with the Ohio State University at Marion (OSUM) and employs police officers. Additionally, MTC and OSUM contracts with the Marion County Sheriff's Office to cover campus security when needed.

“Buckeye Alert” Emergency Notification System:

MTC students are automatically signed up to receive campus wide emergency notifications when they provide their cell phone number during the admission process. Buckeye Alert will be used to notify the campus community of campus wide emergencies, closings, and crime alerts. Emergency notifications for the campus may be generated by the OSU Public Safety Services. Phone numbers are not related to other parties and are strictly used for emergency notifications only.

911 Emergencies:

In the event of a medical, fire, or safety/security incident requiring an emergency response, please call 911. Phones are located in most MTC classrooms.

Emergency Personnel	Phone Number
Marion Campus Public Safety (Non-Emergency)	740-725-6300
Marion County Sheriff's Office (Non-Emergency)	740-382-8244
Marion Township Fire Department (Non-Emergency)	740-387-5404

Public Safety Escort:

A safety escort is available during campus hours. The service is free and requires your MTC identification card. To arrange a safety escort, contact the Marion Campus Public Safety Office at 740-725-6300.

Active Shooter:

Be familiar with your options in the event of an active shooter. If you can escape, do so immediately! Run away from the campus. If you cannot escape, lock and barricade the door. Remain quiet and silence all electronic devices and phones. Do NOT huddle together or stay close. Spread out in the room and develop a way to attack the shooter if they enter the room. An informative six-minute video “Surviving an Active Shooter” is available for viewing at <https://youtu.be/9Z9zkU--FLQ>. We encourage you to watch this video to better prepare should an active shooter incident take place on campus.

Building Evacuation Maps:

There are building evacuation maps located in each campus building. Maps in the single floor buildings are located near the doors. Maps are located in multiple floor buildings at the top of each staircase. The maps include the following information: exit and exit routes (for evacuation), assembly points (to meet in the event of an evacuation), severe weather shelter areas (in the event of a tornado or inclement weather), and AEDS (Automated External Defibrillator – for use in the case of a heart attack).

Be prepared in the event of an emergency. Familiarize yourself with the maps in each building you utilize. Note where the fire extinguishers are located in each building along with fire alarm pull stations.

Emergency Procedures Flip Charts:

Familiarize yourself with the quick reference flip charts, conveniently hung on hooks in all classrooms and department areas close to the doors. They provide information on various emergency procedures and contain safety information that is beneficial for you to know.

MTC Website:

Additional safety and security information can be found online at <https://www.mtc.edu/current-students/health-safety-services>, or go to the MyMTC website and scroll down to Campus Resources. Note: Some links will route you to the OSU Safety and Security website.

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