

# MICRO-ELECTROMECHANICAL SYSTEMS (MEMS)

## **MEMS 122, INTRODUCTION TO MICRO-ELECTROMECHANICAL SYSTEMS (MEMS) 4 (6)**

The course introduces the theory, terminology, application, and hands-on industry practices of the emerging field of microelectronic manufacturing. Topics include: hand soldering and rework of surface mount technology on printed circuit boards, hand dexterity practices of hand-soldering millimeter scale components, manufacturing of printed circuit boards, semiconductor integrated circuits, and microelectromechanical system sensors, integration of Micro-electromechanical systems electronic products, and good electronic manufacturing practices. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1

**Typically Offered:** Summer, Fall and Spring Semesters

## **MEMS 124, PRINTED CIRCUIT BOARD TEST & TROUBLESHOOTING 3 (3)**

This course prepares students to repair and rework electronic products and printed circuit boards while introducing them to using a computer with Microsoft Office and Excel for recording and manipulating data. Students will use electronic test equipment and soldering equipment to repair circuit boards to a functional state. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1, IN2

**Course Entry Requirement(s):** Concurrent: ELCT 111 and MEMS 122

**Typically Offered:** Summer, Fall and Spring Semesters

## **MEMS 132, MEMS PACKAGING 3 (4)**

The course focuses on microelectronic integrated circuit (IC) and chip-on-board packaging. The student will be introduced to common packaging techniques and equipment used in the industry such as epoxy die attach, setup and operation of a thermosonic wire bonder, mechanical strength testing of wire bonds, chip encapsulation, chip-on-board processes, and microscope metrology. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1

**Course Entry Requirement(s):** Prerequisite: MEMS 122

**Typically Offered:** Summer, Fall and Spring Semesters

## **MEMS 134, THRU-HOLE MANUFACTURING 2 (2)**

This course introduces a student to thru-hole soldering, wire crimping, cable harnessing, and thru-hole processing using high-volume manufacturing equipment such as a wave solder system or selective solder system. Students will work independently as well as on a slide line team to manufacture circuit boards with thru-hole components and cables. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1, IN2

**Course Entry Requirement(s):** Concurrent: MEMS 122

**Typically Offered:** Summer, Fall and Spring Semesters

## **MEMS 136, INTRODUCTION TO SEMICONDUCTORS AND CLEANROOM PROCESSING 4 (6)**

This course is an introduction to semiconductor and integrated circuit manufacturing from a technician and maintenance perspective. In lecture, students will learn about what a cleanroom is, why it's important to gown up to work in a cleanroom and have a broad non-quantitative introduction to semiconductor processing such as diffusion, thin film vacuum deposition, photolithography, and plasma reactive ion etching. All students will understand academic and career fields in semiconductor processing. Students will also work in a cleanroom environment on a weekly basis learning how to don & doff a bunny suit, use a computer with Microsoft Teams for accessing & following operating procedures and checklists while observing safety, and use hand-tools to perform maintenance on mechanical fasteners and fixtures. Laboratory required.

**General Education:** IN1, IN2, IN5

**Typically Offered:** Fall Semester

## **MEMS 146, VACUUM SYSTEMS FOR SEMICONDUCTORS 3 (4)**

This class focuses on the mechanical maintenance, processing, and data collection of vacuum systems typically used in semiconductor processes such as thin film deposition, ion implantation, and reactive ion etching. Lectures consist of a introduction to the use of vacuum pumps in semiconductor manufacturing and how to measure vacuum pressure within a multi-pump system. Students will gown up in a bunny suit and work in a cleanroom environment to work with vacuum systems, measure quantities of pressure, and check piping for pressure leaks while recording data on Microsoft Teams. Laboratory required.

**General Education:** IN1, IN2

**Course Entry Requirement(s):** Prerequisite: MEMS 136; Concurrent: MTHM 155

**Typically Offered:** Spring Semester

## **MEMS 211, SEMICONDUCTOR PROCESSING 3 (4)**

The course focuses strongly on the theory, terminology, application and hands-on industry practices in silicon wafer fabrication and Printed Wiring Board (PWB) fabrication with continued practice in working in a cleanroom. Topics include photolithography, chemical etching, silicon oxidation, diffusion, ion implantation, and thin film vacuum deposition. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1, IN2, IN5

**Course Entry Requirement(s):** Prerequisite: ELCT 111 and MEMS 132; Concurrent: CHMY 171

**Typically Offered:** Fall and Spring Semesters

## **MEMS 221, MICRO-SYSTEM CAPSTONE PROJECT 3 (4)**

This course is a capstone project built upon the previous Micro-electromechanical systems (MEMS) classes. The student will design, assemble, and test multiple printed circuit boards (PCB) with sensor(s) or environment interacting elements which will then be packaged and reproduced within the Micro-electromechanical systems (MEMS) cleanroom. Demonstrated circuits are to be fully functional meeting all specifications provided by the instructor at the beginning of class. The student will utilize skills and education learned in electronics (ELCT), computer aided drafting (CADD), and previous MEMS classes to design both electrical schematic and computer-aided artwork of PCB layout to specifications and then assemble PCBs by stencil printing, pick & place of Surface-Mount Technology (SMT) parts and solder reflow. A technical report with full operating procedure is also due at the end of class. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1

**Course Entry Requirement(s):** Prerequisite: MEMS 132; Concurrent: CADD 111 and ELCT 233

**Typically Offered:** Spring Semester

**MEMS 287, WORK-BASED LEARNING I - MEMS 1-3 (1)**

This course documents a student's supervised paid work experience with approved employer(s) and with work related to the student's program.

Emphasis is placed on integrating prior or concurrent classroom learning with work experience through career readiness competencies. Students will be able to evaluate career selection and satisfactorily demonstrate work-related competencies.

**General Education:** IN1, IN2, IN3, IN4

**Course Entry Requirement(s):** A student must be pursuing a degree seeking program at LCCC; have completed 12 semester hours with a minimum of 6 semester hours in the discipline of placement; have a min GPA of 2.5 in the discipline and a 2.0 overall GPA; and have division approval.

**Typically Offered:** Offer as required

**MEMS 288, WORK-BASED LEARNING II - MEMS 1-3 (1)**

Building on experiences from Work Based Learning I, this course documents a student's supervised paid work experience with approved employer(s) and with work related to the student's program. Emphasis is placed on integrating prior or concurrent classroom learning with work experience through career readiness competencies. Students will be able to evaluate career selection and satisfactorily demonstrate work-related competencies.

**General Education:** IN1, IN2, IN3, IN4

**Course Entry Requirement(s):** Prerequisite: MEMS 287

**Typically Offered:** Offer as required

**MEMS 289, WORK BASED LEARNING III - MEMS 1-3 (1)**

Building on experiences from Work Based Learning II, This course documents a student's supervised paid work experience with approved employer(s) and with work related to the student's program. Emphasis is placed on integrating prior or concurrent classroom learning with work experience through career readiness competencies. Students will be able to evaluate career selection and satisfactorily demonstrate work-related competencies.

**General Education:** IN1, IN2, IN3, IN4

**Course Entry Requirement(s):** Prerequisite: MEMS 288

**Typically Offered:** Offer as required

**MEMS 299, INDIVIDUALIZED STUDIES IN MICRO-ELECTROMECHANICAL SYSTEMS 1-3 (1)**

An in-depth study of areas in micro-electromechanical systems presented by discussion and/or individual research and reading. Topics will vary. Repeatable up to six (6) times for a total of six (6) credit hours.

**Course Entry Requirement(s):** Prerequisite: Second year standing and division approval

**Typically Offered:** Offer as required

**MEMS 311, PCB AND FLEX DESIGN 3 (5)**

This course introduces the student to the fundamental concepts of Printed Circuit Board (PCB) design and designing for manufacturing using typical PCB design, simulation, and implementation software. Topics include design based in general rigid Printed Circuit Board (PCB) materials, flexible substrate Printed Circuit Board (PCB) materials, circuit schematic implementation, revision documentation, bill of materials (BOM) generation, Computer-Aided Design (CAD) layout with comparison of electronic design vs. physical design, multilayer auto-router, Gerber (GBR) file generation, and designing a Printed Circuit Board (PCB) to be manufactured on a manufacturing line. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1, IN2

**Course Entry Requirement(s):** Prerequisite: MEMS 221 and MEMS 288, 2.0 GPA in previous MEMS coursework and admission into a bachelor's degree program or division approval; Concurrent: TECN 115

**Typically Offered:** Fall Semester

**MEMS 321, PCB ASSEMBLY 3 (4)**

The course focuses on the training in the operation and programming of automated high-volume equipment used in the manufacturing of printed circuit board (PCB) and surface mount technology (SMT) electronic assembly. Student will be required to read and understand documentation on the standards of electronic assembly related to SMT process engineering while training on high-volume SMT electronic assembly as an operator. Equipment operation includes stencil printers for solder paste dispense, programmable SMT pick & place, belt driven convection reflow ovens, ESD preventative tools and stereo microscope or lens-based inspection equipment. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1, IN2

**Course Entry Requirement(s):** Prerequisite: MEMS 311; Concurrent: ELCT 115 and MEMS 221

**Typically Offered:** Spring Semester

**MEMS 322, SMT MANUFACTURING 3 (4)**

The course focuses on the training in the operation and manufacturing recipe revision of automated high-volume equipment used in the manufacturing of printed circuit board (PCB) and surface mount technology (SMT) electronic assembly. Student will be required to read and understand documentation on the standards of electronic assembly related to surface mount technology (SMT) process engineering while training on high-volume surface mount technology (SMT) electronic assembly equipment as an operator. Equipment operation includes stencil printers for solder paste dispense, solder paste inspection, programmable surface mount technology (SMT) pick & place, belt driven convection reflow ovens, automated optical inspection, Electrostatic discharge (ESD) preventative tools and stereo microscope or lens-based inspection equipment. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1, IN2

**Course Entry Requirement(s):** Prerequisite: MEMS 311 or division approval

**Typically Offered:** Spring Semester

**MEMS 323, SMT PROGRAMMING 3 (4)**

A course about programming a Surface Mount Technology (SMT) pick & place manufacturing line. Students will learn how to use software to program, simulate, and optimize a printed circuit board (PCB) manufacturing line with one or multiple Surface Mount Technology (SMT) pick & place equipment. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1, IN2

**Course Entry Requirement(s):** Prerequisite: MEMS 311 or division approval; Concurrent: MEMS 322 and TECN 345

**Typically Offered:** Spring Semester

**MEMS 387, WORK-BASED LEARNING - MEMS 1-3 (1)**

Building on prior Work Based Learning experience(s), This course documents a student's new or continued supervised paid work experience with approved employer(s) and with work related to the student's program. Emphasis is placed on integrating prior or concurrent classroom learning with work experience through career readiness competencies. Students will be able to evaluate career selection and satisfactorily demonstrate work-related competencies.

**General Education:** IN1, IN2, IN3, IN4, IN5

**Course Entry Requirement(s):** Prerequisite: MEMS 287, Prerequisite: Admission into a Bachelor's Degree Program and MEMS 288 or division approval

**Typically Offered:** Offer as required

**MEMS 388, WORK BASED LEARNING - MEMS 1-3 (1)**

Building on prior Work Based Learning experience(s), this course provides supervised, paid work experience with approved employer(s) in an area related to the student's program. Emphasis is placed on integrating prior or concurrent classroom learning with work experience through career readiness competencies. Students will be able to evaluate career selection and satisfactorily demonstrate work-related competencies.

**General Education:** IN1, IN2, IN3, IN4, IN5

**Typically Offered:** Offer as required

**MEMS 411, PCB INSPECTION & REWORK 3 (4)**

The course focuses on the training in the operation and programming of equipment used in quality inspection and failure analysis of manufactured printed circuit boards (PCB) and surface mount technology (SMT). Students will be required to read and understand documentation on the standards of PCB testing and inspection related to SMT process engineering while training on PCB test & inspection equipment to identify, report on, and repair/rework PCB. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1, IN2

**Course Entry Requirement(s):** Prerequisite: MEMS 321

**Typically Offered:** Fall Semester

**MEMS 412, AOI PROGRAMMING 3 (4)**

The course focuses on the training in the operation and programming of equipment used in visual quality inspection and failure analysis of manufactured printed circuit boards (PCB) with surface mount technology (SMT). Students will be required to read and understand documentation on PCB inspection related to surface mount Technology (SMT) process engineering while training on PCB inspection equipment to identify visual defects on a Printed Circuit Board using an automated optical inspection (AOI) system and programming the AOI system to detect visual defects by color of inspected pictures. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1, IN2

**Course Entry Requirement(s):** Prerequisite: MEMS 322 or division approval

**Typically Offered:** Fall Semester

**MEMS 413, BGA REWORK & X-RAY INSPECTION 2 (2)**

This course is about reworking and repairing circuit boards with ball grid array (BGA) chips as well as inspecting BGA chips with an x-ray inspection tool. Students will use a BGA rework station to rework ball grid array (BGA) chips, use an x-ray inspection microscope to inspect BGA chips before and after rework, as well as learn the principles of repair of ball grid array (BGA) by re-balling. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1, IN2

**Course Entry Requirement(s):** Prerequisite: MEMS 322 or division approval

**Typically Offered:** Spring Semester

**MEMS 421, SENIOR PROJECT - NEW PRODUCT INTRODUCTION 3 (4)**

The course will require a student to work in a pre-determined team with the purpose of manufacturing a batch of identical printed circuit boards (PCB). Student teams will program manufacturing equipment, create manufacturing documentation for assembly, verify multiple working printed circuit boards (PCB) both by inspection and demonstrated test, and write a quality report verifying green-light ready for volume manufacturing based on a successfully produced batch of New Product Introduction (NPI). The class will also require a group presentation, group report, and student peer review. Laboratory required. (A special fee will be assessed.)

**General Education:** IN1, IN2

**Course Entry Requirement(s):** Prerequisite: MEMS 412 or division approval

**Typically Offered:** Spring Semester

**MEMS 487, WORK BASED LEARNING MEMS 1-3 (1)**

Building on prior Work Based Learning experience(s), this course provides supervised, paid work experience with approved employer(s) in an area related to the student's program. Emphasis is placed on integrating prior or concurrent classroom learning with work experience through career readiness competencies. Students will be able to evaluate career selection and satisfactorily demonstrate work-related competencies.

**General Education:** IN1, IN2, IN3, IN4, IN5

**Course Entry Requirement(s):** Prerequisite: MEMS 387

**Typically Offered:** Offer as required