

# MECHATRONICS (MTX)

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| <b>Industrial</b>   | <b>Safety</b>       |                 |
| MTX 100   |                     | 1 Credit/Unit   |
| 1.0 hours of lecture  |                     |                 |
| Introduction to the general safety practices and information needed while working in a manufacturing setting. Material will include federal safety regulations, safe operations and practices in the technical crafts of the industry. [GE]   |                     |                 |
| <b>DC</b>   | <b>Fundamentals</b> |                 |
| MTX 101   |                     | 3 Credits/Units |
| 1.0 hours of lecture / 4.0 hours of lab   |                     |                 |
| <b>Prerequisite:</b> MTX 100 and MTX 103 (grades of "C" or higher) and (PTCS 110 (grade of "C" or higher) or Placement into Math Level 30). Fundamentals of DC circuits with emphasis on algebraic analysis of resistive networks. Includes hands-on experience in DC circuit construction, measurement and troubleshooting. [GE]   |                     |                 |
| <b>AC</b>   | <b>Fundamentals</b> |                 |
| MTX 102   |                     | 4 Credits/Units |
| 2.0 hours of lecture / 4.0 hours of lab   |                     |                 |
| <b>Prerequisite:</b> MTX 101, MTX 106, and MTX 180 (grades of "C" or higher) and (PTCS 110 (grade of "C" or higher) or Placement into Math Level 30). Fundamentals of AC resistive, capacitive and inductive networks with emphasis placed on methods of analysis and circuit characteristics. Includes hands-on experience in AC circuit construction, measurement, and troubleshooting. [GE]        |                     |                 |
| <b>Basic</b>  | <b>Measurement</b>  | <b>Tools</b>    |
| MTX 103   |                     | 2 Credits/Units |
| 1.0 hours of lecture / 2.0 hours of lab   |                     |                 |
| Fundamentals of measurement tools. Topics include basic measurement, S.I. and U.S. customary measurement, precision measurement tools and dimensional gauging. [GE]   |                     |                 |
| <b>Fluid</b>  | <b>Power</b>        | <b>Systems</b>  |
| MTX 106   |                     | 4 Credits/Units |
| 2.0 hours of lecture / 4.0 hours of lab   |                     |                 |
| <b>Prerequisite:</b> MTX 100 and MTX 103 (grades of "C" or higher) and (PTCS 110 (grade of "C" or higher) or Placement into Math Level 30). Explore the fundamentals of fluid power systems, both compressible and non-compressible fluid types. Engage in various hands-on activities to solidify their understanding of fluid power concepts, components and circuit configuration and design. [GE] |                     |                 |
| <b>Electric</b>   | <b>Motor</b>        | <b>Control</b>  |
| MTX 110   |                     | 1               |
| 2.0 hours of lecture / 4.0 hours of lab   |                     |                 |
| <b>Prerequisite:</b> MTX 102, MTX 130, and MTX 132 (grades of "C" or higher). Fundamentals of electric motor control. Topics include electrical safety, control transformers, overload protection, ladder logic, control relays, electronic sensors, and other topics related to the fundamental operation of electronic motor control. [GE]  |                     |                 |
| <b>Semiconductors</b>   |                     | <b>I</b>        |
| MTX 121   |                     | 3 Credits/Units |
| 1.0 hours of lecture / 4.0 hours of lab   |                     |                 |
| <b>Prerequisite:</b> MTX 110 and MTX 140 (grades of "C" or higher). Fundamentals and applications of diodes, transistors and special-purpose semiconductor devices. Includes hands-on experience in semiconductor circuit construction, measurement and troubleshooting. [GE]   |                     |                 |

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|--|----------------|---------------------------|-----------------|
| <b>Programmable</b>  | <b>Logic</b>   | <b>Controllers</b>        | <b>1</b>        |
| MTX 130  |                |                           | 4 Credits/Units |
| 2.0 hours of lecture / 4.0 hours of lab  |                |                           |                 |
| <b>Prerequisite:</b> MTX 101, MTX 106, and MTX 180 (grades of "C" or higher) and (PTCS 110 (grade of "C" or higher) or Placement into Math Level 30). Introduction to programmable logic controllers. Topics include basic programming of PLCs, PLC motor control methods, discrete I/O interfacing, event sequencing, timers, counters and program control instructions. [GE]   |                |                           |                 |
| <b>Siemens</b>   | <b>PLC</b>     | <b>Lvl</b>                | <b>I</b>        |
| MTX 132  |                |                           | 4 Credits/Units |
| 2.0 hours of lecture / 4.0 hours of lab  |                |                           |                 |
| <b>Prerequisite:</b> MTX 101, MTX 106, and MTX 180 (grades of "C" or higher) and (PTCS 110 (grade of "C" or higher) or Placement into Math Level 30). Introduction to Siemens programmable logic controllers. Topics include basic programming of PLCs, PLC motor control methods, discrete I/O interfacing, event sequencing, timers, counters and program control instructions. Exposure to the Sieman STEP 7 programming. May prepare them for Siemens PLC Level 1 certification. [GE]  |                |                           |                 |
| <b>Robotic</b>   |                | <b>Systems</b>            |                 |
| MTX 140  |                |                           | 4 Credits/Units |
| 2.0 hours of lecture / 4.0 hours of lab  |                |                           |                 |
| <b>Prerequisite:</b> MTX 102, MTX 130, and MTX 132 (grades of "C" or higher). Fundamentals of the pick and place robots using the SMC system. Topics include pneumatic robotic systems, preventive maintenance and troubleshooting as well as pneumatic robot control. Introduction to the articulated arm servo robot using the SMC system including basic robot operation, teach point programming, PC software programming, application development, flexible manufacturing cells, quality control and production control. [GE]     |                |                           |                 |
| <b>Electrical</b>  | <b>Power</b>   | <b>&amp; Distribution</b> | <b>Systems</b>  |
| MTX 145  |                |                           | 4 Credits/Units |
| 2.0 hours of lecture / 4.0 hours of lab  |                |                           |                 |
| <b>Prerequisite:</b> MTX 110 and MTX 140 (grades of "C" or higher). Fundamentals of residential, commercial, and industrial electrical wiring as it relates to mechatronics. Topics include an introduction to raceways, conduit bending, rigid conduit, flexible conduit, conductors, disconnects, overcurrent protection, conduit sizing, wire pulling techniques, electrical prints, electrical panels, wiring between panels, wire color coding, control system wiring, and wire bundling. [GE]                                    |                |                           |                 |
| <b>Mechatronics</b>  | <b>Systems</b> | <b>Fundamentals</b>       |                 |
| MTX 175  |                |                           | 3 Credits/Units |
| 2.0 hours of lecture / 2.0 hours of lab  |                |                           |                 |
| <b>Prerequisite:</b> MTX 110 and MTX 140 (grades of "C" or higher). Fundamentals of mechatronic systems troubleshooting. Topics include mechatronics safety, automation operations, open and closed-loop control systems, system block diagrams, block diagram transfer functions, system troubleshooting using block diagrams down to component level, manual operation methods used to troubleshoot automated systems, component adjustments, applications with pneumatic and electric integrated pick and place robot systems. [GE] |                |                           |                 |

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|--|--------------|-------------------|---|---------------------|---------------------|
| <b>Mechanical Systems</b>  |              |                   | <b>Laser Alignment</b>  |                     |                     |
| MTX 180  |              | 5 Credits/Units   | MTX 230   |                     | 2 Credits/Units     |
| 2.0 hours of lecture / 6.0 hours of lab  |              |                   | 1.0 hours of lecture / 2.0 hours of lab   |                     |                     |
| <b>Prerequisite:</b> MTX 100 and MTX 103 (grades of "C" or higher) and (PTCS 110 (grade of "C" or higher) or Placement into Math Level 30). Topics include mechanical power transmission safety, machine installation, motor mounting, shaft speed measurement, torque and power measurement, v-belt, chain and spur gear drives, heavy-duty v-belts, v-belt selection and maintenance, synchronous belt drives, lubrication concepts, precision shaft alignment techniques and heavy duty chain drives, various bearing types as used in mechanical drive systems as well as advanced gear drives, plain bearings, ball bearings, roller bearings and anti-friction bearings, as well as gaskets and seals. Advantages and disadvantages of each system type will be discussed and compared. [GE] |              |                   | <b>Prerequisite:</b> MTX 110 and MTX 140 (grades of "C" or higher). Introduction to the concept and proper practices of laser alignment. Topics include laser shaft alignment, including rough and precision alignment, soft foot correction and analysis. [GE]   |                     |                     |
| <b>Cooperative</b>   | <b>Work</b>  | <b>Experience</b> | <b>Digital</b>  | <b>Electronics</b>  | <b>Fundamentals</b> |
| MTX 199  |              | 1-5 Credits/Units | MTX 232   |                     | 3 Credits/Units     |
| 15.0 hours of clinical   |              |                   | 1.0 hours of lecture / 4.0 hours of lab   |                     |                     |
| Work-based learning experience that enables students to apply specialized occupational theory, skills and concepts. Specific objectives are developed by the College and the employer. [GE]  |              |                   | <b>Prerequisite:</b> MTX 221, MTX 224, and MTX 250 (grades of "C" or higher) Fundamentals and system applications of digital integrated circuits. Digital integrated circuit fundamentals consisting of: numbering systems, number conversion and coding, digital logic gates, combinational logic, flip-flops, counters, shift registers, and memory devices, with circuit applications. Digital circuit building, operation, and troubleshooting, ending with an introduction to microprocessor architecture, instructions, and operation. [GE]   |                     |                     |
| <b>Mechatronics</b>  | <b>2</b>     |                   | <b>Process</b>  | <b>Control</b>      | <b>Systems</b>      |
| MTX 216  |              | 5 Credits/Units   | MTX 240   |                     | 6 Credits/Units     |
| 3.0 hours of lecture / 4.0 hours of lab  |              |                   | 3.0 hours of lecture / 6.0 hours of lab   |                     |                     |
| <b>Prerequisite:</b> MTX 221, MTX 224, and MTX 250 (grades of "C" or higher) Advanced concepts of manufacturing stations of the SMC system as it applies to mechatronics. Topics include flexible materials handling, robot workstations, inventory control, serial robot communications, PLC communications, barcode pallet tracking, manufacturing execution systems, manufacturing management and simulation, ethernet operation and applications. [GE]   |              |                   | <b>Prerequisite:</b> MTX 216, MTX 232, and MTX 275 (grades of "C" or higher). Process control system measurement, control and adjustment. Topics include process control concepts, safety, sight gauges, instrument tags, piping and instrumentation diagrams, loop controllers, final control elements, level management, liquid level control, methods of automatic control thermal energy, temperature control elements, and various sensors, and transmitters and their calibration including inside environment control techniques, concepts and controls. [GE]  |                     |                     |
| <b>Semiconductors</b>  | <b>2</b>     |                   | <b>Advanced</b>   | <b>Programmable</b> | <b>Logic</b>        |
| MTX 221  |              | 3 Credits/Units   | MTX 250   |                     | 4 Credits/Units     |
| 1.0 hours of lecture / 4.0 hours of lab  |              |                   | 2.0 hours of lecture / 4.0 hours of lab   |                     |                     |
| <b>Prerequisite:</b> MTX 121, MTX 145, MTX 175, and MTX 230 (grades of "C" or higher). Fundamentals and system applications of integrated circuit operational amplifiers (op-amp). Op-amp fundamentals consisting of: the input differential amplifier, data sheet parameters, circuit configuration with negative feedback, impedances, troubleshooting, closed and open loop response, positive feedback and stability, op-amp compensation, with circuit applications. Op-amp inverting, non-inverting, comparator, summing amplifier, integrator, differentiator, instrumentation, trans-conductance current-to-voltage converter, trans-impedance voltage-to-current converter, peak detector, timer, voltage regulator, and active filter circuit operation and troubleshooting. [GE]        |              |                   | <b>Prerequisite:</b> MTX 121, MTX 145, MTX 175, and MTX 230 (grades of "C" or higher). Intermediate concepts of Programmable Logic Controls. Topics include analog input and output modules, analog scaling, network concepts, an introduction to Panelview and remote I/O concepts. [GE]   |                     |                     |
| <b>Motor</b>   | <b>Drive</b> | <b>Systems</b>    | <b>Advanced</b>   | <b>Fluid</b>        | <b>Power</b>        |
| MTX 224  |              | 5 Credits/Units   | MTX 275   |                     | 5 Credits/Units     |
| 2.0 hours of lecture / 6.0 hours of lab  |              |                   | 2.0 hours of lecture / 6.0 hours of lab   |                     |                     |
| <b>Prerequisite:</b> MTX 121, MTX 145, MTX 175, and MTX 230 (grades of "C" or higher). Introduction to DC drives and Variable Frequency AC speed control systems. Topics include DC motion control, SCR control, DC spindle drives, DC axis drives, DC pulse width modulations drives, variable frequency AC drives, VFD speed and torque, VFD acceleration, deceleration, braking, VFD fault diagnostics and troubleshooting SCR motor control systems. [GE]  |              |                   | <b>Prerequisite:</b> MTX 221, MTX 224, and MTX 250 (grades of "C" or higher) Advanced concepts of electronically controlled fluid power and vacuum systems. Topics include electrical control systems, basic control devices, power devices, control relays, sequencing, timer and pressure control and circuit applications. Advanced concepts of pneumatics and vacuum troubleshooting as they apply to industry including moving loads pneumatically, vacuum systems, air compressors, air preparation troubleshooting, troubleshooting pneumatic cylinders, motor and rotary actuator troubleshooting, vacuum system troubleshooting and other topics. [GE] |                     |                     |
|  |              |                   | <b>Selected</b>   | <b>Topics</b>       |                     |
|  |              |                   | MTX 280   |                     | 1-5 Credits/Units   |
|  |              |                   | 5.0 hours of lecture  |                     |                     |
|  |              |                   | Selected topics in mechatronics. Topics vary and course theme and content change to reflect new topics. Because the course varies in contents it is repeatable for credit. Individual topics are listed in the class schedules. [GE]  |                     |                     |

**Special Projects**  
MTX 290 1-5 Credits/Units  
5.0 hours of lecture  
Opportunity to plan, organize, and complete special projects approved by the department. [GE]

**Special Projects - Lab**  
MTX 291 1-5 Credits/Units  
10.0 hours of lab  
Opportunity to plan, organize, and complete special projects approved by the department. [GE]

**Manufacturing System Principles**  
MTX 292 4 Credits/Units  
3.0 hours of lecture / 2.0 hours of lab  
**Prerequisite:** MTX 216, MTX 232, and MTX 275 (grades of "C" or higher).  
Introduction to the enterprise system: topics include technology sectors, team concepts, product design and engineering impacts, business presentation and business presentation software, enterprise economics, and marketing basics. [GE]

**Capstone/Final Project**  
MTX 296 4 Credits/Units  
1.0 hours of lecture / 6.0 hours of lab  
**Prerequisite:** MTX 216, MTX 232, and MTX 275 (grades of "C" or higher).  
Department consent required for enrollment. Work as a team and create a manufacturing scenario using the SMC FMS-200 flexible manufacturing system equipment OR work independently on a final project that incorporates the prior coursework in Mechatronics Technology. [GE]