Robotics and Automation (ROB)

ROB 111. Fundamentals of Robotics. 2 Credits.
Introduces students to the robotics and automation profession and helps them transition into the Robotics and Automation degree program. Students explore the various technical fields of Robotics and Automation, the project life cycle, and career opportunities. Emphasis is placed on engineering design basics, teamwork, professional communication, ethical responsibility, and time management. Activities include short design and troubleshooting challenges, reflection and planning assignments, interaction with industry guest speakers, and guided exploration of campus, program, and professional resources that support student success.

ROB 210. Mechanics of Machines for Robotics. 4 Credits.
Introduction to statics, dynamics, and mechanics of materials applied to robotic systems. Topics include forces, motion, power transmission, linkages, stress/strain, and structural response under real-world loading. Emphasis on design verification, torque-speed matching, and actuator/gearbox sizing for robotic frames, drivetrains, and manipulators. Prereq: MATH 146 and PHYS 212.

ROB 220. Applied Circuits and Electrical Troubleshooting. 3 Credits.
Hands on course focused on diagnosing and repairing electrical issues in industrial automation systems. Students practice reading schematics, using meters and oscilloscopes, wiring connectors, and troubleshooting sensors, drives, power distribution, and input or output modules. Emphasis is placed on systematic fault-finding methods, electrical documentation, and strong electrical safety practices in the context of robotics and automation panels Prereq: MATH 146 and PHYS 212.

ROB 230. Programmable Logic Controllers 1. 3 Credits.
Introduces students to programmable logic controllers (PLCs) using IEC 61131-3 languages, with emphasis on ladder logic and early exposure to structured text and function block diagrams. Topics include input and output hardware, timers, counters, state machines, safety interlocks, and basic HMI development. Labs with Rockwell and Siemens platforms culminate in programming and debugging an automated station with sensors, actuators, and operator controls. Prereq: CSCI 160 and MATH 146.

ROB 241. Drone Operations. 3 Credits.
This course introduces students to the use of unmanned aerial vehicles (UAV) in robotics and automation applications. Students will research the use of UAV in inspection, mapping, inventory, and systems monitoring. Students will learn to plan routes, fly, and document UAV missions. Students will integrate the use of sensing data and flight operations in automation workflows in a laboratory environment. Students will also research practical use of UAV in field service, applications engineering, and systems integration. Prereq: ROB 111.

ROB 310. Robotic Mechanisms & EOAT. 3 Credits.
This course provides insight into the design process of End Of Arm Tooling (EOAT) and part presentation hardware for industrial robots. The course includes topics on robot kinematics and actuator design, implementation of end effectors and indexing mechanisms, and the design of part presentation systems. Students will engage in laboratory activities and learn to safely analyze and debug robot workflows. Students will have an end of semester team project implementing a design of their own to present to the class and faculty. Prereq: IMSE 380 and ROB 210.

ROB 311. Industrial Robot Programming and Integration. 3 Credits.
This course provides insight into the programming, simulation, and integration of robot arms and tooling. Students will analyze robot arms using kinematic concepts and learn to write robust programs using industry-standard controllers. Students will engage in laboratory work assignments, providing real world context and problems for students to solve. Prereq: ROB 230.

ROB 312. Fluid Power Systems Design. 3 Credits.
This course introduces students to the design and analysis of pneumatic and hydraulic systems used in industrial automation equipment. Students will design and analyze pneumatic, hydraulic and vacuum circuits for common automation tasks. Students will learn to diagnose and troubleshoot issues and errors with pneumatic and vacuum systems. Prereq: ROB 210 or ME 221.

ROB 320. Field Service Practicum. 3 Credits.
This course prepares students for real-world service roles in robotics and automation through simulated dispatch-to-resolution scenarios. Students will engage in safety check and fault isolation exercises. Students will practice communicating with customers and drafting technical documentation. Students will engage in laboratory exercises troubleshooting PLCs, drives, sensors, and networks in realistic scenarios. Prereq: ROB 210, ROB 220, and ROB 230.

ROB 321. Robotic Welding Systems. 3 Credits.
This course introduces industrial robotic welding systems from the perspective of a technician who will be hired to install, service, and maintain them in production environments. Students learn how robotic welding cells are designed and integrated, how key components work, and how to keep systems safe, reliable, and weld quality within specification over time. Prereq: ROB 210, ROB 220, and ROB 230.

ROB 322. Autonomous Ground Vehicles. 3 Credits.
This course introduces students to the engineering and design of autonomous unmanned ground vehicles (UGV) and their use in industrial and commercial robotics and automation applications. Students will understand the common drive architectures and mechanical design of UGV as well as the electrical sensor and navigation systems used onboard. Students will learn about fleet management and deployment of UGV in common environments. Students will engage in mission planning, configuration, and execution exercises in laboratory and through simulation. Prereq: ROB 210, ROB 220, and ROB 230.

ROB 330. Programmable Logic Controllers 2. 3 Credits.
This course introduces students to advanced PLC programming and automation. This course serves as a continuation of ROB 230 and as such students are expected to be well versed in the contents of basic PLC programming and automation. Students will program and configure drives, relays, controllers, and I/O over industrial network protocols. Students will be introduced to the various device level protocols supplied by common vendors. Students will understand and apply HMI principles and SCADA systems. Students will also use and understand industrial PLC code structure and version control. Prereq: ROB 230.

ROB 340. Vision & Sensing Fundamentals. 3 Credits.
This course introduces students to computer vision and sensing concepts. Students will understand how machines use visual data and sensor data for automated inspection and guidance. Students will understand the different hardware and hardware systems used in machine vision and sensing applications. Students will design and program automation tasks using machine vision. Prereq: CSCI 213 and ROB 230.

ROB 350. Digital Twin & Virtual Commissioning. 3 Credits.
This course introduces students to the use of digital twins and industrial simulation tools. Students will build robotic workcell layouts from CAD and use simulation to study the limits of the workcells. Students will analyze workcells and identify bottlenecks. Students will understand how virtual commissioning is implemented with I/O mapping and handshakes. Students will implement PLC and emulate HMI in robotic workcells. Prereq: CSCI 213 and ROB 230.

ROB 360. Automation Cybersecurity. 3 Credits.
This course introduces students to cybersecurity of robotics and automation. Students will learn to perform risk assessment and troubleshoot networks. Students will explore how to securely transmit data between equipment and across cells. Students will be exposed to industrial cybersecurity practices and gain hands-on experience through laboratory work and case studies. Prereq: ROB 210, ROB 220, and ROB 230.

ROB 361. Applied Automation Challenge 1. 3 Credits.
This course is part one of a two-part course and continues with ROB 362 In this course students will form interdisciplinary teams and will be commissioned to perform an automation task with defined performance targets and budget. Teams will be presented a customer brief and will define the requirements, propose a conceptual design, and design an alpha prototype of the automated workcell. Teams will be required to write client-facing technical documentation. Junior standing in Robotics and Automation is recommended.

ROB 362. Applied Automation Challenge 2. 3 Credits.
This course is the second part of a two-part course and proceeds ROB 361. In this course students will continue developing their alpha prototype from ROB 361. Students will conduct final design, fabrication, assembly, programming, testing, and validating results. The course concludes with a complete demonstration and customer facing presentation. Prereq: ROB 361.

ROB 370. Electric Drives & Motors for Automation. 3 Credits.
This course introduces students to the study of electric motors and drive systems used in automation applications. Students will learn about the electricity and magnetism concepts behind motor design. Students will also learn to interpret motor curves and dynamometer data. Students will be introduced to feedback control systems for motor drives and will learn safe wiring and programming practices. Prereq: ROB 210 and ROB 220.

ROB 380. Industrial Standards Safety & Risk Assessment. 3 Credits.
This course introduces students to industrial safety standards in the automation workplace. Students will study risk assessment and apply ISO 12100 and other standards to complete task and hazard analysis. Students will learn industry standard safety practices, safety systems and documentation practices, and safety validation. Prereq: ROB 220 or ECE 211.

ROB 390. AI & Machine Learning for Robotics. 3 Credits.
This course introduces students to the fundamentals of machine learning algorithms and how artificial intelligence is programmed and used in robotics applications. Students will understand the process in which machine learning algorithms are trained and validated using data. Students will understand and learn to process training and test data for machine learning. Students will apply machine learning algorithms to classify objects and make decisions in robotic contexts. Prereq: ROB 362.

ROB 430. Systems Automation. 3 Credits.
This course introduces students to the design of automated workcells and systems. In this course students will learn problem solving approaches used in industrial automation. Students will learn to identify constraints and bottlenecks within a system and design automated systems using CAD software and simulation. Prereq: ME 212 or IMSE 380.

ROB 440. Industrial Automation Sensors and Logic. 3 Credits.
This course introduces students to the selection, application and integration of common sensors in robotics and automated systems. Students will learn to read and interpret vendor documentation and use the knowledge to implement the vendor specific sensors. Students will learn to program and validate sensor input and data. Students will engage in relevant laboratory work implementing sensors and control logic using sensors. The course concludes with a team project and comprehensive exam. Prereq: ROB 362.

ROB 450. Troubleshooting and Diagnostics. 3 Credits.
This course introduces students to structured methods for diagnosing and resolving faults in automated systems. Students learn diagnostic methods for electrical issues, control system faults, and mechanical hardware. Students will learn to use industry standard tools and vendor software for diagnosis and troubleshooting. Students will engage in laboratory exercises diagnosing and troubleshooting faulty automation systems. Prereq: ROB 362.

ROB 461. Capstone I. 3 Credits.
Students work in teams to scope and design an industry style robotics or automation project under realistic constraints. Emphasis is placed on requirements, risk analysis, system architecture, and concept development with supporting trade studies. Deliverables include design reviews, layout drawings, input and output maps, and a verification and validation plan. Prereq: ROB 362.

ROB 462. Capstone II. 3 Credits.
Continuation of Capstone I focused on building, integrating, and validating a complete robotic or automated workcell. Student teams take their approved Capstone I design through detailed build, wiring, safety implementation, commissioning, and performance testing. Work includes mechanical and electrical assembly, PLC and robot programming, HMI and data integration, and execution of structured verification and validation plans. The course culminates in a factory acceptance style demonstration, a customer facing presentation, and a complete handoff package suitable for transition into production or further development. Prereq: ROB 461.

ROB 464. Robotics in Agriculture. 3 Credits.
This course introduces students to the use and deployment of robotic and automation equipment in agricultural and ag-adjacent industries. Students will study the common platforms used in agricultural equipment and applications of robotics and automation equipment in agricultural settings. Students will understand the variety and scope of agricultural autonomous robots and automation equipment, and get practical experience. Prereq: ROB 362.

ROB 465. CAN-Bus in Robotics and Automation. 3 Credits.
This course introduces students to the Controller Area Network (CAN) bus and its properties. Students will understand how devices connect and interact on a CAN Bus and identify CAN bus devices used in automation settings. Students will learn to wire and configure CAN bus networks and perform troubleshooting and diagnostic tasks on CAN bus networks. Students will understand how CAN bus networks complement other network protocols used in automation. Students will walk away from the course with the technical skills to implement, service, and upgrade CAN bus networks and devices using the CAN bus. Prereq: ROB 362.

ROB 490. AI & Machine Learning for Robotics. 3 Credits.
This course engages students with hands-on design, implementation, and deployment of machine learning systems in robotics and automation contests. This course builds on ROB 390 and the expectation will be that students have a firm understanding of AI and machine learning principles. Students will implement AI enabled features for inspection, guidance, predictive validation, deployment, and monitoring. Students will practice designing, and safely and ethically deploying AI and machine learning systems. Students will design tests and monitoring plans for their deployed systems and provide documentation for consumer and technician use. Prereq: ROB 390.