§130.370. Robotics and Automation (One to Two Credits).

(a) General requirements. This course is recommended for students in Grades 11-12. Prerequisites: Concepts of Engineering and Technology and Electronics.

(b) Introduction. Students enrolled in this course will demonstrate knowledge and skills necessary for the robotic and automation industry. Through implementation of the design process, students will transfer advanced academic skills to component designs in a project-based environment. Students will build prototypes or use simulation software to test their designs. Additionally, students explore career opportunities, employer expectations, and educational needs in the robotic and automation industry.

(c) Knowledge and skills.

(1) The student demonstrates the skills necessary for success in the workplace. The student is expected to:

(A) distinguish the differences between an engineering technician, engineering technologist, and engineer;

(B) identify employment and career opportunities;

(C) investigate and work toward industry certifications;

(D) demonstrate the principles of teamwork related to engineering and technology;

(E) identify and use appropriate work habits;

(F) demonstrate knowledge related to governmental regulations, including health and safety;

(G) discuss ethical issues related to engineering and technology and incorporate proper ethics in submitted projects;

(H) demonstrate respect for diversity in the workplace;

(I) demonstrate appropriate actions and identify consequences relating to discrimination, harassment, and equality;

(J) demonstrate effective oral and written communication skills using a variety of software applications and media; and

(K) explore career preparation learning experiences, including, but not limited to, job shadowing, mentoring, and apprenticeship training.

(2) The student participates in team projects in various roles. The student is expected to:

(A) understand and discuss how teams function;

(B) use teamwork to solve problems; and

(C) serve as a team leader and a team member and demonstrate appropriate attitudes while serving in those roles.

(3) The student develops skills for managing a project. The student is expected to:

(A) use time-management techniques to develop and maintain work schedules and meet deadlines;

(B) complete work according to established criteria;

(C) participate in the organization and operation of a real or simulated engineering project; and

(D) develop a plan for production of an individual product.

(4) The student practices safe and proper work habits. The student is expected to:
(A) master relevant safety tests;
(B) follow safety guidelines as described in various manuals, instructions, and regulations;
(C) identify and classify hazardous materials and wastes according to Occupational Safety and Health Administration regulations;
(D) dispose of hazardous materials and wastes appropriately;
(E) perform maintenance on selected tools, equipment, and machines;
(F) handle and store tools and materials correctly; and
(G) describe the results of negligent or improper maintenance.

(5) The student develops the ability to use and maintain technological products, processes, and systems. The student is expected to:

(A) demonstrate the use of computers to manipulate a robotic or automated system and associated subsystems;
(B) troubleshoot and maintain systems and subsystems to ensure safe and proper function and precision operation;
(C) demonstrate knowledge of process control factors; and
(D) demonstrate knowledge of motors, gears, and gear trains used in the robotic or automated systems.

(6) The student develops an understanding of the advanced concepts of physics, robotics, and automation. The student is expected to:

(A) demonstrate knowledge of rotational dynamics, weight, friction, and traction factors required for the operation of robotic and automated systems;
(B) demonstrate knowledge of torque and power factors used in the operation of robotic systems;
(C) demonstrate knowledge of feedback control loops to provide information; and
(D) demonstrate knowledge of different types of sensors used in robotic or automated systems and their operations.

(7) The student develops an understanding of the characteristics and scope of manipulators and end effectors required for a robotic or automated system to function. The student is expected to:

(A) demonstrate knowledge of robotic or automated system arm construction;
(B) understand and discuss the relationship of torque, gear ratio, and weight of payload in a robotic or automated system operation; and
(C) demonstrate knowledge of end effectors and their use in linkages and the gearing of a robotic or automated system.

(8) The student uses engineering design methodologies. The student is expected to:

(A) understand and discuss principles of ideation;
(B) think critically, identify the system constraints, and make fact-based decisions;
(C) use rational thinking to develop or improve a product;
(D) apply decision-making strategies when developing solutions;
(E) identify quality-control issues in engineering design and production;
(F) describe perceptions of the quality of products and how they affect engineering decisions;
(G) use an engineering notebook to record prototypes, corrections, and or mistakes in the design process; and

(H) use an engineering notebook to record the final design, construction, and manipulation of finished projects.

(9) The student learns the function and application of the tools, equipment, and materials used in robotic and automated systems through specific project-based assessments. The student is expected to:

(A) safely use tools and laboratory equipment to construct and repair systems;
(B) use precision measuring instruments to analyze systems and prototypes; and
(C) use multiple software applications to simulate robot behavior and present concepts.

(10) The student designs products using appropriate design processes and techniques. The student is expected to:

(A) interpret industry standard system schematics;
(B) identify areas where quality, reliability, and safety can be designed into a product;
(C) improve a product design to meet a specified need;
(D) understand use of sensors in a robotic or automated system;
(E) produce system schematics to industry standards;
(F) evaluate design solutions using conceptual, physical, and mathematical models at various times during the design process to check for proper functionality and to note areas where improvements are needed;
(G) implement a system to identify and track all components of the robotic or automated system and all elements involved with the operation, construction, and manipulative functions; and
(H) describe potential patents and the patenting process.

(11) The student builds a prototype using the appropriate tools, materials, and techniques. The student is expected to:

(A) identify and describe the steps needed to produce a prototype;
(B) identify and use appropriate tools, equipment, machines, and materials to produce the prototype;
(C) implement sensors in a robotic or automated system;
(D) construct a robotic or automated system to perform specified operations using the design process;
(E) test and evaluate the design in relation to pre-established requirements such as criteria and constraints and refine as needed;
(F) refine the design of a robotic or automated system to ensure quality, efficiency, and manufacturability of the final product; and
(G) present the prototype using a variety of media.