Three Year Program Curriculum in Automation and Robotics

All students will be required to maintain an Engineering Notebook and a Lab Notebook. These books to be randomly collected to check on usage and grading of assigned work.

Testing is done on a per topic block basis.

First Year – 60/40 split classroom/lab

Objectives

Understanding what engineering is and where it came from. The student gains a glimpse into the myriad of fields available to them.

Student will gain an understanding of two basic tools available to engineers; Excel and Visio.

The student will gain an understanding of basic electrical and analog/digital electronic components.

The comprehending of Test and Measurement procedures and basic test equipment as it applies to digital electronics.

An introduction into Industrial/Process control engineering. The student will gain knowledge in automation and the basic associated equipment.

Topics

Introduction to Engineering

- Description
- History
- Some of fields and descriptions; Electrical, Mechanical, Industrial, Electronic, Robotic and Electronic

Engineering Tools

- Visio basics
- Visio Flowcharting

- Visio wiring diagrams
- Visio Gantt chart introduction
- Excel Basics
- Excel Graphing
- Excel Data Base
- Excel math functions both simple and complex calculations
- Excel cost benefit and ROI
- Labs creating charts and data bases

Electrical components, Analog and Digital Electronics

- Electronics field overview
- Basic concepts of voltage, current and magnetism
- Basic components their function, packaging and utilization; Resistor, Capacitor, Inductor, Relays, Lamps/LED, Batteries and Motor/Generators.
- Basic Digital Electronics with timing diagrams, tables and function parameters; Basic gates (inverter, and, or), Complex gates (comparators, multiplexors), Timers and counters.

Test & Measurement

- Oscilloscopes
- Logic Analyzers
- Pattern Generators
- Labs combining both T&M and the electronics block
    - Gate timing reality compared to data sheet
    - Gate decoding with a Logic Analyzer
    - Timers and constants as measured via an oscilloscope

Automation and Process Control

- Automated Lines
- Automated Factory
- PLC & PAC
- HMI (Human Machine Interface)
- Factory level robots
- Power
- Labs covering PLC and HMI utilization
- Lab on PLC ladder logic creation and function
- Lab using the in-house factory style robots

Open Work Lab

- Basic line following robot for in-house competition

Second year – 50/50 split classroom/lab

Objectives

Student will be introduced into aspects of mechanical engineering as it pertains to robotics and automation.

The student will append the current understanding of basic analog/digital electronics with advanced topics and components.

Student will be introduced to microcontrollers and the software programming of them.

The student will gain understanding and utilize manual and CNC machine shop equipment. Included with the equipment is understanding CAD/CAM.

A building on prior year instruction in Industrial/Process control engineering. The student will gain knowledge in plant/cell communications, cell configuration and SAFETY.

Student will begin advanced studies in guidance systems and robotics systems.

Topics

Introduction to Mechanics

- Concepts of momentum, torque, inertia, force, energy, velocity and acceleration
- Statics and Dynamics
- Types of materials and their usage as pertaining to robotics.
- Lab covering calculation and empirical data for the momentum in a robotic arm

Electrical components, Analog and Digital Electronics

- Basic Semiconductors to include PN junction (diode) and transistors
- Introduction in advanced electronics to include; analog/digital circuits, MEMS, motor drive circuitry and basic printed circuit board design.

Microcontroller and Programming

- Advanced flowcharting
- "C" language basics
- Lab using microcontroller trainer of student development system

- Code development for automation using classroom factory
- Understanding and utilization Microsoft Robotics Studio

Machine shop

- SAFETY
- Manual lathe and vertical mill basics
- Computer Numeric Controlled (CNC) lathe and vertical mill basics
- Inspection types and methods; manual and vision
- Thermoforming and Injection molding
- Production considerations including ROI, production quantity, scrap, material configuration and labor vs. machine time
- The design cycle regiment utilizing 3-D modeling, CAD/CAM and CAM-to-CNC
- Labs to include operation of the equipment designing of components followed by fabrication and full documentation

Factory Automation & Control systems

- Introduction to conveyors, motors & drivers, production robots and pneumatics & hydraulics
- Networking and protocols including Ethernet and Profibus
- Cell layout and configuration including programming of PLCs and PACs for robots and production lines
- Safety controls and equipment

Guidance systems and ARVs

- Overview of an ARV to include processing system, drive train, guidance basics, communications, sensors and power plant
- Inertial navigation and the components of a system
- Software considerations and descriptions for sections of an ARV
- Communications internal and external to include CAN bus, Wi-Fi and ZigBee
- Labs based on classroom ARV chassis to include drive train and controllers, INS systems and external sensors

Class level design project

- Expansion of the OHTS Factory Floor (For other establishments a similar size project)
- Entrance into a robot competition

Third Year – 25/75 split classroom/lab

Objectives

The student will gain further understanding in advanced digital electronic components.

The comprehending of vision systems as applied to process control and robotics.

Students will undertake an independent study in one of the following areas; robotics, industrial controls, factory automation or production equipment

Topics

Introduction to advanced digital electronics

- Construction, utilization and programming of Complex Programmable Logic Devices (CPLDs) and Field Programmable Gate Arrays (FPGAs)

Vision systems

- Discussion of vision systems, their types and impact on production
- Vision systems and their usage with ARVs
- LIDAR systems
- Lab experiment comparing CCD camera data to LIDAR data

Independent study

- Project overview paper
- Project outline with Gantt chart, costing estimates and ROI
- Design and fabrication of components both mechanical and electronic
- Programming source code with flowcharting
- Detailed test procedures for both milestones, modules and final unit

Class level robot competition entrance