Philadelphia University
Faculty of Engineering and Technology
Mechatronics Engineering Department

Course Description 2018

Course number	Course name	Credit hours	Description	Prerequisites
0640253	Engineering Skills	3	Problem solving skills; Engineering skills (personal and analytical); Technical writing; Communication skills (oral presentation skills); Engineering ethics and responsibility; Project management.	0130102
0640216	Electronics for Mechatronics	3	Introduction to semiconductor materials; PN- junction; Diodes; Diode circuits: rectifiers, regulators, clippers; BJT Transistors: DC analysis, biasing, applications; Field-effect transistor: characteristic; JFET; MOSFET; Op-Amps; Circuit simulation.	0610211
0640234	Static and Strength of materials	3	Force vectors; moment of a force; equilibrium of rigid body; Internal Forces; Stress, strain, torsion, and mechanical properties of materials	211101
0640233	Dynamics and Vibrations	3	Kinematics of particles: force and acceleration, work and energy, impulse and momentum; Planner kinematics of rigid bodies: force and acceleration, work and energy, impulse and momentum; Vibration principles.	0640234
0640221	Programming Lab for Mechatronics	1	Building, Simulating, and Testing C++ programming and MATLAB/Simulink exercises. Emphasize is given to Mechatronics systems.	0630263
0640327	Modeling and Simulation	3	Modeling definition; Mathematical modeling of dynamic systems; Laplace transform; Linear time-invariant differential equations; Modeling of different physical systems (mechanical, fluid, thermal, electrical and electromechanical); Analogous systems; Linearization of nonlinear system; State-space approach to modeling dynamic systems; Time-domain analysis of dynamic systems; Dynamic systems simulation.	0640221 + 0650260
0640314	Electrical Machines for Mechatronics	3	Single-phase and three-phase transformers; D.C machines; of D.C machine Excitation; Speed control of D.C motor; Basic theory of A.C machines; Induction motors: slip, equivalent circuits, speed control, phasor diagram; Synchronous motors: equivalent circuit, motor speed, power factor correction; Simulating of machine operation.	0610212

Course number	Course name	Credit hours	Description	Prerequisites
0640312	Power Electronics & Drives	3	Introduction to power electronics system; Power semiconductor devices; Thyristor: thyristor characteristics and operation, turn-on and turn off, commutation circuits; Gate-turn-on thyristor (GTO); Single-phase rectifiers; Three-phase rectifiers; DC-AC inverter: voltage control, pulse-width modulated (PWM) inverter, harmonics; DC-DC converters; DC Drive; AC drive; Simulating of power electronic circuits.	0640314
0640313	Communication for Mechatronics	3	Sensors networks; Field bus Networks; Control Networks; Real-time acquisition, SCADA and control; Communication protocols used in the industrial automation (such as Modbus RTU, EtherNet/IP, Ethernet TCP/IP, Modbus TCP/IP, and Profinet); Communication protocols between devices (such as serial, parallel, SPI, USB, Bluetooth, ZigBee); Java programming; Raspberry PI; Internet-of-Things and Industry 4.0; smart application.	0640216
0640242	Instruments and Transducers	3	Measurement principles: Error types, Statistical analysis, Static and dynamic characteristics; Analogue signal conditioning: Voltage divider, Bridge circuits, Passive filters, Amplifiers circuits; Displacement, Distance, and Level transducers; Digital transducers; Force, torque, Pressure, Stress, and Strain transducers; Temperature transducers; PIR Motion detectors.	0640216
0640337	Mechanics and Vibration LAB	1	Experiments related to Dynamics and Vibrations. Pendulum; One degree of freedom free vibration; Logarithmic Decrement; One degree of freedom harmonic excitation; Unbalance experiment; Fluid experiments: flow measurement, center of pressure and impact of water jet.	0610105
0640328	Microprocessors & Microcontrollers	3	General architecture for microprocessors and microcontrollers; I/O ports interface ; interrupts; timers; interfacing microcontroller systems with sensors (analog and digital) and actuators (DC motors); Programming microcontroller (PIC 16F84 and PIC 16F877) using assembly language; Open-loop and closed-loop DC Motor Control; Arduino Architecture and interface; Programing Arduino using C-Language.	0630211
0640344	Automatic Control	3	Modeling of dynamic systems (mechanical and electrical systems); Block diagrams and signal flow graphs; Time domain analysis (steady state and transient response); Root locus; System stability; Compensators; PID control design and tuning; simulation for control system .	0630327

Course number	Course name	Credit hours	Description	Prerequisites
0640342	Mechatronics Project	1	The course is divided into two parts: Lab experiments and course project. The lab work experiments prepare the students to study engineering problems, specify objectives, compare alternative solutions, analyze, design, build and test systems. Then, the students are expected to design and build a simple Mechatronics system, write a report, and present their project to the class.	0640328
0640415	Machines and Power Electronics Lab	1	Experiments for single phase and three phase rectifiers (controlled & uncontrolled); Single phase converters (choppers & inverters); DC motors (Shunt, series, and separately excited); Single phase and three phase AC motors (induction); Four quadrant drive.	0640312
0640445	Programming Logic Controllers	3	Traditional controller; Introduction to PLC; PLC hardware construction and components; PLC logic fundamentals and principle of operation; PLC programming languages; Program control instructions; Timer/counter instructions; Data manipulation and math instructions; Sequence and Shift register Instructions; Interrupt and subroutine instructions; PLC and process control applications; PLC troubleshooting.	0640328
0640441	Digital Control	3	Concept of discrete control systems; Sampling theory; Quantization procedure: digital signals and coding; Mathematical model; Z- transform; Mapping method; Root- Locus in z-plane; Stability; Micro-control implementation; Simulating of digital control systems.	0640344
0640442	Automatic Control Lab	1	Experiments in servo control valve and open loop position control; Position control (PID); Speed control (PID); Pressure control (PID); MATLAB/ Simulink applications; LABVIEW applications.	0640344
0640412	Electronics and Transducers Lab	1	Diodes and their application; Transistors with switching and amplification application; Op-amp configuration (Differential, integral and proportional) ;instrumentation amplifier; active filters; sensors Temperature sensor, strain gauge, proximity sensor and LVDT,…..etc; Transducers with conditioning circuits design.	0640242
0640448	Microcontrollers Lab	1	Mechatronics Lab experiments based on microcontroller systems. Design and analysis of microcontroller-based systems with sensors and actuators interface. Sensor experiments include temperature, force, and proximity while actuators include DC and Servo motors. The lab experiments are divided into two platforms: PIC microcontrollers and Arduino. Assembly and C programming are used in the experiments.	0640328

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0640458	Reverse Engineering (RE)	3	RE Methodology; RE Ethics; System RE (product teardown, functional models, BOM, subtract and operate); Mechanical RE (Rapid prototyping, CAM/CAD, 3D Printing); Electronic RE (System Analysis and Circuit Extraction); Software RE applications: Operating systems, Software RE basics, RE tools, and hacking; New trends in RE	0640342
0640435	Pneumatic and Hydraulic Systems	3	Introduction to fluid power; Pneumatic principles, characteristics and applications; Pneumatic generation: treatments and distribution; Pneumatic actuators; Pneumatic input, control, and processing elements; Pneumatic and electro-pneumatic system design and development; Hydraulic principles, characteristics and applications; Hydraulic generation treatments and distribution; Hydraulic actuators; Hydraulic input, control, and processing elements; Hydraulic and electro-hydraulic system design and development.	0640445*
0640447	Mechatronics Systems Design	3	Introduction to Mechatronics systems; The stages of mechatronics system design; General engineering principles; Mechanical calculations for mechanisms; Drive concepts; Motor type and size selection; Transducers selection; Signal conditioning; Controllers and programming algorithms selection; System modeling and simulation; MSD Case study.	0640312 + 0640344
0640542	Robotics and Automation	3	Introduction to robotics; Robot system components; Robot manipulators; Manipulator kinematics; Inverse manipulator kinematics; Trajectory planning and control ; Industry automation; Autonomous mobile robots; Localization; Planning and navigation.	0640344
0640544	Mechatronics Systems Design Lab	1	Principles of switching components and circuits (electromechanical relays and transistors); DC motor control (direction and speed) using H-bridge circuit and PWM technique; Sequential applications using PLC; FESTO MPS distribution system control; FESTO MPS sorting system; Overhead crane system/mechanical calculations and motor selection; Overhead crane system / control using PLC; Generating speed profile using PLC digital output module; Analog input and analog output applications using PLC.	0640447
0640541	CAD/CAM lab	1	Auxiliary views; Temporary fasteners (threaded members, Keys, Feathers, Splines, Rivets, Cotters and springs), Their construction and standard; Power screws and welding symbols; Dimensioning; Tolerances; Limits and fits (ISO system); Detail and working drawing; Assembly drawing.	0660132

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0640531	Automation & Fluids Control Lab	1	the difference between the pneumatic and hydraulic system; The relationship of pressure with different variables: pressure vs. force relationship and Pressure drop vs. flow relationship; Directional and speed control of cylinders; Indirect control using Pilot-Operated valves; Controlling the actuators (pneumatic and hydraulic) using the traditional control and the PLC controller;	0640435*
0640543	Signals Processing for Mechatronics	3	Analog signal processing; digital signal processing; the basic mathematical tools to analyze signals in time and frequency domains; Bode plot, passive and active filters are analyzed and designed for the purpose of signal-conditioning; FIR and IIR filters are analyzed, design and implemented on a computer.	0640441
0640440	Engineering Project (I)	1	Students are required to work in teams to design a Mechatronics-related project. This includes the theoretical analysis and simulation. They are expected to write a technical report and present their project to their colleagues.	0640499
0640540	Engineering Project (II)	2	A continuation of Engineering Project I where the student is asked to implement and test a Mechatronics prototype	0640440
0640499	Engineering Training	3	The student is required to work in industry or engineering company for continual 7 week in order to apply his engineering skills.	After passing 115 credit Hour
0640593	Special Topics in Mechatronics	3	New trends in Mechatronics Engineering (topics to be selected by department).	Department Approval
0640512	Computer Numerical Control	3	Introduction to CNC machines: definition, construction, and types; CNC programming: G-code, APET, and CAD/CAM programming languages; Hole operation programming; End mill operation programming: linear and contour profile; programming with cutter diameter compensation; subroutines; Lathe operation programming; Fixed cycles programming.	0640541*
0640462	Process Control	3	Introduction of process control systems ; Dynamic and static process characteristics; control modes (on-off, P, PI, PD, and PID); controller tuning methods, controller implementations; piping and instrumentation diagram (P & ID); pressure, temperature, flow, and level control systems; Advance process control systems (cascaded, feedforward)	0640344
0640424	Machine Intelligence	3	Introduction to Intelligent systems; Fuzzy logic theory and Fuzzy logic controllers; Artificial Neural Network Structures; Learning Algorithms; ANN controllers; Industrial applications for machine intelligence; New trends in machine intelligence; Algorithm software simulation.	0630263