

Undergraduate Handbook

Department of Mechatronics Engineering



Philadelphia University
Amman – Jordan

2012-2013

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1. Contact Information

Department Contacts

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Important websites

Admission and Registration information

<http://www.philadelphia.edu.jo/admission.asp>

<http://www.philadelphia.edu.jo/arabic/admission.asp>

Department of Mechatronics Engineering

<http://www.philadelphia.edu.jo/engineering-se.asp>

Deanship of Student affairs

<http://www.philadelphia.edu.jo/students.asp>

2. Introduction

Philadelphia University

History

Philadelphia University was established in 1989 as a private, accredited university in Jordan. The college of Engineering was established in 1991, and has graduated more than 450 engineers, who are working inside Jordan and abroad. The faculty of Engineering comprises the following departments:

- Computer Engineering
- Electrical Engineering
- Mechanical Engineering
- Communications and Electronics Engineering
- Mechatronics Engineering

The faculty of engineering is housed in several buildings with a total area of 5400m², and has 28 specialized and highly equipped laboratories. The total number of engineering students is about 1200 students.

Mission Statement

As a distinguished academic institution, Philadelphia University commits itself to becoming a full partner in the development of both Jordanian society and other societies at the regional and global levels. The role of science, technology, information and means of communication is becoming absolutely vital to the well-being of humanity. In the coming few years, this role is bound to become a decisive engine of growth. High-quality relevant education, supported by problem-oriented, inter-disciplinary and inter-institutional research, is the only means of leading any society to become an active and productive partner in human civilization.

The speed of globalization and the collapse of cultural and economic barriers require modern education, e-learning and interactive systems to be rooted in democratic interaction, human rights, complete freedom of thought and greater creativity by the younger sectors of society.

As the rapid development of knowledge, science and technology could widen the cultural divide between generations and society, modern approaches to education and lifelong interactive learning will be indispensable in alleviating the effects of this trend.

Carrying a revered name, with deep roots in history, of a major city of the Decapolis on the King Road linking old civilizations, Philadelphia is committed to moving forward, through the twin engines of quality and modernity, along the information highway. It hopes to make a strong bond between knowledge, learning and modern civilization.

The keynote here is proper, fast-developing and morally charged education. Young men and women are the vehicle that launches societies into a future propelled by quality education to prosperity and innovation. Philadelphia University and its sister institutions will be instrumental in bringing this about.

3. Mechatronics Engineering Department

The term mechatronics was first used in the late 1960s by a Japanese Electric Company to describe the engineering integration between mechanical and electrical systems. Mechatronics can be defined as the analysis, design, and integration of mechanics with electronics through intelligent computer control. Today, mechatronics system engineering has gained much recognition and importance in the industrial world and therefore many universities have established engineering degrees in mechatronics.

PU in Jordan is one of the mechatronics engineering pioneers in the middle east region. The mechatronics program was initiated in year 2000 and accredited by the Ministry of Higher Education in Jordan by 2004. The mechatronics faculty at PU includes well qualified professors with educational and industrial experiences from around the globe: USA, Japan, England, and Egypt. This faculty was, and still is heavily involved in workshops around the middle east (Jordan, Lebanon, and Egypt) that discuss, compare, and develop mechatronics systems curricula.

Mission

The main objectives of the mechatronics department is to provide the following:

- a. Integrated system education to equip the graduates with the necessary knowledge and skills needed for the regional industry.
- b. In-depth knowledge in the analytical, experimental, and computational areas of mechanics, electronics, control, and computer engineering.
- c. Knowledge and skills to analyze, design, program, build, and maintain fully integrated engineering systems.

Facilities

Department Laboratories

Mechatronics is a practical engineering field and therefore there is heavy emphasize on laboratories and projects work

The mechatronics curriculum contains eight laboratories (each with one credit hour). Since mechatronics is multi-disciplinary, five of those labs are supported by other engineering departments. These are:

- Electrical circuits lab
- Electric machines lab
- Electronics lab
- Mechanical and vibration labs
- Computer lab

These are traditional laboratories that include oscilloscopes, function generators, power supplies, IC components, spring-mass systems, vibrations apparatus, circuit components, DC & AC Motors, etc.

PU invested heavily in the specialized mechatronics laboratories. Four Labs are offered by the department:

1. Mechtaromics lab: contains experiments that are concerned with the design and analysis of fully integrated mechatronics systems. It emphasizes the microcontrollers and microprocessors input/output interface through sensors and motors. The lab is equipped with PIC microcontrollers kits, Intel 8085 kits, Motorola 68HC11, and TI DSP kits. Programming interfaces include assembly and C languages.
2. The instrumentation lab: contains different sensors and transducers such as temperature, optical, conductive, capacitive, and strain gauge sensors. The sensors are interfaced with processors and computers through data acquisition systems interfaced through dedicated software such as LabView and Matlab.
3. The control lab: contains speed-and-position motor control kits, inverted pendulum system (which represents conventional and intelligent control strategy), and complete pneumatic and hydraulic control units (which include servo drives, PID controllers, and fluidic memory).
4. The automation lab: contains a CNC machine, a robotic system (with conveyers, motors, and sensors, which represents flexible manufacturing system), and PLC units.

4. Faculty Members

The Mechatronics Engineering Department includes the following faculty members:

Dr. Mohammed Bani Younis

Specialization: Re-Engineering

E-mail: mbaniyounis@philadelphia.edu.jo

Dr. Tarek Tutunji,

Assistant Professor

Fields of Expertise: Microcontrollers, DSP, and System Design

Dr. Muhammad alshabi

Assistant Professor

Dr. Ibrahim Alneemi

Assistant Professor

Eng. Sona Alyounis

Lecturer

Field of expertise: Transducers, biomedical applications in Mechatronics.

5. Curriculum

Overview

The mechatronics curriculum at PU was initially developed by the combined efforts of the mechanical, electrical, and computer departments at PU. A specialized committee that consisted of two associate and two assistant professors (two mechanical engineer, one electrical engineer, and one computer engineer) was given the task of developing the curriculum in 1999. The committee studied global curricula (mainly in North America and Europe), modified per regional needs and available expertise, and proposed the mechatronics curriculum in 2000. The initial proposal had heavy emphasis on mechanical engineering since it was the offering (mother) department.

In 2002, the mechatronics engineering department was established as an independent entity in order to nurture and further develop the curriculum, identify the detailed course contents, and establish the laboratories. Initially the department had one professor, two assistant professors, and one lab engineer that provided for 39 students. By 2005, the department had grown to include two professors, two associate professors, two assistant professors, three lab engineers, and two technicians that provide for 206 students.

The current curriculum is a collaborated result from all faculty members with regional workshop consultations over several years of development . The curriculum is described in the rest of this section.

1 University requirements

PU, guided by the ministry of higher education and scientific research in Jordan, has set 27 credit hours for general university requirements to be studied by all university students. They include arabic and english languages, computer skills, and national studies courses.

2 Engineering faculty requirements

The faculty of engineering has set 29 credit hours divided into two main areas: mathematics and engineering skills. The former includes the general calculus, differential equations, and numerical analysis needed for engineering students. The later, engineering skills, is concerned with developing the students' engineering personality and leadership. It was noted that in many programs, graduating students lacked the essential communication skills needed to excel in the real world. In order to treat this phenomena, PU offers three well designed courses: engineering fundamentals, engineering skills, and entrepreneurship to be studied in the first, third, and fifth years accordingly. These three chain courses form the backbone of engineering thought.

3 Mechatronics department requirements

The mechatronics department requirements were set to 104 credit hours. Those include 95 compulsory and nine elective hours. mechatronics engineering was divided into five main fields:

electrical & electronics, mechanics, computer, control & instrumentation, and systems as described below:

1. Electrical and electronics

This field includes electrical circuits, analog and digital electronics, power electronics, drive circuits, and electric machines.

2. Mechanics

This field includes statics, dynamics, vibrations, thermodynamics, heat transfer, fluids, CAD, manufacturing, material science, machine design, hydraulic and pneumatic systems.

3. Control and instrumentation

This field includes analog and digital control systems, robotics, automation, signal processing, sensors & actuators, statistics and quality control.

4. Computer engineering

This field includes logic circuits, microprocessors, microcontrollers, PLC, programming, simulation, interface, and machine intelligence.

5. Mechatronic system design

This field concentrates on the integration among electronics, mechanics, computer, and control in order to analyze and design fully integrated systems.



Student Name:

Student No.:

First: University Requirements (27) Cr.H.

1- Compulsory University Requirements (12) Cr.H.

Course No.	Course Title	Cr.H.	Prere.
0110101	Arabic Skills(1)	3	0110099
0111100	Military Science(*)	3	---
9111101	National Education	3	---
0130101	English Skills(1)	3	0130099

2- Elective University Requirements (15) Cr.H.

*** Social Science : (3-6) Cr.H.**

Course No.	Course Title	Cr.H.	Prere.
0110102	Arabic Skills(2)	3	0110101
0130103	English skills (3)	3	0130102
0140101	French Skills (1)	3	---
0140104	Foreign Language (Italian)	3	---
0140106	Foreign Language (Hebrew)	3	---

*** Social Science and Economics : (3-6) Cr.H.**

Course No.	Course Title	Cr.H.	Prere.
9111111	Introduction to Sociology	3	---
9111112	Introduction to Psychology	3	---
9111133	Human Thought and Civilization(1)	3	---
9111142	Society	3	---
0115235	Culture of Development	3	---

*** Science, Technology, Agriculture and Health : (3-6) Cr.H.**

Course No.	Course Title	Cr.H.	Prere.
9240151	Human and Environment	3	---
9620105	Car Fundamentals	3	---
9761111	Computer Skills	3	0761099
9910101	Human Health & Society	3	---
9910105	Principles of Nursing & First Aid	3	---

Note:

Numbers Using in Study Plan:

- (610) Electrical Eng. (620) Mechanical Eng.
- (630) Computer Eng. (640) Mechatronics Eng.
- (650) Communication & Electronics Eng. (660) Architecture Eng.

Second: Faculty Requirements (29) Cr.H.

2-1 Compulsory Requirements (26) Cr.H.

Course No.	Course Title	Cr.H.	Prere.
0130102	English Skills (2)	3	0130101
0250101	Calculus (1)	3	---
0250102	Calculus (2)	3	0250101
0211104	Applied Physics	3	---
0620171	Engineering Workshop(1)	1	---
0620172	Engineering Workshop(2)	1	0620171
0620131	Engineering Drawing	3	---
0630263	Programming Language	3	---
0640253	Engineering Skills	3	0130102
0610350	Entrepreneurship	3	0640233+120Cr.H.

2-1 Elective Requirements (3) Cr.H.

Course No.	Course Title	Cr.H.	Prere.
0212101	General Chemistry (1)	3	---
0610111	Engineering Principles	3	---

Third: Department of Mechatronics Engineering Requirements (104) Cr.H.

3-1 Compulsory Requirements (89) Cr.H.

Course No.	Course Title	Cr.H.	Prere.
0610211	Electrical Circuits (1)	3	0211104
0610212	Electrical Circuits(2)	3	0610211
0610216	Electrical Circuits Lab	1	0610211*
0650242	Electronics (1)	3	0610211
0620211	Statics	3	0250101
0640233	Dynamics & Vibrations	3	0620211
0640235	Mechanics of Engineering Materials	3	0620211
0620239	Mechanical Drawing	1	0620131
0630211	Logic Circuits	3	0630263
0640221	Mechatronics Programming Lab	1	0630263*
0640242	Sensors & Transducers	3	0650242
0650343	Electronics(1) Lab	1	0610216+0650242*
0640312	Power Electronics & Drives	3	0650242
0640314	Electrical Machines & Mechatronics	3	0650242
0620333	Machine Theory	3	0640233
0640327	Modeling & Simulation	3	0640233+0640342
0640328	Microprocessors & Microcontrollers	3	0630211+0640242
0640335	Thermofluids	3	0620211+0650260
0640337	Mechanics & Vibration Lab	1	0640233*
0640344	Automatic Control	3	0640327

Course No.	Course Title	Cr.H.	Prere.
0640350	Engineering Project (1)	1	0640233+0650242
0640415	Power Electronics & Machine Lab	1	0650343+0640314*
0640432	Mechanical Design	3	0620333
0640435	Pneumatic & Hydraulic Systems	3	0640335+0640344
0640441	Digital Control	3	0640328+0640344
0640442	Automatic Control Lab	1	0640344*
0640445	Microprocessors & Transducers Lab	1	0650343+0640328*
0640458	Reverse Engineering	3	0640350
0640434	Machine Intelligence	3	0630263+0640344
0640445	Programmable Logic Controllers	3	0640328
0640447	Mechatronics System Design	3	0640344+0640445
0640542	Robotics & Automation	3	0640344+0640445
0640544	Mechatronics System Design Lab	1	0640446+0640447*
0640524	CAD/CAM	3	0620172+0640432
0640531	Fluids & Automation Lab	1	0640435*
0640543	Signals Processing	3	0640441
0640551	Engineering Project (2)	1	0640350+120Cr.H.
0640555	Engineering Project (3)	2	0640447+0640551
0640450	Engineering Practising	0	90 Cr.H.

* Synchronously

** 8 Weeks Continually After Completing 90 Cr.H.

3-2 Aiding Compulsory Requirements (9) Cr.H.

Course No.	Course Title	Cr.H.	Prere.
0650163	Principles of Engineering Analysis	3	0250102
0650260	Engineering Analysis (1)	3	0250102
0630262	Engineering Analysis (2)	3	0650260

3-3 Elective Requirements in Mechatronics Engineering (6) Cr.H.

Course No.	Course Title	Cr.H.	Prere.
0630512	Real Time Systems	3	0640344
0640462	Automation & Operations Control	3	0640344
0640593	Special Topics in Mechatronics	3	Dep. Approval
0640333	Industrial Electronics	3	0640314+0640312

Student Name:

Student No.:

Philadelphia University
Faculty of Engineering
Mechatronics Engineering Department
Course Description 2012

Course number	Course name	Credits	Description	Prerequisites
610211	Electric Circuits 1	3	Basic concepts (charge, current, voltage, power energy). Circuit elements (independent and dependent voltage and current sources. Resistors. Capacitors. Inductors). Kirchof Voltage and Current Laws (KVL and KCL). Mesh and Nodal circuit analysis. Network theorems. Transient analysis of RL, RC, and RLC circuits. Introduction to AC circuits.	Applied physics (211104)
610212	Electric Circuits 2	3	Periodic waveforms. Phasor analysis, RMS and average values, maximum power transfer, sinusoidal analysis of inductive and capacitive reactance, impedance, phase angle, series and parallel AC circuits. AC power analysis. AC response of RL, RC and RLC circuits. Impedance concept. Resonance. Steady state analysis of AC circuits. Coupled circuits. Three Phase circuits. Fourier analysis. Laplace analysis. Two-Port networks. Circuit analysis in computers.	Electric Circuits1 (610211)
610216	Electric Circuits Lab	1	Experiments that work with DC circuits and implement/analyze theoretical results for KVL and KCL. Mesh and Nodal. Transient analysis of RL, RC and RLC circuits. AC circuits.	Electric Circuits1 (610211)
610550	Engineering Entrepreneurship	3	Basic Concepts of macro & micro economics, economy architecture, production process, the effect of science and technology on production, the use of science and technology in production, skills, free business, services and commodities production, methods of project propagation, marketing studies, export, import and interior market consumption, project forming, project requirements, economic appraisal studies, project financing, banking, companies, cost studies, project management, marketing.	Engineering Skills (640253) + 120 hours
620131	Engineering drawing	3	Instruments and their use. Graphic geometry. Lettering. Orthographic and isometric drawing and sketching. Sectional views. Introduction to descriptive geometry. Surface intersections and Developments. Computer (ACAD)	None
620171	Engineering Workshop (1)	1	Development of basic skills in fields of: hand filing, turning, welding, piping and plumbing, carpentry, sand casting, glass works, sheet metal fabrication, metal forming.	None

620172	Engineering Workshop (2)	1	Household electric circuits. Florescent lamps circuits, parallel and series circuits, switches and fuses installations, electronic welding, electronic devices maintenance and circuit-boards design.	Engineering Workshop (1) (620171)
620211	Statics	3	Introduction to mechanics of rigid bodies. Basic concepts; force and displacement vectors, force systems, equivalent force systems, static equilibrium, analysis of simple structures, friction, geometric properties; centroids and moments of inertia.	Calculus (1) (250101)
620239	Mechanical Drawing	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), detailed and working drawing, assembly drawing. 3-D drawing.	Engineering Drawing (620131)
620333	Machine Theory	3	Kinematic analysis of mechanisms, velocity and acceleration polygons, static and inertia, force analysis of machinery. Dynamic analysis of cams, gears, gear trains, balancing of machines, governors.	Dynamics and Vibrations (640233)
630211	Logic Circuits	3	Number Systems: decimal, binary, octal and hexadecimal. Boolean Algebra: basic identities and algebraic manipulation. K-map simplification. Combinational circuits design with MSI components. Sequential circuits analysis and design. Counters and registers, flip flops.	Programming Languages (630263)
630262	Engineering Analysis II	3	Matrices, determinants, solution of linear and nonlinear equations. Direct and iterative solutions. Interpolation and curve fitting. Numerical integration and differentiation. Numerical Solution of differential equations.	Engineering Analysis I (650260)
630263	Programming languages	3	C and C++ Programming Environment: compiled language, program creation, structure of programs, problem solving techniques, elements of C++ programming language, operands of C++, expressions, program design process, control structures, looping, functions, C++ stream input/output, structured types, data abstraction and classes, arrays, pointers, dynamic data and reference types, file processing, templates.	None
630512	Real-Time Systems	3	Introduction to real-time systems. Time handling. Objects. Real-time applications. Real-time system lifecycle. Structured design approaches. Petri Net models. Language support and restriction. Verification & Validation of real-time software. Real-time operating systems. Allocation & Scheduling Applications.	Automatic control (640344)
640221	Programming for Mechatronics Laboratory	1	Building, Simulating, and Testing C++ programming and MATLAB/Simulink exercises. Emphasize is given to mechatronics systems.	Programming languages (630263)

640233	Dynamics and Vibrations	3	Newton's laws. Kinematic of particles, equilibrium of particles, kinetics of particles, work and energy, rotational motion, impulse and momentum. Kinematics of rigid bodies, kinetics of rigid bodies, equilibrium of rigid bodies, rotational motion, work and energy, impulse and momentum. Vibration principles, vibration types, free and forced vibrations (harmonically excited motion, rotating and reciprocating unbalance), vibration measurements.	Statics (620211)
640235	Mechanics of Engineering Materials	3	Introduction to various stresses, principal stresses, Mohr circle, properties of materials, stress and strain curves, axial stress, shear stress, bending stress. Structure of metals and crystallized. Materials used in engineering applications. The collapse of material during loading, thermal treatment processes. Structure of alloys. Plans for the balance of iron and equivalent carburetor, heat treatment of steels.	Statics (620211)
640242	Instruments and Transducers	3	Measurements and statistics (error, sensitivity, accuracy, resolution, and precision); signal conditioning (amplifiers, filters, and bridge circuits); analog sensors (proximity, thermal, pressure, flow and strain gauges); analog-to-digital conversion; digital encoders (position and speed); optical and ultrasonic sensors.	Electronics1 (650242)
640253	Engineering Skills	3	Introduction to engineering, problem solving skills, engineering design, engineering skills (personal and analytical), technical report writing, communication skills (presentation skills), engineering ethics, project management.	English 2 (130102)
640312	Power Electronics and Drive	3	Steady-state characteristics of SCR devices. Triggering Circuits, SCR commutation methods. Controlled Rectifiers. AC voltage controllers. DC choppers. AC to DC Converter (Inverter), cycloconverters applications. Triac devices and applications. DC drives, AC drives.	Electronics 1 (650242)
640314	Electric Machines for Mechatronics	3	Single-phase and three-phase transformers. DC motors and generators. Single-phase & Three-phase AC motors (Induction and Synchronous). Special machines (stepper motors and universal motors). Electromagnetic theory.	Electronics 1 (650242)
640327	Modeling Simulation and Interface	3	Modeling definition. Modeling of different physical systems (mechanical, fluid, thermal and electrical). Differential and Laplace equations. State Space representation, state model from linear graphs Computer simulation techniques (applications using MATLAB Program). System response and analysis. PC Interface through DAQ cards	Dynamics & Vibrations (640233) + Instruments & Transducers (640242)

640328	Microprocessors & Microcontrollers	3	General architecture for microprocessors and microcontrollers, interfacing and programming microcontroller systems, programming and downloading PIC microcontrollers using Assembly and C languages. DC motor control (position and speed). A/D interface. Timing and interrupt.	Logic Circuits (630211) + Sensors & Actuators (640242)
640333	Industrial Electronics	3	Solid state devices in industrial logic, PLCs (introduction), Solid state devices to control Power SCRs, UJTs, TRIACs, Power Transistors, Solid state devices for firing circuits, Photoelectronics, Input Devices, signal conditioning, circuitry, output devices, data communications.	Electrical Machines for Mechatronics (640314) + Power Electronics and Drives (640312)
640335	Thermofluids	3	Introduction to first and second law of thermodynamics, modes of heat transfer, one-dimensional conduction heat transfer, introduction to convection heat transfer, boiling and condensation, internal flow heat exchangers. Fluid and gas properties, Equation of: Continuity, Momentum and Energy. Introduction to boundary layer theory. Introduction to viscous fluid flow. Turbomachinery.	Statics (620211) + Engineering Analysis1 (650260)
640337	Mechanics & 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. Torsion test. Thermal conductivity. Material properties and stresses.	Dynamics and Vibrations (40233)
640344	Automatic Control Systems	3	Mathematical background (complex variables, differential equations, Laplace transforms); Modeling of dynamic systems (mechanical and electrical systems); Block diagrams and signal flow graphs; Time domain analysis (steady state and transient response). Root locus, PID control stability. Frequency response.	Modeling and Simulation (640327)
640350	Engineering Project I	1	A 3rd year project where the students are taught the basic skills for simple designs and are asked to implement a project	Dynamics and Vibration (640233) + Electronics I (650242)
640415	Machines and Power Electronics Lab	1	Experiments for Single phase and three phase Transformers. DC Motors (Shunt, series, and compound), Single Phase & Three Phase Ac Motors (Synchronous and Induction). MISSING POWER ELECTRONICS Experiments?	Electric Machines for Mechatronics (640314) + Electronics lab (650343)
640424	Machine Intelligence	3	Neural networks and Fuzzy logic. Industrial applications for machine intelligence, new trends in machine intelligence. Applying Fuzzy and Neural techniques for control application using MATLAB/Simulink Toolboxes.	Automatic Control Systems (640344) + Programming languages (630263)
640432	Mechanical Design	3	Introduction to design processes. Fit and tolerance. Review of stress and deflection analysis. Prevention of failure due to static loads. Prevention of failure due to fatigue and dynamic loads. Threaded connections and fasteners. Welded and riveted joints. Mechanical	Machine Theory (620333)

			springs. Design of shafts and pulleys. Rolling and sliding bearings. Gear design. Friction drives. Flexible mechanical elements.	
640435	Pneumatic & Hydraulic Systems	3	Fluid systems. Properties of hydraulic fluids. Components of hydraulic systems. Components of Pneumatic systems, hydraulic circuits, pneumatic circuits, electrical control of hydraulic & pneumatic circuits, PLC. Control of hydraulic & pneumatic circuits.	Thermofluid (640335) + Automatic Control Systems (640344)
640441	Digital Control	3	Digitization and sampling. Discrete system analysis (difference equations, discrete transfer function, Z-Transform, block diagrams, system response, and stability). Discrete equivalents (numerical integration, zero-pole mapping, and hold). Design (Root Locus, and frequency response). PID controller design. Controller realization and microcontroller implementation	Automatic Control Systems (640344)
640442	Automatic Control Lab	1	Experiments in servo control valve & open loop position control. Position control (PID). Speed control (PID). Pressure control (PID). DC motor control. MATLAB/Simulink applications. LABVIEW applications.	Automatic Control Systems (640344*)
640445	Programming Logic Controllers	3	PLC operations principles; Memory systems and I/O interaction (structure, organization, configuration, and interaction). Discrete I/O (racks, instructions, and types). Analog I/O (instructions, data representation and handling). PLC programming (ladder diagrams format, timers/counters, arithmetic and logic operations, and flow control). IEC standards. Industrial applications.	Microprocessors and Microcontroller Systems (640328)
640446	Microprocessor and Sensors Lab	1	Experiments in the principles of different sensors and transducers with conditioning circuits design. Microcontroller programming, simulation and download. Interfacing microcontrollers with sensors and actuators	Microprocessor and Microcontroller (640328) + Electronics Lab I (650343)
640447	Mechatronics System Design	3	Overview of mechatronics system. Design methodology. Actuators (review and selection). Sensors (review and selection), Control systems (overview and selection of physical controllers and control algorithms). Interconnection and interfacing Systems. Case studies	Programmable Logic Controllers (640445) + Automatic Control Systems (640344)
640450	Engineering Training	0	Practical training at an engineering firm for 8-weeks within Jordan and 6 weeks outside Jordan.	90 credit hours + Department approval
640458	Reverse Engineering	3	System RE (RE steps, product teardown, functional models, bill of materials, subtract and operate). Mechanical RE (Rapid prototyping, CAM/CAD, conventional vs. nonconventional development). Electronic RE (Methods, PCB, electronic components, and VHDL). Software RE (applications, S/W RE basics, and RE tools)	Engineering Project I (640350)
640462	Process Control and Automation	3	Pressure, temperature, flow and level control. Process	Automatic Control Systems (640344)

			control methods (open and closed loops). Pneumatic, electronic (Analog), and digital electronic controllers are studied and applied to specific processes. Transmitters, positioners, valve operators, and controller mechanisms which produce proportional, rate, and reset responses are studied. Techniques of obtaining optimal controller settings are studied.	
640524	Computer Manufacturing Technology	3	Solid modeling, transformation, rotation, scaling, windowing, simulation and animation of mechanical problems. Optimal synthesis and selection of machine elements. Applications and individual problems. Implementation of CAD package for visualization. Simulation & animation of specific types of machine units. Basic concepts of CNC and, DNC, Programming CNC milling using G code, Programming CNC lathe using G code, APT programming.	Workshop(2) (620172) + Mechanical Design (640432)
640531	Automation & Fluids Control Lab	1	Experiments to illustrate the following: Pressure vs. force relationship. Pressure drop vs. flow relationship. Directional and speed control of cylinders. Indirect control using Pilot-Operated valves. Pneumatic motor circuits. Basic electrically controlled pneumatic circuits. Basic memory and Priority electro pneumatic circuits. Time-Delay electro pneumatic applications. Counter electro pneumatic applications. PLC in electro pneumatic systems. PLC programming.	Pneumatic & Hydraulic Systems (640435*)
640542	Robotics and Automation	3	Robot system components; sensors and actuators; Robot manipulators (spatial descriptions and transformations, kinematics and inverse kinematics, trajectory planning and control). Robotics use in automated industrial systems; Autonomous mobile robots (locomotion, kinematics, perception, and planning and navigation)	Programmable Logic Controllers (640445) + Automatic Control Systems (640344)
640543	Signal Processing for Mechatronics	3	Analog signal processing (signal conditioning, design and analysis of passive and active filters); Sampling and quantization; Digital signal processing (signals and systems properties, convolution, Z-transform, and DFT/FFT); FIR and IIR filter design and implementation; DSP architectures (fixed point vs. floating point);	Digital Control (640441)
640544	Mechatronics System Design Lab	1	Experiments that allow students to use the knowledge gained throughout his studies in the design of mechatronic systems. This includes components selection, interface, and programming controllers.	Microprocessors and Sensors Lab (640446) + Mechatronic System Design (640447*)
640551	Engineering Project II	1	Students are required to design a mechatronics-related project. This includes the theoretical analysis and simulation.	Engineering Project I (640350) +120 hours
640555	Engineering Project III	2	A continuation of Engineering Project II where the student is asked to implement and test a mechatronics prototype	Engineering Project II (640551) + Mechatronics System Design (640447)

640593	Special Topics in Mechatronics	3	New trends in Mechatronics Engineering (topics to be selected by department)	Department Approval
650163	Basic Engineering Analysis	3	Complex functions. Mapping. Integration in the complex plane. Taylor and Laurent expansion. Singularities and the residue theorem. Eigen values and eigenvectors	Calculus (2) (250102)
650242	Electronics 1	3	Semiconductor diode circuit analysis, semiconductor diodes rectifiers, zener diodes, clippers, clampers. Bipolar junction transistor (BJT), models biasing circuits. Common emitter amplifier. Common collector amplifier. Common base amplifier. Design of BJT amplifier. Field effect transistor (FET) & MOSFET, operation. Biasing and FET amplifiers. Design of FET amplifier. Introduction to OP-AMP & its applications.	Electric Circuits1 (610211)
650260	Engineering Analysis (1)	3	Differential equations. Second and higher order differential equations. Power series method, Laplace transform.	Calculus (2) (250102)
650343	Electronics 1 Lab	1	Experiments to illustrate diode characteristics, half and full wave rectifiers, diode applications, voltage doublers, clamper (zener diodes applications), transistor characteristics, BJT and FET, small signal analysis of CB, CC and CD amplifiers.	Electric Circuits lab (610216) + Electronics1 (650242)

* Concurrent to the Lecture