The Hashemite University
Faculty of Engineering
Department of Mechatronics Engineering

(2015)

Graduation Requirements:

The Bachelor of Science degree in Mechatronics Engineering requires a minimum of a hundred and sixty (160) credit hours of coursework. A detailed distribution of the credit hours required is shown below:

	Credit Hours
1. University Requirements	**27**
a. Compulsory	12
b. Elective	15
2. Faculty Requirements	**33**
a. Compulsory	33
b. Elective	–
3. Department Requirements	**97**
a. Compulsory	85
b. Elective	12
4. Free Course	**3**
Total	**160**

Indications of course subject digits

Specialization	Field Number
Mechanics	1
Electronics	2
Control Systems	3
System Design	4
Mechatronics Systems	5
Special Topics, Graduation Project, and Training	6

Example

Robotics					0405354	
0	4	0	5	3	5	4
Faculty		Department		Level	Field	Sequence

University requirements (27 credit hours):

1- Compulsory: (12) credit hours, as follows:

Course Number	Course Title	Credit Hours	Weekly Credit Hour		Prerequisite
			Lecture	Practical	
111404117	Military Sciences	3	3	–	–
111404118	National Education	3	3	–	–
111405101	Arabic Language	3	3	–	Level Test in Arabic Language or 111405098
111405110	English Language	3	3	–	Level Test in English Language or 111405099

2- Elective: (15) credit hours. The student is allowed to choose only from the following groups:

(a) Fields of Human Sciences.
(b) Fields of Social and Economic Sciences.
(c) Fields of Sciences, Technology, Agriculture, and Health.

Fields of Human Sciences: From three (3) to six (6) credit hours

Course Number	Course Title	Credit Hours	Weekly Credit Hour		Prerequisite
			Lecture	Practical	
111405112	Technical Translation	3	3	–	–
111404111	Islamic Thought	3	3	–	–
111404114	Jordan History and Civilization	3	3	–	–
111404113	Principles of Art and Literature in literature	3	3	–	–
111405102	Applied Arabic Language	3	3	–	–

111405111	Applied English Language	3	3	–	–
111404112	Jerusalem: History and Civilization	3	3	–	–
111404110	Islam and Contemporary Issues	3	3	–	–

Fields of Social and Economic Sciences: From three (3) to six (6) credit hours

Course Number	Course Title	Credit Hours	Weekly Credit Hour		Prerequisite
			Lecture	Practical	
111404115	Science of Sociology	3	3	–	–
111404121	Law and the Ordering of Our Life	3	3	–	–
111404101	University life of Student				
111404104	Family and Child				
111404120	Economic and Science	3	3	–	–
111404103	Life Skills	3	3	–	–
111404102	Introduction to Psychology	3	3	–	–
111404116	Archeology and Tourism Science	3	3	–	–

Fields of Sciences, Technology, Agriculture, and Health: From three (3) to six (6) credit hours

Course Number	Course Title	Credit Hours	Weekly Credit Hour		Prerequisite
			Lecture	Practical	
110108104	Energy and Its sources	3	3	–	–
110108113	Biotechnology and Society	3	3	–	–
110108114	Vehicles Mechanics Principles	3	3	–	–
110107130	Health and Nutrition enhancement	3	3	–	–
110108131	Nutrition and First Aids	3	3	–	–
110108132	Sports and Health	3	3	–	–
110108133	Environment Awareness	3	3	–	–

Faculty Requirements (33 credit hours):

This core coursework is required to fulfill the faculty requirements and includes:

Course Number	Course Title	Credit Hours	Weekly Credit Hour		Pre-requisite or Co-requisite*
			Lecture	Practical	
110101102	Calculus 2	3	3	–	110108101
110101201	Calculus 3	3	3	–	110101102
110101203	Ordinary Differential Equations 1	3	3	–	110101102
110102101	General Physics 1	3	3	–	–
110102102	General Physics 2	3	3	–	110102101
110102103	General Physics Lab 1	1	–	3	110102101*
110103107	Basics of General Chemistry	3	3	-	–
110103108	Basics of General Chemistry Laboratory	1	–	3	110103107*
110108101	Calculus 1	3	3	–	–

110108112	C++ Programming	3	3	–	Level Test in Computer Skills or 110108099
110400101	Engineering Workshop	1	0.5	2	–
110400201	Manual Engineering Drawing	2	1	3	–
110400202	Computer Aided Engineering Drawing	1	–	3	110400201
110400203	Ethics and Communication Skills	3	3	–	111405110

Department Requirements (97 credit hours):

1- **Compulsory:** (85) credit hours of engineering coursework are required to fulfill the department requirements and they include:

Course Number	Course Title	Credit Hours	Weekly Credit Hour		Pre-requisite or Co-requisite*
			Lecture	Practical	
110401214	Engineering Mechanics	3	3	–	110108101 + 110102101
110402303	Numerical Analysis	3	3	–	110101203 + 110108112
110402330	Strength of Materials Lab.	1	–	3	110401214 or 110402212
110402384	Mechanical Design	2	2	–	110401214
110403242	Statistics and Probabilities	3	3	–	110101102
110403363	Engineering Materials and Manufacturing Technology	2	2	–	110103107 + 110400101
110405211	Dynamics and Vibrations	3	3	–	110101203 + 110401214
110405311	Modeling and Simulation	3	3	–	110409201 + 110405211
110405322	Digital Logic and Digital Electronics	3	3	–	110406329
110405323	Electrical Machines	3	3	–	110409203
110405331	Automatic Control	3	3	–	110101203
110405411	Theory of Mechanisms and Machinery	2	2	–	110405211
110405421	Logic and Electronics Lab	1	–	3	110405322
110405422	Motor Drive Systems	3	3	–	110406329 + 110405323
110405423	Electrical Machines and Drive Lab.	1	–	3	110405422
110405424	Microprocessors and Microcontrollers	3	3	–	110405322
110405425	Microprocessors and Microcontrollers Lab.	1	–	3	110405424
110405426	Digital Signals	3	3	–	110406260
110405431	Transducers and Interfacing	3	3	–	110406329
110405432	Control and Transducers Lab.	1	–	3	110405431+ 110405331
110405441	Automation	2	2	–	110405331
110405442	Robotics	3	3	–	110405331 + 110406260

110405451	Practical Training	3	–	3	The student should pass at least 112 credit hours from the curriculum before starting the practical training including 110400203
110405511	Hydraulic and Pneumatic Systems	3	3	–	110405331
110405531	Advanced Control	3	3	–	110405331 + (110405426 or 110409325)
110405532	Artificial Intelligence	3	3	–	110405331
110405541	Process Control Lab.	1	–	3	110405441
110405542	Design of Mechatronics Systems	3	3	–	110405331 + 110405323 + 110405431
110405543	Mechatronics System Lab.	1	–	3	110405442 + 110405542
110405551	Graduation Project 1	1	–	3	The student should pass at least 120 credit hours from the curriculum including 110400203 + 110405331 + 110405323 + 110405431
110405552	Graduation Project 2	2	–	6	110405551
110406260	Applied Mathematics	3	3	–	110101203
110406329	Electronics	3	3	–	110409203
110409201	Electrical Circuits 1	3	3	–	110101102 + 110102102
110409203	Electrical Circuits 2	3	3	–	110409201
110409300	Electrical Circuits Lab.	1	–	3	110102103 + (110409203 or 110406229)

2- **Electives:** Nine (12) credit hours of engineering coursework are required to fulfill the requirements of bachelor degree.

Course Number	Course Title	Credit Hours	Weekly Credit Hour		Pre-requisite
			Lecture	Practical	
110402481	Thermofluids	3	3	–	110406260
110403302	Engineering Economy	3	3	–	110403242
110405533	Theory of Modern Control	3	3	–	110405331+ 110406260
110405534	Control of Robotic Systems	3	3	–	110405442
110405544	Computer Aided Design	3	3	–	110405331
110405545	Micro-Electro-Mechanical Systems (MEMS)	3	3	–	110405431

110405546	Building Automation	3	3	–	110405431
110405547	Autotronics	3	3	–	110406329
110405548	Automated Principles	3	3	–	110406329 + 110405323
110405549	Fundamentals for Renewable Energy Systems	3	3	–	110406329 + 110405323
110405553	Special Topics in Mechatronics	3	3	–	Dept. Approval

3- **Free course** of three (3) credit hours selected from the university faculties.

Courses Offered by the Department of Mechatronics Engineering

Course Number	Course Title	Credit Hours	Weekly Credit Hour		Pre-requisite
			Lecture	Practical	
110405211	Dynamics and Vibrations	3	3	–	110101203 + 110401214
110405311	Modeling and Simulation	3	3	–	110409201 + 110405211
110405322	Digital Logic and Digital Electronics	3	3	–	110406329
110405323	Electrical Machines	3	3	–	110409203
110405331	Automatic Control	3	3	–	110101203
110405411	Theory of Mechanisms and Machinery	3	3	–	110405211
110405421	Logic and Electronics Lab,	1	–	3	110405322
110405422	Motor Drive Systems	3	3	–	110406329 + 110405323
110405423	Electrical Machines and Drive Lab.	1	–	3	110405422
110405424	Microprocessors and Microcontrollers	3	3	–	110405322
110405425	Microprocessors and Microcontrollers Lab.	1	–	3	110405424
110405426	Digital Signals	3	3	–	110406260
110405431	Transducers and Interfacing	3	3	–	110406329
110405432	Control and Transducers Lab.	1	–	3	110405431+ 110405331
110405441	Automation	2	2	–	110405331
110405442	Robotics	3	3	–	110405331 + 110406260
110405451	Practical Training	3	–	3	The student should pass at least 112 credit hours from the curriculum before starting the practical training including 110400203
110405511	Hydraulic and Pneumatic Systems	3	3	–	110405331

110405531	Advanced Control	3	3	–	110405331 + (110405426 or 110409325)
110405532	Artificial Intelligence	3	3	–	110405331
110405533	Theory of Modern Control	3	3	–	110405331 +110406260
110405534	Control of Robotic Systems	3	3	–	110405442
110405541	Process Control Lab.	1	–	3	110405441
110405542	Design of Mechatronics Systems	3	3	–	110405331 + 110405323 + 110405431
110405543	Mechatronics System Lab.	1	–	3	110405442 + 110405542
110405544	Computer Aided Design	3	3	–	110405331
110405545	Micro-Electro-Mechanical Systems (MEMS)	3	3	–	110405431
110405546	Building Automation	3	3	–	110405431
110405547	Autotronics	3	3	–	110406329
110405548	Automated Principles	3	3	–	110406329 + 110405323
110405549	Fundamentals for Renewable Energy Systems	3	3	–	110406329 + 110405323
110405551	Graduation Project 1	1	–	3	The student should pass at least 120 credit hours from the curriculum including 110400203 + 110405331 + 110405323 + 110405431
110405552	Graduation Project 2	2	–	6	110405551
110405553	Special Topics in Mechatronics	3	3	–	Dept. Approval

Courses Offered by the Department for other departments

Course Number	Course Title	Credit Hours	Weekly Credit Hour		Pre-requisite
			Lecture	Practical	
110405331	Automatic control	3	3	-	110101203
110405332	Automatic control lab	1	-	3	110405331
110405531	Advanced control	3	3	-	110405331+(110405426 or 110409325)

Course Description

Course Number	Description	Pre-requisites
110405211	**Dynamics and Vibrations:** Introduction to dynamics and	110101203 +

	vibration of mechanical systems, three-dimensional particle kinematics, force-momentum formulation for systems of particles and for rigid bodies, Newton-Euler equations, work-energy formulation for systems particles and for rigid bodies, virtual displacements and work, free and forced vibration of linear damped lumped parameter multi-degree of freedom models of mechanical systems.	110401214
110405311	**Modeling and Simulation:** Unified methods for modeling and simulating mechatronics systems with emphasis on mixed component systems containing electrical, mechanical, thermal and fluid elements; modeling of mixed physical systems by lumped-parameter linear elements, energy methods, linear graphs, bond graphs, system analogies, state space formulation, analytical and numerical solutions, time response, dynamic response specifications, stability considerations and closed-loop systems, elementary feedback control systems, case studies of mechatronics systems .	110409201 + 110405211
110405322	**Digital Logic and Digital Electronics:** Number systems, arithmetic operations and Boolean algebra, DeMorgan's theorem, Karnough map, simplification and manipulation, concept of minterms and maxterms, combinational logic design, design and analysis procedure for decoders, encoders, multiplexers, binary adders/subtractors: half, full and ripple carry adders, sequential logic circuits; design and analysis procedures for latches, flip-flops, registers and counters, diodes and transistors as switches and types of amplifiers, logic family gates as TTL, DTL, RTL, and ECL, analogue-to-digital and digital-to-analogue circuits.	110406329
110405323	**Electrical Machines:** Basic principles of electrical machines and energy conversion, principles and operation of single and three phase transformers, principles, operation, key characteristics, and applications of DC motors, single and three-phase AC motors, and special purpose motors (e.g., stepper motors, brushless dc motors, and linear motors), introduction to DC and AC generators.	110409203
110405331	**Automatic Control:** Introduction to control systems, modeling of physical systems: electrical, mechanical, system representations: system block diagrams and signal flow graphs, state variable models, feedback control system characteristics, performance of feedback control systems, Routh-Hurwitz stability criterion, root locus method, frequency response, and PID control.	110101203
110405411	**Theory of Mechanisms and Machinery:** kinematics and dynamics of various machine elements and systems used in mechatronics systems: linkages, cams, gears, and gear trains, analysis and synthesis (design) with multiple solutions, visualization and analysis of motions in mechanics, mechanisms design to achieve desired motion specifications, graphical, analytical, and computer-based techniques.	110405211
110405421	**Logic and Electronics Lab:** Experiments on digital logic gates, half and full adders and comparators, multiplexers and decoders, state diagram (D-flip-flops and JK-flip-flops), counters, shift registers, diodes, voltage regulators,	110405322

	bipolar junction transistors (BJTs), DC biasing, operational amplifiers, amplifier frequency response, multistage amplifiers, JFET amplifiers, and power electronics.	
110405422	**Motor Drive Systems:** Review of modeling and characteristics of DC and AC motors during transient and steady state, power electronic devices and switches, operation, drive, and control of electric motors using classical (relays and contactors) and modern (power electronics) methods, motor behavior when operated from variable power sources (converters), DC motor drives using phase-control and choppers, AC motor drives for induction motors using phase, frequency (inverters), and vector control.	110406329 + 110405323
110405423	**Electrical Machines and Drive Lab:** Experiments on single and three-phase transformers, autotransformers, separately excited, shunt, series, and compound DC motors, three-phase induction motors, DC and AC generators, speed control and drive systems (convertors and invertors).	110405422
110405424	**Microprocessors and Microcontrollers:** Introduction to microprocessor and microcontroller systems, architecture of 8088/8086 microprocessors and fundamentals of operation, architecture of microcontrollers and fundamentals of operation, hardware and software techniques for real-time applications incorporating electrical, electronic, and electromechanical systems, hardware-software interactions, programming internal peripherals, and real-time control and conditioning of external devices using microprocessors and microcontrollers such as Motorola, Microchip, Intel, or any other equivalent product.	110405322
110405425	**Microprocessors and Microcontrollers Lab.:** Experiments on hardware and software techniques for real-time applications incorporating electrical, electronic, and electromechanical systems, hardware-software interactions, programming internal peripherals, and real-time control and conditioning of external devices using microprocessors and microcontrollers such as Motorola, Microchip, Intel, or any other equivalent product.	110405424
110405426	**Digital Signals:** Classification of signals and systems, time-domain representations of continuous time signals, time-domain analysis of continuous LTI systems, frequency-domain representations of continuous time signals, frequency-domain analysis of continuous LTI systems, time-domain representation of discrete time signals, time-domain analysis of discrete LTI systems, analog to digital conversion, sampling theorem, reconstruction of continuous time signals, z-transform, Fourier analysis, Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT), digital filter terminology and design, design of Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters, continuous and discrete filters.	110406260
110405431	**Transducers and Interfacing:** Static and dynamic characteristics as well as time response of measurement	110406329

	systems, error and uncertainty analysis, analog and digital signal conditioning, basics of data acquisition systems, transducers of thermal, mechanical, and optical systems, measurement systems design.	
110405432	**Control and Transducers Lab:** Experiments on temperature, optical, and mechanical transducers, analog and digital signal conditioning.	110405431 +110405331
110405441	**Automation:** Industrial control systems: sensors, actuators and other control components, Process Control Systems, Programmable Logic Controllers (PLCs), PLC-based system design, integration, operation, and programming (using ladder diagrams), fundamentals of Computer Numerical Controlled (CNC) machines and programming concepts.	110405331
110405442	**Robotics:** Introduction to robotics, applications of robotics, spatial description and transformation, manipulator forward and inverse kinematics, workspace, singularity, redundancy, manipulator dynamics, trajectory generation.	110405331 + 110406260
110405451	**Practical Training:** A practical training of eight (8) weeks period in an engineering institute approved by the department is a must whether it is inside or outside Jordan.	The student should pass at least 112 credit hours from the curriculum including 110400203 before starting the practical training
110405511	**Hydraulic and Pneumatic Systems:** Review of fluid power systems, physical properties of hydraulic systems, hydraulic energy and power, frictional losses in pipelines, hydraulic pumps, cylinders, motors, and valves, circuit design and analysis, maintenance of hydraulic systems, air preparation and components of pneumatic systems, circuits and applications, basic electrical control for fluid power circuits, fluid logic control.	110405331
110405531	**Advanced Control:** Frequency response methods: Bode diagram, polar plot, and log-magnitude-phase plot, Nyquist stability criterion, compensators, PID controllers, signal sampling and reconstruction, digital control algorithms and filters, time response of discrete time systems, and design and implementation of control systems using digital computers.	110405331 + (110405426 or 110409352)
110405532	**Artificial Intelligence:** Introduction to intelligent systems and their application in modeling and control, basic concepts of fuzzy logic elements, design, tuning and operation, basic concepts of neural network elements, architecture, and training, basic concepts of genetic algorithms, design, optimization problems.	110405331
110405533	**Theory of Modern Control:** Introduction to feedback control, basic matrix theory, state-space modeling and dynamic response of linear systems, frequency-domain analysis, controllability, observability, pole placement design, estimation and compensator design, optimal	110405331 +110406260

	control.	
110405534	**Control of Robotic Systems:** Introduction to sensors and actuators in robotic systems, linear and nonlinear control techniques for robotic systems, force and motion control methods, introduction to control of mobile robots and telerobotics.	110405442
110405541	**Process Control Lab.:** Experiments on PLC programming: ladder diagram and instruction list, process control, scale-down production stations, pneumatic and electro-pneumatic systems, troubleshooting of PLC systems, PID control laws in process control systems, advanced control strategies in process control.	110405441
110405542	**Design of Mechatronics Systems:** Introduction to mechatronics systems design, mathematical modeling and computer simulation of mechatronics systems, control system performance analysis and applications, comprehensive projects where the students try to combine their skills in electrical, mechanical and computer technologies to produce integrated mechatronics systems.	110405331 + 110405323 + 110405431
110405543	**Mechatronics Systems Lab:** Experiments related to various topics in mechatronics engineering such as robotics, industrial lines control systems, and robot applications in manufacturing	110405442 + 110405542
110405544	**Computer Aided Design:** Introduction to methods of determining, analyzing, and modeling of mechatronics systems using software packages such as Matlab and Simulink, systimatically analyze, design, and tune linear control systems, tune the controller parameters using automated and interactive techniques, and verify performance, design of single- and multi- loop control systems using a variety of classical and state space techniques.	110405331
110405545	**Micro-electro-mechanical Systems (MEMS**): Principles and applications of micro-electromechanical systems, fabrication and micromachining techniques, micromechanics, microsensing, and microactuating mechanisms, modeling and simulation of microstructure, case studies include mechanical, electrical, Industrial, biomedical, and computer applications.	110405431
110405546	**Building Automation:** Introduction to building automation, control signals, devices, and strategies, HVAC principles, HVAC control devices, lighting control systems, fire alarm systems, video surveillance systems, voice-data-video systems, access control systems, data networks and networks integration, building management systems, building automation protocols, smart buildings and building systems integration, energy and sustainability in automated buildings, other building systems (elevators, electric power.	110405431
110405547	**Autotronics:** Applications of mechatronics systems in modern automobiles, fuel, ignition, and braking systems, electronic suspension and steering systems, actuators' diagnosis and services, emission control, on-board diagnostic, road safety systems, air conditioning systems, automatic transmissions, comfort and safety systems, and	110406329

	automotive computers.	
110405548	**Automated Principles:** Introduction to conventional internal combustion engine vehicles, electric vehicles, hybrid electric vehicles, and hybrid fuel cell vehicles**,** vehicle performance characteristics, power train architecture design, control strategies, components selection and sizing, and fundamentals of regenerative braking.	110406329 + 110405323
110405549	**Fundamentals of Renewable Energy Systems:** Introduction to renewable energy resources, photovoltaic (PV) systems, solar-thermal systems, wind power systems, hydropower systems, geothermal heat and power systems, biomass heat and power systems, hydrogen and fuel cells systems, special focus on PV and wind energy system, hybrid power system, energy conversion systems, components selection and sizing, energy storage, control systems, and applications.	110406329 + 110405323
110405551	**Graduation Project 1:** Collection of Background scientific material relating to the project which the undergraduate selects for project 2.	The student should pass at least 120 credit hours from the curriculum including 110400203 + 110405331 + 110405323 + 110405431
110405552	**Graduation Project 2:** Practical Implementation of theoretical and experimental knowledge gained from the course of his study and work carried out in project one.	110405551
110405553	**Special Topics in Mechatronics:** Current trends and development in the field of Mechatronics engineering	Dept. Approval