# German Jordanian University

## School of Applied Technical Sciences

## Department of Mechatronics Engineering

## Bachelor of Science in Mechatronics Engineering

## Study Plan

## 2014

# I. Program Objectives

The objective of this undergraduate Mechatronics Engineering program is to prepare students for careers in industry or further studies in mechatronics engineering and related disciplines. This will be accomplished through the following educational focus:

- Students will have breadth of fundamental knowledge in mathematics, basic sciences, and engineering as well as depth of knowledge in mechatronics engineering.
- Students will have strong practical experience obtained through hands-on learning methodologies.
- Students will have effective communication, interpersonal, and critical thinking skills, a spirit of curiosity, and conduct reflecting professionalism and engineering ethics.

# II. Learning Outcomes

a) Apply knowledge of mathematics, science and mechatronics engineering to the solution of problems particularly in the areas of mechatronics systems and subsystem integration.
b) Design and conduct experiments in addition to analyzing, interpreting resulting data.
c) Formulate engineering problems and use modern computer tools.
d) Thrive in a team environment and understand ethical responsibility.
e) Demonstrate knowledge and technical skills of key mechatronics specialties needed in Jordan and the region.

# III. Assessment of Learning Outcomes

a) Apply knowledge of mathematics, science and mechatronics engineering to the solution of problems particularly in the areas of mechatronics systems and their integration.

**Assessment Methods:**

- Exams.
- Capstone projects.
- Employer surveys.
- Students' evaluation.
- Students' portfolios.

b) Design and conduct experiments in addition to analyzing, interpreting data obtained from experiments.

**Assessment Methods:**

- Exams.
- Performance in laboratory work.
- Capstone projects.
- Employer surveys.
- Students' evaluation.

c) Formulate engineering problems and use modern technical tools necessary for engineering practice such as simulation software and equation solvers.

**Assessment Methods:**

- Performance in Mechatronics Systems design and integration course.
- Capstone projects.
- Employer surveys
- Students' evaluation.
- Students' portfolios.

d) Function in a team environment and understand ethical responsibility.

**Assessment Methods:**

- Final year project.
- Employer surveys.

e) Demonstrate knowledge and technical skills of key Mechatronics specialties needed in Jordan and the region.

**Assessment Methods:**

- Field trips reports
- Final year project.
- Employer surveys.

# IV. Framework for B.Sc. Degree (Semester Credits)

| Classification | Credit Hours | | |
|---|---|---|---|
| | Compulsory | Elective | Total |
| University Requirements | 21 | 6 | 27 |
| School Requirements | 37 | - | 37 |
| Program Requirements | 103 | 12 | 115 |
| **Total** | **161** | **18** | **179** |

## 1. University Requirements: (27 credit hours)

### 1.1. Compulsory: (21 credit hours)

| Course ID | Course Title | Credit Hours | Contact Hours | | Prerequisite |
|---|---|---|---|---|---|
| | | | Lecture | Lab | |
| ARB099 | Arabic 99[a] | 0 | 3 | - | - |
| ARB100 | Arabic | 3 | 3 | - | ARB099 |
| ENGL098 | English I[a] | 0 | 3 | - | - |
| ENGL099 | English II[a] | 0 | 3 | - | ENGL098 |
| ENGL101 | English III | 1 | 3 | - | ENGL099 |
| ENGL102 | English IV | 1 | 3 | - | ENGL101 |
| ENGL201 | English V | 2 | 3 | - | ENGL102 |
| ENGL202 | English VI | 2 | 3 | - | ENGL201 |
| GERL101 | German I | 3 | 9 | - | - |
| GERL102 | German II | 3 | 9 | - | GERL101 |
| MILS100 | Military Science | 3 | 3 | - | - |
| NE101 | National Education | 3 | 3 | - | - |
| | **Total** | **21** | **48** | **-** | |

### 1.2. Elective: (6 Credit Hours) (two courses out of the following)

| Course ID | Course Title | Credit Hours | Contact Hours | | Prerequisite |
|---|---|---|---|---|---|
| | | | Lecture | Lab | |
| DES101 | Arts' Appreciation | 3 | 3 | - | - |
| EI101 | Leadership and Emotional Intelligence | 3 | 3 | - | - |
| IC101 | Intercultural Communications | 3 | 3 | - | - |
| SE301 | Social Entrepreneurship and Enterprises | 3 | 3 | - | - |
| SFTS101 | Soft Skills | 3 | 3 | - | - |
| TW303 | Technical and Workplace Writing | 3 | 3 | - | - |
| BE302 | Business Entrepreneurship | 3 | 3 | - | - |
| PE101 | Sports and Health | 3 | 3 | - | - |
| | **Total** | **6** | **6** | **-** | |

[a] Not required for students who pass placement test

## 2. School Requirements: (37 Credit Hours)

| Course ID | Course Title | Credit Hours | Contact Hours | | Prerequisite |
|---|---|---|---|---|---|
| | | | Lecture | Lab | |
| CS116 | Computing Fundamentals | 3 | 3 | - | - |
| CS1160 | Computing Fundamentals Lab | 1 | - | 3 | Corequisite: CS116 |
| ENE211 | Electrical Circuits I | 3 | 3 | - | PHYS104 |
| ENE213 | Electrical Circuits Lab | 1 | - | 3 | ENE211 |
| GERL201 | German III | 3 | 6 | - | GERL102 |
| GERL202 | German IV | 3 | 6 | - | GERL201 |
| IE121 | Workshop | 1 | - | 3 | - |
| MATH099 | Pre-Math[1] | 0 | 3 | - | - |
| MATH101 | Calculus I | 3 | 3 | - | MATH099 |
| MATH102 | Calculus II | 3 | 3 | - | MATH101 |
| MATH203 | Applied Mathematics for Engineers | 3 | 3 | - | MATH102 |
| MATH205 | Differential Equations | 3 | 3 | - | MATH102 |
| ME111 | Computer Aided Engineering Drawing | 3 | 2 | 3 | CS116, CS1160 |
| PHYS103 | Physics I | 3 | 3 | - | - |
| PHYS104 | Physics II | 3 | 3 | - | PHYS103 |
| PHYS106 | General Physics Lab | 1 | - | 3 | PHYS103, Corequisite: PHYS104 |
| | Total | 37 | 41 | 15 | |

## 3. Program Requirements (115 credit hours)

### 3.1. Program Requirements (Compulsory): (103 credit hours)

| Course ID | Course Title | Credit Hours | Contact Hours | | Prerequisite |
|---|---|---|---|---|---|
| | | | Lecture | Lab | |
| ME223 | Thermofluids | 3 | 3 | - | MATH205 |
| ME323 | Thermofluids Lab | 1 | - | 3 | ME223 |
| ME344 | Control Systems I | 3 | 3 | - | TME214, MATH205, ENE211 |
| ME345 | Vibration and Control Lab | 1 | - | 3 | ME344 |
| ME362 | Sensors and Actuators | 4 | 3 | 3 | ENE211, ENE213, MATH205 |
| ME391 | Field Training | - | - | 160 hr | Dept. Approval |
| ME491 | International Internship | 12 | - | 20 wks | ME391 |
| ME522 | Hydraulics and Pneumatics | 3 | 2 | 3 | ME223 |
| ME534 | Electrical Machines and Control | 3 | 3 | - | ENE211 |
| ME535 | Electrical Machines and Control Lab | 1 | - | 3 | ME534 |
| ME548 | Control Systems II | 3 | 3 | - | ME344 |
| ME551 | Robotics | 3 | 3 | - | TME331, ME344 |
| ME554 | Programmable Logic Controllers | 3 | 2 | 3 | ME344 |
| ME555 | Machine Intelligence | 3 | 3 | - | ME344, ME362 |
| ME561 | Mechatronics Systems Design and Integration | 3 | 2 | 3 | ME362, CE341 |
| ME567 | Modeling and Simulation | 3 | 3 | - | TME214, ME223 |
| ME591 | Graduation Project I | 3 | - | 9 | ME491, min 124 CH |
| ME592 | Graduation Project II | 3 | - | 9 | ME591 |
| IE224 | Materials and Mechanics Lab | 1 | - | 3 | IE121, TME213 |
| IE325 | Manufacturing Processes | 4 | 3 | 3 | IE121, TME213 |
| TME212 | Statics | 3 | 3 | - | PHYS103, MATH102 |
| TME213 | Mechanics of Materials | 3 | 3 | - | TME212 |
| TME214 | Dynamics and Vibrations | 3 | 3 | - | TME212 |
| TME331 | Theory of Machines | 3 | 3 | - | TME214, ME111, MATH203 |
| TME332 | Machine Design | 4 | 3 | 3 | TME213, IE325, ME111 |
| BM371 | Numerical Methods for Engineers | 3 | 2 | 3 | CS116, MATH203, MATH205 |
| CE211 | Digital Systems | 4 | 3 | 3 | - |
| CE331 | Signals and Systems | 3 | 3 | - | ME344 |
| CE341 | Microprocessor and Microcomputer Systems | 4 | 3 | 3 | CE211 |
| ENE214 | Electronics | 3 | 3 | - | ENE211 |
| ENE312 | Power Electronics | 3 | 3 | - | ENE214 |
| ENE314 | Power Electronics Lab | 1 | - | 3 | ENE312 |
| GERL301 | German V | 3 | 9 | - | GERL202 |
| GERL302 | German VI | 3 | 9 | - | GERL301 |
| | **Total** | **103** | **83** | **42** | |

## 3.2. Program Requirements (Electives[b]): (12 credit hours)

A minimum of 12 credit hours of engineering coursework are required. This list is considered to be open for modifications on the base of the decision of the school council before registration.

| Course ID | Course Title | Credit Hours | Contact Hours | | Prerequisite |
|---|---|---|---|---|---|
| | | | Lecture | Lab | |
| ME516 | Waves and Vibrations | 3 | 3 | - | TME214 |
| ME533 | Advanced Electronics | 3 | 3 | - | ENE214 |
| ME541 | Real-Time Computer Control Systems | 3 | 3 | - | ME344 |
| ME542 | Digital Control Systems | 3 | 3 | - | ME344 |
| ME543 | Process Control | 3 | 3 | - | ME344 |
| ME545 | CNC and Manufacturing Control | 3 | 3 | - | IE325, ME344 |
| ME546 | Linear Systems | 3 | 3 | - | ME344 |
| ME547 | State Space Control and Observers | 3 | 3 | - | ME344 |
| ME553 | Mobile Robots | 3 | 3 | - | TME331, ME344 |
| ME556 | Autonomous Systems | 3 | 3 | - | ME344, ME362 |
| ME557 | Process Automation | 3 | 3 | - | ME344 |
| ME558 | Industrial Robotics | 3 | 3 | - | TME331, ME344 |
| ME564 | Mechatronics of Smart Materials | 3 | 3 | - | ME344, ME362 |
| ME566 | Mechatronics Projects | 3 | 3 | - | ME344, CE341 |
| ME568 | Embedded Systems | 3 | 2 | 3 | ENE211, BM371, CE341 |
| ME569 | Smart Sensors | 3 | 3 | - | ME362, CE211, ENE211 |
| ME573 | Digital Image Processing | 3 | 3 | - | MATH203, Math205, CE211 |
| ME582 | Micro-Electromechanical Systems | 3 | 3 | - | ENE211, TME213, ME223 |
| ME583 | Nano Systems | 3 | 3 | - | ENE211, TME213, ME223 |
| ME585 | Autotronics | 3 | 3 | - | ENE214, ME362 |
| ME539 | Special Topics in Electrical and Electronics Engineering | 3 | 3 | - | Dept. Approval |
| ME549 | Special Topics in Control Engineering | 3 | 3 | - | Dept. Approval |
| ME559 | Special Topics in Robotics and Automation | 3 | 3 | - | Dept. Approval |
| ME579 | Special Topics in Computer and Digital Sciences | 3 | 3 | - | Dept. Approval |
| ME589 | Special Topics in Mechatronics Technology | 3 | 3 | - | Dept. Approval |
| ME597 | Special Topics I | 1 | - | 3 | Dept. Approval |
| ME598 | Special Topics II | 2 | 2 | - | Dept. Approval |
| IE371 | Engineering Economics | 3 | 3 | - | MATH205 |
| TME513 | Multi-Body Dynamics | 3 | 3 | - | TME331 |
| TME514 | Machine Dynamics | 3 | 3 | - | TME331 |

[b] ME491 International Internship is prerequisite for all elective courses

# V. Study Plan[c] Guide for the Bachelor Degree in Mechatronics Engineering

| First Year | | | | |
|---|---|---|---|---|
| **First Semester** | | | | |
| **Course ID** | **Course Title** | **Cr. Hr.** | **Prerequisites** | **Co-requisite** |
| IE121 | Workshop | 1 | - | - |
| CS116 | Computing Fundamentals | 3 | - | - |
| CS1160 | Computing Fundamentals Lab | 1 | - | CS116 |
| MATH101 | Calculus I | 3 | MATH099 | - |
| PHYS103 | Physics I | 3 | - | - |
| ARB100 | Arabic | 3 | ARB099 | - |
| ENGL101 | English III | 1 | ENGL099 | - |
| GERL101 | German I | 3 | - | - |
| | **Total** | **18** | | |

| First Year | | | | |
|---|---|---|---|---|
| **Second Semester** | | | | |
| **Course ID** | **Course Title** | **Cr. Hr.** | **Prerequisites** | **Co-requisite** |
| ME111 | Computer Aided Engineering Drawing | 3 | CS116,CS1160 | - |
| ME1110 | Computer Aided Engineering Drawing Lab | 0 | - | ME111 |
| MATH102 | Calculus II | 3 | MATH101 | - |
| PHYS104 | Physics II | 3 | PHYS103 | - |
| PHYS106 | General Physics Lab | 1 | PHYS103 | PHYS104 |
| ENGL102 | English IV | 1 | ENGL101 | - |
| GERL102 | German II | 3 | GERL101 | - |
| MILS100 | Military Science | 3 | - | - |
| NE101 | National Education | 3 | - | - |
| | **Total** | **20** | | |

[c] The following study plan guide assumes having passed all placement tests

| Second Year | | | | |
|---|---|---|---|---|
| **First Semester** | | | | |
| **Course ID** | **Course Title** | **Cr. Hr.** | **Prerequisites** | **Co-requisite** |
| TME212 | Statics | 3 | MATH102, PHYS103 | - |
| CE211 | Digital Systems | 4 | - | - |
| CE2110 | Digital Systems Lab | 0 | - | CE211 |
| ENE211 | Electrical Circuits I | 3 | PHYS104 | - |
| MATH205 | Differential Equations | 3 | MATH102 | - |
| ENGL201 | English V | 2 | ENGL102 | - |
| GERL201 | German III | 3 | GERL102 | - |
| | **Total** | **18** | | |

| Second Year | | | | |
|---|---|---|---|---|
| **Second Semester** | | | | |
| **Course ID** | **Course Title** | **Cr. Hr.** | **Prerequisites** | **Co-requisite** |
| TME213 | Mechanics of Materials | 3 | TME212 | - |
| TME214 | Dynamics and Vibration | 3 | TME212 | - |
| ME223 | Thermofluids | 3 | MATH205 | - |
| ENE214 | Electronics | 3 | ENE211 | - |
| ENE214 | Electrical Circuits I Lab | 1 | ENE211 | - |
| MATH203 | Applied Math for Engineers | 3 | MATH102 | - |
| ENGL202 | English VI | 2 | ENGL201 | - |
| GERL202 | German IV | 3 | GERL201 | - |
| | **Total** | **21** | | |

| Third Year | | | | |
|---|---|---|---|---|
| **First Semester** | | | | |
| **Course ID** | **Course Title** | **Cr. Hr.** | **Prerequisites** | **Co-requisite** |
| IE224 | Materials and Mechanics Lab | 1 | IE121, TME213 | - |
| ME362 | Sensors and Actuators | 4 | ENE211, ENE213, MATH205 | - |
| ME3620 | Sensors and Actuators Lab | 0 | - | ME362 |
| ME344 | Control Systems I | 3 | MATH205, TME214, ENE211 | - |
| IE325 | Manufacturing Processes | 4 | IE121, TME213 | - |
| IE3250 | Manufacturing Processes Lab | 0 | - | IE325 |
| CE341 | Microprocessor and Microcomputer Systems | 4 | CE211 | - |
| CE3410 | Microprocessor and Microcomputer Systems Lab | 0 | - | CE341 |
| GERL301 | German V | 3 | GERL202 | - |
| | **Total** | **19** | | |

| Third Year | | | | |
|---|---|---|---|---|
| **Second Semester** | | | | |
| **Course ID** | **Course Title** | **Cr. Hr.** | **Prerequisites** | **Co-requisite** |
| TME331 | Theory of Machines | 3 | TME214, ME111, MATH203 | - |
| ME323 | Thermofluids Lab | 1 | ME223 | |
| ME344 | Control Systems II | 3 | ME344 | - |
| ME345 | Vibration and Control Lab | 1 | ME344 | - |
| ME391 | Field Training | 0 | - | - |
| BM371 | Numerical Methods for Engineers | 3 | CS116, MATH203, MATH205 | - |
| BM3710 | Numerical Methods for Engineers Lab | 0 | - | BM371 |
| CE331 | Signals and Systems | 3 | ME344 | - |
| ENE312 | Power Electronics | 3 | ENE214 | - |
| GERL302 | German VI | 3 | GERL301 | - |
| | **Total** | **20** | | |

| Fourth Year | | | | |
|---|---|---|---|---|
| **First Semester** | | | | |
| **Course ID** | **Course Title** | **Cr. Hr.** | **Prerequisites** | **Co-requisite** |
| - | Technical Elective | 3 | - | - |
| - | Technical Elective | 3 | - | - |
| - | Technical Elective | 3 | - | - |
| - | Technical Elective | 3 | - | - |
| | **Total** | **12** | | |

| Fourth Year | | | | |
|---|---|---|---|---|
| **Second Semester** | | | | |
| **Course ID** | **Course Title** | **Cr. Hr.** | **Prerequisites** | **Co-requisite** |
| ME491 | International Internship[d] | 12 | ME391 | - |
| | **Total** | **12** | | |

### German year prerequisites

- A minimum GPA of 60.0%
- Successful completion of 90 credit hours excluding all German language courses
- Passing GERL302 German VI, ENGL201 English V, and Arabic 99
- Passing four out of the five following courses:
  - ME344 Control Systems I
  - ME362 Sensors and Actuators
  - ENE214 Electronics
  - CE331 Signals and Systems
  - CE341 Microprocessor and Microcomputer Systems

[d] Courses attended and/or passed during International Training are not transferable

| Fifth Year | | | | |
|---|---|---|---|---|
| **First Semester** | | | | |
| **Course ID** | **Course Title** | **Cr. Hr.** | **Prerequisites** | **Co-requisite** |
| TME332 | Machine Design | 4 | TME213, IE325, ME111 | - |
| TME3320 | Machine Design Lab | 0 | - | TME332 |
| | | | | |
| ME534 | Electrical Machines and Control | 3 | ENE211 | - |
| ME551 | Robotics | 3 | TME331, ME344 | - |
| ME522 | Hydraulics and Pneumatics | 3 | ME223 | - |
| ME5220 | Hydraulics and Pneumatics Lab | 0 | - | ME522 |
| ME591 | Graduation Project I | 3 | ME491, and min of 124 CH | - |
| ENE314 | Power Electronics Lab | 1 | ENE312 | - |
| - | University Elective | 3 | - | - |
| | **Total** | **20** | | |

| Fifth Year | | | | |
|---|---|---|---|---|
| **Second Semester** | | | | |
| **Course ID** | **Course Title** | **Cr. Hr.** | **Prerequisites** | **Co-requisite** |
| ME561 | Mechatronics Systems Design and Integration | 3 | ME362, CE341 | - |
| ME555 | Machine Intelligence | 3 | ME344, ME362 | |
| ME535 | Electrical Machines and Control Lab | 1 | - | ME534 |
| ME567 | Modeling and Simulation | 3 | TME214, ME223 | - |
| ME594 | Graduation Project II | 3 | ME591 | - |
| ME554 | Programmable Logic Controllers | 3 | ME344 | - |
| ME5540 | Programmable Logic Controllers lab | 0 | | ME554 |
| - | University Elective | 3 | - | - |
| | **Total** | **19** | | |

# VI. Course Identification Convention

**Example**: ME321

**Program**: ME is short for Mechatronics Engineering
**Level**: The first number (3) represents the level of the course in the study plan
**Field**: The second number (2) represents the group number of the course
**Sequence**: The third number (1) represents a unique serial number of the course in its group

## Groups

| | Course ID | Course Title |
|---|---|---|
| **Group 1:** Applied Mechanics | ME111 | Computer Aided Engineering Drawing |
| | ME211 | Statics and Dynamics |
| | ME516 | Waves and Vibrations |
| | | |
| **Group 2:** Thermal Sciences | ME223 | Thermofluids |
| | ME323 | Thermofluids Lab |
| | ME522 | Hydraulics and Pneumatics |
| | | |
| **Group 3:** Electrical and Electronics | ME533 | Advanced Electronics |
| | ME534 | Electrical Machines and Control |
| | ME535 | Electrical Machines and Control Lab |
| | ME539 | Special Topics in Electrical and Electronics Engineering |
| | | |
| **Group 4:** Control Engineering | ME343 | Automatic Control Systems |
| | ME344 | Control Systems I |
| | ME345 | Vibration and Control Lab |
| | ME346 | Instrumentation and Measurements |
| | ME347 | Instrumentation and Measurements Lab |
| | ME541 | Real-Time Computer Control Systems |
| | ME542 | Digital Control Systems |
| | ME543 | Process Control |
| | ME545 | CNC and Manufacturing Control |
| | ME546 | Linear Systems |
| | ME547 | State Space Control and Observers |
| | ME548 | Control Systems II |
| | | |
| **Group 5:** Robotics and Automation | ME551 | Robotics |
| | ME553 | Mobile Robots |
| | ME554 | Programmable Logic Controllers |
| | ME555 | Machine Intelligence |
| | ME556 | Autonomous Systems |
| | ME557 | Process Automation |
| | ME558 | Industrial Robotics |
| | ME559 | Special Topics in Robotics and Automation |

| | | |
|---|---|---|
| **Group 6:** Applied Mechatronics | ME362 | Sensors and Actuators |
| | ME561 | Mechatronics Systems Design and Integration |
| | ME564 | Mechatronics of Smart Materials |
| | ME566 | Mechatronics Projects |
| | ME567 | Modeling and Simulation |
| | ME568 | Embedded Systems |
| | ME569 | Smart Sensors |
| | | |
| **Group 7:** Computer and Digital Sciences | ME573 | Digital Image Processing |
| | | |
| **Group 8:** Mechatronics Technologies | ME582 | Micro-Electromechanical Systems |
| | ME583 | Nano Systems |
| | ME585 | Autotronics |
| | ME589 | Special Topics in Mechatronics Technology |
| | | |
| **Group 9:** Practical Topics | ME391 | Field Training |
| | ME491 | International Internship |
| | ME591 | Graduation Project I |
| | ME592 | Graduation Project II |
| | ME597 | Special Topics MI |
| | ME598 | Special Topics MII |

# VII. Description of Courses offered by the Mechatronics Engineering Department

**ME111: Computer Aided Engineering Drawing** **3 Cr (2,3)**

The use of computer aided software in drawing such as AutoCAD. Geometric construction. Orthographic and Isometric projections; Sketching, sectioning, dimensioning and layering. Model layout (wire-frame, surface, and solid modeling), plotting to scale, blocks and attributes, Introduction to descriptive geometry, perspective drawing. Engineering applications.

*Prerequisites: CS116, CS1160*

**ME211: Statics and Dynamics** **3 Cr (3,0)**

Basic concepts of mechanics, vectors, equilibrium of particles, force systems, equilibrium of rigid bodies, distributed forces, centroids and moments of inertia, friction, internal shear force and bending moment in beams, kinematics of particles, rectilinear and curvilinear motion, kinematics of rigid bodies.

*Prerequisites: MATH102, PHYS103*

**ME223: Thermofluids** **3 Cr (3,0)**

Properties of pure substances, Energy transfer, First law of Thermodynamics, Second law of thermodynamics, Basic concepts of fluid mechanics, Bernoulli and Energy equation, Momentum equation, Flow in pipes, Mechanisms of Heat transfer.

*Prerequisites: MATH205*

**ME323: Thermofluids Lab** **1 Cr (0,3)**

Measurement of thermal conductivity, forced convection heat transfer, measurement of specific heat ratio, flow through nozzles, losses in pipes and fittings, hydrostatic pressure, impact of water jet, flow visualizations, performance of hydraulic positive displacement pumps.

*Prerequisites: ME223*

**ME346: Instrumentation and Measurements** **2 Cr (2,0)**

Introduction to instrumentation, Units, Dimensions and standards, Error measurements, Statistical analysis of experimental data, Op-Amp circuits in instrumentation, Basic electrical measurement and sensing devices: physics of electric, magnetic, chemical sensors displacements, area, pressure, flow, temperature, thermal and transport properties, force, torque and strain measurements. Smart sensors and networking of sensor systems. Data acquisition and processing.

*Prerequisites: ENE211, MATH205*

**ME347: Instrumentation and Measurements lab** **1 Cr (0,3)**

Measurements with different micrometers & Vernier measuring instruments, angular measurements, roundness & concentricity of cylindrical work pieces, tool maker's microscope, optical projectors, surface measurements. Analysis of experimental data and error estimation. Basic electrical measurement and sensing devices: physics of electric, magnetic, chemical sensors, displacement, area, pressure, flow, temperature, thermal and transport properties, force, torque and strain measurements. Smart sensors and networking of sensor systems. Data acquisition and processing.

*Corequisites: ME346*

**ME362: Sensors and Actuators** **4 Cr (3,3)**

Introduction to instrumentation, Units, Dimensions and standards, Error measurements, Statistical analysis of experimental data, Op-Amp circuits in instrumentation. Overview of transducers, sensors and actuators, physical principles, technical characteristics, application scenarios, integration of sensors and actuators into PLC and computer based solutions, data acquisition, processing and monitoring techniques, practical applications. Sensor and Actuators Lab: Measurements with different micrometers & Vernier measuring instruments, angular measurements, roundness & concentricity of cylindrical work pieces, tool maker's microscope, optical projectors, surface measurements. Analysis of experimental data and error estimation. Basic electrical measurement and sensing devices: physics of electric, magnetic, chemical sensors, displacement, area, pressure, flow, temperature, thermal and transport properties, force, torque and strain measurements. Smart sensors and networking of sensor systems. Data acquisition and processing.

*Prerequisites: ENE211, ENE213, MATH205*

**ME391: Field Training** **0 Cr (0,0)**

160 hours of training at a company in Jordan.

*Prerequisites: Dept. Approval*

**ME491: International Internship** **12 Cr (0,0)**

Twenty-weeks of internship at a company in Germany.

*Prerequisites:* ME391

**ME516: Waves and Vibrations** **3 Cr (3,0)**

Harmonic oscillator, mechanical and electromagnetic oscillations, forced oscillations, resonance, coupled oscillators, electromagnetic waves, traveling waves, standing waves, interference and diffraction of waves, dispersion of waves.

*Prerequisites: TME214*

**ME522: Hydraulics and Pneumatics** **3 Cr (2,3)**

Pneumatic and hydraulic components; compressor, cooler, compressed-air containers, filters, valves, pumps, piping system basic circuits in pneumatics and hydraulics, design and simulation of pneumatic and hydraulic circuits, servo pneumatics and servo hydraulics, basics of servo drives, assembling, measuring techniques.

*Prerequisites: ME223*

**ME533: Advanced Electronics** **3 Cr (3,0)**

Physical principles and operational characteristics of advanced semiconductor electronic devices with emphasis on metal-oxide systems, bipolar, high-electron mobility, and field-effect transistors. Topics also include quantum point contact and tunneling devices. Advanced background in solid state electronic devices intended to help students to continue advanced research in the variety of different branches of semiconductor microelectronics.

*Prerequisites: ENE214*

**ME539: Special Topics in Electrical and Electronics Engineering** **3 Cr (3,0)**

A course on a special topic in Electrical and Electronics.

*Prerequisites: Dept. Approval*

**ME541: Real-Time Computer Control Systems** **3 Cr (3,0)**

Review of continuous control. Dynamic response, Feedback properties, Root locus and frequency response designs. Introduction to digital control. Discrete system analysis. Difference equations, Discrete transfer functions, z-transform, Discrete signal analysis. Discrete approximation of differential equations, Effects of Sampling, PID control in discrete systems. Sampled-data systems. Sample & Hold, Spectrum of sampled signals, Data extrapolation, Block diagram analysis. Discrete equivalences. Numerical integration, Pole & zero mapping, Hold equivalence. Design using transforms techniques. Design by emulation, Design by root-locus, Design by frequency response. Implementation of Direct Digital Control algorithms. Implementation of the basic PID algorithm, Synchronization of the control loop, Timing Considerations in Implementation of Control Loops. Hard and soft real-time systems, Real-time scheduling theory, Deadlines in real-time control systems.

*Prerequisites: ME344*

**ME542: Digital Control Systems** **3 Cr (3,0)**

Discrete time control theory, z-transform, sampling and hold operations, A/D and D/A conversions, modeling of digital systems, response evaluation; stability, basis of digital control, modeling of sampled-data systems, system identification using the batch least squares method, time response characteristics, stability analysis techniques, discrete-time approximation of continuous-time controllers, classical design methods based on root locus and frequency response, and modern design methods including state and observer feedback design.

*Prerequisites: ME344*

**ME543: Process Control** **3 Cr (3,0)**

Dynamics of mechanical, food, beverage and chemical processes; system capacity; resistance; piping complexes; characteristics and dynamics of control valves; control of pressure, speed, PH, mixing ration, Boolean algebra and fluid logic, sequential circuits, process time constants; proportional, reset, and derivative control actions; feedforward and cascade control; direct digital control.

*Prerequisites: ME344*

**ME545: CNC and Manufacturing Control** **3 Cr (3,0)**

Concepts and benefits of computer integrated manufacturing (CIM), design for manufacturing, computer-aided design, process planning, manufacturing (computer numerical control parts programming), and inspection, robots in CIM, production planning and scheduling in CIM, system integration.

*Prerequisites: IE325, ME344*

**ME546: Linear Systems** **3 Cr (3,0)**

Review of matrix algebra. State-space description of dynamic systems: linearity, causality, time-invariance, linearization. Solution of state-space equations. Transfer function representation. Discrete-time models. Controllability and observability. Canonical forms and minimal-order realizations. Stability. Stabilizability and pole placement. Linear quadratic control. Observer design.

*Prerequisites: ME344*

**ME547: State Space Control and Observers** **3 Cr (3,0)**

Pole placement design of both controllers and observers using MATLAB. Regulator and servo design. Optimal design of controllers and observers. Quadratic Optimal Regulator Systems.

*Prerequisites: ME344*

**ME548: Control Systems II** **3 Cr (3,0)**

State-space modeling of multi-variable systems, stability, sensitivity, controllability, and observability, optimal observers, Kalman filter, linear quadratic regulators, digital control systems, z-transform, stability, transient response, digital cascade compensators.

*Prerequisites: ME344*

**ME549: Special Topics in Control Engineering** **3 Cr (3,0)**

A course on a special topic in Robotics and Automation.

*Prerequisites: Dept. Approval*

**ME551: Robotics** **3 Cr (3,0)**

Planar and spatial transformations, forward and inverse kinematics, trajectory planning, robot dynamics, robot control (linear, nonlinear, and force control).

*Prerequisites: ME344, TME331*

**ME553: Mobile Robots** **3 Cr (3,0)**

Introduction to variety of autonomous mobile robots, wheeled robots, robot platforms and modeling, control structures, sensing & estimation, localization, motion planning and multi-robot systems. Students will build, experiment with, and compete with mini-mobile robots.

*Prerequisites: ME344, TME331*

**ME554: Programmable Logic Controllers** **3 Cr (2,3)**

Theoretical and applied material, including: application and hardware composition of programmable logic controllers; functional programming blocks such as logic gates including AND, OR etc. as well as latches, timers, counters, and analog blocks; design approaches based on Boolean and structured logic, state machines, flowcharts; programming methodologies including: ladder diagrams, blocks and text-based.

*Prerequisites: ME344*

**ME555: Machine Intelligence** **3 Cr (3,0)**

The objective of this course is to introduce the students to current intelligent system concepts. An overview of different learning schemes will be provided, including: Decision Tree, Bayesian, Inductive, Analytical and Rule-based Learning. The main focus of the course will be on Neural Nets, Genetic Algorithms and Reinforcement Learning, adaptive control.

*Prerequisites: ME344, ME362*

**ME556: Autononous Systems** **3 Cr (3,0)**

Introduction to essential aspects of autonomous systems; mobility, flexibility, adaptability, intelligence, modeling, control, sensing and estimation, sensor fusion and data mining, localization and navigation, motion and action planning, scheduling and applications.

*Prerequisites: ME344, ME362*

**ME557: Process Automation** **3 Cr (3,0)**

Definition of industrial processes, structures and layout design, hierarchical concepts, comprehensive view of material, energy and information flow; structure, principles of task planning, placing and final reporting, use of knowledge based systems for planning and optimization, modeling of product data, use of distributed data base systems.

*Prerequisites: ME344*

**ME558: Industrial Robotics** **3 Cr (3,0)**

Basic robotics technology, application in manufacturing, manipulators and mechanical design, programming languages, intelligence, and control.

*Prerequisites: ME344, TME331*

**ME559: Special Topics in Robotics and Automation** **3 Cr (3,0)**

A course on a special topic in Robotics and Automation.

*Prerequisites: Dept. Approval*

**ME561: Mechatronics Systems Design and Integration** **3 Cr (3,0)**

Design and planning of the system, purchase (virtual) of different components, sensors and actuator units, machine parts, devices, electric, mechanical, pneumatic, hydraulic components, PLC and control units, assembly, commissioning, interfacing, software and programming, calibration, standard checks, test operation, troubleshooting, documentation, service and maintenance, safety, cost, delivery and disassembly and packing.

*Prerequisites: ME362, CE341*

**ME564: Mechatronics of Smart Materials** **3 Cr (3,0)**

Properties of smart materials, classes of smart materials, shape memory alloy materials, piezoelectric materials, smart sensors, smart actuators, mechatronics of smart materials: modeling, design, digital control, and their applications.

*Prerequisites: ME344, ME362*

**ME566: Mechatronics Projects** **3 Cr (3,0)**

Implementation of a mechatronics projects through all stages of modeling, simulation, control, component interface, signal conditioning, subsystem integration, documentation and presentation.

*Prerequisites: ME344, CE341*

**ME567: Modeling and Simulation** **3 Cr (3,0)**

Notations and definitions, structure of mechatronics systems, modeling and simulation of mechanical, electrical, hydraulic, pneumatic and thermal subsystems, various mathematical forms of model descriptions, systems of differential equations, transfer functions, state space representations, multi-port systems, merging of models of subsystems into a model of a mechatronic system, linear graphs, bond graphs, multi-energy domain models, introduction and application of simulation software tools.

*Prerequisites: ME223, TME214*

**ME568: Embedded Systems** **3 Cr (3,0)**

Fundamentals of embedded system hardware and firmware design, embedded processor selection, A/D and D/A conversion, signal conditioning, glue logic, circuit design, circuit layout, circuit debugging, microcontroller architecture and instruction set, microcontroller peripheral interfaces, sensor and actuator interfacing, real-time and power requirements, development tools.

*Prerequisites: ENE211, BM371, CE341*

**ME569: Smart Sensors** **3 Cr (3,0)**

Active sensors: Piezo sensor for force, pressure and vibration, electrodynamic sensors for speed and rotation, photodiodes and thermocouples. Passive sensors: resistive sensors, capacitive sensors, inductance sensors. Analog data processing: operational amplifiers, amplification, addition, multiplication, division, integration and derivation, filtering. Digital data processing: data acquisition, multiplexing, digital filters, programmable devices. A/D-converter: bit-number, resolution, sampling rate, bipolar- and unipolar inputs. D/A-converters: flash, Weighing converter, Dual slope converter IOs, data lines.

*Prerequisites: ME362, CE211, ENE211*

**ME573: Digital Image Processing** **3 Cr (3,0)**

Fundamentals of digital image processing, image acquisition and display, properties of the human visual system, color representations, types of image sources, image enhancement, sampling and quantization, histograms, point operations, linear image filtering and correlation, transforms and subband decompositions, nonlinear filtering, contrast and color enhancement, image restoration, image registration, feature extraction and recognition techniques, frequency domain analysis.

*Prerequisites: CE211, MATH203, MATH 205*

**ME579: Special Topics in Computer and Digital Sciences** **3 Cr (3,0)**

A course on a special topic in Computer and Digital Sciences.

*Prerequisites: Dept. Approval*

**ME582: Micro Electromechanical Systems** **3 Cr (3,0)**

Introduction to micromachining processes; mechanical properties of materials used in micromechanical systems; design and fabrication of free standing structures; sacrificial and structural layers; finite element modeling; micromechanical components; solid lubrication of microbearings; special techniques: double-side lithography, anodic bonding, electro-chemical drilling, deep etching, LIGA process, laser microfabrication; influence of IC fabrication processes on the mechanical properties; applications in microdevices; simulation and packaging.

*Prerequisites: ME223, ENE211, TME213*

**ME583: Nano Systems** **3 Cr (3,0)**

Assembly, manipulation and control of materials at the atomic and molecular scale to fabricate structures, devices and systems that have novel properties and functionality.

*Prerequisites: ME223, ENE211, TME213*

**ME585: Autotronics** **3 Cr (3,0)**

Electronic control systems and component in motor vehicle sub-systems, motor vehicle mechanical systems and sub-systems, electrical and electronic principles, faults and diagnosis of automotive electronic systems, engine management, fuel injection, electronics, transmission, stability, and ABS controls.

*Prerequisites: ENE214, ME362*

**ME589: Special Topics in Mechatronics Technology** **3 Cr (3,0)**

A course on a special topic in Mechatronics Technology.

*Prerequisites: Dept. Approval*

**ME591: Graduation Project I** **3 Cr (3,0)**

The first part of a team-based one-year senior design project in the field of mechatronics engineering.

*Prerequisites:* ME491, min 124 CH

**ME592: Graduation Project II** **3 Cr (3,0)**

The second and final part of a team-based one-year senior design project in the field of mechatronics engineering.

*Prerequisites: ME591*

**ME597: Special Topics I** **1 Cr (0,3)**

A course on a special topic in mechatronics.

*Prerequisites: Dept. Approval*

**ME598: Special Topics II** **2 Cr (2,0)**

A course on a special topic in mechatronics.

*Prerequisites: Dept. Approval*

# VIII. Description of Courses offered by other Departments

**IE121: Workshop** **1 Cr (0,3)**

General safety, materials and their classifications, measuring devices and their accuracy, basic household plumbing and electricity, fits and tolerances, theoretical background for the practical exercises including fitting, forging, carpentry, casting, welding, mechanical saws, shearers, drills, lathes, milling machines, shapers and grinders.

*Prerequisites: -*

**IE224: Materials and Mechanics Lab** **1 Cr (0,3)**

Studying the properties of engineering materials and the relationship between these properties and atomic structure, cross-sectional sample preparation, optical microscopy, heat treatment, corrosion behavior, tensile and compression strength, hardness testing, impact testing, creep behavior, and fatigue behavior.

*Prerequisites: IE121, TME213*

**IE325: Manufacturing Processes** **4 Cr (3,3)**

Traditional manufacturing processing of materials (ferrous and non-ferrous) including metal cutting, casting, rolling, forging, and drawing. Modern manufacturing processes and related topics including ceramics, composites, powder metallurgy, property enhancing and surface processing operations, and rapid prototyping. Manufacturing Processes Lab: Experiments in casting, forming, machining, welding, heat treatment and plastic manufacturing.

*Prerequisites: IE121, TME213*

**IE371: Engineering Economics** **3 Cr (3,0)**

Principles of Engineering Economy, cost concepts, time value of money, interest formula, depreciation models, rate of return, cash flow, project evaluation methods, replacement analysis, break even analysis, economic studies for decision making.

*Prerequisites: MATH205*

**TME212: Statics** **3 Cr (3,0)**

Vector mechanics of forces and moments, free-body diagrams, couples, resultants, equilibrium of particles and rigid bodies in two and three dimensions, forces in trusses, frames, and machines, centroids, centers of mass, distributed forces, internal shear forces and bending moments in beams, shear force and bending moment diagrams, friction, area of moments of inertia.

*Prerequisites: MATH102, PHYS103*

**TME213: Mechanics of Materials** **3 Cr (3,0)**

Normal and shear stress and strain, deflection of axially loaded members, thermal stress, torsion of bars with circular sections, shear stress, angle of twist, power transmission, bending of beams, bending and shear stress, combined loadings, beam deflection, column buckling.

*Prerequisites: TME212*

**TME214: Dynamics and Vibration** **3 Cr (3,0)**

Kinematics and kinematics of particles, Newton's laws, planar kinematics and kinetics of a rigid bodies, free vibration of single degree of freedom systems, harmonic excitation, general force response.

*Prerequisites: TME212*

**TME331: Theory of Machines** **3 Cr (3,0)**

Position analysis, mechanisms, vector analysis of velocity and acceleration, analytic and graphical loop closure methods, cam design, spur, bevel, and helical gears, gear trains, force analysis, static and dynamic balance of rotors, synthesis of linkage, spatial mechanisms.

*Prerequisites: ME111, TME214, MATH203*

**TME332: Machine Design** **4 Cr (3,3)**

Introduction to design process, design considerations, stress analysis and deflection of mechanical elements, energy methods, static strength and failure theories, fatigue strength and failure theories, shafts, nonpermanent joints, mechanical springs, and rolling bearings, CAD software, stress analysis using FEM codes, kinematics simulations, surface generation, 3D printing.

*Prerequisites: TME213, IE325, ME111*

**TME513: Multi-Body Dynamics** **3 Cr (3,0)**

Principles of kinematics and dynamics in spatial motion, constraint equations describing various types of spatial kinematic joints, algorithms for automatic generation of the constraint equations, techniques for automatic generation of the spatial equations of motion.

*Prerequisites: TME331*

**TME514: Machine Dynamics** **3 Cr (3,0)**

Force analysis of machinery, resonance (symptoms, tests, fixes), rotors dynamics, dynamic balance of machinery, analytical determination of unbalance, dynamic behavior of drives and machine frames as complex systems, typical dynamic effects, such as the gyroscopic effect, damping and absorption, shocks.

*Prerequisites: TME331*

# IX. Description of Courses offered by other Schools

**Pre-Math: Math 99** **0 Cr (3,0)**

Real numbers and their properties, Solutions of equations and inequalities, Functions, Domain of functions, Operations on functions, Polynomials, Zeros of polynomials, Power, Exponential, Logarithmic, and Trigonometric functions and their graphs, Applications of trigonometry, Analytic Geometry: Lines, circles and parabolas.

*Prerequisites:-*

**MATH101: Calculus I** **3 Cr (3,0)**

Review of functions, functions, Inverse functions, Inverse trigonometric functions, The concept of limits, Computation of limits, Continuity, Asymptotes, The Derivative, Computation of derivatives, The product and quotient rules, The Chain Rule, Derivatives of Trigonometric, Inverse Trigonometric, Exponential, Logarithmic, and Hyperbolic Functions. Applications of Differentiation: Increasing and Decreasing Functions, Extrema of Functions, Graphs of Functions, Indeterminate Forms and L'Hopital Rule. Antiderivatives, Definite integrals, Fundamental Theorem of Calculus, Integration by Substitutions, Integration by Parts, Applications of integration: Area between curves, Arc length, Volume and Surface Area of Solids of Revolution.

*Prerequisites: Pass MATH099*

**MATH102: Calculus II** **3 Cr (3,0)**

Review of Integration, Integration by Trigonometric Substitutions, Integration using Partial Fractions, Improper Integrals. Vectors in 2 and 3 Spaces, The Inner and Cross Products of vectors. Polar Coordinates, Graphs and Arc length of Polar curves. Functions of Several Variables; Domain, Limits, and Continuity. Partial Derivatives, The Chain Rule, The Gradient and Directional Derivatives, Extrema of Functions of Several Variables and Lagrange multipliers. Double Integrals, Area of Plane Region and Volumes of Solids using Double integrals, Triple Integrals, Cylindrical and Spherical Coordinates, Triple Integrals using Cylindrical and Spherical Coordinates.

*Prerequisites: MATH101*

**MATH203: Applied Math for Engineers** **3 Cr (3,0)**

Vector analysis in Cartesian coordinates. General Curvilinear Coordinates, Vector calculus in general curvilinear coordinates with emphasis on Spherical and Cylindrical coordinates, transformations between different coordinate systems, vector differentiation. Matrices and linear equations; Matrices and Linear Operators; Determinants, Eigenvalues and eigenvectors. Complex Numbers and Complex Variables; Representation of complex numbers, Powers and roots of complex numbers, Functions of a complex variable. Review of Infinite Series; Infinite series of constant terms, Convergence tests, Power series and radius of convergence, Taylor, and Maclaurin series and Fourier series.

*Prerequisites: MATH102*

**MATH205: Differential Equations** **3 Cr (3,0)**

Ordinary differential equations; Sturm-Liouville theory, properties of Special Functions, Solution methods including Laplace transform, and Fourier transform. Eigenvalue problems and expansions in orthogonal functions. Partial differential equation: classification, separation of variables, solution by series and transform methods. Models in Applied Mathematics; Applications to illustrate typical problems and methods of applied mathematics in solid and fluid mechanics, fields of physics, deformation and vibration, wave phenomena, diffusion phenomena, heat conduction, chemical and nuclear reactors, and biological processes.

*Prerequisites: MATH102*

**PHYS103: Physics I** **3 Cr (3,0)**

Physics and measurement. Motion in one dimension. Vectors. Motion in two dimensions. Force and motion. Kinetic energy and work. Potential energy and conservation of energy. Linear momentum and collisions. Rotation. Rolling and angular momentum.

*Prerequisites:-*

**PHYS104: Physics II** **3 Cr (3,0)**

Electric Fields. Gauss's Law. Electric Potential. Capacitance and Dielectrics. Current and Resistance. Direct Current Circuits. Magnetic Fields. Sources of Magnetic Field. Faraday's Law.

*Prerequisites: PHYS103*

**PHYS106: General Physics Lab** **1 Cr (0,1)**

Laboratory exercises that apply physical principles introduced in Physics I and Physics II courses. The lab includes the use of data logging techniques, observations, and scientific reasoning in practical situations.

*Prerequisites: PHYS103*
*Corequisites: PHYS104*

**BM371: Numerical Methods for Engineers** **3 Cr (2,3)**

Fundamentals of error analysis, numerical solutions of linear and nonlinear equations, numerical solution of system of equations, curve fitting, numerical integration and differentiation, numerical solution of ordinary differential equations. Application of numerical methods using relevant software packages.

*Prerequisites: CS116, MATH203, MATH 205*

**CS116: Computing Fundamentals** **3 Cr (3,0)**

Basic computer skill; Programming concepts; algorithms: data types, arithmetic, logical, relational, Boolean, and assignment operators, simple input and output statements; programming control structures; data structures: single and multidimensional arrays; character strings; functions; pointers; file structures and representation; 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the course using Gnu C compiler on a Solaris/Sun environment.

*Prerequisites: -*

**CS1160: Computing Fundamentals Lab** **1 Cr (0,3)**

Basic computer skill; Programming concepts; algorithms: data types, arithmetic, logical, relational, Boolean, and assignment operators, simple input and output statements; programming control structures; data structures: single and multidimensional arrays; character strings; functions; pointers; file structures and representation; 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the course using Gnu C compiler on a Solaris/Sun environment.

*Corequisites: CS116*

**CE211: Digital Systems** **4 Cr (3,3)**

Fundamentals of digital electronics, Binary number system; Boolean algebra, logic operations, algebra and gates, digital circuits analysis, gate-level and block level design of digital circuits, adders, subtractors, comparators, multiplexers, decoders, analysis, design and applications of sequential circuits: flip-flops, registers, counter, and their design procedures, RAM and ROM memory elements. The course also includes 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the course: basic logic gate experiments, combinational logic circuits experiments, and sequential logic circuits experiments. The experiments on all topics vary from functional troubleshooting to gate and block level design implementation.

*Prerequisites: -*

**CE331: Signals and Systems** **3 Cr (3,0)**

Concepts and mathematical tools in continuous and discrete-time signal processing and linear systems analysis with examples from digital signal processing, communications, and control. Discrete-time signal models. Continuous-discrete-continuous signal conversion. Discrete-time impulse and step response. Frequency domain representations: Fourier series and transforms. Connection between continuous and discrete time frequency representations. Discrete Fourier transform (DFT) and fast Fourier transform (FFT). Digital filter and signal processing examples. Discrete-time and hybrid linear systems. Stability and causality. Z transforms and their connection to Laplace transforms. Frequency response of discrete-time systems.

*Prerequisites: ME344*

**CE341: Microprocessor and Microcomputer Systems** **4 Cr (3,3)**

Introduction to theoretical concepts of 8-bit and 16-bit microprocessors including microprocessor architecture, memory organization, instruction set, input/output organization, and interrupts. Design of microcomputer systems, address maps, system bus, memory maps, peripheral I/O, memory mapped I/O, interrupt-driven I/O, interface devices, and general-purpose programmable peripheral devices.

*Prerequisites: CE211*

**ENE211: Electrical Circuits I** **3 Cr (3,0)**

Overview: SI units , voltage and current; Ohm's and Kirchhoff"s Laws, circuits with dependent sources; simple resistive circuits: series, parallel and delta to wye; Techniques of circuit analysis: nodal and mesh analyses, source transformation, Thevenin and Norton equivalents; Amplifiers; Inductance, capacitance and mutual inductance; Natural and step responses of RL and RC circuits; Natural and step response of series and parallel RLC circuits; Sinusoidal steady state analysis.

*Prerequisites: PHYS104*

**ENE213: Electrical Circuits Lab** **1 Cr (0,3)**

Resistive circuits, Potentiometers, Superposition, Thevenin’s theorem and maximum power transfer, RLC current and voltage characteristics, Frequency response of RL, RC and RLC circuits, Series and parallel resonant circuits, Amplifiers.

*Prerequisites: ENE211*

**ENE213: Electronics** **4 Cr (3,3)**

Introduction to (semiconductor) electronic devices. Semiconductor p-n junction, the transistor. Analysis and synthesis of linear and nonlinear electronic circuits containing diodes and transistors. Elementary analog circuit analysis. Fundamentals of transistors and voltage amplification. Characterization of MOS transistors for circuit simulation. Common-source amplifiers, MOSFET source-follower buffer stage, differential amplifier stage, and MOSFET current sources. Operational amplifiers. Development of a Basic CMOS Operational amplifier.

*Prerequisites: ENE211*

**ENE312: Power Electronics** **3 Cr (3,0)**

Power semiconductor devices: types, drive circuits, protection circuits and power loss calculations. AC-DC converters: uncontrolled, half-controlled and fully controlled single-phase and three-phase rectifiers. AC-AC converters: cycloconverters. DC-AC inverters: single-phase and three-phase. DC-DC converters' topologies analysis and design: stepdown, step-up, and step-down/up converters.

*Prerequisites: ENE214*

**ENE314: Power Electronics Lab** **1 Cr (0,3)**

Single-phase fully-controlled bridge rectifier with static and rotating loads. Single-phase half-controlled bridge rectifier. Three-phase controlled bridge rectifier. Single-phase ac voltage controller. Frequency converter. Single-phase bridge inverter with static and rotating loads. Three-phase bridge inverter. Step-down and step-up converter.

*Prerequisites: ENE312*

**ARB099: Arabic 99** **0 Cr (3,0)**

This course aims to develop student's ability to read, comprehend, literary analyze, grammatically analyze, linguistically analyze, poetically analyze, and rhetorically analyze texts properly. The course also includes a selection of Arabic literature in poetry and prose representing different literary ages, in addition to several common forms of writing such as: scientific article, news article, and others.

*Prerequisites: -*

**ARB100: Arabic** **3 Cr (3,0)**

This course aims to improve the student’s competence in the various linguistic skills in terms of: reading, comprehension, and taste. This is achieved through the study of selected texts with many implications that raise issues in spelling, grammar, composition, meaning, and inference, and the use of an old and modern thesaurus.

*Prerequisites: ARB099*

**GERL101: German I** **3 Cr (9,0)**

Can understand and use familiar, everyday expressions and very simple sentences, which aim at the satisfaction of specific needs. Can introduce oneself, and others, and ask others questions to themselves - e.g. where they live, which people they know or what kind of things they have - and can give answers on questions of this kind. Can communicate on a basic level if those involved with him/ her in a conversation speak slowly and clearly and are willing to help.

*Prerequisites: -*

**GERL102: German II** **3 Cr (9,0)**

Can understand sentences and frequently used expressions if those are connected with things of immediate meaning (e.g. information to the person and to the family, buying, work, closer environment). Can communicate in simple, routine situations, with the purpose of a simple and direct exchange of information about familiar and common things. Can describe with simple means their own origin and training, direct environment and things that are in connection with direct needs.

*Prerequisites: GERL101*

**GERL201: German III** **3 Cr (6,0)**

Can understand the main points if no dialect is used and if it concerns familiar things about work, school, spare time etc. Can master most situations which one encounters on journeys in a German speaking area. Can express oneself simply and coherently about familiar topics and areas of personal interest. Can report experiences and events, describe dreams, hopes and goals and give short reasons or explanations about plans and opinions.

*Prerequisites: GERL102*

**GERL202: German IV** **3 Cr (6,0)**

Can understand the main contents of complex texts, as well as concrete and abstract topics; even discussions between specialists in his/ her own special field. Can communicate spontaneously and fluidly a normal discussion with native speakers, without larger effort on both sides. Can express oneself clearly and in detail in a broad spectrum of topics, describe a point of view to a current question and indicate the pro and cons of different possibilities.

*Prerequisites: GERL201*

**GERL301: German V** **3 Cr (9,0)**

Can understand and also seize implicit meanings of a broad spectrum of demanding, longer texts. Can express oneself spontaneously and fluidly, recognizing words without having to search for words frequently. Can use the language effectively and flexibly in social and vocational life or in training and study. Can express oneself clearly, structured and detailed, to complex subjects and use appropriate different means for linkage of texts.

*Prerequisites: GERL202*

**IC101: Intercultural Communication** **3 Cr (3,0)**

This course is designed to provide prospective students (whose majors have an international flavor) with tools that offer powerful possibilities for improving the communication process. We will examine the process of sending and receiving messages between people whose cultural background could lead them to interpret verbal and nonverbal signs differently. We will learn about the diversity of these cultural differences and at the same time learn how we might overcome them. Our efforts to recognize and surmount cultural differences will hopefully open up business opportunities throughout the world and maximize the contribution of all the employees in a diverse workforce.

*Prerequisites:-*

**MILS100: Military Science** **3 Cr (3,0)**

History of the Jordanian Arab Army. United Nations Peace Keeping Forces. Preparation of the nation for defense and liberation. History of the Hashemite Kingdom of Jordan and its development.

*Prerequisites:*

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**NE101: National Education** **3 Cr (3,0)**

In a context of striving towards democracy like the one Jordan enjoys today, the meaning and practice of active and responsible citizenship becomes more crucial. It is often argued that democracy requires “democrats” to flourish, and become well established. Democrats are those women and men who recognize pluralism, inclusion, positive engagement, and participation as the main values that govern their interaction with the state as citizens and with each other as diverse people of different interests. In this course you will be able to understand your rights and responsibilities as Jordanian citizen expand your knowledge about the frameworks, and processes that regulates citizen-state relationships as well as the basic necessary skills for you to practice your citizenship rights in a civic manner.

*Prerequisites:*

**SE301: Social Entrepreneurship and Enterprises** **3 Cr (3,0)**

This course will serve as an introduction to the field of social entrepreneurship and social enterprises. Through lectures, field visits, analyses of relevant literature, case studies and exercises, this course will explore social entrepreneurship's potentials, opportunities and limitations. The topics will cover: Defining Social Entrepreneurship. Contextualizing Social Entrepreneurship (need, motives, forms, criteria). Role of Leadership, Creativity and Innovation. Locating SE on the profit/non-profit continuum. SE in the larger fields of development, social change, community activism. Social Enterprises (Missions, Markets, Finances). Ethical business and Corporate social responsibility.

*Prerequisites:-*