



الجامعة الألمانية الأردنية
German Jordanian University

German Jordanian University

School of Sustainable Systems and

Engineering (SSSE)

Electrical and Energy Department

Bachelor of Science in Energy Engineering

Study Plan 2021/2022

I. Program Vision

The vision of the Energy Engineering Department is to be internationally recognized for excellence in education, pioneering research and in full compliance with international standards of quality assurance.

II. Program Mission

The mission of the Energy Engineering Department is to provide high quality education in the multidisciplinary field of Energy Engineering; materialize partnerships with industry by addressing the everchanging market needs for future engineers, while providing students with the knowledge and experience for future professional leadership.

III. Program General Description

The department offers a bachelor's degree in Energy Engineering with a total of 180 credit hours. The total number of credit hours consists of university requirements (27 credit hours), school requirements (42 credit hours), and department requirements (111 credit hours). As part of this program, students spend one academic year abroad in Germany. The German year includes one study semester at one of GJU's partner universities and an internship semester for at least 20 weeks in a German company.

The undergraduate program has two program tracks: Electrical Power and Renewable Energy. Each track has unique compulsory and elective courses (24 credit hours) that should be taken in the fourth and fifth years. To enhance the practical experiences for our students, the department offers the following laboratories: Electrical Circuits, Electronics, Electrical Machines, Power Electronics, Energy Systems Simulation, Power Systems, Energy, Renewable Energy, Energy Efficiency, Electric Drives, Power System Protection and Power Systems Integrations.

IV. Program Objectives

The main objectives of Energy Engineering program can be summarized as follows:

- a. Provide the technical knowledge of energy engineering from both the electrical and mechanical engineering aspects and principles, along with the required supporting knowledge of mathematics, science and computing fundamentals. Emphasis is made on the specialty areas of Renewable Energy and Electrical Power.
- b. Develop the skills needed to perform and design experimental projects. Develop the ability to formulate problems and projects, and to plan a solution process deploying diverse technical knowledge and skills.
- c. Develop the ability to organize and present information effectively whether orally, written or visual.
- d. Provide sufficient breadth and depth for successful subsequent graduate study and lifelong learning.
- e. Provide an appreciation for the broad spectrum of issues arising in professional practice, including teamwork, leadership, safety, ethics, service, economics, and professional organizations.

V. Learning Outcomes

Energy Engineering program graduates bachelor's students with an understanding of fundamental energy engineering concepts, methodologies, and technologies as demonstrated by:

- a. An ability to apply knowledge of mathematics, science and engineering.
- b. An ability to design and conduct experiments, as well as to analyze and interpret data.
- c. An ability to design a system, component, or process to meet desired needs.
- d. An ability to function in teams.
- e. An ability to identify, formulate and solve engineering problems.
- f. An understanding of professional and ethical responsibility.
- g. An ability to communicate effectively.
- h. A broad education necessary to understand the impact of electrical engineering solutions in a global and societal context.
- i. A recognition of the need for an ability to engage in life-long learning.
- j. A knowledge of contemporary issues.
- k. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

Teaching method:

- Face-to-Face (FF) [95/180] = 52.7%
- Blended (BL) [64/180]= 35.6%
- Online [21/180] = 11.7%

VI. Framework for B.Sc. Degree (Credit Hours)

Classification	Credit Hours		
	Compulsory	Elective	Total
University Requirements	21	6	27
School Requirements	42	0	42
Program Requirements	99	12	111
Total	162	18	180

1. University Requirements: (27 credit hours)

1.1. Prerequisite courses (6 credit hours)

Course ID	Course Name	Credit Hours	Teaching method	Contact Hours		Prerequisites / Co-requisites(#)
				Lect	Lab	
ARB099	Arabic 99 ^a	0	Online	3	-	-
ENGL099	English II ^a	0	FF	3	-	
Total		0		6	0	

1.2. Compulsory: (21 credit hours)

Course ID	Course Name	Credit Hours	Teaching method	Contact Hours		Prerequisites / Co-requisites(#)
				Lect	Lab	
ARB100	Arabic	3	Online	3	-	ARB099
ENGL101	English III	1	FF	3	-	ENGL099
ENGL102	English IV	1	FF	3	-	ENGL101
ENGL201	English V	2	FF	3	-	ENGL102
ENGL202	English VI	2	FF	3	-	ENGL201
GERL101B1	German I B1 track	3	FF	9	-	-
GERL102B1	German II B1 track	3	B1: FF	9	-	GERL101B1
GERL102B2	German II B2 track	3	B2: BL	9	-	GERL101B1
MILS100	Military Science	3	Online	3	-	-
NE101	National Education	3	Online	3	-	-
NEE101	National Education (English)					
Total		21		39	0	

^a Not required for students who pass placement test

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

Course ID	Course Name	Credit Hours	Teaching method	Contact Hours		Prerequisites / Co-requisites(#)
				Lect	Lab	
BE302	Business Entrepreneurship	3	Online	3	-	ENGL101
DES101	Arts' Appreciation	3	Online	3	-	ENGL101, ARB099
EI101	Leadership and Emotional Intelligence	3	Online	3	-	ENGL101
IC101	Intercultural Communications	3	Online	3	-	ENGL101
PE101	Sports and Health	3	Online	3	-	ARB099
SE301	Social Entrepreneurship and Enterprises	3	Online	3	-	ENGL101
SFTS101	Soft Skills	3	Online	3	-	ENGL101
TW303	Technical and Workplace Writing	3	Online	3	3	ENGL102
Total		6		6	0	

2. School Requirements: (42 Credit Hours)

Course ID	Course Name	Credit Hours	Teaching method	Contact Hours		Prerequisites/ Co-requisites(#)
				Lect	Lab	
GERL201B1	German III B1 track	3	B1: FF	6	-	GERL102B1
GERL201B2	German III B2 track	3	B2: BL	6	-	GERL102B2
GERL202B1	German IV B1 track	3	B1: FF	9	-	GERL201B1
GERL202B2	German IV B2 track	3	B2: BL	9	-	GERL201B2
CHEM 103	General Chemistry I	3	FF	3	0	-
CHEM106	General Chemistry lab	1	BL	0	3	#CHEM 103
CS116	Computing fundamentals	3	FF	3	0	#CS 1160
CS1160	Computing fundamentals lab	1	BL	0	3	#CS 116
ENE437	Economics of Natural Resources Engineering	3	FF	3	0	MATH 203
IE0121	Probability and Statistics	3	FF	3	0	MATH 101
IE0141	Engineering Workshop	1	BL	0	3	-
MATH101	Calculus I	3	BL d	3	0	-
MATH102	Calculus II	3	FF	3	0	MATH 101
MATH203	Applied Mathematics for Engineers	3	FF	3	0	MATH 102
MATH205	Differential equations	3	FF	3	0	#MATH 203
ME0111	Computer Aided Engineering Drawing	2	BL	3	0	CS 116
PHYS103	Physics I	3	BL	3	0	-
PHYS104	Physics II	3	FF	3	0	PHYS 103, #PHYS 106
PHYS106	General Physics Lab	1	BL	0	3	#PHYS 104
Total		42		48	12	

3. Program Requirements (111 credit hours)

3.1. Program Requirements (Compulsory): (87 credit hours)

Course ID	Course Name	Credit Hours	Teaching method	Contact Hours		Prerequisites / Co-requisites(#)
				Lect	Lab	
GERL301B1	German V B1 track	3	FF	9	-	GERL202B1
GERL301B2	German V B2 track	3		9		GERL202B2
GERL302REG	German VI Regular	3	FF	6	-	GERL301B1
GERL302INT	German VI Intensive	3		9		GERL301B1
GERL302B2	German VI B2 track	3		6		GERL301B2
ENE211	Fundamentals of Electrical Circuits	3	FF	3	0	PHYS 104, #MATH 203
ENE212	Electrical Circuits and Systems Analysis	3	FF	3	0	ENE 211
ENE213	Electrical Circuits Lab	1	BL	0	3	ENE 211
ENE214	Electronics	3	FF	3	0	ENE 211
ENE215	Electronics Lab	1	BL	0	3	ENE 213, ENE 214
ECE333	Electromagnetics	3	FF	3	0	MATH 203
MECH0221	Thermodynamics	3	BL	3	0	MATH 102
MECH0222	Fluid Mechanics	3	BL	3	0	MATH 102, PHYS 103
ENE301	Introduction to Digital Systems and Microcontrollers	3	Online	2	2	#ENE 214
ENE302	Statistical and Numerical Methods for Energy Engineers	3	BL	3	0	MATH 205
ENE311	Electrical Machines	3	FF	3	0	ENE 212, ECE 333
ENE312	Power Electronics	3	BL	3	0	ENE 212, ENE 214
ENE313	Electrical Machines Lab	1	BL	0	3	ENE 311
ENE314	Power Electronics Lab	1	BL	0	3	ENE 312
ENE316	Introduction to Communication Systems for Energy Engineers	3	Online	3	0	ENE 212
ENE321	Heat Transfer	3	FF	3	0	MECH 0221, MECH 0222, MATH 205
ENE323	Fluid Mechanics Lab	1	FF	0	3	MECH 0222
ENE324	Introduction to Energy Systems	3	FF	3	0	ENE 321
ENE399	Field Training	0	-	-	-	University Regulations
ME0346	Instrumentations and Measurements	2	BL	2	3	ENE 211, MATH 205, #ME 0347
ME0347	Instrumentation and Measurements Lab	1	BL	0	3	#ME 0346
ENE401	Energy Systems Simulation Lab	2	BL	1	2	ENE 312, ENE 324, #ENE 444
ENE432	Power Plant Engineering	3	FF	3	0	ENE 324
ENE434	PV Technology I	3	FF	3	0	ENE 212, ENE 214,

						ENE 324
ENE441	Power Systems	3	FF	3	0	ENE 302, ENE 311
ENE442	Power Systems Lab	1	BL	0	3	ENE 441
ENE443	Electrical Power Generation, Transmission & Distribution	3	FF	3	0	ENE 441
ENE444	Modeling and Control of Energy Systems	3	FF	3	0	MATH 205, ENE 311
ENE499	International Internship	12	BL	0	36	ENE 399
ENE598	Graduation Project I	1	FF	0	3	ENE 499
ENE599	Graduation Project II	3	FF	0	9	ENE 598
Total		87		71	76	

3.2. Program Requirements (Renewable Energy - Compulsory): (12 credit hours)

Course ID	Course Name	Credit Hours	Teaching method	Contact Hours		Prerequisites / Co-requisites(#)
				Lect	Lab	
ENE433	Solar Energy I	3	FF	3	0	ENE 324
ENE435	Wind Energy Technology	3	FF	3	0	ENE 311, ENE 312, ENE 324
ENE436	Renewable Energy lab	1	BL	0	3	ENE 434
ENE532	Energy lab	1	BL	0	3	ENE 324
ENE536	Energy Efficiency Lab	1	BL	0	3	ENE 436
ENE537	Energy Efficiency, management and laws	3	FF	3	0	ENE 324
Total		12		9	9	

3.3. Program Requirements (Electrical Power - Compulsory): (12 credit hours)

Course ID	Course Name	Credit Hours	Teaching method	Contact Hours		Prerequisites / Co-requisites(#)
				Lect	Lab	
ENE445	Electric Drives	3	FF	3	0	ENE 312, ENE 444
ENE446	Electric Drives Lab	1	BL	0	3	ENE 445
ENE517	Power System Protection	3	FF	3	0	#ENE 542
ENE540	Power Systems Integrations Lab	1	BL	0	3	ENE 301, ENE 314, ENE 442
ENE542	Power System Analysis	3	FF	3	0	ENE 441
ENE543	Power System Protection Lab	1	BL	0	3	#ENE 517
Total		12		9	9	

3.4. Program Requirements (Renewable Energy - Electives^b): (12 credit hours)

Course ID	Course Name	Credit Hours	Teaching method	Contact Hours		Prerequisites / Co-requisites(#)
				Lect	Lab	
ENE520	Thermal Energy Storage	3	FF	3	0	ENE 324
ENE521	Thermal and Hydrodynamic equipment	3	BL	3	0	ENE 321
ENE522	Heating Ventilating and Air Conditioning (HVAC)	3	FF	3	0	ENE 321
ENE523	Turbomachinery	3	BL	3	0	MECH 0222
ENE524	Geothermal and Hydropower systems	3	BL	3	0	ENE 324
ENE525	Fuel Cell & Hydrogen Production Technology	3	BL	3	0	ENE 324
ENE526	Bio-Energy Technology	3	BL	3	0	ENE 324
ENE527	Techno-economics of energy systems	3	FF	3	0	ENE 324
ENE529	Modeling and Simulation	3	BL	3	0	ENE 401
ENE530	Advanced Renewable Energy Systems	3	FF	3	0	ENE 324
ENE531	Environmental and Energy Engineering	3	BL	3	0	ENE 324
ENE533	Solar Energy II	3	FF	3	0	ENE 433, ENE 434
ENE534	Low Carbon Buildings	3	FF	3	0	ENE 321
ENE535	PV Technology II	3	BL	3	0	ENE 434
ENE538	Applied Refrigeration	3	BL	3	0	ENE 321
ENE539	Energy Audit	3	BL	3	0	ENE 434. ENE 441
ENE595-A	Special Topics	1	BL	1	0	-
ENE595-B	Special Topics	2	BL	2	0	-
ENE595-C	Special Topics	3	BL	3	0	-
Total		12		12	0	

3.5. Program Requirements (Electrical Power - Electives^b): (12 credit hours)

Course ID	Course Name	Credit Hours	Teaching method	Contact Hours		Prerequisites / Co-requisites(#)
				Lect	Lab	
ENE510	Switched Mode Power Supplies	3	FF	3	0	ENE 312
ENE511	Special Electrical Machines	3	FF	3	0	ENE 311
ENE512	Power Semiconductor Devices	3	FF	3	0	ENE 312
ENE513	Power Systems Operation and Control	3	FF	3	0	ENE 443
ENE514	Mixed Signal Test Engineering	3	FF	3	0	ENE 301, ME 0346
ENE516	Smart-Grids	3	FF	3	0	ENE 312, ENE 316, ENE 441
ENE518	High Voltage Engineering	3	FF	3	0	ENE 441
ENE519	Electronic Circuit Design	3	FF	3	0	ENE 214, ENE 301
ENE545	Power System Quality	3	FF	3		ENE 441
ENE546	Power Electronic Applications in Power Systems	3	FF	3	0	ENE 312
ENE547	Power System Stability	3	FF	3	0	ENE 542
ENE548	Power System Reliability	3	FF	3	0	ENE 542
ENE549	Electrochemical Energy Storage	3	BL	3	0	ENE 324
ENE595-A	Special Topics	1	BL	1	0	-
ENE595-B	Special Topics	2	BL	2	0	-
ENE595-C	Special Topics	3	BL	3	0	-
Total		12		12	0	

^b ENE499 International Internship is a prerequisite for all elective courses

VII. Study Plan^c Guide for the Bachelor's Degree in Energy Engineering

First Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL098	English I *	0	-	
GERL101	German I *	3	-	
CS116	Computing fundamentals	3	-	CS 1160
CS1160	Computing fundamentals lab	1	-	CS 116
MATH101	Calculus I	3	-	
PHYS103	Physics I	3	-	
CHEM103	General Chemistry I	3	-	
CHEM106	General Chemistry lab	1	-	CHEM 103
MILS100	Military Sciences	3	Only for Jordanian	
Total		20		

First Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL099	English II *	0	ENGL 098	
ARB100	Arabic *	3	-	
MATH102	Calculus II	3	MATH 101	
GERL102	German II	3	GERL 101	
PHYS104	Physics II	3	PHYS 103	PHYS 106
PHYS106	General Physics Lab	1	-	PHYS 104
ME0111	Computer Aided Engineering Drawing	2	CS 116	
IE0141	Engineering Workshop	1	-	
NE101	National Education (in Arabic)	3	ARB 099	
	National Education (in English)		ENGL 101	
Total		19		

First Year				
Summer Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
University Elective	See Elective courses in Table 1.3	3	-	
Total		3		

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

* Student's score on placement test will decide the course level to start from

Second Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL101	English III *	1	ENGL 099	
GERL201	German III	3	GERL 102	
MECH0221	Thermodynamics	3	MATH 102	
ENE211	Fundamentals of Electrical Circuits	3	PHYS 104	MATH 203
MATH203	Applied Mathematics for Engineers	3	MATH 102	
MATH205	Differential equations	3		MATH 203
University Elective	See Elective courses in Table 1.3	3		
Total		19		

Second Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL102	English IV *	1	ENGL 101	
GERL202	German IV	3	GERL 201	
IE0121	Probability and Statistics	3	MATH 101	
ENE212	Electrical Circuits and Systems Analysis	3	ENE 211	
ENE214	Electronics	3	ENE 211	
ECE333	Electromagnetics	3	MATH 203	
ENE301	Introduction to Digital Systems and Microcontrollers	3		ENE 214
ENE302	Statistical and Numerical Methods for Energy Engineers	3	MATH 205	
Total		22		

Second Year				
Summer Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
	Any Course from First Year table above student could not take and/or pass		-	
Total				

Third Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL201	English V *	2	ENGL 102	
GERL301	German V	3	GERL 202	
ENE316	Introduction to Communication Systems for Energy Engineers	3	ENE 212	
MECH0222	Fluid Mechanics	3	MATH 102, PHYS 103	
ENE213	Electrical Circuits Lab	1	ENE 212	
ENE311	Electrical Machines	3	ENE 212, ECE 333	
ENE312	Power Electronics	3	ENE 214, ENE 212	
ENE323	Fluid Mechanics Lab	1		MECH 0222
ENE444	Modeling and Control of Energy Systems	3	MATH 205, ENE 311	
Total		22		

Third Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL202	English VI *	2	ENGL 201	
ENE215	Electronics Lab	1	ENE 214, ENE 213	
ENE313	Electrical Machines Lab	1	ENE311	
ENE314	Power Electronics Lab	1	ENE 312	
GERL302	German VI	3	GERL 301	
ENE321	Heat Transfer	3	MECH 0221, MECH 0222, MATH205	
ENE324	Introduction to Energy Systems	3	ENE 321	
ENE432	Power Plant Engineering	3	ENE 324	
ENE441	Power Systems	3	ENE 311, ENE 302	
Total		20		

Third Year				
Summer Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENE399	Field Training	0	University Regulations	
Total		0		

Fourth Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
Elective courses in Tables 3.4 and 3.5	Elective Course	3		
	Elective Course	3		
	Elective Course	3		
	Elective Course	3		
Total		12		

Fourth Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENE499	International Internship ^d	12	ENE 399	
Total		12		

German year prerequisites are:

1. A minimum GPA of 61.0%
2. Successful completion of 90 credit hours excluding all German language courses
3. Passing GERL302 German VI and B1 German language test (all 4 language skills) conducted by Goethe Institute or another approved provider
4. ENGL201 English V, and Arabic 99
5. Passing the following four courses:
 - ENE311 Electrical Machines
 - ENE312 Power Electronics
 - ENE321 Heat Transfer
 - ENE331 Energy Conversion

^dCourses attended and/or passed during International Internship are not transferable

Renewable Energy Track

Fifth Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ME0346	Instrumentations and Measurements	2	ENE 211, MATH 205	ME 0347
ME0347	Instrumentation and Measurements Lab	1		ME 0346
ENE401	Energy Systems Simulation Lab	2	ENE 312, ENE 324, #ENE 444	
ENE434	PV Technology I	3	ENE 324, ENE 212, ENE 214	
ENE442	Power Systems Lab	1	ENE 441	
ENE443	Electrical Power Generation, Transmission & Distribution	3	ENE 441	
ENE537	Energy Efficiency, management and laws	3	ENE 324	
ENE433	Solar Energy I	3	ENE 324	
ENE598	Graduation Project I	1	ENE 499	
Total		18		

Fifth Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENE435	Wind Energy Technology	3	ENE 311, ENE 312, ENE 324	
ENE436	Renewable Energy lab	1	ENE 434	
ENE532	Energy lab	1	ENE 324	
ENE536	Energy Efficiency Lab	1	ENE 436	
ENE599	Graduation Project II	3	ENE 598	
ENE437	Economics of Natural Resources Engineering	3	MATH 203	
Total		12		

Electrical Power Track

Fifth Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ME0346	Instrumentations and Measurements	2	ENE 211, MATH 205	ME 0347
ME0347	Instrumentation and Measurements Lab	1		ME 0346
ENE401	Energy Systems Simulation Lab	1	ENE 312, ENE 324, #ENE 444	
ENE434	PV Technology I	3	ENE 324, ENE 212, ENE 214	
ENE442	Power Systems Lab	1	ENE 441	
ENE443	Electrical Power Generation, Transmission & Distribution	3	ENE 441	
ENE445	Electric Drives	3	ENE 312, ENE 444	
ENE542	Power System Analysis	3	ENE 441	
ENE598	Graduation Project I	1	ENE 499	
Total		18		

Fifth Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENE446	Electric Drives Lab	1	ENE 445	
ENE517	Power System Protection	3		ENE 542
ENE540	Power Systems Integrations Lab	1	ENE 301, ENE 314, ENE 442	
ENE543	Power System Protection Lab	1		ENE 517
ENE599	Graduation Project II	3	ENE 598	
ENE437	Economics of Natural Resources Engineering	3	MATH 203	
Total		12		

VIII. Compulsory Courses Offered by Energy Engineering Department

ENE211 Fundamentals of Electrical Circuits	3 Cr Hr
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.	
<i>Prerequisites: PHYS 104; Corequisites: MATH203</i>	
ENE212 Electrical Circuits and Systems Analysis	3 Cr Hr
Average, reactive and complex power, power measurements; polyphase circuits, mutual inductances; Laplace Transforms, frequency response, impulse and step response, passive and active filters, Fourier series and the Fourier Transform, two-port circuits.	
<i>Prerequisites: ENE211</i>	
ENE213 Electrical Circuits Lab	1 Cr Hr
Resistive circuits, potentiometers, superposition, Thevenin theorem, maximum power transfer, RLC current and voltage characteristics, frequency response of RL and RC circuits, series and parallel resonant circuits.	
<i>Prerequisites: ENE211</i>	
ENE214 Electronics	3 Cr Hr
Semiconductor material, covalent bond model, doping, PN junction, the diode (IV-characteristics, reverse behavior, zero and forward biasing, ideal and real diode), Zener diode, Schottky diode, diode circuit analysis, half-wave rectifier circuits, full-wave rectifier circuits, dynamic switching behavior of the diode, diode applications, Bipolar Junction Transistor (BJT) (NPN and PNP transistors, iv-characteristics, DC analysis (Q-point) & AC small-signal analysis), Field- Effect Transistors (FETs) (Junction FET (JFET) transistor, Metal-Oxide Semiconductor FET (MOSFET) transistor) and i-v characteristics of FET transistors, DC analysis (Q-point) & AC small-signal analysis. Ideal Operational Amplifiers (Op-amps) and their applications.	
<i>Prerequisites: ENE211</i>	
ENE215 Electronics Lab	1 Cr Hr
Diode circuits, DC and AC characteristics of BJT and FET amplifiers, operational amplifiers and applications, Lab project.	
<i>Prerequisites: ENE213, ENE214</i>	
ENE301 Introduction to Digital System and Microcontrollers	3 Cr Hr
Combinational and sequential circuit design using Boolean algebra and Karnaugh Maps, digital circuit design using random logic gates, interfacing circuits, interrupt signals and routines, analog and digital peripherals programming: digital I/Os, timers, ADC, Low power modes of operation and application of microcontrollers.	
<i>Corequisites: ENE214</i>	

ENE302 Statistical and Numerical Methods for Energy Engineers

3 Cr Hr

introduction to MatLab, error analysis, interpolation, extrapolation, curve-fitting, solving systems of linear equations, root-finding for non-linear equations, numerical differentiation and integration, numerical solutions to ordinary differential equations.

Prerequisites: MATH205

ENE311 Electrical Machines

3 Cr Hr

Transformers: performance characteristics, three-phase connections, autotransformers; DC machines: performance equations, generator and motor characteristics, starting and speed control of motors; single phase induction motors; three-phase induction motors: operation, performance calculations, starting and speed control; synchronous machines: generator and motor operation; small synchronous motors; universal motors.

Prerequisites: ENE212, ECE333

ENE312 Power Electronics

3 Cr Hr

Power semiconductor devices: types, drive circuits, protection circuits, and power loss calculation; AC-DC converters: uncontrolled and fully-controlled single-phase and three-phase rectifiers, half-controlled rectifiers; DC-DC converters: step-down, step-up, and step-down/up converters; DC-AC converters: single-phase and three-phase inverters; AC-AC converters: cycloconverters, ac voltage controllers.

Prerequisites: ENE212, ENE214

ENE313 Electrical Machines Lab

1 Cr Hr

Transformers, three-phase transformer methods of connection, DC motors, DC generators, three-phase induction motors, single-phase induction motors, three-phase synchronous generator and motor, AC series motor, lab project.

Prerequisites: ENE311

ENE314 Power Electronics Lab

1 Cr Hr

Uncontrolled single phase half wave rectifier, uncontrolled single phase full wave rectifier, uncontrolled three phase rectifiers, controlled single phase rectifiers, controlled three phase rectifiers, DC chopper (buck converter), DC chopper (boost converter), DC chopper (buck boost converter), single phase AC inverter, lab project.

Prerequisites: ENE 312

ENE316 Introduction to Communication Systems for Energy Engineers

3 Cr Hr

Equivalent low-pass models, AM modulation and demodulation, FM modulation and demodulation, sampling and quantization, pulse width modulation, tuned circuits and crystals, light emitting diodes, optoelectronics integrated circuits.

Prerequisites: ENE 212

ENE321 Heat Transfer**3 Cr Hr**

Conduction: steady state (1D and 2-D), transient state; convection: forced (external and internal), natural convection and heat exchangers; radiation: black body radiation, radiative properties, shape factors and gray surfaces radiation.

Prerequisites: MECH0221, MECH0222, MATH205

ENE323 Fluid Mechanics Lab**1 Cr Hr**

Fluid properties: density, specific gravity, viscosity; fluid characteristics; continuity, conservation of energy; fluid behavior: center of pressure, pipe flow, open channel flow; and pump performance.

Prerequisites: MECH0222

ENE324 Introduction to Energy Systems**3 Cr Hr**

Thermodynamic, mechanical, and electrical aspects of modern energy conversion systems; traditional systems (steam electric power plants, gas turbines, internal combustion engines, refrigeration systems); renewable systems (solar, wind, geothermal); combined heat and power and co-generation; economic and environmental aspects of energy conversion.

Prerequisites: ENE321

ENE399 Field Training**0 Cr Hr**

University Regulations

Prerequisites:

ENE401 Energy Systems Simulation Lab**2 Cr Hr**

Mathematical and algebraic modeling, linear programming, programming and simulation of Power Systems, renewable energy systems, energy economy modelling.

Prerequisites: ENE312, ENE324; Corequisites: ENE444

ENE432 Power Plant Engineering**3 Cr Hr**

Introduction to power plants engineering, energy: A Measure for work potential, gas power cycles, vapor and combined power cycles, thermal power plant components, steam and gas turbine, steam generators, condenser and condensate, feed-water systems compressors, pumps.

Prerequisites: ENE324

ENE433 Solar Energy I**3 Cr Hr**

Heat transfer phenomena (radiation, convection, conduction) in solar thermal systems; materials used in solar thermal applications and their properties: selective treatments, phase change materials, transparent insulating surfaces; design methodologies and calculation of solar thermal systems and equipment; heat transfer calculation software; testing of solar thermal collectors and solar thermal systems; applications of solar energy: absorption cooling systems, solar thermal energy system as a primary source of electricity; solar thermal concentration (solar thermo-electric).

Prerequisites: ENE324

ENE434 PV Technology I**3 Cr Hr**

Characteristics of sunlight and types of solar irradiance, sun position calculator, solar radiation potential assessment with fixed inclination (tilt) and orientation (azimuth) angles; semiconductor and silicon PN junction photovoltaic (PV) cells; Photovoltaic (PV) effect of silicon solar cells; the behavior and performance of silicon PV cells; PV cell properties and design; IV-characteristics of ideal and real PV cells; ideal silicon cell IV-curve equation and modelling; real silicon cell equation; PV cells interconnections and fabrication of wafer based and thin-film PV modules; datasheets of commercial PV modules; PV power system components: PV battery charge controllers, DC/AC inverters and batteries; datasheets of PV charge controllers, inverters and batteries; PV mounting structures; electrical single line diagram and module arrangement layout; design and sizing of off-grid/standalone PV systems; design and sizing of on-grid/grid-connected PV systems; Specific Energy Yield (SEY) and Performance Ratio (PR) of grid-connected PV systems; economics of PV systems (time value of money, capital cost, savings, simple payback period, return on investment and internal rate of return).

Prerequisites: ENE212, ENE214, and ENE324

ENE435 Wind Energy Technology**3 Cr Hr**

Introduction to Wind energy technology, basic characteristics of wind, site characterization statistical methods of wind analysis, wind resources assessment, fundamental principles of wind turbines, aerodynamics, mechanical and electrical components of wind turbines, performance analysis of wind turbines/farms, wind turbines integrations into power systems, environmental and social impact of wind technology, economics of wind technology.

Prerequisites: ENE311, ENE312, and ENE324

ENE436 Renewable Energy Lab**1 Cr Hr**

Assessment of the viability of a wind power, solar radiation, solar thermal, PV or biomass system for a given site; measurement and data collection techniques; analyzing and evaluation these renewable energy resources and calculate savings fractions, backup energy needs, financing options, and economic analyses; the principles of solar home design, solar hot water, and space heating and solar cooling for both new and existing construction; investigation of the potentials of renewable energy technologies to help solve environmental and economic problems within society.

Prerequisites: ENE434

ENE437 Economics of Natural Resources Engineering**3 Cr Hr**

Introduction to engineering economy, importance of engineering economics, price elasticity and its application, cost concepts and design economics, cost-estimation techniques, the time value of money, evaluating a single project, comparison and selection among alternatives, depreciation and income taxes, climate change and energy-related environmental externalities.

Prerequisites: MATH203

ENE441 Power Systems**3 Cr Hr**

Introduction to power systems, transformers, series impedance of transmission lines, capacitance of transmission lines, current and voltage relations on a transmission line, impedance and admittance models and network calculations, Gauss-Seidel and Newton-Raphson methods to solve nonlinear algebraic equations, power flow, symmetrical faults.

Prerequisites: ENE302, ENE311

ENE442 Power Systems Lab**1 Cr Hr**

Transmission line performance under different operating conditions, load characteristics, real and reactive power flow and control for a transmission line, characteristics of different types of sequence components, balanced and unbalanced faults, power system transients and stability.

Prerequisites: ENE441

ENE443 Electrical Power Generation, Transmission and Distribution**3 Cr Hr**

Substation design, distribution systems, transmission systems, transformers, high voltage cables, introduction to power system protection, circuit breakers, switch gear, introduction to power quality, wiring and grounding.

Prerequisites: ENE441

ENE444 Modeling and Control of Energy Systems**3 Cr Hr**

Transfer functions, Block diagrams, Signal flow graphs, State-space description, Mathematical modeling of physical systems, Time-domain analysis, Root locus techniques, Frequency-domain analysis and design, Compensation design, closed loop control of electrical systems, resonant systems.

Prerequisites: MATH205, ENE311

ENE445 Electric Drive**3 Cr Hr**

DC-motor drives using controlled AC-DC converters; DC-motor drives using DC-DC converters; frequency-controlled induction-motor drives; slip energy recovery; synchronous motor drives using inverters and cycloconverters; variable reluctance drives: switched reluctance and stepper-motor drives using bridge inverters.

Prerequisites: ENE312, ENE444

ENE446 Electric Drive Lab**1 Cr Hr**

DC-motor drives using controlled AC-DC converters, DC-motor drives using DC-DC converters, Frequency-controlled Induction-motor drives, Synchronous motor drives using inverters and cycloconverters.

Prerequisites: ENE445

ENE499 International Internship**12 Cr Hr**

University Regulations.

Prerequisites: ENE399

ENE517 Power System Protection**3 Cr Hr**

Power system protection, fault analysis, instrument transformers, overcurrent protection, distance protection, differential protection, pilot protection, generator protection, motor protection, transmission line protection, transformer protection, bus protection, radial reactor and shunt capacitor protection.

Prerequisites: ENE542

ENE532 Energy Lab	1 Cr Hr
Data measurements, collection, analysis, evaluation and basic fabrications techniques for major renewable energy systems such as: wind energy, PV and solar thermal, biomass and hydro systems; sizing for each system and calculate predicted energy yield; feasibility for specific locations.	
<i>Prerequisites: ENE324</i>	
ENE536 Energy Efficiency Lab	1 Cr Hr
Energy efficiency in existing buildings in terms of: energy use, indoor comfort, use, technical and economic feasibility, cultural values; system perspectives such as: energy supply and environmental aspects; energy simulations in buildings; peer critique; energy efficiency measures for apartment buildings evaluation.	
<i>Prerequisites: ENE436</i>	
ENE537 Energy Efficiency, Management and Laws	3 Cr Hr
Technical and physical processes involved in energy usage in: residential, commercial, industrial and transport sectors; economic tools required to justify expenditure on energy efficiency programs; “whole system” design and analysis; policy and environmental requirements to enhance implementation of energy efficiency measures.	
<i>Prerequisites: ENE324</i>	
ENE540 Power System Integrations Lab	1 Cr Hr
Application and integration of hardware and software techniques for modern power systems.	
<i>Prerequisites: ENE301, ENE314, ENE442</i>	
ENE542 Power System Analysis	3 Cr Hr
Fault analysis, symmetrical components, unsymmetrical faults, transient stability, economic dispatch and operation.	
<i>Prerequisites: ENE441</i>	
ENE543 Power System Protection Lab	1 Cr Hr
Protective relaying, fuses, time overcurrent relays, instantaneous relays, differential relaying for transformers, distance relaying, current and voltage transformers.	
<i>Corequisites: ENE517</i>	
ENE598 Graduation Project I	1 Cr Hr
Project preparation by forming teams supervised by faculty member, selecting the project scope; understand the theory, background and application; understand the ethical and professional issues in engineering practice; final presentation and report are required.	
<i>Prerequisites: ENE499</i>	
ENE599 Graduation Project II	3 Cr Hr
Practical implementation of the project approved in the first portion of the graduation project sequence; a final report and presentation are required.	
<i>Prerequisites: ENE598</i>	

IX. Elective Courses Offered by Energy Engineering

Department

ENE510 Switched Mode Power Supplies	3 Cr Hr
Power capabilities and switching speeds of power semiconductors; DC-DC switched-mode converters: types, design, control, applications; DC-AC switched-mode inverters: types, design, control of AC output, applications; computer simulation of switched-mode converters.	
<i>Prerequisites: ENE312</i>	
ENE511 Special Electrical Machines	3 Cr Hr
Linear Electric machines: comparison with rotating machines; linear induction motors: simplified electromagnetic field theory, force equation, characteristics; superconducting AC generators and motors; variable reluctance motors: performance and characteristics; printed circuit motors.	
<i>Prerequisites: ENE311</i>	
ENE512 Power Semiconductor Devices	3 Cr Hr
Carrier transport physics, breakdown phenomenon in semiconductor devices, power bipolar transistors, thyristors, power Junction Field-Effect Transistors (JFET), power diodes, power Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFET), power MOS-bipolar devices.	
<i>Prerequisites: ENE312</i>	
ENE513 Power Systems Operation and Control	3 Cr Hr
General characteristics of modern power systems, evolution of power systems, power system control. Equipment characteristics and modeling, control of protective functions, modeling of excitation system. Prime mover and energy supply systems. Control of active and reactive power; modern stability of power systems; linear and nonlinear systems.	
<i>Prerequisites: ENE443</i>	
ENE514 Mixed Signal Test Engineering	3 Cr Hr
Mixed signal testing, the test specification process, DC and parametric measurements, measurement accuracy, tester hardware, sampling theory, DSP-based testing, analog channel testing, digital channel testing, design for test, data analysis, test economics.	
<i>Prerequisites: ENE301, ME0346</i>	
ENE516 Smart-Grids	3 Cr Hr
This course presents a new concept in power systems, by integrating Power systems with Power electronics, Communications and information technology. In addition, the concept of involving intelligent control using SCADA system will be presented.	
<i>Prerequisites: ENE312, ENE316, ENE441</i>	
ENE518 High Voltage Engineering	3 Cr Hr
Generation and measurement of high voltage, electrostatic field and field stress control, electrical breakdown in gases, solids and liquids, non-destructive insulation test techniques, over-voltages and insulation coordination.	
<i>Prerequisites: ENE441</i>	

ENE519 Electronic Circuit Design	3 Cr Hr
Feedback amplifiers, oscillators, power amplifiers, current mirrors, active loads, differential amplifiers, active filters, internal structure of operational amplifiers, integrated analog circuits and applications.	
<i>Prerequisites: ENE214, ENE301</i>	
ENE520 Thermal Energy Storage	3 Cr Hr
Energy storage technologies with emphasis on thermal energies storage, energy storage strategies for system optimization, sensible heat, latent heat, inorganic phase change materials, organic phase change materials, Quasi-latent heat, heat pumps.	
<i>Prerequisites: ENE324</i>	
ENE521 Thermal and Hydrodynamic equipment	3 Cr Hr
Thermal and hydrodynamic equipment design, operation, maintenance and selection of flowing items: boilers, heat exchangers, piping system and fitting, burners, pumps; for these equipment.	
<i>Prerequisites: ENE321</i>	
ENE522 Heating Ventilating and Air Conditioning (HVAC)	3 Cr Hr
Psychometric principles, thermal comfort, air conditioning processes, inside and outside design conditions, heating load calculations, infiltration, cooling load calculations, solar gain, design of heating and air conditioning systems, HVAC equipment and components.	
<i>Prerequisites: ENE321</i>	
ENE523 Turbomachinery	3 Cr Hr
Impulse and reaction turbines, velocity diagrams, energy equations and degree of reaction, total pressure correlation, turbine design, three-dimensional analysis, free vortex design, estimation of stage and design point performance.	
<i>Prerequisites: MECH0222</i>	
ENE524 Geothermal and Hydropower systems	3 Cr Hr
Geothermal systems: geothermal exploration techniques, drilling techniques and logging methods, reservoir physics, well test analysis, monitoring & forecasting, direct and indirect use of geothermal resources, visualization and modeling techniques, design, sizing, analysis and environmental impacts of geothermal systems (geothermal power plants and its types and heat pump systems; hydropower systems: hydropower systems including mini, small and large scale plants; general overview of types of hydropower plants, planning, assessment of hydropower resources, dam design, mechanical and electrical equipment, economic analysis of hydropower plant and the environmental impacts.	
<i>Prerequisites: ENE324</i>	
ENE525 Fuel Cell & Hydrogen Production Technology	3 Cr Hr
Fundamentals of fuel cells & hydrogen production technology, basic structure of fuel cells, operations and conversion of chemical potential energy into electrical energy, evaluation of the cell performance, and characterization.	
<i>Prerequisites: ENE324</i>	

ENE526 Bio-Energy Technology**3 Cr Hr**

Introduction to biomass; low-carbon energy systems including: biopower, bioheat and biofuels; scientific examination of feedstock conversion technologies and scale up for industrial production, end products, and their applications; concepts of sustainability, Life Cycle Analysis (LCA); bioenergy systems; advantages of low-carbon energy in developing a low-carbon economy and society.

Prerequisites: ENE324

ENE527 Techno-economics of energy systems**3 Cr Hr**

Economic competitiveness of renewable energy systems for utility scale electric generation systems, design parameters for the installation and operation of photovoltaic and wind energy systems, building-integrated applications of renewable energy sources, design methodologies of hybrid systems, techno-economic feasibility, funding resources and positive environmental impact assessment for energy saving systems, energy storage technology selection, energy consumption analysis and assessment of energy saving potential and development of energy saving recommendations.

Prerequisites: ENE324

ENE529 Modeling and Simulation**3 Cr Hr**

Modeling techniques of system's Components. Simulation techniques of Systems. This course introduces the basic deterministic optimization techniques which includes LaGrange multiplies, search method, linear and dynamic programming. These techniques are applied to energy-related problems. Moreover, Simulation techniques related to thermal and electrical systems are introduced.

Prerequisites: ENE401

ENE530 Advanced Renewable Energy Systems**3 Cr Hr**

Analysis of alternative and renewable energy systems; methods of integrating these solutions with society; sustainable energy; principles, possibilities, and limits of alternative and renewable energy.

Prerequisites: ENE324

ENE531 Environmental and Energy Engineering**3 Cr Hr**

Environmental issues associated with human activity; mass and energy transfer, environmental chemistry, water and air pollution, pollutant transport modeling, pollution management, and risk assessment, and global atmospheric change; physical, chemical, and biological systems relating to the quality of water, land and air environments; topics relating energy to environmental engineering including: carbon production, heat and energy transfer and thermal pollution.

Prerequisites: ENE324

ENE533 Solar Energy II**3 Cr Hr**

Design of solar thermal and solar photovoltaic power generating units in various modes, financial and related environmental implications, case studies and actual application of available software for design of solar power systems.

Prerequisites: ENE433, ENE434

ENE534 Low Carbon Buildings**3 Cr Hr**

Low carbon buildings; methods for balancing architectural and human requirements; relationship between building design and: thermal comfort inside the building, lighting performance, heating, cooling and lighting loads; psychrometric chart to analyze climate and human comfort; the effects of common passive solar strategies on building design; different thermal comfort models; determine the thermal and lighting performance of a building using manual methods and software; appropriate passive solar and low energy design strategies; assess solar access at a site using manual methods; energy assessment tools for building simulation; energy efficiency techniques in the residential sector.

Prerequisites: ENE321

ENE535 PV Technology II**3 Cr Hr**

Solar radiation basics; PV technology basics; emerging PV technologies: Building Integrated PV (BIPV) and Concentrated PV system (CPV); PV tracking systems: 1-axis and 2-axis; PV system types (on-grid and off-grid); testing and commission of PV systems; maintenance of PV systems; large-scale PV systems planning, design and sizing; hybrid systems planning, design and sizing; PV grid connection requirements and codes; construction and installation of PV systems; cost breakdown of PV systems; tender documents preparation for PV systems; technical and financial evaluation of PV tenders; economics of PV systems.

Prerequisites: ENE434

ENE538 Applied Refrigeration**3 Cr Hr**

Vapor compression cycle; alternative cycles: absorption cycle, multiple effect cycles, ejector cycles, expansion cycles, electric and magnetic cycles; refrigerants: the properties, refrigerant mixtures, refrigeration system components.

Prerequisites: ENE321

ENE539 Energy Audit**3 Cr Hr**

Lighting fundamentals, energy utilities and rates, and identification of opportunities for efficiency changes in buildings. Topics include scientific principles of energy, light and heat, energy codes and standards, metering and monitoring. Students will examine the economic, regulatory, and infrastructure issues affecting implementation of energy efficiency measures as well as their potential for solving energy and environmental problems.

Prerequisites: ENE441

ENE545 Power System Quality**3 Cr Hr**

Power quality concepts, wiring and grounding issues, voltage sags, voltage variations, transients, harmonics, longer duration voltage variation, distributed generation and power electronics, instrumentation and analyzers.

Prerequisites: ENE441

ENE546 Power Electronic Applications in Power Systems**3 Cr Hr**

Semiconductor devices for power engineering applications, common power electronic circuits, impact of power electronics loads on power quality, HVDC converter plant, transmission plant control strategies, flexible AC transmission: conventional and advanced devices, shunt compensation, static VAR compensation, series compensation, angle compensation, quadrature boosters, unified power flow controller.

Prerequisites: ENE312

ENE547 Power System Stability**3 Cr Hr**

Power system stability concepts, the classical machine model, modeling of synchronous machines, modeling of loads, excitation system types, dynamic models of excitation system, response of a power network to disturbances, small signal stability, voltage stability.

Prerequisites: ENE542

ENE548 Power System Reliability**3 Cr Hr**

Power system reliability concepts, modern random processes methods, the universal generating function method, Monte Carlo simulation, reliability of generation systems, reliability assessment of transmission lines, reliability assessment of transformers, and reliability of distribution systems.

Prerequisites: ENE542

ENE549 Electrochemical Energy Storage**3 Cr Hr**

Electrochemical energy storing technologies with emphasis on: supercapacitors, batteries, electrode materials, power and energy density, electrochemical characterization techniques, different cell setups.

Prerequisites: ENE324

X. Courses offered by Other Schools

ARB099: Arabic 99

0 Cr Hr (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 Hr (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

ENGL099: English II

0 Cr Hr (3,0)

Students will focus on English at a pre-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include such things as comparatives and superlatives, quantifiers, possessive adjectives and pronouns, vocabulary building, role-play activities for speaking, reading comprehension and writing short descriptive paragraphs.

Prerequisites: -

ENGL101: English III

1 Cr Hr (3,0)

Students will focus on English at an intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include collocations, tense review, affirmative, negative statements, synonyms and antonyms, time clauses, conditionals, active and passive forms, reported speech, phrasal verbs, reading comprehension with detailed questions, vocabulary and writing developed descriptive and opinion essays.

Prerequisites: ENGL099

ENGL102: English IV

1 Cr Hr (3,0)

Students will focus on English at an upper-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. Model verb review, silent letters and proper pronunciation, jobs and careers, requests and offers, more phrasal verbs with vocabulary building, relative clauses and relative pronouns, narrative tenses for writing exercises, wishes and regrets, reading and comprehending longer passages with direct and inference questions of medium difficulty, hypothesizing, and writing fully developed descriptive, argumentative and analytical essays of 350 words.

Prerequisites: ENGL101

ENGL201: English V**2 Cr Hr (3,0)**

Students will focus on English at an Advanced level. Students will analyze and produce 2 – 3 page essays with an emphasis on argumentation and persuasion working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Class activities include interactive lectures, small group and class discussions, informal debates, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using basic literary terms and concepts.

Prerequisites: ENGL102

ENGL202: English VI**2 Cr Hr (3,0)**

Students will continue to focus on English at an Advanced level. Students will analyze and produce 4 – 5 page essays emphasizing argumentative, persuasive and discursive styles of writing, working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Students will integrate the practice of critical thinking and reading into the writing process. Class activities include interactive lectures, small group and class discussions, informal debates, mini-conferences, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using stronger and more intensive literary terms and concepts than in 201.

Prerequisites: ENGL 201

GERL101B1: German I B1 track**3 Cr Hr (9,0)**

By the end of this module, the student will be able to:

- Comprehend very familiar, everyday expressions and very simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the Level A1.1 (beginners without pre-knowledge).
- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and partially in past tense, set private and semi-official appointments, describe people and things and express frequency and quantity in a very basic way both orally and in writing.
- Communicate with native speakers on a very basic level if those involved in the conversation speak slowly and clearly and are willing to support the non-native speaker.

Prerequisites: Intensive pre-course (only for 1st semester of an academic year)

GERL102B1: German II B1 track**3 Cr Hr (9,0)**

By the end of this module, the student will be able to:

- Understand and use familiar, everyday expressions and very simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A1.2 (basic users).
- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and past tense, set private and official appointments, describe people and things, ask for directions, express frequency and quantity in a basic way both orally and in writing.
- Communicate with native speakers on a very basic level if those involved in the conversation speak slowly and clearly and, if need be, are willing to support the non-native speaker.

Prerequisites: **GERL101B1**

GERL201B1: German III B1 track**3 Cr Hr (6,0)**

By the end of this module, the student will be able to:

- Understand and use familiar, frequently used expressions and simple sentences and structures related to areas of a wider immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A2.1 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, describe health problems and talk with medical doctors and nurses, express pity, sorrow and hopes, express frequency and quantity in a basic way both orally and in writing.
- Communicate with native speakers within simple and familiar tasks requiring a simple and direct exchange of information on familiar and routine matters.

Prerequisites: **GERL102B1**

GERL202B1: German IV B1 track**3 Cr Hr (9,0)**

By the end of this module, the student will be able to:

- Distinguish between familiar expressions, sentences and structures related to areas of immediate relevance and more elaborated components like the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A2.2 (basic users) and, partially, at the level B1.1 (independent user).
- Talk about personal experiences with languages, express feelings of happiness, joy and discomfort, describe own media consumption habits, describe travel experiences, convince others, describe and report in official situations, describe statistics, write formal invitations and short emails, make suggestions and talk about future events and situations, describe dreams hopes and ambitions and briefly give reasons or explanations for opinions and plans.
- Communicate with native speakers about essential points and ideas in familiar contexts.
- Understand the characteristics of the official B1 exam according to the CEFR and use strategies to overcome obstacles while solving said exam.

Prerequisites: **GERL201B1**

GERL301B1: German V B1 track**3 Cr Hr (9,0)**

By the end of this module, the student will be able to:

- Understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B1.1 and B1.2 (independent user).
- Deal with most situations likely to arise whilst traveling in an area where German is spoken, produce simple connected texts on topic which are familiar or of personal interest, describe experiences and events, dreams, hopes and ambitions, statistics, and briefly give reasons and explanations for opinions and plans.
- Understand the main point of many radio or TV programmes on current events and topics, understand the description of events, feelings and wishes in personal letters, write personal letters/texts describing experiences and impressions, write straightforward connected texts on topics which are familiar or of personal interest.
- Communicate with native speakers about essential points and ideas in familiar contexts and about topics of personal or partially professional interest.
- Follow a lecture or talk within her/his field, provided the subject matter is familiar and the presentation straightforward and clearly structured.
- Understand simple technical information, such as operating instructions for everyday equipment.
- Understand all characteristics of the official B1 exam according to the CEFR and use a variety of strategies to overcome obstacles while solving said exam and all its components.

Prerequisites: **GERL202B1**

GERL302REG: German VI Regular**3 Cr Hr (6,0)**

By the end of this module, the student will be able to:

- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.
- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in Germany as well as understand the concepts of open-mindedness and 'culture clash'.

Prerequisites: **GERL301B1**

GERL302INT: German VI Intensive**3 Cr Hr (9,0)**

By the end of this module, the student will be able to:

- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.
- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in Germany as well as understand the concepts of open-mindedness and 'culture clash'.
- Understand all characteristics of the official B1 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.

Prerequisites: GERL301B1

GERL102B2: German II B2 track**3 Cr Hr (9,0)**

By the end of this module, the student will be able to:

- Understand and use familiar, everyday expressions and simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A1.2 and, partially, A2.1 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, express pity, sorrow and hopes, express frequency and quantity in a basic way both orally and in writing.
- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and past tense, set private and official appointments, describe people and things, ask for directions, express frequency and quantity in a basic way both orally and in writing.
- Communicate with native speakers on a basic level if those involved in the conversation speak slowly and clearly and, if need be, are willing to support the non-native speaker.

Prerequisites: GERL101B1

GERL201B2: German III B2 track**3 Cr Hr (6,0)**

By the end of this module, the student will be able to:

- Distinguish between familiar expressions, sentences and structures related to areas of immediate relevance and more elaborated components like the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A2.1 and A2.2 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, describe health problems and talk with medical doctors and nurses, express pity, sorrow and hopes, describe simple statistics, express frequency and quantity in a basic way both orally and in writing, express feelings of happiness, joy and discomfort and write personal emails and letters, understand and produce comments, blogs and reports.
- Communicate with native speakers in simple and familiar tasks requiring a simple and direct exchange of essential information on familiar and routine matters.

Prerequisites: **GERL102B2**

GERL202B2: German IV B2 track**3 Cr Hr (9,0)**

By the end of this module, the student will be able to:

- Understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B1.1 and B1.2 (independent user).
- Deal with most situations likely to arise whilst traveling in an area where German is spoken, produce simple connected texts on topic which are familiar or of personal interest, describe experiences and events, dreams, hopes and ambitions and briefly give reasons and explanations for opinions and plans.
- Understand the main point of many radio or TV programmes on current events and topics, understand the description of events, feelings and wishes in personal letters, write personal letters/texts describing experiences and impressions, write straightforward connected texts on topics which are familiar or of personal interest.
- Communicate with native speakers about essential points and ideas in familiar contexts and about topics of personal or partially professional interest.
- Follow a lecture or talk within her/his field, provided the subject matter is familiar and the presentation straightforward and clearly structured.
- Understand simple technical information, such as operating instructions for everyday equipment.
- Understand all characteristics of the official B1 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and all its components.

Prerequisites: **GERL201B2**

GERL301B2: German V B2 track**3 Cr Hr (9,0)**

By the end of this module, the student will be able to:

- Largely understand and produce rather complex texts on both concrete and abstract topics, including technical discussions in her/his field of specialisation and according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B2.1 (independent user).
- Interact with an initial degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party.
- Largely understand standard spoken language, live or broadcast, on both familiar and unfamiliar topics normally encountered in personal, social, academic or vocational life.
- Show a relatively high controlled degree of grammatical control without making errors which cause misunderstanding and with the growing ability to correct most of her/his mistakes.
- Largely follow essentials of lectures, talks, reports and other forms of academic/professional presentation which are propositionally and linguistically complex.
- Understand announcements and messages on concrete and abstract topics spoken in standard dialect at normal speed.
- Scan quickly through long texts, locating relevant details and understand and exchange complex information and advice on the full range of matters related to her/his occupational role.
- Understand the main characteristics of the official B2 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.

Prerequisites: **GERL202B2**

GERL302B2: German VI B2 track**3 Cr Hr (6,0)**

By the end of this module, the student will be able to:

- Understand and produce rather complex texts on both concrete and abstract topics, including technical discussions in her/his field of specialisation and according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B2.2 (independent user).
- Interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party.
- Understand standard spoken language, live or broadcast, on both familiar and unfamiliar topics normally encountered in personal, social, academic or vocational life.
- Show a highly controlled degree of grammatical control without making errors which cause misunderstanding and with the growing ability to correct most of her/his mistakes.
- Follow essentials of lectures, talks, reports and other forms of academic/professional presentation which are propositionally and linguistically complex.
- Understand announcements and messages on concrete and abstract topics spoken in standard dialect at normal speed.
- Scan quickly through long texts, locating relevant details and understand and exchange complex information and advice on the full range of matters related to her/his occupational role.
- Understand all characteristics of the official B2 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.

- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.
- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in Germany as well as understand the concepts of open-mindedness and 'culture clash'.

Prerequisites: GERL301B2

BE302: Business Entrepreneurship

3 Cr Hr (3,0)

The course focuses on critical skills necessary to develop appropriate financing strategies for new venture creation and growth. Students will use case studies and team projects in course studies. Three primary topics are covered: first, an overview of the entrepreneurial finance process and involved players; second, performing business valuations; and third, securities law with emphasis on developing term sheets and private placement memorandums. Student teams will complete a valuation and mock securities offering for an existing small to mid-size business. Financial valuations and terms sheets developed by student teams will be presented to a panel of venture capital professionals for evaluation and critique

Prerequisites: English101

DES101: Arts Appreciation

3 Cr Hr (3,0)

An introductory course designed for non-art students to give them the basic knowledge of arts and simple approaches to the understanding of the history, development, elements, criticism, esthetics and materials of different art forms (visual, aural and performing arts). A comparative approach between the different arts is given to enhance the students' global understanding of arts and to give them the ability to look at art works and form their own opinions. The course is combined with examples of audio and visual arts.

Prerequisites: ARB099, ENGL101

IC101: Intercultural Communication**3 Cr Hr (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: English101

MILS100: Military Science**3 Cr Hr (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:

NE101: National Education**3 Cr Hr (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 Hr (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: English101

SFTS101: Soft Skills**3 Cr Hr (3,0)**

This course is designed to help develop strong oral and written communication skills. The student will be given opportunities to practice writing and editing professional correspondence and technical reports. Additionally, the student will compose and deliver oral presentations. Assignments will include the use of inductive and deductive approaches to conveying a variety of messages. The course emphasis the use of software tools to prepare presentations, stress management, confidence, and sensitivity to others. It also stresses on resume writing and conducting interviews.

Prerequisites: English101

CHEM103 General Chemistry I**3 Cr Hr**

Stoichiometry of formulas and equations. Gases and the kinetic-molecular theory. Quantum theory and atomic structure. The components of matter. The major classes of chemical reactions (precipitation, acid-base, oxidation-reduction, and reversible reactions). Thermodynamics: energy flow and chemical change. Quantum theory and atomic structure. Electron configurations and chemical periodicity. Kinetics: rates and mechanisms of chemical reactions. Equilibrium: The extent of chemical reactions. Acid-base equilibria.

Prerequisites: -

CHEM106 General Chemistry lab**1 Cr Hr**

Performing Chemical Experiments based on the general chemistry course.

Corequisites: CHEM103

CS116 Computing Fundamentals**3 Cr Hr**

Basic computer skills, programming concepts, algorithms, variables and data types; arithmetic, logical, relational, Boolean, and assignment operators; simple input and output statements, selection structures, loop structures, single and multidimensional arrays, character strings, functions, data structures, pointers, input/output file operations.

Corequisites: CS1160

CS1160 Computing Fundamentals Lab**1 Cr Hr**

Lab session every week to offer hands-on experience on the topics that are covered in CS116, which are: algorithms, variables and data types; arithmetic, logical, relational, Boolean, and assignment operators; simple input and output statements, selection structures, loop structures, single and multidimensional arrays, character strings, functions, data structures, pointers, input/output file operations.

Corequisites: CS116

IE0121 Probability and Statistics**3 Cr Hr**

Descriptive statistics, probability concepts, discrete and continuous random variables and distributions, joint probability distributions, covariance and correlation of random variables, point and interval estimation for single sample, sampling distributions, and statistical inference for single sample.

Prerequisites: MATH101

IE0141 Engineering Workshop**1 Cr Hr**

General safety, materials and their classifications, measuring devices and their accuracy, theoretical background and practical exercises including, carpentry, welding, mechanical fasteners, drills, lathes, milling machines, and sheet-metal working.

Prerequisites: -

MATH101 Calculus I**3 Cr Hr**

This course introduces the student to the calculus of single-valued functions. Topics include: limits, continuity, rates of change, rules for differentiating, differentials and local linear approximations, maxima and minima problems, L'Hôpital's rule, related rates, logarithmic and implicit differentiation, inverse trigonometric and hyperbolic functions, Rolle's Theorem, the mean-value theorem, and applications of derivatives and integrals. An overview of integration, basic techniques for integration, algebraic techniques of integration and applications of integrations are also included.

Prerequisites: -

MATH102 Calculus II**3 Cr Hr**

Sequences and series, power series, convergence theorems: integral, ratio, and alternating - series tests, Polar coordinates and functions, integration and differentiation of polar functions, Vectors in three-dimensional space, spherical and cylindrical coordinates, Vector valued functions, Partial derivatives, Multiple integrals, Topics in vector calculus.

Prerequisites: MATH101

MATH203 Applied Mathematics for Engineers**3 Cr Hr**

Vector analysis in Cartesian coordinates; Curvilinear coordinates and transformations to Cartesian, Spherical, and Cylindrical coordinates; line integrals, surface integrals, Green's theorem, Gauss's divergence theorem, and Stokes's theorem. Scalar and vector potential. Review of Series. Linear Algebra; Matrices and linear equations; Matrices and Linear Operators; Determinants, Eigenvalues and eigenvectors. Complex Numbers and Complex Variable; Representation of complex numbers, DeMoivre's formula, Powers and roots of complex numbers, Functions of complex variable.

Prerequisites: MATH102

MATH205 Differential equations**3 Cr Hr**

First-order ordinary differential equations, Second-order ordinary differential equations, System of ODEs. Solution Techniques including Laplace transforms, Fourier series: 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, dynamics and vibrations, wave phenomena, diffusion phenomena, heat conduction, and biological processes.

Prerequisites: MATH203

ME0111 Computer Aided Engineering Drawing**2 Cr Hr**

The use of computer aided software in drawing such as AutoCAD. Geometric constructions. 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

ME0346 Instrumentations and Measurements**2 Cr Hr**

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; Corequisites: ME0347

ME0347 Instrumentation and Measurements Lab**1 Cr Hr**

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: ME0346

PHYS103 Physics I**3 Cr Hr**

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 Hr**

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

Prerequisites: PHYS103; Corequisites: PHYS106

PHYS106 General Physics Lab**1 Cr Hr**

Developing a good understanding of a few important concepts in Mechanical physics, Learning to apply these concepts to familiar and unfamiliar situations and Gaining the ability to reason qualitatively and quantitatively about Mechanics.

Corequisites: PHYS104

MECH0221 Thermodynamics**3 Cr Hr**

Introduction to thermodynamics concepts, properties of pure substances, first law of thermodynamics: analysis of closed systems, analysis of open systems under steady and unsteady conditions, second law of thermodynamics, entropy.

Prerequisites: MATH102

MECH0222 Fluid Mechanics**3 Cr Hr**

Physical properties of fluids and fundamental concepts in fluid mechanics, hydrostatics, conservation laws for mass, momentum and energy, flow similarity and dimensional analysis as applied to engineering problems in fluid mechanics, laminar and turbulent flow, engineering applications such as flow measurement flow in pipes and fluid forces on moving bodies.

Prerequisites: MATH102, PHYS103

ECE333 Electromagnetics**3 Cr Hr**

Electrostatic fields, magneto-static fields, solution of Laplace's and Poisson's equations, faraday's law and applications, Maxwell's equations, plane waves: propagation, reflection and refraction, transmission lines.

Prerequisites: MATH203