جامعة الإمام عبد الرحمن بن فيصل

IMAM ABDULRAHMAN BIN FAISAL UNIVERSITY

COLLEGE OF ENGINEERING

Mechanical and Energy Engineering Department

Program Bulletin
Handbook & Course Catalogue

2023

Department of Mechanical and Energy Engineering

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Program Offering

B.Sc. in Energy Engineering

Website: https://www.iau.edu.sa/en/colleges/college-of-engineering/departments/mechanical-and-energy-engineering-department

• Mechanical and Energy Engineering Department – An Introduction

The Mechanical and Energy Engineering Department has the distinction of being the first in the Kingdom of Saudi Arabia and the region to offer the degree of Bachelor of Science in Energy Engineering to address the emerging needs of the Kingdom in the Renewable Energy field in harmony with its Vision 2030. The College of Engineering (CoE) at Imam Abdulrahman bin Faisal University (IAU) is one of the unique colleges within the Kingdom of Saudi Arabia. The CoE established its Fifth department, namely the Mechanical and Energy Engineering Department in 2018. Currently, the department is offering only a Bachelor of Science (B.Sc.) in Energy engineering. The program is dedicated to male students only. The program was established by the decree of the University Council of Imam Abdulrahman bin Faisal University on the 29th of Shaban 1439 (15th May 2018). It is geared towards preparing future graduates with the necessary and state-of-the-art knowledge, skills, and competencies to take up new challenges as the Kingdom embarks upon renewable energy production to fulfill its future energy needs via its Vision 2030.

The B.Sc. in Energy Engineering Program is designed as a multidisciplinary program that integrates fundamental knowledge in the core areas of mechanical, electrical, renewable and materials fields to form a solid basis to carry out preliminary design of renewable energy related systems addressing societal and contemporary issues in energy and sustainability. It is derived from top international programs in renewable energy and broadly covers a few essential areas of the energy sector, in general, that include energy generation, consumption, efficiency, distribution, storage, markets, and applications. In addition, fundamental areas in the renewable energy sector, in particular, include solar, PV, CSP, wind, geothermal, wave and tidal. These subjects are taught by faculty and staff who are international experts in these fields. The studies are further reinforced through practical work in state-of-the-art laboratories, engineering workshop equipped with advanced CNC machines, Fab-House center equipped with 3D rapid prototyping facilities, renewable, and photovoltaic laboratories. The culminating design experience is a stepping-stone for the graduates to take up real life challenges in the renewable energy field for further advancement in their career.

Mechanical and Energy Engineering Department is considered a pioneer in the region since it is the first department to offer a bachelor's degree in energy engineering for males in the Kingdom of Saudi Arabia. Its curriculum is equipped with the most demanding and influential topics that can attract national, regional, and international students and was reviewed and approved by highly experienced local, regional, and international experts' reviewers. In 2017, the program was sent to local and regional highly reputable and experienced reviewers from universities, companies, and research centers in Saudi Arabia. The reviews formed the pre-final form of the proposed program. Then, the proposed program was benchmarked against similar programs in some of the top reputable universities to identify the need of additional new courses and necessary modifications, to fulfil the regional and global job market niche.

The program scope requires 174 credit hours for graduation, including core and elective courses. The program covers areas of basic, social and engineering sciences and engineering design with sufficient depth to meet the requirements of national (NCAAA) and international (ABET) accreditation bodies. The testimony of the program's success can be judged by a three-fold increase in its enrollment since it graduated its first batch in July of 2020.

- ## Mechanical and Energy Engineering Program Vision

To serve as a proactive contributor to the country's progress toward energy security and sustainable development under Saudi Arabia's Vision 2030.

- ## Mechanical and Energy Engineering Program Mission

To provide education and training to serve the community by producing solution-oriented leadership and expert advice on energy issues of regional and national interest.

- ## Mechanical and Energy Engineering Program Goals

The main goals of the program are that it will prepare graduates with the following attributes:

1. Able to engage with society to provide innovative, professional, and ethical solutions in the energy and other engineering fields.
2. Able to identify local and international energy issues and provide constructive solutions in a societal context.
3. Able to display leadership and initiative in advancing knowledge and technology in the energy and other engineering fields.

- ## Energy Program Educational Objectives

The program educational objectives for the B.Sc. in Energy Engineering program reflect the mission of Imam Abdulrahman bin Faisal University and Mechanical and Energy Engineering Department. The overall educational objective of the Energy Engineering program is to prepare graduates for careers in the renewable energy engineering profession and related disciplines, and/or receive an advanced graduate degree within three to five years from their graduation. Specifically, the expected professional accomplishments of the program graduates within five years from their graduation are that they will:

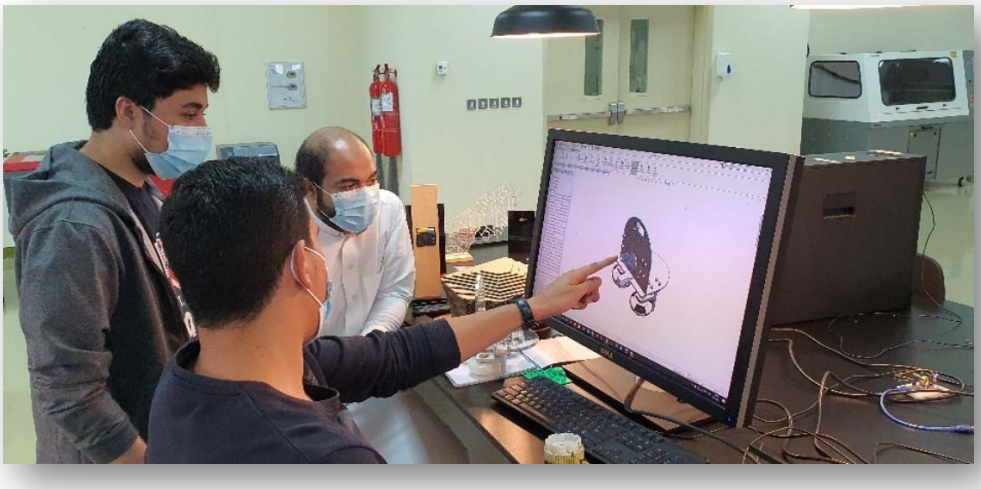
1. Pursue advanced studies in energy engineering or in other disciplines.
2. Meet or exceed the expectations of their employers in the energy engineering workplace, or in other professional careers.
3. Continue to learn and to adapt to evolving technology and changing career opportunities to serve community needs.

- ## Student Outcomes

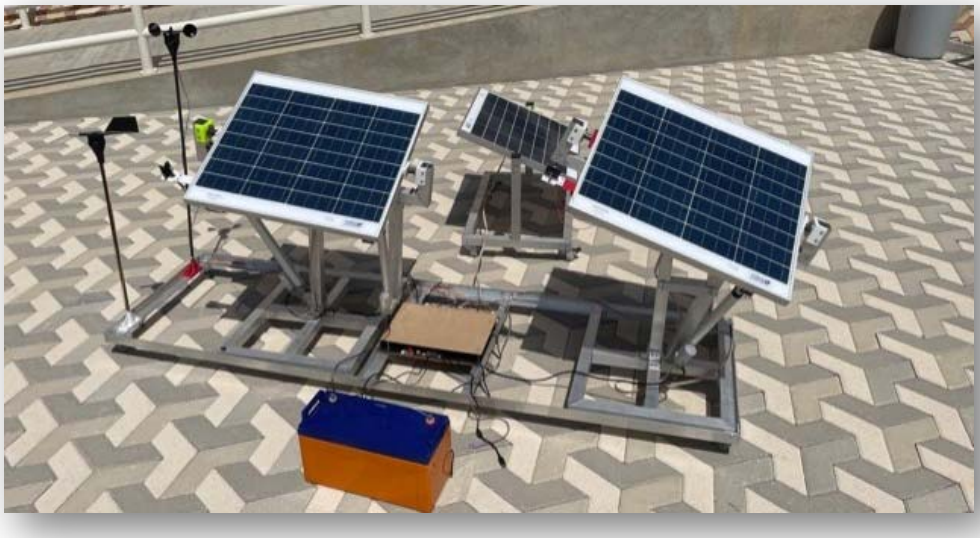
Student outcomes relate to the knowledge, skills, and competencies that the graduates of B.Sc. in Energy Engineering program will possess. Students graduating from this program should have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.

4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.



Students working on an Autonomous PV Cleaning Project



Senior Design Project: The Dual-Axis Solar Tracker

- **Jobs Opportunities and Categories after Graduation**

Graduates can work as engineers in private and public departments for design, construction, and maintenance of both conventional and renewable energy related fields. Table 1 lists some employment locations after graduation and possible job classifications. Graduates with high GPA can be employed as teaching assistants in academia as well.

Table 1: Employment Locations & Possible Job Classifications after Graduation

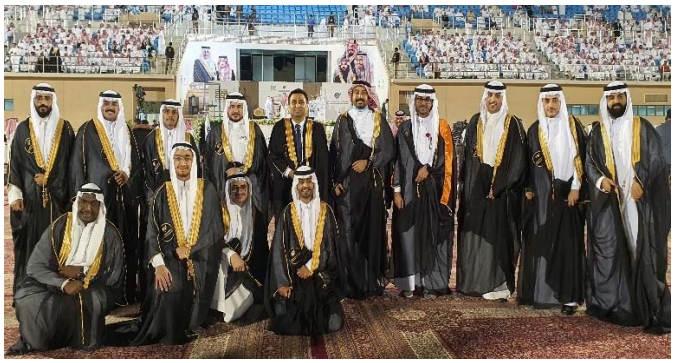
Employment Locations After Graduation	
Renewable Energy Initiatives Renewables Department Research and Technology Development	Saudi Electricity Company (SEC) Saudi Council of Engineers (SCE), GCC Electrical Testing Lab Saudi Energy Efficiency Center
Energy Efficiency Department	Saudi Standards Metrology and Quality Organization (SASO) Saudi Energy Efficiency Center
Research and Technology Development	Ministry of Energy, Industry and Mineral Resources, KACARE, KACST, KFUPM-RI or CoRE-RE, Sustainable Energy Technology Center at KSU
Policy and Regulation	KAPSARC
Power Systems Renewables Department	Saudi ARAMCO
Engineering Offices or Research and Technology Development	Industrial Cities: Local & International Energy Sector Companies
Possible Job Classifications	
Quality Assurance Engineer	Site Engineer
Renewable Energy Engineer	Design & Consultant Engineer
Energy/Solar/Wind Engineer	Design & Consultant Engineer
Power Engineer	Design & Consultant Engineer
Project Manager	Design & Consultant Engineer
Energy Engineer	Design & Consultant Engineer
Mechanical Engineer	Design & Consultant Engineer

Table 2 lists the enrollment and graduation data for Bachelor of Science in Energy Engineering program since its inception.

Table 2: Student enrollment and graduation data

Academic Year	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Enrollment	16	47	73	94	121	139
Graduation	-	-	12	18	27	35

First Program Graduates, May 2020

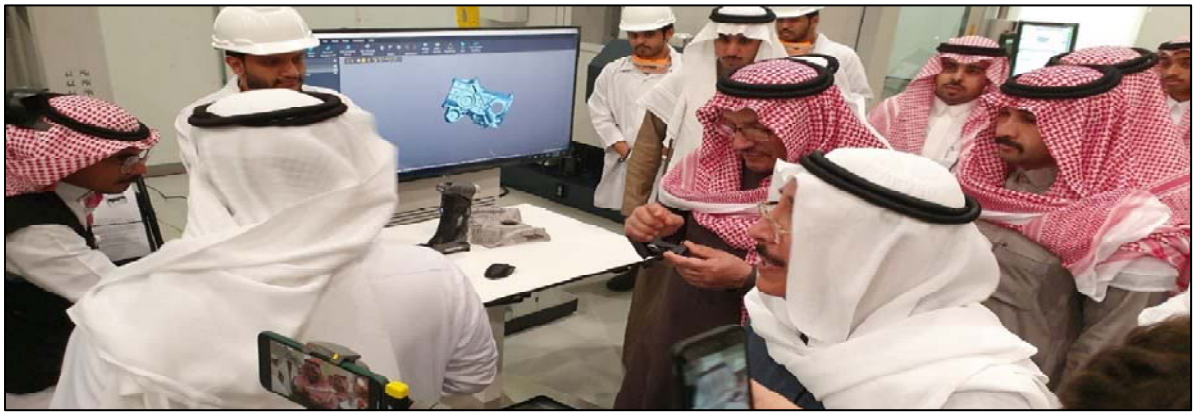


Third (Recent) Program Graduates, May 2022

- **Department Faculty, Staff, and Laboratories**

There are nine faculty members, one lecturer, two teaching assistants, one administrative member, and six technicians and engineers in the Mechanical and Energy Engineering Department. Two teaching assistants are currently on scholarship, pursuing higher degrees in the UK and USA, respectively. Table 3 below lists the current faculty members, their major fields, specialties and their highest degree university.

Faculty members in Mechanical and Energy Engineering Department



The Minister of Education and University President Visit the Mechanical Workshop in 2020

Table 3: Faculty members in Mechanical and Energy Engineering Department

No.	Name	Academic Rank	Specialty	Highest Degree University
1	Fahad G. Al-Amri	Professor	Ph.D. Mechanical Engineering: Thermal Sciences	King Fahd University of Petroleum & Minerals, KSA
2	Amro Owais Elsayed	Associate Professor	Ph.D. Mechanical Engineering: Thermal Engineering & Energy Storage	Warsaw University of Technology, Poland
3	Farooq Saeed	Associate Professor	Ph.D. Aerospace Engineering: Aerodynamics, CFD & HT, Renewable (Solar and Wind) Energy	University of Illinois at Urbana-Champaign, USA
4	Nagmeldeen Abdo Mustafa Hassanain	Associate Professor	Ph.D. Electrical Engineering: Electrical Power & Machines	University of Strathclyde, UK
5	Muhammad Saleem	Professor	Ph.D. Civil Engineering: Materials; Analytical Modeling & Numerical Analysis	Yokohama National University, Japan
6	Tahir S. Maatallah	Associate Professor	Ph.D. Mechanical Engineering: CFD & HT, Renewable Energy - Solar and CSP	University of Savoy Mont Blanc, Chambery, France
7	Sajid Ali Khanzada	Assistant Professor	Ph.D. Mechanical Engineering: Design & Vibrations	King Fahd University of Petroleum & Minerals, KSA
8	Nasir Ghazi Hariri **Department Head**	Assistant Professor	Ph.D. Mechanical Engineering: Mechatronics	Florida Institute of Technology, USA
9	Mussad Mohammed Alzahrani	Assistant Professor	Ph.D. Renewable Energy	University of Exeter, UK
10	Sadaqat Ali	Lecturer	M.Sc. Metallurgy & Material Engineering	University of the Punjab, Pakistan
11	Sultan Saleh AlSalimi	Teaching Assistant	M.Sc. Mechanical Engineering	The George Washington University, USA
12	Mohammed Al-Mutawa	Teaching Assistant	B.Sc. Electrical Engineering Power Electronics, Power Systems, Microelectronics	King Fahd University of Petroleum & Minerals, KSA
13	Omar Alfayez	Administrative staff	Diploma Computer Science	IAU, Dammam, KSA
14	Baqer Adil Almadlouh	Lab Engineer	B.Sc. Mechanical Engineering	Dammam College of Technnlogy, KSA
15	Mohammed Obaid Alshahrani	Lab Engineer	B.Sc. Mechanical Engineering	Dammam College of Technnlogy, KSA
16	Abdulaziz Hussain Alhosan	Lab Engineer	B.Sc. Mechanical Engineering	Dammam College of Technnlogy, KSA
17	Naif Al-Rubai	Lab Technician	Diploma Electronics and Control Systems Technologies	Dammam College of Technnlogy, KSA
18	Faisal Abdulwahab Alzahrani	Lab Technician	Diploma Electronics and Control Systems Technologies	Dammam College of Technnlogy, KSA
19	Rayan Al-Warthan	Lab Technician	Diploma Industrial Instrumentation and control	Dammam College of Technnlogy, KSA

The Mechanical and Energy Engineering Department is equipped with a host of state-of-the-art laboratories, that include a metal-working Mechanical Workshop, a Welding Shop, and a fabrication laboratory called the Fab-House. The Computer Lab is available for students to compliment student learning and enhance their skills through the use of modern engineering tools necessary for engineering practice. The laboratories are used by all the departments in the College of Engineering for the basic engineering courses common to all engineering programs. The Mechanical and Energy Engineering Department provides major part of support in terms of lab instructors and up-keep of lab equipment. Table 4 lists the different department labs along with the associated equipment.

Table 4: Laboratories and the Associated lab Equipment

No.	Laboratory Name	Associated Lab Equipment
1	Renewable Energy Lab	Artificial Light Source Trainer for Domestic Water Heating with Flat Solar Collector Photovoltaic Solar Module Measurements Unit: PV Module, Illuminance Sensor, Variable Load Resistor, Display Unit Solar System Trainer: Solar PV Panel, Charge Controller, Inverter, Battery, and Electrical Loads Parabolic Dish unit
2	Refrigeration and Air Conditioning Lab	Industrial Refrigeration Trainer with Cooling and Freezing Chambers Forced Draft Wet Cooling Tower Humidity Measurement Test Rig Air conditioning system with climatic chamber Full-Scale Air Conditioning Trainer
3	Photovoltaic Lab	Solar Simulator Multiple Battery Life and Condition Analyzer PV Power & IV Characteristics Analyzer 3D Tracker Systems Infra-Red Thermal Imager Camera
4	Thermodynamics Lab	Temperature Measurement and Calibration apparatus Flow Boiling Demonstration Unit Condensation Test rig Unit Test stand for Combustion Engines Exhaust Gas Analyzer Regenerative Engine Test Set
5	Heat and Mass Transfer Lab	Heat Conduction Experimental Unit Thermal Conductivity of Building Materials Measuring Unit Free and Forced Convection Experimental Unit Emissivity, Natural Convection and Radiation Experimental Unit Cross Flow Heat Exchanger in a Wind Tunnel Mass Diffusion Measurement in Liquids and Gases Radiant Transfer Experimental Unit Forced Converction Heat transfer Unit Foucsing Solar Energy Collector
6	Welding Lab	Oxy Acetylene Welding and Cutting Machine Stick Arc Welding Rectifier AC/DC TIG Pulse Welding Machine Spot and Projection Welding Machine

		Plasma Cutting Machine Mobile Fume Extraction Machines	
8	Prototyping Lab	Portable CMM 3D Laser Scanner Industrial Professional 3D Printer	
9	Power System Lab	Line-commutated converters working station with desktop computer. Self-commutated converters working station with desktop computer.	
10	Computer Lab	27 Dell Precision 7810 workstations (Dual 2.40GHz Intel Xeon CPUs, 32 GB RAM) running 64-bit Windows 10 Enterprise OS Installed commercial software programs include: ANSYS, AutoCAD, Adobe Acrobat Pro, 3D Builder, COMSOL, EES, Mathematica, MS Office 365, MS Visual Studio, SOLIDWORKS, Turbo C++, and other essential Windows software.	
11	Electrical Machine Lab	DC Machines Trainer includes: Power supply DC motor shunt, series and compound excitation DC generator shunt, series and compound excitation Electromagnetic brake Excitation and Starting rheostats Digital AC/DC multirange voltmeter & ammeter Electrical & Mechanical power digital measuring unit Load cell, Resistive load And accessories	AC Machines Trainer includes: Power supply Star/delta starter Pole changing unit Starting rheostat, Eddy-current brake, Load cell Squirrel cage & Slip ring 3-phase asynchronous motor 3-phase 2-speed (2/4 poles) squirrel cage asynchronous motors Dahlander type & Separate windings type
12	Fluid Mechanics Lab	Losses in Pipping System Fluid Friction Apparatus Venturi Meter Apparatus Friction Loss in small Pipe Flow Measurement Apparatus Stability of a Floating Body Centre of Pressure Apparatus Vortex Apparatus Flow Through an Orifice Pipe Surge & Water Hammer Apparatus	Impact of a Jet Apparatus Hele-Saw Apparatus Pipework Energy Losses, Orifice & Free Jet Flow Apparatus, Reynolds No & Transitional Flow, Liquid Sedimentation Apparatus, Model Reservoir & Surge Tower, Hydrology Apparatus, Water Hammer Apparatus, Discharge Over a Notch Permeability Tank Flow Channel Volumetric Bench, and Gravimetric Bench.
13	Turbomachinery Lab	Gas Turbine Jet Engine: Turbojet engine, Display and Control Unit, Operation Unit, PC DAQ System Wind Tunnel Simulator for Wind Turbines: Wind Tunnel, Wind Turbine Models that include HAWT, VAWT, and Savonius Wind Turbines, Anemometer, and associated DAQ Systems. Open-Circuit Subsonic Wind Tunnel Flow visualization wind tunnel	Tilting Multitube Manometer Single Component Lift and Drag Balance Three Component Balance Differential Pressure Transducer 32-Way Pressure Display Pitot-Static Traverse (300 mm) Test Models: Cylinder Model, Airfoil with Pressure Tappings, NACA 2412 Airfoil w/Variable Flap, NACA 0012 Airfoils 150 mm chord, Flat Plate Boundary Layer Model, and 3D Drag Models

14	Measurement and Control Lab	Function Generator Keithley Digital Power supply Analog Training system. Automation Sensors and Transducers Trainer Engineering Training Solutions Actuators (DC motors/Relays/Solenoids)	2-channel Digital Oscilloscope Soldering Station Digital Multimeter Desktop Computers Electronics components MyDAQ/myRIO DAQ device Sensors
15	Fab-House	3-axis CNC Router 3-axis CNC PCB Engraver 3D Scanner, Soldering Stations, Drill hammer C/L, Digital calliper, Different Tools/Screwdrivers sets Electronics components, Laptop	10 × 3D Printers Laser Cutter & Engraver Level 50cm, Clamp on vise 3'' Rotary tool 200v (with headset) Power Supplies, 4 channels oscilloscopes, DC & stepper motor
16	Engineering Workshop	5-Axis CNC Milling Machine 3-Axis CNC Lathe Fiber laser Cutter Vertical Milling Machine Horizontal Bandsaw Vertical Bandsaw Radial Drill Press Vertical Drilling/Milling Machine Benchtop Shaper Lathe Machine Universal Milling Machine Benchtop Drill Press & Lathe	NC Hydraulic Press Brake Motorized Shears Bench Shear Motorized Plate Rolling Machine Iron Worker Pipe Bending Machine Manual Sheet Bender Manual Sheet Cutter Sheet Notcher Pedestal Grinder Bench Grinders Surface Grinder

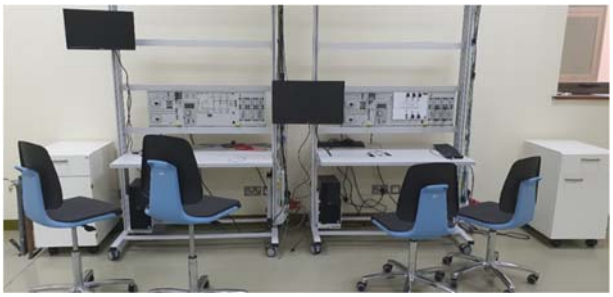
Fluid Mechanics Lab

Refrigeration and Air Conditioning Lab

Heat and Mass Transfer Lab

Renewable Energy Lab

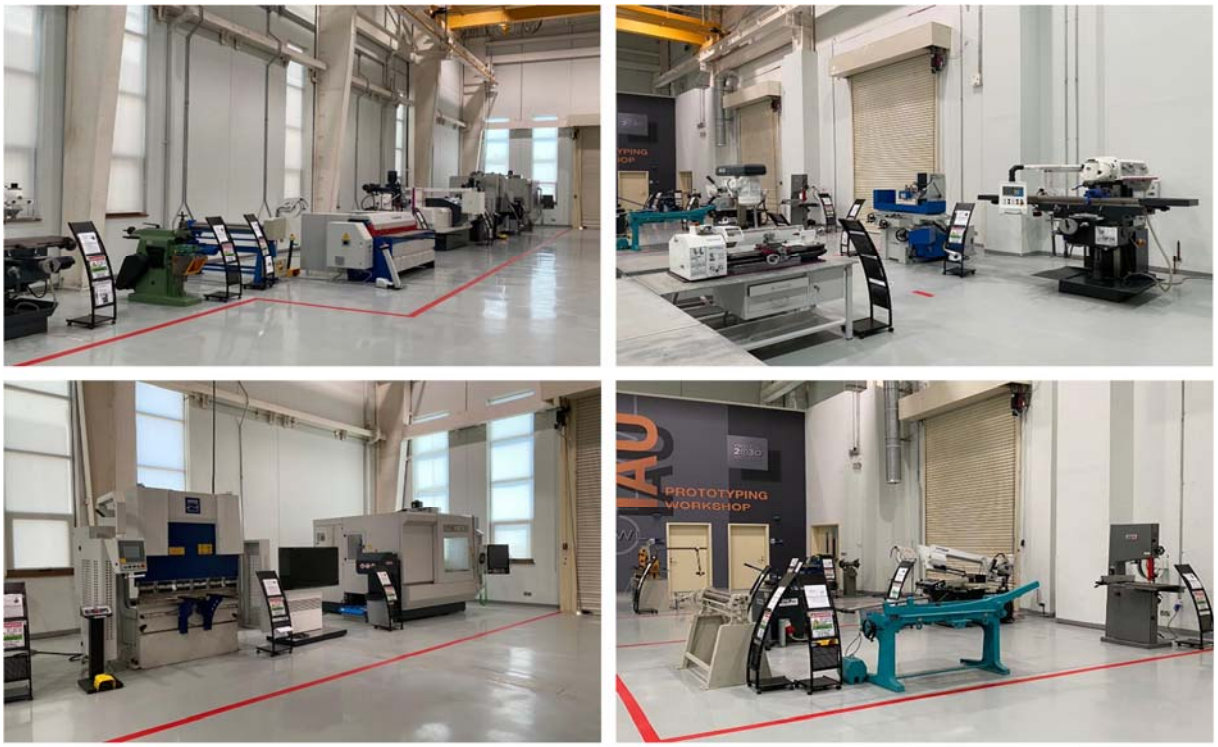
Turbo-Machinery and Aerodynamics Lab



Power Systems Lab

Electrical Machines Lab

Measurements and Control Lab



The Mechanical Workshop

- ## B.Sc. Program Curriculum

The B.Sc. in Energy Engineering program curriculum is a four-year program preceded by a one-year Preparatory-Year Program during which a student is taught English and some pre-college subjects and skills. The number of credits required for the degree of B.Sc. in Energy Engineering is 138 while for the Preparatory-Year Program is 36 credit hours. Students need a total of 174 credit hours to graduate.

The B.Sc. in Energy Engineering program curriculum has been designed to satisfy the requirements set forth by the Accreditation Board for Engineering and Technology (ABET), USA, in that it has:

(a) a minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program
(b) a minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design, and utilizing modern engineering tools.
(c) a broad education component that complements the technical content of the curriculum and is consistent with the program educational objectives, and
(d) a culminating major engineering design experience that 1) incorporates appropriate engineering standards and multiple constraints, and 2) is based on the knowledge and skills acquired in earlier course work.

Tables 5 and 6 list the sequence of courses for the Preparatory-Year and the Bachelor of Science in Energy Engineering programs for the two-semester system, respectively. Since the start of the academic year 2022-2023, a trimester system is being followed at IAU without any changes to the total program credit hours. In the trimester system, each term is of 10-week duration and in order to be consistent with the definition of a credit hour, which is a 50-minute lecture session each week over a 15-week term, a multiplication factor of 1.5 is used to keep the same amount of lecture contact hours as in a 15-week term. As a consequence, the average course load each term has also been reduced by the same factor. Table 7 lists the study plan for the trimester Bachelor of Science in Energy Engineering program effective from Academic-Year 2022-2023.

Table 5: Preparatory-Year Program Courses

Semester	Course			Category (Credit Hours)			
	Course Number		Title	Math and Basic Sciences	Engineering Topics		Broad Education Component
					Science	Design	
First Preparatory Semester	ISLM	181	Creed and Family in Islam				2.0
	ENGL	101	General English Language*				7.0
	MATH	111	Math I	3.0			
	ARCH	121	Basic Design Studio I*			3.0	
	LRSK	141	Learning & Searching Skills		2.0		
	PHEDU	162	Physical Education*				1.0
Second Preparatory Semester	ARAB	182	Arabic Language Skills				2.0
	ENGL	102	English for Academic and Specific Purpose				3.0

	MATH	112	Math II	3.0			
	ARCH	122	Basic Design Studio II*			3.0	
	PHYS	132	Physics	3.0			
	LRSK	142	Communication Skills				2.0
	COMP	131	Computer Skills*		2.0		

(*) indicates that the course includes tutorial/laboratory/experimental experience.

Table 6: Bachelor of Science (B.Sc.) in Energy Engineering Curriculum

Semester	Course			Category (Credit Hours)			
	Course Number		Title	Math and Basic Sciences	Engineering Topics		Broad Education Component
					Science	Design	
First Freshman Semester	HUMN	201	Library Skills*				1.0
	ENGL	211	English Composition				3.0
	CHEM	221	General Chemistry*	3.0			
	ENG	251	Introduction to Engineering*		1.0		
	MATH	261	Calculus I	4.0			
	PHYS	271	Physics I*	4.0			
	HIST	281	History and Civilization of Kingdom				2.0
Second Freshman Semester	COMP	212	Computer Programming*		2.0		
	ENG	222	Engineering Drawings*		3.0		
	ENG	232	Statics		3.0		
	MATH	262	Calculus II	4.0			
	PHYS	272	Physics II*	4.0			
	ISLM	282	Islamic Ethics and Values				2.0
First Sophomore Semester	HUMN	301	Oral Communication and Public Speaking				1.0
	ENRG	307	Workshop Practice*		1.0		
	ENRG	308	Thermodynamics	3.0			
	ENG	311	Dynamics		2.0		
	ENG	331	Electric Circuits*		3.0		
	MATH	331N	Differential Equations*	3.0			
	ENG	351	Strength of Materials*		3.0		
	BUS	381	Entrepreneurship				2.0
Second Sophomore	MATH	302	Linear Algebra	3.0			
	GEOL	312	Geology	2.0			

Semester	ENRG	312	Measurements and Data Acquisition Systems*		3.0		
	ENRG	313	Heat & Mass Transfer*		4.0		
	ENRG	314	Fluid Mechanics*		4.0		
First Junior Semester	ENG	401	Technical Writing				2.0
	ENRG	403	Renewable Energy*		4.0		
	ENRG	404	Refrigeration and Air Conditioning*		3.0		
	ENRG	405	Control System*		3.0		
	ENRG	406	Heat Exchanger Design			2.0	
	MATH	411	Probability and Statistics*	3.0			
Second Junior Semester	HUMN	402	Research Methodology				1.0
	ENRG	410	Machine Design			2.0	
	ENRG	411	Introduction to Electric Power Systems*		3.0		
	ENRG	412	Energy and Environment		2.0		
	ENG	412	Engineering Economics		2.0		
	ENRG	413	Desalination*		2.0		
	MATH	472	Numerical Methods	2.0	1.0		
	ENRG	5xx	Elective I		3.0		
	ENRG	444	**Summer Training**	0.0			
First Senior Semester	HUMN	501	Professional Practice and Ethics				2.0
	ENRG	502	Energy Efficiency for Sustainable Development		2.0		
	ENRG	503	Senior Design Project I*			2.0	
	ENRG	504	Steam Power Production*		3.0		
	ENRG	505	Project Management and Scheduling*		3.0		
	ENRG	506	Energy Markets		3.0		
	ENRG	5xx	Elective II		3.0		
Second Senior Semester	ENRG	509	Senior Design Project II*			4.0	
	ENRG	510	Energy Storage		2.0		
	ENRG	511	Turbo-Machinery*		3.0		
	ENRG	5xx	Elective III		3.0		
	ENRG	5xx	Elective IV		3.0		

	Math and Basic Sciences	Engineering Topics		Broad Education Component
		Science	Design	
Total Basic-Level Energy Engineering Program Requirements	35	77.0 + 10.0 = 87.0		16
Overall Total for Energy Engineering Degree	**138.0**			
ABET Requirements: Minimum Semester Credit Hours	**30**	**45** (including Design Component)		Broad Education Component

(*) indicates that the course includes tutorial/laboratory/experimental experience.

Table 7: The Trimester Bachelor of Science (B.Sc.) in Energy Engineering Curriculum Effective since Academic Year 2022-2023

Semester	Course			Category (Credit Hours)			
	Course Number		Title	Math and Basic Sciences	Engineering Topics		Broad Education Component
					Science	Design	
First Freshman Semester	ENGL	211	English Composition				3.0
	MATH	261	Calculus I	4.0			
	PHYS	271	Physics I*	4.0			
	HIST	281	History and Civilization of Kingdom				2.0
Second Freshman Semester	CHEM	221	General Chemistry*	3.0			
	ENG	251	Introduction to Engineering*		1.0		
	MATH	262	Calculus II	4.0			
	PHYS	272	Physics II*	4.0			
Third Freshman Semester	HUMN	201	Library Skills*				1.0
	COMP	212	Computer Programming*		2.0		
	ENG	222	Engineering Drawings*		3.0		
	ENG	232	Statics		3.0		
	ISLM	282	Islamic Ethics and Values				2.0
First Sophomore Semester	MATH	302	Linear Algebra	3.0			
	ENG	311	Dynamics		2.0		
	ENRG	307	Workshop Practice*		1.0		
	GEOL	312	Geology	2.0			
	ENG	331	Electric Circuits*		3.0		
Second	MATH	331N	Differential Equations*	3.0			

Sophomore Semester	ENRG	308	Thermodynamics	3.0			
	ENRG	312	Measurements and Data Acquisition Systems*		3.0		
	ENG	351	Strength of Materials*		3.0		
Third Sophomore Semester	BUS	381	Entrepreneurship				2.0
	HUMN	301	Oral Communication and Public Speaking				1.0
	ENRG	313	Heat & Mass Transfer*		4.0		
	ENRG	314	Fluid Mechanics*		4.0		
First Junior Semester	MATH	411	Probability and Statistics*	3.0			
	ENG	401	Technical Writing				2.0
	ENRG	404	Refrigeration and Air Conditioning*		3.0		
	ENRG	406	Heat Exchanger Design			2.0	
	ENRG	413	Desalination*		2.0		
Second Junior Semester	ENG	412	Engineering Economics		2.0		
	ENRG	403	Renewable Energy*		4.0		
	ENRG	411	Introduction to Electric Power Systems*		3.0		
	ENRG	412	Energy and Environment		2.0		
Third Junior Semester	HUMN	402	Research Methodology				1.0
	MATH	472	Numerical Methods	2.0	1.0		
	ENRG	405	Control System*		3.0		
	ENRG	410	Machine Design			2.0	
	ENRG	5xx	Elective I		3.0		
	ENRG	444	**Summer Training**				
First Senior Semester	HUMN	501	Professional Practice and Ethics				2.0
	ENRG	503	Senior Design Project I*			2.0	
	ENRG	505	Project Management and Scheduling*		3.0		
	ENRG	5xx	Elective II		3.0		
Second Senior Semester	ENRG	502	Energy Efficiency for Sustainable Development		2.0		
	ENRG	504	Steam Power Production*		3.0		
	ENRG	509	Senior Design Project II*			4.0	
	ENRG	5xx	Elective III		3.0		

Third Senior Semester	ENRG	506	Energy Markets		3.0		
	ENRG	510	Energy Storage		2.0		
	ENRG	511	Turbo-Machinery*		3.0		
	ENRG	5xx	Elective IV		3.0		

	Math and Basic Sciences	**Engineering Topics**		**Broad Education Component**
		Science	**Design**	
Total Basic-Level Energy Engineering Program Requirements	35	77.0 + 10.0 = 87.0		16
Overall Total for Energy Engineering Degree	**138.0**			
ABET Requirements: Minimum Semester Credit Hours	**30**	**45** (including Design Component)		Broad Education Component

(*) indicates that the course includes tutorial/laboratory/experimental experience.

The B. Sc. Program in Energy Engineering allows flexibility in course offerings through four choices for Elective courses related to the field to enhance student learning experience. A list of the elective courses offered by the program is given in Table 8.

Table 8: Elective Courses

Course Number	Course Title	Credit hours	Lecture hours	Lab hours
ENRG 551	Internal Combustion Engine	3	2	2
ENRG 552	Nuclear Power	3	3	0
ENRG 553	Petrochemical Energy	3	3	0
ENRG 554	Atmospheric Pollution	3	3	0
ENRG 555	Occupational Health & Safety	3	3	0
ENRG 556	Energy & Environmental Policy	3	3	0
ENRG 557	Solar Power System Design	3	2	2
ENRG 558	Hybrid Energy System	3	3	0
ENRG 559	Tidal & Wave Energy	3	3	0
ENRG 560	Material Science & Technology	3	3	0
ENRG 561	Power Station Engineering	3	3	0
ENRG 562	Electric Machines	3	2	2
ENRG 563	Embedded Computing & Remote Sensing	3	2	2
ENRG 564	Smart Grid Systems	3	3	0
ENRG 565	Directed Research	3	3	0

- ## Courses Descriptions

A brief description of the core and elective courses offered by the Bachelor of Science in Energy Engineering program is provided below and indicates the Course number, credit hours, lecture hours, laboratories/practical/tutorial hours, and the required prerequisites. Courses are listed according to their order in the program curriculum listed in Table 7 and then as electives as listed in Table 8.

First Freshman Semester

ENGL 211: English Composition

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: None*

This course will enable the student to improve his ability to write expository essays. The course topics include: Investigation of topic-selection processes, development of thesis statements, outlining as it relates to support for a selected thesis statement, both in sentence and slug-style, and practice and emphasis on critical thinking skills. The course is designed to introduce the general process of communicating meaning through writing and to enable student practicing writing short personal essays drawn from explorations of memory, observation, conversation, and reading.

MATH 261: Calculus I

Credit Hours: 4	*Lecture hours: 6*	*Lab/Practical hours: 0*	*Prerequisite: None*

In this course students will learn the basics of the calculus of functions of one variable. They will also apply these ideas to a wide range of problems to improve their ability to think critically, to analyze a problem and solve it using a wide array of tools. The course topics include: Functions and graphs, polynomials, exponential, logarithmic and trigonometric functions. Limits and continuity, Limits at infinity, infinite limits, properties of continuous functions, and the intermediate value theorem. The derivative, techniques of differentiation, chain rule, implicit differentiation, L'Hopital rule, and applications. Integration, definite and indefinite integrals, fundamental theorem of calculus, integration by substitution, integration by parts, improper integrals, and applications.

PHYS 271: Physics I

Credit Hours: 4	*Lecture hours: 4.5*	*Lab/Practical hours: 3*	*Prerequisite: None*

The course will introduce to the student concepts of Physics and Measurement, Motion in One Dimension, Vectors, Motion in Two Dimensions, The Laws of Motion, Circular Motion and Other Applications of Newton's Laws, Energy of a System, Conservation of Energy, Linear Momentum and Collisions, Rotation of Rigid Objects About a Fixed Axis, Angular Momentum, Static Equilibrium and Elasticity.

HIST 281: History and Civilization of Kingdom

Credit Hours: 2	*Lecture hours: 2*	*Lab/Practical hours: 0*	*Prerequisite: None*

University mandated course. Description to be provided by concerned department.

Second Freshman Semester

CHEM 221: General Chemistry

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: None*

This course will introduce the student to the basic vocabulary used in different branches of chemistry, and to major concepts in the field (e.g. stoichiometry, thermochemistry, etc., with emphasis on problem solving. The course topics include: General chemistry concepts. Thermo-chemistry, bonding, solid-state structures, fundamentals of organic chemistry including polymers. solution chemistry, thermodynamics, kinetics, equilibrium, acids and bases, electrochemistry, and nuclear chemistry. Use of computers for data acquisition and multimedia resources. Introduction to atomic theory, chemical reactions, bonding, stoichiometry, nomenclature, gas laws, colligate properties, colloids and solutions. Oxidation-reduction reactions, kinetics. Acid and base equilibria, buffers, transition elements, solubility, complex ions, hybridization. Laboratory

study of the chemical properties and semi-micro qualitative analysis of the representative group elements of the periodic table.

ENG 251: Introduction to Engineering

Credit Hours: 1	*Lecture hours: 0*	*Tutorial hours: 1.5*	*Prerequisite: None*

This course is designed to allow students to explore engineering through case studies, and problem-solving using computers. Students will learn about the various aspects of the engineering profession and acquire both technical skills and non-technical skills. The course topics include: Engineering profession, computer applications and programming related to engineering. Broad overview of the different fields of engineering, including professional societies and their student chapters, professional licensing and registration, professional codes of ethics, introduction to engineering design, and problem-solving techniques. Students learn design, teamwork, written and oral communication skills through participation in a conceptual design project.

MATH 262: Calculus II

Credit Hours: 4	*Lecture hours: 6*	*Lab/Practical hours: 0*	*Prerequisite: MATH 261*

The course topics include: Analytic geometry in calculus, polar coordinates, area in polar coordinates, tangent lines and arc length, conic sections. Three-dimensional space, vectors, parametric equations of lines and planes. Vector-valued functions, unit tangent, normal and binormal vectors, curvature. Partial derivatives, limits and continuity, chain rule, directional derivatives, gradients, maxima and minima of functions of two variables, Lagrange multipliers. Multiple integrals, double and triple integrals.

PHYS 272: Physics II

Credit Hours: 4	*Lecture hours: 4.5*	*Lab/Practical hours: 3*	*Prerequisite: PHYS 271*

The course will introduce to Electric Fields; Gauss's Law; Electric Potential; Capacitance and Dielectrics; Current and Resistance; Direct Current Circuits; Magnetic Fields; Sources of the Magnetic Field; Faraday's Law; Inductance.

Third Freshman Semester

HUMN 201: Library Skills

Credit Hours: 1	*Lecture hours: 1.5*	*Tutorial hours: 0*	*Prerequisite: None*

This course will enable the student to distinguish among various library and information resources, recognize citation elements, search databases, use print indexes, locate books in a classified system. The course topics include: Use of libraries and information sources, both print and electronic, including locations and services of the University Library with an emphasis on basic library research tools and information literacy concepts. Library skills. Library research. Brainstorming. Library orientation. Call Numbers. Library cataloguing & Classification System (Library of Congress & Dewey Decimal). General care and maintenance of books and library. Library language. Finding a book using the library computer. Introduction to Databases and efficient use of it for research purposes.

COMP 212: Computer Programming

Credit Hours: 2	*Lecture hours: 1.5*	*Lab/Practical hours: 3*	*Prerequisite: None*

This course aims at the provision of the concepts of algorithm, programming language, and program and developing basic problem-solving skills to the learner. The course topics include: Overview of computer programming and programming languages (machine, assembly, and High-level languages). Programming principles of algorithm and flow of control, including sequential execution, selection, iteration, and subroutine. Basics of a typical programming language (e.g. MATLAB). Introduction to computer methods and algorithms for analysis and solution of engineering problems using numerical methods in a workstation environment (Numerical integration, roots of equations, simultaneous equation solving and matrix analysis).

ENG 222: Engineering Drawings

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: None*

This course aims at helping the learner to develop clear concept and perception of form, proportion and develop the skill of expressing three-dimensional and two-dimensional objects into professional language. The course topics include: Fundamental graphics. Introduction to computer aided drafting and modeling. Practice in creating and evaluating typical designs drawn from different specialty areas (Electrical, Electronics, and Mechanical). Use of CAD packages to illustrate and quantify design alternatives.

ENG 232: Statics

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: PHYS 271*

This course enables the students to learn the tools necessary to have a deeper understanding of the principles of applied mechanics and the modeling of force systems in engineering statics. The course topics include: Analysis of forces on engineering structures in equilibrium. Properties of forces, moments, couples, and resultants. Equilibrium conditions, friction, Section properties (centroids, area moments of inertia).

ISLM 282: Islamic Ethics and Values

Credit Hours: 2	*Lecture hours: 2*	*Lab/Practical hours: 0*	*Prerequisite: None*

University mandated course. Description to be provided by concerned department.

First Sophomore Semester

MATH 302: Linear Algebra

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: MATH 262*

In this course the student will appreciate the importance of linear algebra and learn its applicability to practical engineering problems. Topics include: Systems of linear equations, row reduction and echelon forms, solution sets of linear systems, linear transformations. Matrix algebra, matrix operations, inverse of a matrix, matrix factorizations, subspaces of the Euclidean n-space, dimension and rank. Determinants, Cramer's rule. Eigenvalues and eigenvectors, diagonalization. Inner product, length, and orthogonality, Gram-Schmidt process.

ENG 311: Dynamics

Credit Hours: 2	*Lecture hours: 3*	*Lab/Practical hours: 0*	*Prerequisite: ENG 232*

In this course the student learns how to demonstrate an integrated understanding of engineering dynamics principles through applications involving problem solving and through creation of design solutions to engineering scenarios. The course topics include: Analysis of motions of particles and rigid bodies encountered in engineering. Velocity, acceleration, relative motion, work, energy, impulse, and momentum. Mathematical modeling and problem solving.

ENRG 307: Workshop Practice

Credit Hours: 1	*Lecture hours: 0*	*Lab/Practical hours: 1.5*	*Prerequisite: ENG 222*

Introduction to principles of production, production management and production planning, materials, measurements, standards' specifications, metal forming processes (forging, extrusion, drawing, press work, rolling), sheet metal work related processes using machine tools (shearing, sawing, drilling, turning, milling, shaping, boring, grinding), and workshop safety.

GEOL 312: Geology

Credit Hours: 2	*Lecture hours: 3*	*Lab/Practical hours: 0*	*Prerequisite: None*

This course explores the fundamentals of geology applied to energy engineering problems. Topics include rock and mineral types, soil properties, rock mechanics, geologic structures, active tectonics and earthquake hazards, slope stability and landslides, groundwater, rivers and flood hazards. Instruction is conducted through lecture and field trips.

ENG 331: Electric Circuits

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: PHYS 272*

Students learn electric circuits techniques for the analysis and simulation of linear electric circuits, and measurements of their properties. The course builds upon the student's background gained in physics and calculus courses and prepares students for learning electronic devices and circuits, Signals and Systems. The topics include: Models of circuit elements; circuit analysis using Ohm's and Kirchoff's laws; nodal and mesh analysis; Thevenin and Norton equivalent circuits, solution of first and second order circuits; phasor-based solutions to AC circuits; elementary frequency response. MATLAB is used throughout the course. Includes lab.

Second Sophomore Semester

MATH 331N: Differential Equations

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: MATH 262*

This course covers some major mathematical methods that are useful for engineering applications. The student will learn the relation between mathematics, physics, and engineering. The course topics include: Solutions and Initial Value problems, Existence and Uniqueness of Solution. First-Order Differential Equations, linear and exact equations, special integrating factors, substitutions, and transformations. Linear second order differential equations, fundamental solutions of homogeneous equations, homogeneous linear equations with constant coefficients. Superposition and non-homogeneous equations. Laplace transform, and inverse Laplace transform.

ENRG 308: Thermodynamics

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: MATH 261, PHYS 271*

This course covers major thermodynamics principles that are useful to engineering applications. The student will learn thermodynamics basic concepts and definitions; properties of pure substances; system and control volume; working fluid, processes and cycles; work, heat and energy; ideal gases, state equation. Pure substance and phase changes; thermal equilibrium. First law of thermodynamics, internal energy and enthalpy. Applications of first law of thermodynamics for closed and open systems; second law of thermodynamics; Carnot cycle, entropy; reversible and irreversible systems. Applications such as: vapor power systems, gas power systems, fuel and combustion, refrigeration, heat pumps, etc. that will be applied to modern engineering systems.

ENRG 312: Measurement and Data Acquisition Systems

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: ENG 331*

Introduction to Measurements and Data Acquisition Systems with emphasis on analog electronics, digital electronics, sensors and transducers, and actuators. Course is intended to provide the student with foundational concepts in measurements and data acquisition systems and practical familiarity with commonly used electronic test and measurement instrumentation. Elementary techniques for the characterization of systems' responses. Fundamental aspects of data acquisition and data conversion (e.g. measuring position and speed, differential transformer, digital optical encoder, resistance thermometer, pressure and flow Measurement).

ENG 351: Strength of Materials

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: ENG 232*

Introduction to properties of materials (shrinkage, expansion, creep, tension, compression, shear, torsion, bending, fatigue, ductility, hardness, etc..). Stresses, strains, and deformations associated with torsion, axial, shear, moment, flexural loading of bars, shafts, beams. and pressure vessel loadings. Combined loadings and principal representations of the states of stress and strain at a point. Basic failure criteria. Introduction to stability including buckling of columns. Experimental determination of mechanical properties of concrete, asphalt, and soils as required for engineering applications. Experimental verification of assumptions made in mechanics of materials procedures. Use of strain measuring devices. Introduction to experimental stress analysis. Verification of analytical equations through strain gage measurements.

Third Sophomore Semester

BUS 381: Entrepreneurship

Credit Hours: 2	*Lecture hours: 2*	*Lab/Practical hours: 0*	*Prerequisite: None*

University mandated course. Description to be provided by concerned department.

HUMN 301: Oral Communication and Public Speaking

Credit Hours: 1	*Lecture hours: 1.5*	*Lab/Practical hours: 0*	*Prerequisite: ENGL 211*

In this course the students will develop their ability to speak confidently and effectively in a variety of public speaking situations. Students will prepare and present several different types of speeches that arts managers are often required to make. Particular attention is paid to style, persuasion, and credibility in public speaking.

ENRG 313: Heat & Mass Transfer

Credit Hours: 4	*Lecture hours: 4.5*	*Lab/Practical hours: 3*	*Prerequisite: ENRG 308, MATH 331N*

Principles of heat transfer, Steady state and transient conduction in different co-ordinates, Extended surfaces, Convective heat transfer, Analysis and empirical relations for forced and natural convection, Various forced convection problems involving flow across different shops, Radiation heat transfer, radiation exchange between black and gray surfaces, Heat transfer applications (Heat Exchangers) and fundamentals of mass transfer, Numerical methods in heat transfer with computer applications, Laboratory.

ENRG 314: Fluid Mechanics

Credit Hours: 4	*Lecture hours: 4.5*	*Lab/Practical hours: 3*	*Prerequisite: ENRG 308*

A study of fluid properties and their significance; fluid statics, use of differential and finite control volume analysis with continuity, momentum, and energy equations, Bernoulli and Euler equations, vorticity, potential flow. Fundamental mechanics of compressible and incompressible viscous flow using Navier-Stokes equations; Resistance of fluids in laminar, viscous, and turbulent flow; Open–channel uniform and non-uniform flow; Fluid statics; Dimensional analysis and similitude. Conservation equations of fluid dynamics; Boundary layer concepts; Lift and drag; Application of basic fluid dynamic principles to various systems; Flow through pipes; Branching of pipes and pipe networks; Hydraulic jumps; Gradually varied flow. laboratory exercises in flow measurement, open channel flow, pipe friction, physical modeling, and data collection.

First Junior Semester

MATH 411: Probability and Statistics

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: MATH 302, MATH 331N*

In this course students will acquire an understanding of probability and statistics through mathematical formulas, and examination of data. Students will apply probability and statistics concepts through class activities and projects related to the engineering field. Topics include: Presentation of data, textual, tabular and graphical, sampling techniques. Measures of central tendency, mean, median, mode. Measures of variation, range, variance, standard deviation. Probability distributions, counting techniques, uniform, binomial, normal, and exponential distributions. Test of hypothesis, test concerning means, variation, and proportion. Analysis of variance, combinatorial mathematics, fundamental principles of counting, binomial theorem.

ENG 401: Technical Writing

Credit Hours: 2	*Lecture hours: 3*	*Lab/Practical hours: 0*	*Prerequisite: ENGL 211*

This course focuses on effective process of written, oral, and visual technical communication for academic settings. Topics include: Various forms of academic and personal essay-writing. Original essay writing and class criticism and discussion. Model essays and essays on the craft of writing reading and discussion for verbal logic, communicative power, and visceral appeal.

ENRG 404: Refrigeration and Air Conditioning

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: ENRG 308*

Review of thermodynamics basics, Refrigeration introduction and fundamentals, Basic refrigeration cycles, Analysis of simple and actual vapor compression cycle, performance of vapor compression refrigeration system, Cycle components: compressor, condenser, evaporators, expansion devices, Multistage refrigeration cycles, Refrigerants. Introduction to absorption refrigeration, Cooling/Freezing storage load estimation. Properties of moist air by: Psychometric chart, air conditioning processes, Air conditioning load analysis and estimation, Air conditioning cycles, Design of air duct systems.

ENRG 406: Heat Exchanger Design

Credit Hours: 2	*Lecture hours: 3*	*Lab/Practical hours: 0*	*Prerequisite: ENRG 313, ENRG 314*

In this course students will learn heat transfer mechanisms that involve basic equations of heat exchangers, classification of heat exchangers and detailed analysis of heat exchangers. The detailed analysis involves geometric analysis, heat transfer analysis and flow friction analysis. The students will learn the applications and procedures for designing shell-and-tube and compact heat exchanger. Additional topics include effect of heat recovery over the efficiency of heat exchangers; effects of fouling in design; maintenance of heat exchangers and the effects of noise and vibration due to flow within heat exchangers. The students will also be introduced to the techniques to mitigate the fouling and corrosion problems within heat exchangers.

ENRG 413: Desalination

Credit Hours: 2	*Lecture hours: 1.5*	*Lab/Practical hours: 3*	*Prerequisite: ENRG 313*

This course introduces the students to the thermal and membrane fundamentals of desalination extensively used in industry: flash-type desalination – single and multiple stages and reverse osmosis. The attractive features of the other desalination techniques will also be introduced to the students. The students will study case studies of existential desalination plants. Prediction models of desalination systems and their comparison with the available measured plant data. The students will be introduced to the design procedures of different components of desalination systems that involve evaporators, flashing units, condensers, and membrane separation. The students will also be introduced to several applications of desalination processes in industries and wastewater treatment, food, petrochemical, and power generation. The students will also learn the theory, thermodynamics performance, design, and economics of desalination processes. The course also includes laboratory experiments to complement theory.

Second Junior Semester

ENG 412: Engineering Economics

Credit Hours: 2	*Lecture hours: 3*	*Lab/Practical hours: 0*	*Prerequisite: None*

This course is designed to equip students to acquired engineering economy concepts, principles and methods. The focus of this course is to provide understanding on engineering economic principles and methods and to apply it in engineering field. The course has is designed to teach students to formulate cash-flow, perform analysis on engineering economic problems and evaluate between alternative of engineering investment/projects to make decision to teach students to perform cost estimates using traditional and current costing techniques in production process, prepare simple financial statement and interpret financial performance of business firms for decision and control. Interpretation and use of accounting reports and supplemental information for engineering economic analyses, consideration of cost-volume-profit analyses, use of discounted cash flow techniques.

ENRG 403: Renewable Energy

Credit Hours: 4	*Lecture hours: 4.5*	*Lab/Practical hours: 3*	*Prerequisites: ENRG 313, GEOL 312 and ENG 311*

This is an application oriented course that includes performance analysis and design of various renewable energy systems with emphasis on solar, wind and geothermal energy systems. Topics include solar radiation characteristics, measurement and estimation, solar energy conversion systems such as thermal solar collectors, photovoltaic panels, concentrating collectors for thermal and photovoltaic applications including

design considerations, working principle of solar cells, electrical characterization of Photovoltaics (PV) units (cell, module, & array), PV technologies and applications, geothermal power systems, thermodynamic performance analysis, efficiency and environmental impact, wind power technology, wind turbine theory and working principle, wind resource and power assessment. The course also includes laboratory experiments related to solar and wind energy to complement theory.

ENRG 411: Introduction to Electric Power Systems

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: ENG 331*

This course is designed for undergraduate students in the field of electric power systems and electrical to mechanical energy conversion. Electric power has become an extremely important to transmit and transform energy in industrial, military, and transportation applications. Electric power systems are also used in solar systems, wind energy generation and in hydroelectric generation. The course material includes fundamentals of energy handling electric circuits, power electronic circuits, simplification and transformation techniques, analysis of electric power circuits, magnetic circuits, and elements of linear and rotating electric machines, models of DC machines, and synchronous and induction machines, the integration and interconnection of electric power modules and operation of power systems.

ENRG 412: Energy & Environment

Credit Hours: 2	*Lecture hours: 3*	*Lab/Practical hours: 0*	*Prerequisite: CHEM 221*

This course studies some management aspects of atmospheric energy, resources, manufacturing and transportation in the context of natural resources, sustainable practices, and human health. The driving forces that influence policies and human activities will be discussed and analyzed. For the initial half, lectures and reading material will be provided to the students with a detailed introduction to the impacts of conventional and renewable energy production and consumption on the natural environment, health, economics and their related management structures. Following the midterm examination, students will be exposed to new transportation technologies, main causes of air pollution, impacts of international commerce, sustainable manufacturing and industrial ecology basics, green buildings, energy management and sustainable production.

Third Junior Semester

HUMN 402: Research Methodology

Credit Hours: 1	*Lecture hours: 1.5*	*Lab/Practical hours: 0*	*Prerequisite: HUMN 201*

In this course students learn the tools to be familiar with their theses in terms of research questions and design, methodology, data collection and analysis. Topics include: Research methodology concepts and definition. Research ethics. Problem identification. Research plan preparation. Data gathering and collection. Data presentation and analysis. Design of research report. Case study.

MATH 472: Numerical Methods

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: MATH 331N*

In this course the students learn an introduction to numerical methods and error analysis, numerical solutions of nonlinear equations, numerical solutions of systems of linear equations, interpolation, numerical differentiation and integration, numerical solutions of 1st–order differential equations and numerical solutions of some partial differential equations.

ENRG 405: Control Systems

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: ENG 331*

The course is designed for undergraduate students in energy engineering. The course is focused on the introduction to linear systems, transfer functions, the Laplace transform, control systems design, human-machine interface (HMI control), stability in control systems, system modeling principles for electrical and mechanical systems, open and closed loop control, feedback in control systems, real-time systems, transient and steady state performance, frequency response analysis, and practical issues in implementation of control systems. The course also includes laboratory experiments related to these topics to give hands-on experience to the students in the field of control systems.

ENRG 410: Machine Design

Credit Hours: 2	*Lecture hours: 3*	*Lab/Practical hours: 0*	*Prerequisite: ENG 311, ENG 351*

Fundamentals of machine design; stress, strain and deformation analysis as applied to mechanical design; consideration of manufacturing aspects of the design (limits and fits); use of standard and technical manuals; designing against static and fatigue failure theories for various loadings and materials; element design analysis including, shafts, screws, fasteners, gears, springs and bearings; design and analysis of welded joints.

First Senior Semester

ENG 501: Professional Practice and Ethics

Credit Hours: 2	*Lecture hours: 3*	*Lab/Practical hours: 0*	*Prerequisite: ENG 412*

This course examines ethical frameworks and moral issues related to the profession. Topics include: Examination of the non-technical issues dealt with by design professional, including professional ethics, marketing and business development, professional engagement, personnel and project management, risk management, professional liability insurance, and dispute resolution.

ENRG 503: Senior Design Project I

Credit Hours: 2	*Lecture hours: 0*	*Lab/Practical hours: 6*	*Prerequisite: HUMN 402, MATH 472*

This course is an integral part of the final project program. The course emphasizes the identification and development of practical and technical ideas and concepts which are to be researched, analyzed, programmed, and documented in an effective and efficient professional report. The research should include pertinent analysis and solutions and issues in an integrated form. The student is responsible for the independent development of the research under the direction of a faculty advisor with expertise in the areas of investigation. Individual research in a field of special interest under the supervision of a faculty member as a requirement for the B.Sc. degree, culminating in a written report/thesis. The central goal of which is a substantive paper or written report containing significant analysis and interpretation of a previously approved topic. The Graduation Project is divided between two semesters. Methodology is developed and pre-data are collected in the first semester. Experiment is run, data is analyzed, and conclusion are sought in the second semester.

ENRG 505: Project Management and Scheduling

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: ENG 412, MATH 411*

In this course, the students will learn the fundamentals of project management and scheduling. Project management involves managing teams globally distributed while following the scope, time constraints, budget while balancing rigorous quality demands and project risks. This course will provide students with the tools and – as important – behavioral skills to systematically manage projects for profit and non-profit organizations. The course involves topics of triple constraints, work breakdown structure, scheduling tools, time estimation, budget planning, resource allocation, cost reports, risk and contingency, monitoring tools and supply chain management.

Second Senior Semester

ENRG 502: Energy Efficiency for Sustainable Development

Credit Hours: 2	*Lecture hours: 3*	*Lab/Practical hours: 0*	*Prerequisite: ENRG 313*

In this course, the students will learn some measures which are effectively used to encourage energy efficiency that include, the elimination of subsidies for the use of fossil fuel, provision of incentives for short-term as reward for application of efficiency measures, general public awareness for setting energy policies, taxes on energy inefficient products and pollution, the adoption of standards for minimum level of energy efficiency, the disclosure of contents, awards and rating of different technologies, environmental impact audits and assessment, investment on the development and research of new technologies, transfer of technology, governmental procurements of efficient technologies and products and consumer education and awareness program.

ENRG 504: Steam Power Production

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: ENRG 313, ENRG 314*

This course covers steam power production principles that are essential in engineering applications. The student will learn: Introduction to steam power station, Steam boilers (fire tube boiler, water tube boiler, Supercritical boiler), and their accessories (steam superheater – economizers, air preheater, feed water heater). Classification of Pressure Vessels, boiler efficiency calculation, control systems of steam boilers, fuels and combustion, types of condensers and cooling tower. Steam Turbines: types & theory of action, turbine efficiency, calculation velocity diagrams, and flow of steam through nozzles. Also, introduction to economics of power plants and load curve variation.

ENRG 509: Senior Design Project II

Credit Hours: 4	*Lecture hours: 0*	*Lab/Practical hours: 12*	*Prerequisite: ENRG 503*

This course provides individual research in a field of special interest under the supervision of a faculty member as a requirement for the B.Sc. degree, culminating in a written report/thesis. The central goal of which is a substantive paper or written report containing significant analysis and interpretation of a previously approved topic. The Graduation Project is divided between two semesters. Methodology is developed and pre-data are collected in the first semester. Experiment is run, data is analyzed, and conclusions are sought in the second semester.

Third Senior Semester

ENRG 506: Energy Markets

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: ENG 412*

This course provides an overview of the Energy Markets enabling the students to understand the nature of conventional and emerging energy generation and delivery within the global economic market. The topics include energy as an economic system and dealing with market failures, Organized energy markets and efficiency, Energy Supply and Demand, Utility-Scale generation options, experience curves and disruptions, energy storage options with influence on energy market, Oil and transportation markets, Electricity supply and demand, Natural Gas Market, Climate change and impact of energy systems and Global energy poverty and access.

ENRG 510: Energy Storage

Credit Hours: 2	*Lecture hours: 3*	*Lab/Practical hours: 0*	*Prerequisite: ENRG 308, CHEM 221*

This course explores the various energy storage technologies, their working, and their practical applications. The course focuses on the most recent technologies and covers many different energy storage systems such as Mechanical (flywheels, hydro-storage and compressed-air Storage), Thermal (sensible and latent energy storage), Hydrogen storage and Chemical Energy storage (e.g. batteries and fuel cells). The course permits the students an opportunity to explore various innovations and future developments in the field of energy storage.

ENRG 511: Turbo-Machinery

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: ENRG 314*

In this course, the students will learn the theory, performance, design, and economics of gas turbines. The topics cover gas turbine theory and principles, simple cycle, combined cycle, gas turbine types including industrial, heavy-duty, aero-derivative, generator-drive, and compressor drive, gas turbine engine components including compressor, combustor types and fuels, startling devices, gas turbines performance calculations, velocity triangles, vibration and rotor dynamics, gas turbine fouling, operation and maintenance, special considerations for CHP gas turbines, economics and environmental aspects.

Elective Courses

ENRG 551: Internal Combustion Engine

Credit Hours: 3 Lecture hours: 3 Lab/Practical hours: 3 Prerequisite: CHEM 221

In this course, students will be introduced to the fundamentals of internal combustion engines. The students will learn the design parameters and their effect over the operation and performance of internal combustion engines. Specific topics include thermodynamic and fluid flow analysis of internal combustion engine, combustion and heat transfer phenomena within the internal combustion engine and pressure drop and friction phenomena of internal combustion engines. The students will also be introduced to the effect of properties of fuel on power output of the engine, efficiency of the engine, and environmental impact of emissions from the engine. The students will also study the basic design parameters of different types of internal combustion engines such as diesel, spark-ignition, compression ignition engines, real cycle of IC engines, characteristic of engine fuels knock resistance, ignition tendency and combustion chemistry, mixed-cycle and stratified-charge type internal combustion engines.

ENRG 552: Nuclear Power

Credit Hours: 3 Lecture hours: 4.5 Lab/Practical hours: 0 Prerequisite: ENRG 313

In this course, the students will learn about the fundamentals of nuclear power. The students will learn the concepts of nuclear physics and radioactivity. The students will be introduced to nuclear reactions and reactor mechanics. The students will learn the reactor theory of nuclear chain reactors, reactor kinetics, classification of nuclear reactors, nuclear power production, and nuclear economics. The students will also be introduced to the safety procedures of a nuclear power plant, applications for peaceful purposes and storage of nuclear waste.

ENRG 553: Petrochemical Energy

Credit Hours: 3 Lecture hours: 4.5 Lab/Practical hours: 0 Prerequisite: CHEM 221

This course will cover various petrochemicals from methane, production of olefins, petrochemical energy from ethylene, petrochemical energy from propylene and higher olefins. Petrochemical energy from benzene and xylenes. Thermoplastics, thermosetting and engineering resins.

ENRG 554: Atmospheric Pollution

Credit Hours: 3 Lecture hours: 4.5 Lab/Practical hours: 0 Prerequisite: ENRG 412

Sources of air pollution from major industries, internal combustion engines, and other sources. Techniques available for measuring particulate and gaseous pollutants in the atmosphere and at their sources. Techniques available for control and future possibilities for control of air pollution. Basic concepts in physics and chemistry of the atmosphere. Production, transformation, transport, and removal of air pollutants. The problems of photochemical smog, the greenhouse effect & climate change, stratospheric ozone, acid rain, and visibility. Analytical techniques for gases and particles. Numerical simulation of air pollution. Health and environmental effects of air pollution in the developed and developing world.

ENRG 555: Occupational Health & Safety

Credit Hours: 3 Lecture hours: 4.5 Lab/Practical hours: 0 Prerequisite: HUMN 501

This course introduces the student to study of workplace occupational health and safety. The student will learn safe work practices in offices, industry and construction as well as how to identify and prevent or correct problems associated with occupational safety and health in these locations as well as in the home. The course is designed to assist the student with the implementation of safe healthy practices at work and at home. Course topics include: Adverse effects of occupational hazards: physical, chemical, and biological. Occupational Health engineering; the measurement of chemical, physical, and biological hazards in the workplace. Accident analysis and prevention. Industrial ventilation. Ergonomics. Protective clothing Well person screening. Introduction to occupational psychology. Presentation of technical reports and scientific papers. Field visits to places of relevance to the subject and practical environmental measurements at factory level.

ENRG 556: Energy and Environmental Policy

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: ENRG 412*

This course deals with problems from a broad national and public perspective. Energy policy decision making is a multi-objective optimization problem where policy makers tend to satisfy a set of heterogeneous objectives. In this course, multi-objective optimization modeling will be discussed with application on a wide range of policy making cases.

ENRG 557: Solar Power System Design

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: ENRG 403*

Introduction to solar power, solar energy systems, solar cell and PV systems, theoretical principles and practical design aspects of solar energy systems, applications, solar cells, fabrication of solar cells, PV module construction and the design of a PV system using state of the art commercial software. In addition, the course reviews topics on principles of radiation, heating load computation, air and liquid flat-plate collectors, concentrating collectors, energy storage, photovoltaic conversion, power electronics, cost and economic analysis, manufacturing aspects of the solar power systems with practical applications. Laboratory experiments to complement theory. Applications in desalination systems.

ENRG 558: Hybrid Energy System

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: ENRG 403*

This course covers basics, recent advances and developments, selection, design and sizing of hybrid renewable energy systems. Renewable energy systems covered include wind, solar, thermal, electrical and end-use energy efficient systems, including cogeneration and multi-generation systems. The course will cover technical aspects of various renewable energy systems, its components, the control strategies and system architecture, and the use of storage (thermal and electrical) and other demand-side technologies. Students will learn how to use simulation tools to design and optimize of hybrid renewable energy systems and apply these techniques to a case study.

ENRG 559: Tidal and Wave Energy

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: ENRG 314*

The course covers topics related to ocean energy harvesting technologies: tidal and wave energies. Review of fluid mechanics fundamentals essential to understanding and design of ocean energy harvesting systems is presented. Then tidal and wave energy harvesting systems are studied with focus on resource potential, assessment and forecasting, environmental and socio-economic impacts, grid integration, array configuration, installation, operation and maintenance. Emerging technologies such as hydro-kinetic energy are also introduced.

ENRG 560: Material Science & Technology

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: ENG 351*

The aim of this course is the acquaintance of the students with the properties of materials which are important in renewable energy applications: Mechanical properties, opto-electronic properties, hydrogen storage materials; knowledge about available materials; material selection. The course involves topics about classification of materials, atomic bonding, crystal structure, diffusion. Mechanical properties: stress, strain, tension test, hardness test. Phase diagrams, Fe-C system. Martensitic transformation. Commercially available metallic materials: steels, cast irons, copper alloys, aluminum alloys. Composites. Introduction to semiconductors, photovoltaic conversion. Introduction to hydrogen storage.

ENRG 561: Power Station Engineering

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: ENRG 411*

This course is designed for the undergraduate students of energy engineering. The main topics include: The electric power system from producer to consumer, principles of power transmission high voltage AC (HVAC) and high voltage DC (HVDC), power components, overhead wires, cables, insulations, power transformers, generators, power switching equipment, design of power systems and substations, laws, regulations, and standards of power stations, calculation models of transient conditions, fault detections, and measurement equipment.

ENRG 562: Electric Machines

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: ENRG 405*

Basic principles of electromechanical machines. Circuit models and parameter tests for single-phase and 3-phase transformers. Fundamentals of DC machinery; circuit models and characteristics of DC motors. Fundamentals of AC machinery; theory and operation of synchronous machines and induction motors. AC and DC machinery principles and applications; introduction to magnetic circuits, transformers, and electrical machines, including laboratory applications.

ENRG 563: Embedded Computing and Remote Sensing

Credit Hours: 3	*Lecture hours: 3*	*Lab/Practical hours: 3*	*Prerequisite: COMP 212*

Topics to be covered: Embedded Computing Vs. Generic PC Computing, Controllers, Dedicated Computing System, Basics for Input/output interfacing with MCU, Real Time Operating System (RTOS) Structure, Hardware Software Interaction, Interface technologies with MCU (Analog/ Digital, SPI, Serial Ports, I2C, etc.). Applications, Data loggers, Control System, Signal Control, Navigation System. Introduction to FPGA (Field Programming Gate Arrays).

ENRG 564: Smart Grid Systems

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: ENRG 411*

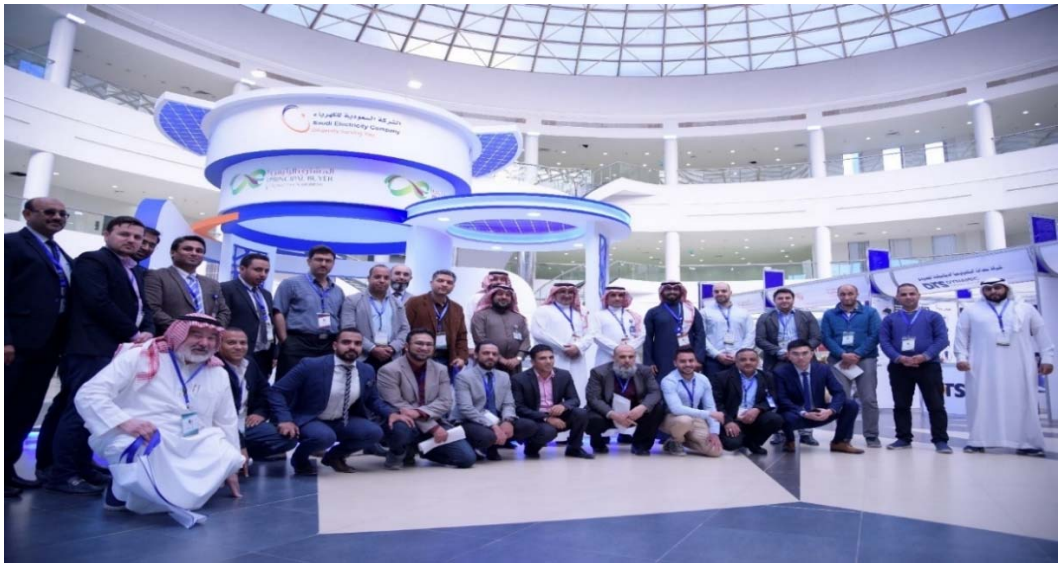
This course is aimed for undergraduate students of Energy Engineering. The course starts with the introduction of fundamental concepts of micro grids and smart grids. Students will be given the concepts of renewable energy generation, grid integration, energy storage technologies and future developments. The later topics include advanced management and control concepts of smart grids, data management requirements, ICT technologies for smart grids, standards related to the development of smart grids and identifying key stakeholders and potential impact. By the end of the course students will be able to evaluate technology options pertaining to renewable energy generation, energy storage, data handling and communications for smart grids.

ENRG 565: Directed Research

Credit Hours: 3	*Lecture hours: 4.5*	*Lab/Practical hours: 0*	*Prerequisite: None*

This course is for active research projects that could be taken as a one-time Elective Special Topic. It is only open to students having a GPA of 3 or above and consent of the instructor is mandatory. Faculty conducting the course must submit a formal well-written program of research work and deliverables and grading policy in semester prior to enrollment for approval from department.

2nd Solar & Wind Energy Symposium & Exhibition, March 2019



2nd Solar & Wind Energy Symposium & Exhibition, March 2019

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