



BETHLEHEM
UNIVERSITY

جامعة بيت لحم



Faculty of Applied Sciences, Technology, and Engineering

Sustainable Energy Engineering Program

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2023

Degree Requirements

The Bachelor of Sustainable Energy Engineering follows a rigorous curriculum, requiring a minimum of 160 credit hours, which takes approximately five years to complete. All courses listed in the curriculum map for the catalog year of graduation must be completed to be eligible for graduation.

To earn a Bachelor degree in SEEN from Bethlehem University a student must complete:

- The University requirements as listed below.
- The requirements as listed below with a minimum Grade Point Average (GPA) of 2.00.
- The Faculty requirements as listed below.
- A minimum cumulative GPA of 2.00 computed on all grades earned at Bethlehem University.

The number of credits of the program is distributed following the tables:

Requirement	Number of credits
Faculty requirements	25
University requirements	34
Program requirements	89
Program electives	12
Minimal Total number of credits	160

The details of these courses are presented in the following subsections.

Major Program Required Courses (A total of 89 credit hours)

The table below indicates the program's required courses with the number of credit hours for each course. Also indicated in the last column the potential teacher for each course.

Required courses list:

Code	Title	Credits	Potential teachers	Status at BU	Status in Program
SEEN133	Electromagnetism	3	J. Ghabboun, A. Salhab	F/P	F/P
SEEN101	Engineering Design	3	A. Moreno Vendrell, Q. Mayyala	P/P	P/P
SEEN321	Theory of Machines and Mechanisms	3	A. Salhab	P	P
SEEN102	Engineering Workshop	1	A. Moreno Vendrell, N. Adawi	P/P	P/P
SEEN104	Introduction to sustainable Energy	3	J. Ghabboun	F	F
SEEN201	Electricity	3	Q. Mayyala, A. Salhab	P/P	P/P
SEEN202	Electricity lab	1	N. Adawi	P	P
SEEN204	Thermal solar Energy	3	J. Ghabboun	F	F
SEEN325	Photo-voltaic systems	3	J. Ghabboun, Q. Mayyala, A. Salhab	F/P/P	F/P/P
SEEN203	Solar cells lab	1	J. Ghabboun, N. Adawi	F/P	F/P
SEEN205	Electronics I	3	Q. Mayyala, A. Salhab	P/P	P/P
SEEN220	Electronics (Power) I	3	Carlos Ortega, Q. Mayyala, A. Salhab	P/P/P	P/P/P
SEEN206	Electronics lab I	1	N. Adawi, Q. Mayyala, A. Salhab	P/P/P	P/P/P
SEEN221	Electronics lab (Power) II	1	Carlos Ortega, A. Salhab	P/P	P/P
SEEN401	Automation and Industrial control	3	A. Salhab	P	P
SEEN230	Material science	3	J. Ghabboun	F	F
SEEN300	Internship I	1	All		
SEEN301	Thermal and fluid Engineering	3	Jose Maria Ruiz	P	P
SEEN302	Fluid Mechanics lab	1	A. Attiyah	F	F
SEEN425	Geothermal Energy	3	J. Sanchez	P	P
SEEN421	Wind and biomass energy	3	Angel Borrell	P	P
SEEN422	Wind energy lab	1	Q. Mayyala, N. Adawi	P/P	P/P
SEEN304	Energy Conservation Efficiency	3	Victor Gallarodo, Q. Mayyala	P/P	P/P
SEEN400	Internship II	1	All		
SEEN435	Simulation and modeling of Energy Systems	3	Angel Borrell, A. Salhab	P/P	P/P
SEEN430	Engineering programming	3	Andreu Moreno, R. Gedeon, A. Samara	P/F/F	P/F/F
SEEN208	Probability and Statistics	3	H. Rabea, Q. Mayyala	F/P	F/P
SEEN235	Introduction to Linear Algebra	3	H. Rabea	F	F
SEEN315	Applied Mathematics for Engineering	3	M. Abu Ayyash, Q. Mayyala	F/P	P/P
SEEN460	Environmental engineering	3	Jordi Cruz	P	P
SEEN410	Advanced Chemistry for Energy applications	3	M. Hanania	F	P
BUSA210	Introduction to Business Management	3	U. Khalilieh	F	P
ENTR320	Project management	2	I. Ghayeb	F	P
SEEN510	Economics of Energy Markets	3	R. Handal	F	P
SEEN389	Seminar	2	All		
SEEN500	Graduation Project	4	All		
Total		89			

- Courses offered by the Department of Computational Sciences and Engineering
- Courses offered by the Chemistry Department
- Courses offered by the Faculty of Business Administration

Notes: F = Full time member P – Part time member

New full time faculty members will be recruited upon accreditation of this program

Program Elective Courses (Select 12 credit hours out of 45)

Following are elective courses from which a student must select 4 courses making up a total of 12 credit hours (students will be encouraged to enroll in SEEN503):

Program Elective Courses list: Select any 4 courses

Code	Title	Crs	Potential teachers	Status at BU	Status in Program
SEEN105	Industrial manufacturing	3	Q. Mayyala, A. Salhab, A. Moreno Vendrell	P/P/P	P/P/P
SEEN106	Computer Graphics and Multimedia	3	R. Gedeon, N. Abu Saad	F/F	P/P
SEEN235	Materials for energy	3	J. Ghabboun	F	F
SEEN308	Electrical energy storage	3	A. Salhab, Q. Mayyala	P/P	P/P
SEEN432	Advanced Object Oriented Programming	3	Andrew Moreno H., R. Gedeon, A. Samara	P/F/F	P/F/F
SEEN433	Energy Web Technologies	3	Andrew Moreno H., R. Gedeon, A. Samara	P/F/F	P/F/F
SEEN428	Bioenergy system	3	Angell Borel	P	P
SEEN322	Hydraulic wave energy	3	J. Ghabboun, Q. Mayyala	F/P	F/P
SEEN400	Special topics in sustainable energy	3	J. Ghabboun, A. Salhab	F/P	F/P
SEEN502	Energy Legislation	3	J. Daboub	P	P
SEEN429	Power Electronics	3	A. Salhab, Q. Mayyala, Carlos Ortega	P/P/P	P/P/P
SEEN503	Scientific research methods	3	A. Salhab, J. Ghabboun	P/F	P/P
SEEN504	Transmission Lines and Field theory	3	A. Salhab, Q. Mayyala	P/P	P/P
SEEN420	Nanotechnology	3	J. Ghabboun	F	F

Notes: F = Full time member P – Part time member

New full time faculty members will be recruited upon accreditation of this program

Paradigm

A student must earn 160 credit hours in order to graduate. These credit hours are allocated over five academic years as follows:

- | | | |
|---|----|--------------------------|
| • | UR | University Requirements |
| • | FR | Faculty Requirements |
| • | PR | Program Required Courses |
| • | PE | Program Elective Courses |

First Year

Fall Semester							
Code	Course Title	Credit Hours				LAB	Total Cr. Hrs.
		UR	FR	PR	PE		
MATH141	Calculus & Analytic Geometry I		4				
ENGL120	English Language Skills I	3					
SEEN101	Engineering Design						
PHYS131	General Physics I			3		Yes	
PHYS113	Laboratory Practice		3				
LIBR101	Library Skills		1			Yes	
SEEN102	Engineering Workshop	0		1			
PSED101	Physical Education	1					
Total Fall Semester		4	8	4			16
Spring Semester							
MATH142	Calculus & Analytic Geometry II		4				
ENGL121	English Language Skills II	3					
SWER141	Computer Programming I		3				
PHYS132	General Physics II		3				
SEEN104	Introduction to Renewable Energy			3			
Total Spring Semester		3	10	3			16
Total First Year		7	18	7			32

Second Year

Fall Semester							
Code	Course Title	Credit Hours				LAB	Total Cr. Hrs.
		UR	FR	PR	PE		
ARAB120	Arabic Language Skills I	3					
SEEN201	Electricity			3			
SEEN202	Electricity Lab			1		Yes	
SEEN203	Solar Cells Lab			1		Yes	
SEEN204	Thermal Solar Energy			3			
SEEN205	Electronics I			3			
SEEN206	Electronics Lab I			1		Yes	
Total Fall Semester		3		12			15
Spring Semester							
ENGL213	English Language Skills III	3					
SEEN208	Probability and Statistics			3			
SEEN220	Electronics II			3			
SEEN221	Electronics Lab II			1		Yes	
CHEM131	General Chemistry I		3				
CHEM113	Laboratory Practice		1				
SEEN230	Material Science			3			
Total Spring Semester		3	4	10			17
Summer Semester							
ARAB121	Arabic Language Skills II	3					
HIST120	Modern & Cont. History of Palestine	3					
Total Summer Semester		6					6
Total Second Year		12	4	22			38

Third Year

Fall Semester							
Code	Course Title	Credit Hours				LAB	Total Cr. Hrs.
		UR	FR	PR	PE		
SEEN235	Introduction to Linear Algebra			3			
SEEN301	Thermal and Fluid Engineering			3			
SEEN304	Energy Conservation Efficiency			3			
SEEN302	Fluid Mechanics Lab			1		Yes	
ARTI101	Art Appreciation	2					
CHEM132	General Chemistry II		3				
Total Fall Semester		2	3	10			15
Spring Semester							
BUSA210	Introduction to Business Management			3			
CMSR101	Community Service	1					
SEEN321	Theory of Machines and Mechanisms			3			
SEEN315	Numerical Analysis			3			
SEEN133	Electromagnetism			3			
Elective	Program Elective Course				3		
Total Spring Semester		1		12	3		16
Summer Semester							
SEEN300	Internship I			1			
Total Summer Semester				1			1
Total Third Year		3	3	23	3		32

Fourth Year

Fall Semester							
Code	Course Title	Credit Hours				LAB	Total Cr. Hrs.
		UR	FR	PR	PE		
RELS300	Cultural Religious Studies	3					
SEEN401	Automation and Industrial Control			3			
Elective	Program Elective Course				3		
SEEN410	Adv. Chem. For Energy Applications			3			
ENTR320	Project Management			2			
SEEN460	Environmental Engineering			3			
Total Fall Semester		3		11	3		17
Spring Semester							
ECON300	Basic Economics	3					
SEEN421	Wind and Biomass Energy			3			
SEEN425	Geothermal Energy			3			
SEEN422	Wind Energy Lab			1		Yes	
SEEN430	Engineering Programming			3			
SEEN435	Simulation & Modeling of Energy Sys.			3			
Total Spring Semester		3		13			16
Summer Semester							
SEEN400	Internship II			1			
Total Summer Semester				1			1
Total Fourth Year		6		25	3		34

Fifth Year

Fall Semester							
Code	Course Title	Credit Hours				LAB	Total Cr. Hrs.
		UR	FR	PR	PE		
SEEN510	Economics of Energy Markets			3			
SEEN325	Applied Mathematics for Engineering			3			
PHIL302	Issues in Philosophy and Ethics			2			
SEEN389	Seminar	3					
Total Fall Semester		3		8			11
Spring Semester							
POLS300	Political Science (Or replacement)	3					
Elective	Program Elective Course				3		
Elective	Program Elective Course				3		
SEEN500	Graduation Project			4			
Total Spring Semester		3		4	6		13
Total Fifth Year		6		12	6		24

Summary of Distribution of Credit Hours

Academic Year	Credit Hours				# of LABS	Total Cr. Hrs.
	UR	FR	PR	PE		
First Year	7	18	7		2 Labs	32
Second Year	12	4	22		4 Labs	38
Third Year	3	3	23	3	1 Lab	32
Fourth Year	6		25	3	1 Lab	34
Fifth Year	6		12	6		24
Total	34	25	89	12	8 Labs	160

Courses Description

SEEN101 - Engineering Design

3 Credit Hours

Pre-Requisite - None

The course will teach students to produce great designs, be a more effective engineer, and communicate with high emotional and intellectual impact. This project based course gives students the ability to understand, contextualize, and analyze engineering designs and systems. By learning and applying design thinking, students will more effectively solve problems in any domain.

SEEN102 - Engineering Workshop

1 Credit Hour

Pre-Requisite - None

This course intends to impart basic know-how of various hand tools and their use in different sections of manufacturing. Irrespective of branch, the use of workshop practices in day to day industrial as well domestic life helps to dissolve the problems.

SEEN104 - Introduction to Renewable Energy

3 Credit Hours

Pre-Requisite - PHYS131

The course will introduce students to the followings: Principles of energy and energy resources; renewable and non-renewable, the importance of sustainable energy systems and their impact on the environment, hydro-power energy conversion principles, technical means and limitations, geothermal energy use and possible future trends, biomass as sustainable energy resources, its different types, and the technical processes for energy conversion, solar energy concept and its conversion to power; whether directly (PV) or indirectly (thermal systems), applications of solar energy and integration of solar energy into buildings, the wind energy resources and its limitations, technical concept an energy conversion and wind energy analysis, energy management and energy efficiency and their integration with sustainable energy for sustainable development, energy audit as a tool in energy management and international recognized codes and standards (i.e. LEED) as energy management tools.

SEEN133 - Electromagnetism

3 Credit Hours

Pre-Requisite - PHYS132

Review of vector analysis, Stokes' theorem and Divergence theorem, Electrical field intensity, Gauss's law and electrical field theorems, Magnetic field theorems, Faraday's law, Maxwell's equations, Solutions to Electric and Magnetic Field problems, Engineering Applications.

SEEN201 - Electricity

3 Credit Hours

Pre-Requisite - PHYS132

This course covers electrical units and their measurement. Conductors and insulators are described. Basic types of electrical sources and loads are studied. Circuit diagrams are interpreted. Basic DC and AC circuits are analyzed. The response of resistors, capacitors, and coils are examined.

SEEN202 - Electricity Lab

1 Credit Hour

Pre-Requisite - PHYS132

This course introduces students to both passive and active electronic components (op-amps, 555 timers, TTL digital circuits). Basic analog and digital circuits and theory of operation are covered. The labs allow the students to master the use of electronic instruments and construct and/or solder several circuits. The labs also reinforce the concepts discussed in class with a hands-on approach and allow the students to gain significant experience with electrical instruments such as function generators, digital multimeters, oscilloscopes, logic analyzers and power supplies. In the last lab, the students build an electronic circuit that they can keep. The course is geared to freshmen and others who want an introduction to electronics circuits.

SEEN203 - Solar Cells Lab**1 Credit Hour****Pre-Requisite - SEEN104**

In this course, you will learn about the fundamentals of photoelectric conversion: charge excitation, conduction, separation, and collection. You will become familiar with commercial and emerging photo-voltaic (PV) technologies and various cross-cutting themes in PV: conversion efficiencies, loss mechanisms, characterization, manufacturing, systems, reliability, life-cycle analysis, and risk analysis.

SEEN204 - Thermal Solar Energy**3 Credit Hours****Pre-Requisite - SEEN104**

The course will focus on an understanding of the practical applications of solar energy utilization. A variety of subject matter encompassing concepts from different fields such as architecture and design, physics, geosciences, mathematics engineering and the social sciences will be presented helping students to integrate previously acquired knowledge and experience with new knowledge. Learning activities have been structured so that students can investigate and apply new knowledge toward the identification and possible solution of issues and problems surrounding the solar field.

SEEN205 - Electronics I**3 Credit Hours****Pre-Requisite - PHYS132**

This course introduces basic signal, spectrum, and amplifier concepts for the analog electronic circuits. The electronic devices including diodes, bipolar junction transistors (BJTs), and Operational Amplifiers (Op-Amps) will be discussed.

SEEN206 - Electronics Lab I**1 Credit Hour****Pre-Requisite - PHYS132**

The course offers Laboratory experiments and projects in the testing and design of analog and mixed-signal electronic circuits.

SEEN208 - Probability and Statistics**3 Credit Hours****Pre-Requisite - MATH142**

Topics covered are: review of descriptive statistics and basic probability, Bayes' theorem; random variables, commonly used discrete and continuous distributions including Bernoulli, binomial, geometric, hypergeometric, Poisson, uniform, exponential, normal, log-normal, the Poisson process, linear combinations of random variables, central limit theorem; inference for normal means, hypothesis tests, type 1 and type 2 error rates, confidence intervals, single sample, two independent samples, paired samples, inference for proportions; SPC, the Xbar chart, control limits, runs rules, process capability, general control charts, cusum charts; regression and correlation, simple linear regression, least squares estimation, inference for regression coefficients, prediction and estimation, regression diagnostics; multiple linear regression, least squares estimation, inference, prediction and estimation, diagnostics.

SEEN220 - Electronics (Power)**3 Credit Hours****Pre-Requisite - SEEN220**

This course introduces the basic concepts of switched-mode converter circuits for controlling and converting electrical power with high efficiency. Principles of converter circuit analysis are introduced, and are developed for finding the steady state voltages, current, and efficiency of power converters. Assignments include simulation of a dc-dc converter, analysis of an inverting dc-dc converter, and modeling and efficiency analysis of an electric vehicle system and of a USB power regulator.

SEEN221 - Electronics Lab (Power) II**1 Credit Hour****Pre-Requisite - SEEN205 and SEEN206**

In this laboratory, the fundamentals of power electronics will be illustrated in practice. Students will be building different kinds of circuits in order to convert between AC and DC. Students are expected to apply the theoretical principle you learn in lectures, validate them by simulation using LTspice software and finally build them.

SEEN230 - Material Science**3 Credit Hours****Pre-Requisite - PHYS132**

The course will introduce the student to the fundamental concepts of Materials Science and Engineering which will be used as background knowledge for the understanding of specialized design for the applications in the field of energy engineering. Thus this course provides an introduction to the type of materials, structure, properties, characteristics and applications, with special emphasis on the relationships between internal structure and properties.

SEEN235 - Introduction to Linear Algebra**3 Credit Hours****Pre-Requisite - MATH142**

The course teaches students, Linear equations, matrices, determinants, vector spaces and sub-spaces, linear transformation, eigenvalues and eigenvectors, similarity of square matrices, diagonalization. This is essential as a prerequisite course to the applied mathematics for engineers course AND the engineering programming course. The course is important in solving electric circuit problems and in understanding the application to rotating magnetic fields.

SEEN301 - Thermal and Fluid Engineering**3 Credit Hours****Pre-Requisite - PHYS132**

The course combines the traditional thermal disciplines in Thermodynamics, heat transfer and fluid mechanics into one integrated subject: Design and analysis of thermal systems. Case studies based on real-world thermal systems will be used throughout the class to illustrate the connection between these interdisciplinary subjects.

SEEN302 - Fluid Mechanics Lab**1 Credit Hour****Pre-Requisite - PHYS132**

The course is an Introduction to fluid mechanics laboratory and design of experiments, including experiments on flow patterns, velocity profile in an air pipe, wind tunnel calibration, draining of a tank, pipe friction, drag forces, boundary- layer studies, falling-ball experiments, and measurements of fluid properties.

SEEN304 - Energy Conservation Efficiency**3 Credit Hours****Pre-Requisite - SEEN230**

This course is designed to give students the skills to identify and understand energy efficiency and conservation methods used to reduce energy consumption in the built environment. Students will analyze residential and commercial facilities for opportunities to employ these energy saving measures. Students will become familiar with the use of energy monitoring and measuring equipment used for energy auditing. Students will also learn to calculate energy savings and determine environmental impacts of these energy saving methods.

SEEN305 – Applied Mathematics for Engineering**3 Credit Hours****Pre-Requisite - MATH142**

Vectors in space; multivariable function, multivariable functions, partial derivatives and multiple integrals, vector integral calculus; complex numbers and complex function, Fourier series and partial differential equations; application of Laplace and Z-transforms to electrical control circuits.

SEEN315 - Numerical Analysis**3 Credit Hours****Pre-Requisite - MATH142**

The course discusses solutions of equations in one variable, polynomial approximation, numerical differentiation and integration, initial value problems for ordinary differential equations, linear systems, iterative technique, and numerical solutions to partial differential equations are covered in the course.

SEEN321 - Theory of Machines and Mechanisms**3 Credit Hours****Pre-Requisite - SEEN301 and SEEN220**

The course includes mainly the study of the design of machines based on kinematic and kinetic requirements. Machine elements considered include linkages, cams, and engines. Presents inertia force analysis as a base for the dynamic balancing of rotating machinery. Students conduct lab experiments and design and construct mechanism models.

SEEN401 - Automation and Industrial Control**3 Credit Hours****Pre-Requisite - SEEN220**

The course discusses applications of industrial automation systems, including identification of system requirements, equipment integration, motors, controllers, and sensors. Coverage of set-up, maintenance, and testing of the automated system.

SEEN410 - Advanced Chemistry for Energy Applications**3 Credit Hours****Pre-Requisite - CHEM132**

As an overview, the course discusses the hydrogen economy, Water electrolysis technologies, Hydrogen purification, transport and storage, Fuel Cells and other chemical energy vectors.

SEEN421 - Wind and Biomass Energy**3 Credit Hours****Pre-Requisite - SEEN301**

This course provides an overview of industrial wind turbine operation and maintenance. Topics include rotor design and aerodynamics, tower and turbine safety, instrumentation and control systems. Also covered are turbine testing, operation, and routine maintenance of electro-mechanical systems, environmental considerations, and current and future trends in wind turbine design.

SEEN422 - Wind Energy Lab**1 Credit Hour****Pre-Requisite - SEEN301**

The course explores how wind turbines can be used to generate electricity. It intends to teach students how to use electricity generated by a wind turbine to light a LED. Build and understand basic circuits. Verify that energy is transferred by electric currents.

SEEN425 - Geothermal Energy**3 Credit Hours****Pre-Requisite - SEEN301**

The course introduces students to geothermal energy: deep and shallow system, occurrence, Heat transport: free and forced convection, conduction processes, heat transport Deep geothermal systems: Tectonics and geological context, geothermal gradient. In addition to exploitation of high-temperature geothermal systems, sustainability and challenges. Shallow and low- temperature geothermal systems: principle of low-temperature, open and closed systems, introduction to heat pumps, sustainability and conflicting use of groundwater.

SEEN430 - Engineering Programming**3 Credit Hours****Pre-Requisite - SWER141**

Introduces the fundamental concepts of procedural programming. Topics include data types, control structures, functions, arrays, files, and the mechanics of running, testing, and debugging.

This course covers introductory programming and problem solving in MATLAB and C or Fortran. Algorithms and problem-solving: Problem-solving strategies; the role of algorithms in the problem-solving process; implementation strategies for algorithms; debugging strategies; the concept and properties of algorithms. Fundamental programming constructs: Syntax and semantics of a higher-level language; variables, types, expressions, and assignment; simple I/O; conditional and iterative control structures; functions and parameter passing; structured decomposition. Fundamental data structures: Primitive types; arrays; records; strings and string processing. Software development methodology: Fundamental design concepts and principles; testing and debugging strategies; test-case design (black box testing and requirements testing); unit testing; programming environments.

SEEN435 - Simulation and Modeling of Energy Systems

3 Credit Hours

Pre-Requisite - SWER141

The purpose of this course is to provide fundamental knowledge of building sciences for the development of high-performance buildings utilizing energy modeling and simulation technology as an energy performance analysis. Occupant comfort is also assessed using the simulation technology. Students calculate the energy consumption of heating, cooling, lighting, and other equipment by hand to understand the energy & thermal behavior of buildings, then compare and analyze these calculations with others calculated using energy modeling and simulation programs. Architecture and engineering students work together in this course, exchanging knowledge and collaborating to develop high-performance buildings, resulting in energy savings and environmental protections through greenhouse gas emission reductions.

SEEN460 - Environmental Engineering

3 Credit Hours

Pre-Requisite - CHEM132 and SEEN104

This course presents a broad introduction to Environmental Engineering. A set of fundamental principles that serves as the foundation for the entire field of environmental engineers will be overviewed. These principles are based on scientific fundamentals: chemistry, biology, physics, and mathematics. This course explores how these fundamental principles are applied. Applications are selected from water quality engineering, air quality engineering, and hazardous waste management. The main elements of assessing environmental impacts of human activities, projects and plans will be explained. Students will conduct an environmental impact assessment and apply environmental design techniques for a specific problem definition.

SEEN389 - Seminar

2 Credit Hours

Pre-Requisite - None

Students in the last year will prepare a Seminar to engage in valuable and relevant engineering design projects in the field of energy engineering and student will give a presentation in front of the faculty members and specialized people.

SEEN500 - Graduation Project

4 Credit Hours

Pre-Requisite - None

Graduation project leading to BSc. Degree in SEEN will be arranged between a student, a faculty member and an external company (could be governmental). The aim of the project must be the following: application of new scientific methods for solving different energy engineering problems, including analysis and investigation of opening new research areas in this field.

SEEN510 - Economics of Energy Markets

3 Credit Hours

Pre-Requisite - ECON300 or ENTR300

This course builds understanding of the global energy situation, energy and climate policies, and the market outlook for various energy carriers. Coverage includes conventional power generation, wind power, solar energy, oil and natural gas. Drivers of demand, supply and price formation will be explored, including their relationship to resource scarcity, technology and innovation, economic

factors, and policy variables. Finally, the course explores the macro-economics of energy market developments for importers and exporters of energy resources.

BUSA210 - Introduction to Business Management

3 Credit Hours

Pre-Requisite - None

This course involves a review of the principles of management. It aims to provide a framework for the orderly presentation of basic facts in business management, utilizing the functions of the manager with respect to planning, organizing, staffing, directing, and controlling.

ENTR320 - Project Management

2 Credit Hours

Pre-Requisite - BUSA210

This course guides students through fundamental project management concepts and behavioral skills needed to successfully launch, lead, and realize benefits from projects in profit and non-profit organizations. Successful project managers skillfully manage their resources, schedules, risks, and scope to produce a desired outcome. In this course, students explore project management with a practical, hands-on approach through case studies and class exercises. A key and often overlooked challenge for project managers is the ability to manage without influence—to gain the support of stakeholders and access to resources not directly under their control. Special attention is given to critical success factors required to overcome resistance to change. We will review causes of project failure and how to mitigate risks through proper planning in the early phases of a new initiative.

Elective courses description

SEEN105 - Industrial Manufacturing

3 Credit Hours

Pre-Requisite - SEEN321 or simultaneous

The course is an introduction to manufacturing systems and manufacturing processes including assembly, machining, injection molding, casting, thermoforming, and more. Emphasis on the relationship between physics and randomness to quality, rate, cost, and flexibility. Attention to the relationship between the process and the system, and the process and part design. Project (in small groups) requires fabrication (and some design) of a product using several different processes.

SEEN106 - Computer Graphics and Multimedia

3 Credit Hours

Pre-Requisite - SWER141

Basic principles and techniques for computer graphics on modern graphics hardware. Students will gain experience in interactive computer graphics using the OpenGL API. Topics include: 2D viewing, 3D viewing, perspective, lighting, and geometry.

SEEN235 - Materials for Energy

3 Credit Hours

Pre-Requisite - SEEN230

This course is intended as a review of the challenges facing materials scientists working in sustainable energy and sustainability science and technology. It aims to give the student a birds-eye view of the current topics in energy harvesting and storage materials. The potential of various energy harvesting approaches will be discussed in the context of energy needs facing the world. This will be done with particular focus on materials innovations required to improve the state of the art. After this thorough introduction, the course will discuss solar power and electrochemical energy storage in more depth.

SEEN308 - Electrical Energy Storage

3 Credit Hours

Pre-Requisite - SEEN104 and SEEN220

Topics covered in the course include major components, typical architectures, storage types, operating states, planning, inspection and testing, design, specification, modeling and safety. The course also looks at Electrical Energy Storage Systems operation and maintenance, handover and documentation, and network connection/DNO approval.

SEEN322 - Hydraulic Wave Energy

3 Credit Hours

Pre-Requisite - SEEN301

The course overview in details Fluids and Fluid flow, Hydraulic and air system implementations, Installation and modeling of principles of performance, function and applications of hydraulic and air component, Valves, cylinders and pumps, linear and circular motion control circuits, design principles and implementation in hydraulic and air systems. Systems and devices of hydraulic energy generation, the transfer and control of energy, drawing and installation, Circuit and hydraulic systems, Performance improvements for the systems in Industrial processes.

SEEN400 - Special Topics in Sustainable Energy

3 Credit Hours

Pre-Requisite - SEEN104

The course gives an overall introduction to energy issues as they relate to generation, delivery, conversion and efficiency. Topics include efficiencies of both new and established energy generation and conversion methods; electricity generation by fossil fuels, nuclear, solar, wind and hydro-power; and alternative energy technologies. Other topics include space heating and cooling by traditional methods and by solar, transportation energy in automobiles, mass transit and freight. Topics are evaluated quantitatively by modeling and using principles of fluid mechanics, thermodynamics and heat transfer. The environmental consequences of energy choices on local, national and global scales, including toxic emissions, greenhouse gases and resource depletion are also discussed and integrated throughout the course.

SEEN420 - Nanotechnology**3 Credit Hours****Pre-Requisite - SEEN230**

This course introduces the fundamentals of nano-scale engineering and manufacturing. Current and future applications of nanostructured materials will be reviewed with respect to their impact in commercial products and technologies. Particular emphasis will be placed in biomedical applications. The main physical forces controlling the nucleation and deposition of nanostructures will be presented allowing a better understanding of key design factors at the nano-scale. Well-established and novel synthesis/fabrication methods nanostructures will be critically discussed giving a broad overview of the state-of-the-art nano-manufacturing processes. Standard characterization methods will be elucidated using various examples and exercises throughout the course.

SEEN428 - Bioenergy Systems**3 Credit Hours****Pre-Requisite - SEEN104 and CHEM132**

The course provides an introductory understanding to biomass, biomass to low-carbon energy systems including bio-power, bio-heat and biofuels, with a scientific examination of feedstocks, conversion technologies and scale up for industrial production, end products, and their applications. The course will also provide entry level understanding of the concepts of sustainability, systems thinking and Life Cycle Analysis (LCA) and incorporation of these concepts into bioenergy systems. The class will explore the potential advantages of low-carbon energy in developing a low-carbon economy and society. The class may also include a tour of the EcoComplex, "Clean Energy Innovation Center and Business Incubator".

SEEN429 - Power Electronics**3 Credit Hours****Pre-Requisite - SEEN220**

The course examines the application of electronics to energy conversion and control. Topics covered include: modeling, analysis, and control techniques; design of power circuits including inverters, rectifiers, and DC-DC converters; analysis and design of magnetic components and filters; and characteristics of power semiconductor devices. Numerous application examples will be presented such as motion control systems, power supplies, and radio-frequency power amplifiers.

SEEN432 - Advanced Object Oriented Programming**3 Credit Hours****Pre-Requisite - SWER141**

This course investigates object-oriented methods including object-oriented programming, analysis and design. Current methodology is emphasized. The use of object-oriented features such as encapsulation, information hiding, inheritance and polymorphism is reinforced by class assignments and programming exercises.

SEEN433 - Energy Web Technologies**3 Credit Hours****Pre-Requisite - SWER141**

The aim of the course is to give students basic knowledge of central energy technologies. This includes how the systems function, how they can be evaluated quantitatively, what they cost and what is their benefits for or effects on the natural environment. A secondary aim is to give the students an overview of the contexts in which these systems are used and developed today and in the future.

SEEN502 - Energy Legislation**3 Credit Hours****Pre-Requisite - ECON300**

The primary objective of the class includes providing a high-level survey of laws and policies related to the generation, transmission, sale, and use of energy resources, with a particular focus on electricity and state jurisdictional boundaries.

SEEN503 - Scientific research methods**3 Credit Hours****Pre-Requisite - None**

The course covers concepts of science, scientific research, basics of scientific approach, and literature review. It introduces how research problems and hypotheses are selected, defined, stated and evaluated. It also presents the main components of proposal writing. The course then focuses on experimental research approach and experimentation as a tool for obtaining data. In addition, it demonstrates the main route of descriptive approach and its tools including observation and questionnaire.

SEEN504 - Transmission Lines and Field**3 Credit Hours****Pre-Requisite - SEEN133**

Time varying fields in Maxwell's equations; Plane Electromagnetic field; transverse and reflection. Transmission lines theory. Fundamentals of the electromagnetic model are developed for electric and magnetic fields, for the propagation of electromagnetic waves in various media and for reflection and refraction at material interfaces. Basic applications of the model to transmission lines, waveguides, and radiating systems are developed.