# The British University in Egypt

## Faculty of Energy and Environmental Engineering

## (Bachelor of Science Bylaw)


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# Part A: Introduction

The British University in Egypt (BUE) was established in accordance with the provisions of law No. 101/1992 regulating private universities. The University has a special legal personality and is represented by the University president. The President of the Arab Republic of Egypt issued Decree No. 411 of 2004 to establish the BUE as a private non-profit Egyptian university.

The British University in Egypt (BUE) is considered an added value to the system of higher education in Egypt as it provides excellent educational opportunities aiming to qualify distinguished new generations in the fields of modern science and technology in Egypt, Africa, and the entire Arab world as per the needs of the current and future job market by striving to achieve the following goals:

- Qualifying a class of graduates specialized in the various fields of technology and the other fields required for the labour market to enable them to accommodate the modern scientific and technological developments, whether by dealing efficiently with, maintaining, or developing the state-of-the-art technology-enhanced tools with the assistance of modern management and information systems.
- Qualifying graduates of faculties and institutes, as per the needs of the labour market, in the fields and specialisations that the University provides.
- Providing postgraduate opportunities for solving problems arising in the industry and in other productive and service units which are keen on keeping pace with the scientific and technological developments.
- Providing a wide range of continuous education and training opportunities for engineers, technicians, administrators, and others who work in the different fields of science to raise the efficiency of their work performance.
- Conducting preliminary studies which aims to raise the efficiency of performance and productivity, save energy, protect the environment, and enhance the other activities necessary for the technological development of the environment and society in various fields.

Accordingly, the President of the Arab Republic of Egypt issued Decree No. 344 of 2015 to establish the Faculty of Energy and Environment Engineering (FEEE) at the BUE.

## Rationale for the Establishment of FEEE at the BUE:

- Expectations of an increase in the demand for graduates specializing in the fields of energy and environmental engineering in the upcoming stage, the matter which requires a prompt action on the part of the educationalists concerned to introduce education systems that meet the current and future demands and needs of society.
- A belief in the role of private universities in enriching the Egyptian educational system with untraditional educational specialisations and systems that keep pace with the new and advanced specialisations of the developed world.
- The need for adopting untraditional teaching and assessment methods based on providing learning opportunities through research and practical projects assigned in the modules of specialisation upon the completion of the mandatory modules.
- The need for exposing undergraduates to diverse scientific backgrounds that are lacking in the specialty modules of other engineering faculties and that create of them a future workforce equipped with solid scientific basis to contribute to advanced areas of energy, design, planning, construction, installation, maintenance, and scientific as well as technological research which aim at ensuring the availability of economical, regular, and renewable energy sources that are open to global technological developments and are capable of making the best use of such developments in Egypt.
- The need for introducing unique learning skills that would qualify the graduates to understand essential economic, administrative and environmental dimensions and would enable them to plan and set up small projects, deal with problems arising from the use of traditional sources of energy, and address the environmental problems resulting from industrial, agricultural, and urban activities.
- The existence of manifold branches of energy specialties involving traditional and renewable energy (wind - solar - nuclear), the matter which makes the inclusion of all these disciplines in one department difficult.
- The adoption of this mainstream by various countries worldwide.

# The Faculty Vision, Mission, and Goals

## Vision of the Faculty

The Faculty of Energy and Environmental Engineering strives to be regionally recognised as a leading institution dedicated to professionalism, research and community development, while offering students and researchers internationally accredited Energy and Environmental Engineering programmes.

## Mission of the Faculty

The Faculty's mission is to provide a broad spectrum of education and research in line with British standards, to work closely with UK and global partners for the purpose of offering internationally recognised quality degrees that enable graduates to develop their knowledge related to Energy and Environmental Engineering and entrepreneurship skills and allow them to contribute to community development.

## Faculty Goals

1. Providing a high-quality educational and research environment that is capable of attracting distinguished students to assist them in receiving education, conducting scientific research, and transferring skills and knowledge in order for them to be creative society members who are capable of facing challenges.
2. Graduating students with high academic levels, professional behavior and high moral commitment in addition to providing them with the intellectual, analytical and innovative abilities as well as practical skills needed in the fields of engineering sciences and practical and technical applications in order for them to be capable of rendering community services and developing the environment.
3. Being a leading centre for scientific research in Egypt and the Middle East region in the various fields of energy engineering as well as environmental engineering through its openness to the world and partnership with internationally distinguished institutions in the various energy fields.
4. Providing advisory services to the engineering sector and the society in the various fields of energy engineering, studying the impact of such services on the environment, and providing high-quality expertise to stimulate and support

innovative solutions, knowledge transfer, and cooperation to endorse economic development.

5. Ensuring the availability of the structures and mechanisms necessary for supporting the academic ambition and success.
6. Studying community needs and developing educational programmes on an ongoing and periodic basis to keep pace with technological developments and to face challenges for achieving the entire needs of society in the fields of energy and environmental engineering.

## The Faculty's Competitive Edge

- Modern study programmes that are compatible with the needs of the labour market in the fields of energy engineering (traditional and renewable) and the environment.
- Unique educational specialisations and systems that keep pace with the new and advanced disciplines in the developed world.
- Variety of scientific backgrounds and uniquely offered modules which are unavailable in other faculties of engineering.
- Latest software used in energy and environmental engineering sciences.
- Field training programmes for students inside and outside Egypt.
- Practice-based scientific curricula.
- Graduation projects that enhance the students' research and self-learning skills.

## General Qualities of the Faculty Graduates

The Faculty graduates will be able to:

- Apply their knowledge in mathematics, science, and engineering to solve sophisticated engineering problems.
- Conduct experiments, perform data analysis, and interpret data.
- Design systems, components, or processes to fulfil the needs in demand.
- Work in teams of multiple specialisations.
- Comprehend the professional and moral responsibilities.
- Communicate effectively.

- Avoid the harmful impact of some engineering solutions nationally and internationally.
- Use the most updated necessary engineering technologies, potentials, and tools.

The aforementioned qualities are revealed in the graduates' knowledge and understanding, and in their cognitive, practical, transferrable, and acquired skills that the entire module specifications of the Faculty address.

## Article (1) The Faculty Departments

The Faculty of Energy and Environmental Engineering at the British University in Egypt consists of the following **scientific departments**:

1. Renewable Energy Engineering
2. Biochemical Engineering
3. Petroleum Engineering and Gas Technology
4. Environmental Sustainable Architecture Engineering
5. Basic Sciences

## Article (2) Degrees Awarded

The British University in Egypt award, upon the request of the Faculty Council, a Bachelor of Science (B.Sc.) in Engineering in one of the following specialisations:

1. Renewable Energy Engineering
    a. Renewable Energy Engineering - Mechanical Power.
    b. Renewable Energy Engineering-Electrical Energy.
2. Biochemical Engineering
3. Petroleum Engineering and Gas Technology
4. Environmental Sustainable Architecture Engineering

- The Faculty has future plans for developing postgraduate programmes in energy and environmental engineering, establishing a number of research centres that develop scientific research and serve the community and that are consistent with the general strategy of Egypt, the Middle East, and the North Africa region in the field of energy,

in general, and renewable energy, in particular, in addition to the field of environmental engineering.

- The basic organizational structure of the Department of Renewable Energy Engineering will include professors specialising in the field of new and renewable energy engineering (mechanical power, wind energy, solar thermal energy, electric energy, photovoltaic energy, electric energy transmission, and thermal fluid mechanics).
- The basic organisational structure of the Department of Biochemical Engineering will include professors specialising in the field of biochemical engineering (biomass energy, biofuel energy, and bio-product energy, etc.)

## Article (3) International Agreements

All the Faculty of Energy and Environmental Engineering programmes are partnered with UK university by offering double degrees.

# Part B: Admission Regulations and Academic System (Two Semesters)

## Definitions and Terminology

**The academic year**: two semesters, the first and second semesters.

**The academic semester**: a period of time not less than fifteen weeks during which the academic modules are studied.

**Academic level**: It denotes the stage of study according to the approved study plans.

**The study plan**: It is a set of compulsory and optional modules, the sum of which forms the graduation requirements that the student must pass successfully to obtain the academic degree in the specified specialty.

**The major programme**: It is the field of study that the student passes and specialises in to obtain a bachelor's degree, considering the requirements of each academic programme with regard to the student's achievement level or to his success in passing some modules or in passing the agreed upon aptitude admission test.

**The academic module**: a subject within the approved study plan of each major. Each academic module is given a number, code (code), name, and detailed specification where the module's overview, objectives, content, and intended learning outcomes are explained. Moreover, a special file for each module is prepared at the end of each semester for the purpose of follow-up, evaluation, and development.

## Article (4): Language of Study

The English language is the language of study in the Faculty's entire scientific specialisations.

## Article (5): Study System

The academic year consists of two semesters where 6 modules are delivered per semester.

## Article (6): Registration Conditions

- Registration is permitted for Egyptian and foreign students, of the mathematics division or its equivalent, who passed Thanaweya Amma with a minimum score that is specified by the Council of Private Universities and the University Council annually. Registration is also permitted for students who transferred from other faculties with not less than the Thanaweya Amma or its equivalent minimum score which is accepted by the Engineering Studies Sector and in accordance with the conditions set by the Supreme Council of Universities.
- The Faculty establishes general rules for admission where the student's interest and the principle of equal opportunities are a top priority. The regulations of the University and its faculties specify the other conditions that must be met for the admission of students as well as the conditions required to award any of the academic degrees referred to according to the relevant stage.
- Registration is permitted for holders of technical certificates upon the approval of the Engineering Studies Sector Committee and the Supreme Council of Universities, in accordance with the regulating rules.

## Article (7): Study Grades

- The general evaluation of the students' success in each degree year is calculated according to the grades they obtain as per the system specified by the University's general academic regulations, taking into account that their grade does not exceed "pass" in the module which he has previously failed or was absent in without an acceptable excuse. But if a student was absent with an acceptable excuse, he/she passes the module.

- The grades of each student per an academic year equal the total grades obtained in the two semesters of this year.

-The student's success in the undergraduate modules is expressed by one of the following letter grades: D, C, B, A. The following table shows the equivalent percentages for each letter grade.

| Degree Class | Percentage | Letter Grade |
|---|---|---|
| Excellent | 85-100 | A |
| Very Good | 75-84 | B |
| Good | 65-74 | C |
| Pass | 50-64 | D |

- The student's failing is expressed in the following two degree classes:

| Degree Class | Percentage | Letter Grade |
|---|---|---|
| Poor | 30- 49 | F |
| Extremely Poor | 29 | |

For UK accreditation and equivalence purposes, the marking scheme for all assessments, and the honours classifications, are as follows. The right hand column shows Egyptian equivalent grades against their UK degree class.

| UK Degree Class | Egyptian Grade Band |
|---|---|
| First Class | A+, A, A- |
| Second Class, Division One | B+, B, B- |
| Second Class, Division Two | C+, C, C- |
| Third Class | D+, D, D- |
| Fail | F |

## Article (8): Class Honours & Awards of Excellence

- Class honours is awarded to the student whose general grade is very good throughout the entire study years except for the prep year. The student is awarded class honours only if he/she does not fail any module throughout his/her study years at the Faculty.
- Awards of excellence are calculated as per the accumulative score as follows:

| Grade in Percentage % | Fees Discounts (%) |
|---|---|
| From 75- 78 | 20% |
| From 79- 81 | 25% |
| From 82-84 | 30% |
| From 85-86 | 35% |
| From 87-88 | 40% |
| Above 89 | 45% |
| Ranking the First (Cohort or Major) | 100% |

The following fees discounts are carried out for Thanaweya Amma students as follows:

| Grade in Percentage | Fees Deductions (%) |
|---|---|
| From 85- 89.9% | 10% |
| From 90-94.5% | 20% |
| From 95-99.9% | 30% |
| 100% and above | 40% |

## Article (9): Examination System

- The marks of each module are distributed in percentages between coursework- including exercises, reports, projects, in-class tests, laboratory reports, or oral assessment- mid-term exam, and final written exam. All of this is done according to the assessment strategy of each module separately.
- In internship modules where students receive corporate training, the student's work is assessed and the training grades are added to the GPA.
- Students must attend 75% of the module sessions in order for them to be allowed to take any module exam. Upon the request of the Department Councils of different specialties, the Faculty Council bars the student from taking the final module exam if he does not attend 75% of the module's sessions in the semester.
- The student passes a module if his/her total module score is at least 50%, provided that he obtains 40% of the final exam score.
- The Faculty Council may, upon taking the opinion of the relevant Department Council and according to the nature of the academic modules, decide to hold the examination in one or more modules, and it is also permissible to hold the examination in the whole module or part of it in a way that allows it to be corrected electronically, provided that a request is submitted to the University's Council of teaching and learning which will then approve and submit it to the University board for final approval.

## Article (10): Conditions for obtaining a bachelor's degree

In order to obtain a bachelor's degree from the Faculty of Energy and Environmental Engineering, the student must:

- pass all academic modules.
- pass the two graduation projects (the design project and the research project).
- pass the mandatory summer training modules.

## Article (11): Academic Modules

- The Teaching and Learning Committee reviews the mandatory and optional modules in all specialties and may assign other members in the various specialties to give feedback before presenting the modules to the Faculty Council.
- The Faculty Council determines the minimum number of students registered for each optional module.
- Each department issues a brief including the specifications of its programme and modules per each semester of the Faculty's entire academic years.
- The specification of each scientific programme includes an introduction to the programme and its management, the goal of the programme, the characteristics of the graduate and the intended learning outcomes that the graduate must acquire, the structure of modules, the academic standards adopted, assessment methods, and student support methods.
- The specification of each module includes an introduction to the module, the objective of the module, the intended learning outcomes that the student should acquire at the end of teaching this module, the module content, teaching and learning methods, assessment methods, and a reference list.
- Each educational programme creates a matrix that demonstrates the acquisition of the various skills required for the graduate (the programme matrix with the modules), taking into account the general skills needed for engineers and specified in the accreditation requirements for the National Authority for Quality Assurance and Accreditation model.

## Article (12): Study Plan

- Studying in the Faculty is a two-semester system. The internal bylaws of the departments indicate the various study materials, the distribution of the compulsory and the elective modules among the academic levels for the different departments, and the number of the assigned credit hours. In light of the suggestions offered by the relevant departments' councils, the college determines the scientific content for each module. Consequently, the University Council

issues its approval in the light of the continuous development of the educational process keeping pace with the scientific and technological developments.

- The study plan for a bachelor's degree is offered as a four-year full-time programme in the major/specialisation after the preparatory year.
- The student proceeds from the academic level in which he/she is enrolled to the next one when he/she passes all the modules. The same applies in case the student fails or is absent in no more than two academic modules from the academic level that he/she is enrolled to or a lower academic level.
- If a student fails in one of the humanities modules in addition to two courses in his/her own specialisation, as referred to in the previous item, he/she is allowed to proceed to the next academic level.
- After consulting with the relevant Department Council and according to the nature of the academic modules, the Faculty Council may decide to have one module or more to be delivered using the Blended Learning method, where 60% of the module is covered through online interaction and 40% covered in traditional face-to-face place-based method, provided that this is presented to the University's Student Affairs Council and, consequently, submitted to the University Council for approval.

## Article (13): Programme Dates

- The academic year at the university is based on a two-semester system, each semester consists of 15 weeks.
- The academic year begins in September of each year and ends in June of the following year. The University Council decides on the exact start and end dates of the academic year as well as the mid-year vacation dates.
- The Board of Trustees may decide to start or end the academic year before or after the pre-specified dates, based on what is proposed by the University Council.

## Article (14): Programme Duration

- The study period for a regular student is ten semesters (five years), starting with a general preparatory year for all students, and then the student chooses the

specialisation after that according to his/her desire and the prerequisites of the different departments.

## Article (15): Programme Admission

- Student admission in any of the programmes/specialisations is based on his/her desire as well as the conditions set by the Faculty in case the numbers exceed the planned enrolment numbers set for each programme separately.

## Article (16): Suspension and Re-registration

- A student may apply to suspend his/her registration for a period of an academic level for an excuse acceptable to the Faculty, provided that the registration suspension does not exceed two consecutive or non-consecutive years as a maximum.
- A dismissed student can apply for re-registration, keeping his same ID number and academic records before dismissal, according to the following regulations:
    - To apply for re-registration within two academic years from the date of dismissal.
    - The Faculty Council and the relevant parties agree to re-enrol the student.
    - It is not permissible to re-enrol a student who was dismissed from the University for educational or moral misconduct. The same applies to that whoever was dismissed from another university for moral misconduct. Moreover, if it becomes clear after his/her re-registration that he/she was previously dismissed for such reasons, his/her registration shall be deemed cancelled from the date of re-registration.

## Article (17): Student Transfer and Registration Transfer

Student transfer from the institutes and faculties of national and international universities to the Faculty of Energy and Environmental Engineering at the British University in Egypt is carried out according to the following regulations:

- Year One or preparatory year students are transferred to the Faculty of Energy and Environmental Engineering at the British University in Egypt if they have obtained the Egyptian General Secondary Education Certificate or its equivalent with the minimum required marks; the same students should also meet the Faculty's admission requirements and any other Faculty Council decisions regarding student transfer.
- Students enrolled in higher academic levels may be transferred to the Faculty of Energy and Environmental Engineering in the same or a different academic level upon equating the credits of the modules they already studied in another university with the credits of the specialised scientific programmes offered by the Faculty. The student may also take or be exempted from the examinations in any modules according to the decision of the Scientific Committee of Equating Credits as per the study plan decided by the Faculty Council, the general academic regulations of the university, and in accordance with any other regulations approved by the Faculty Council.
- A transferred student from any other university is enrolled as a new student in the academic level to which he/she is assigned to. The student's failed years are calculated starting from his/her enrolment date in the British University in Egypt regardless his/her enrolment status in his/her previous university.
- A decision approving the student transfer or the registration transfer shall be issued by the President of the University or his deputy.

## Article (18): Foreign Students Admission and Transfer

- The minimum admission score for international students at the university is the nominal total of marks in equivalent certificates, provided that these marks are not less than the prescribed minimum, in addition to any other prerequisites determined by both the Faculty and the university.
- Admission applications are submitted directly to the admission office for inspecting the prerequisites according to the governing procedures.
- It is permissible to accept transfer students coming from foreign and Egyptian universities and institutes according to the transfer regulations applied to Egyptian students.

- International students are accepted and transferred according to the terms and conditions set by the Egyptian Supreme Council of Universities for both private and governmental universities.

## Article (19): Graduation Projects

- Year Four students prepare two graduation projects; the first one is a research project (individual) and the second one is a design project (collective). The relevant departments' councils decide on the suggested research topics taking into account associating these graduation projects with industry and community services.
- Students submit their graduation projects a month after completing their final exams.
- The two graduation projects are evaluated/assessed by committees consisting of external members.
- Graduation projects are assessed as follows: 50% based on the student's coursework and 50% based on a project presentation and discussion at the end of the year.

## Article (20): Field Training and Internships

- Year Two and Year Three students receive at least two field trainings/internships in all specialisations.
- By the end of the field training/internship, the student submits a report on the acquired skills and knowledge.
- The student presents a report to a committee formed from each scientific department and includes a representative from the industry to assess, discuss, and verify the skills acquired during the internship.

## Article (21): Academic Misconduct and Programme Dismissal

- Reference is to be made to the Student Handbook that is issued annually by the university regarding the rules and regulations for student discipline. For further

regulations, reference is to be made to the provisions of the Universities Organization Law.

## Article (22): Academic Programme Components

- The academic programmes include modules which are divided according to the qualitative distribution of the terms of reference for the 2020 undergraduate regulations set by the Egyptian Supreme Council of Universities which align with the undergraduate's required skills and knowledge, which include social sciences, business administration, mathematics and basic sciences, engineering culture, basic engineering sciences, engineering applications and design, and project and field training.
- According to the percentages specified in the frame of reference, the modules included in each academic programme should meet the requirements of the university, Faculty, general specialization, and the precise specialisation.
- The programmes and modules include all the points mentioned in the reference framework for preparing study programmes for the undergraduate level in the faculties of engineering (2020).

## Article (23): Quality Unit and Its Responsibilities

- The Faculty Dean has the authority to decide on establishing the Faculty quality unit with a board of directors with the dean of the Faculty as the head of the unit and members from all the scientific departments including representatives from the Faculty staff, administrators, and students.
- This unit is to be concerned with following up on the educational process and writing the annual self-report and the development plan to ensure a continuous improvement according to the model prepared by the National Authority for Quality Assurance and Accreditation of Education. Moreover, the unit will work spreading the culture of quality to all Faculty members.

## Article (24): The Academic Curricula Code System

The academic curricula code system (e.g., 2BES011) includes the following:

- The first number on the left side is a variable number indicating the department in which this module is taught.
- Followed by three letters indicating the department of the module.
- Followed by a number indicating the academic level in which the module is taught.
- Followed by a number indicating the semester in which the module is taught.
- Followed by a number indicating the module's ranking/position among the modules of the same level.

**The following is a table showing the code system for the undergraduate level at the Faculty of Energy and Environmental Engineering at the British University in Egypt:**

| | | **Code** |
|---|---|---|
| 1. | Renewable Energy Engineering<br>- Mechanical Power<br>- Electrical Energy | REN<br>RENM<br>RENE |
| 2. | Biochemical Engineering | BIO |
| 3. | Petroleum Engineering and Gas Technology | PET |
| 4. | Environmental Sustainable Architecture Engineering | ESA |
| 5. | Basic Sciences | BAS |
| 6. | Basic Engineering Sciences | BES |

## Article (25): The National Academic Reference Standards (NARS)

- The Faculty adopts the National Academic Reference Standards (2018) in addition to the academic standards applied in the United Kingdom so that all the Faculty programmes are compatible with the national and international systems.

## Article (26): Additional Regulations

- Any matter not stipulated herein or in the bylaw of the British University in Egypt shall be settled by virtue of the provisions of the Universities Regulation Law.

## Article (27): Student Transfer and Registration Transfer among Faculty Programmes

- The student can transfer from one programme to another within the Faculty according to the Faculty internal rules which are approved by the Faculty Council every year taken into consideration the necessary equating procedures.

# Part C: Study plan for Academic Programmes (Two-Semester System)

1. Renewable Energy Engineering:
    a. Mechanical Power Engineering
    b. Electrical Energy Engineering
2. Biochemical Engineering
3. Petroleum Engineering and Gas Technology
4. Environmental Sustainable Architecture Engineering

# (Renewable Energy Engineering –Mechanical Power)

| | | Semester 1 | Lec | Tut | Lab | Cr | ECTS | SWL | | Semester 2 | Lec | Tut | Lab | Cr | ECTS | SWL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preparatory Year | BAS011 | Mathematics (1) | 2 | 2 | -- | 3 | 6 | 150 | BAS021 | Mathematics (2) | 2 | 2 | -- | 3 | 5 | 125 |
| | BAS012 | Physics 1 | 2 | 2 | 2 | 3 | 6 | 150 | BAS022 | Physics 2 | 2 | 2 | 1 | 3 | 6 | 150 |
| | BES013 | Workshop technology | 1 | -- | 3 | 2 | 4 | 100 | BAS023 | Chemistry | 2 | 2 | 2 | 3 | 6 | 150 |
| | BES014 | Engineering design and graphics | 2 | -- | 2 | 2 | 4 | 100 | BES024 | engineering mechanics (1) | 2 | 2 | -- | 3 | 5 | 125 |
| | HUM015 | Energy and human development | 2 | -- | -- | 2 | 3 | 75 | BAS025 | Algebra and Geometry | 2 | 2 | -- | 3 | 5 | 125 |
| | HUM017 | Engineering Ethics and Communications | 2 | 1 | -- | 2 | 4 | 100 | HUM026 | English language | 2 | -- | -- | 2 | 3 | 75 |
| | HUM016 | English language | 2 | -- | -- | 2 | 3 | 75 | | | | | | | | |
| | | | 13 | 5 | 7 | 16 | 30 | 750 | | | 12 | 10 | 3 | 17 | 30 | 750 |
| Year 1 | 1BAS112 | Calculus | 2 | 1 | -- | 2 | 4 | 100 | REN125 | Measurements Lab | 1 | -- | 3 | 2 | 3 | 75 |
| | 1BES113 | Materials Science | 2 | 2 | 1 | 3 | 6 | 150 | 1BES122 | Thermodynamics (1) | 2 | 2 | 1 | 3 | 6 | 150 |
| | 1BES117 | Electrical circuits | 2 | 2 | 1 | 3 | 6 | 150 | 1HUM126 | Computer programming | 1 | -- | 3 | 2 | 3 | 75 |
| | 1BES111 | Introduction to Mechatronics & Measurements | 2 | 1 | -- | 2 | 4 | 100 | 1BES124 | Electrical Machines (1) | 2 | 2 | -- | 3 | 6 | 150 |
| | 1BAS116 | Physical Chemistry | 2 | 1 | -- | 2 | 4 | 100 | 1BAS123 | Differential Equations | 2 | 2 | -- | 3 | 6 | 150 |
| | REN115 | Introduction to Renewable Energy Systems | 2 | -- | -- | 2 | 3 | 75 | 1BAS121 | Physics 3 | 2 | 2 | 1 | 3 | 6 | 150 |
| | 1HUM114 | Technical Report Writing and Communication | 2 | -- | 1 | 2 | 3 | 75 | | | | | | | | |
| | | | 14 | 7 | 3 | 16 | 30 | 750 | | | 10 | 8 | 8 | 16 | 30 | 750 |
| Year 2 | 1BES214 | Fundamentals of Heat and Mass Transfer | 2 | 2 | -- | 3 | 5 | 125 | REN221 | Storage Energy Technologies | 2 | 2 | 1 | 3 | 6 | 150 |
| | 1BES216 | Fluid Mechanics | 2 | 2 | 1 | 3 | 6 | 150 | 1BES222 | Electronics | 2 | 2 | -- | 3 | 5 | 125 |
| | 1BAS213 | Probability and Statistics | 2 | 2 | -- | 3 | 5 | 125 | 1HUM223 | Project Management and Economics | 2 | 1 | -- | 2 | 4 | 100 |
| | 1BAS212 | Energy & Environmental Issues | 2 | 1 | -- | 2 | 4 | 100 | 1BES226 | Thermodynamics (2) | 2 | 2 | 1 | 3 | 6 | 150 |
| | REN211 | Theory and Applications of Automatic Control | 2 | 2 | 2 | 3 | 6 | 150 | 1BAS225 | Numerical Methods | 2 | 2 | 1 | 3 | 6 | 150 |
| | 1HUM217 | Foundation of Marketing | 2 | 1 | -- | 2 | 4 | 100 | 1HUM224 | Fundamentals of Management | 2 | 1 | -- | 2 | 3 | 75 |
| | | | | | | | | | ENGG03I | Industrial Training | -- | -- | -- | -- | -- | -- |
| | | | 12 | 10 | 3 | 16 | 30 | 750 | | | 12 | 10 | 3 | 16 | 30 | 750 |
| Year 3 | RENM311 | Sustainable Energy: Principles & Processes | 2 | 1 | -- | 2 | 4 | 100 | RENM325 | Thermal Power Plants | 2 | 2 | -- | 3 | 5 | 125 |
| | 1BES316 | Combustion and Fuels | 2 | 2 | -- | 3 | 5 | 125 | REN322 | Data Acquisition and Sensors | 2 | 2 | -- | 3 | 6 | 150 |
| | REN313 | Solar Thermal Energy Systems | 2 | 2 | 1 | 3 | 6 | 150 | RENM323 | Energy Efficiency and Energy Management | 2 | 1 | -- | 2 | 4 | 100 |
| | REN314 | Wind energy systems | 2 | 2 | 1 | 3 | 6 | 150 | RENM326 | Mechanical power Generation | 2 | 2 | 2 | 3 | 6 | 150 |
| | REN315 | Hydraulic, Geothermal and Bio Energy | 2 | 2 | -- | 3 | 5 | 125 | 1BES321 | Modelling and Simulation for Renewable Energy Systems | 1 | -- | 3 | 2 | 3 | 75 |
| | 1BES312 | Structural and Stress Analysis | 2 | 1 | -- | 2 | 4 | 100 | RENM324 | Alternative Fuels & Fuel Cell Technology | 2 | 2 | -- | 3 | 6 | 150 |
| | | | | | | | | | ENGG07 | Industrial Training | -- | -- | -- | -- | -- | -- |
| | | | 12 | 10 | 2 | 16 | 30 | 750 | | | 11 | 9 | 5 | 16 | 30 | 750 |
| Year 4 | REN401 | Graduation Research Project | -- | -- | -- | 2 | 4 | 100 | REN401 | Graduation Research Project | -- | -- | -- | 2 | 4 | 100 |
| | REN402 | Design Project | -- | -- | -- | 2 | 4 | 100 | REN402 | Design Project | -- | -- | -- | 2 | 4 | 100 |
| | RENM411 | Smart Materials for Renewable Energy Systems | 2 | 2 | -- | 3 | 6 | 150 | 1HUMXXX | Elective course | 2 | 2 | -- | 3 | 6 | 150 |
| | RENM413 | Design of Solar Energy Equipment | 2 | 2 | -- | 3 | 6 | 150 | RENXXX | Elective course | 2 | 2 | -- | 3 | 5 | 125 |
| | 1BES412 | Turbo Machinery | 2 | 2 | -- | 3 | 5 | 125 | RENXXX | Elective course | 2 | 2 | -- | 3 | 5 | 125 |
| | RENXXX | Elective course | 2 | 2 | -- | 3 | 5 | 125 | 1BES426 | Environmental Risk Analysis | 2 | 2 | -- | 3 | 6 | 150 |
| | | | 8 | 8 | 0 | 16 | 30 | 750 | | | 8 | 8 | 0 | 16 | 30 | 750 |

# (Renewable Energy Engineering – Electrical Energy)

| | | Semester 1 | Lec | Tut | Lab | Cr | ECTS | SWL | | Semester 2 | Lec | Tut | Lab | Cr | ECTS | SWL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preparatory Year | BAS011 | Mathematics (1) | 2 | 2 | -- | 3 | 6 | 150 | BAS021 | Mathematics (2) | 2 | 2 | -- | 3 | 5 | 125 |
| | BAS012 | Physics 1 | 2 | 2 | 2 | 3 | 6 | 150 | BAS022 | Physics 2 | 2 | 2 | 1 | 3 | 6 | 150 |
| | BES013 | Workshop technology | 1 | -- | 3 | 2 | 4 | 100 | BAS023 | Chemistry | 2 | 2 | 2 | 3 | 6 | 150 |
| | BES014 | Engineering design and graphics | 2 | -- | 2 | 2 | 4 | 100 | BES024 | engineering mechanics (1) | 2 | 2 | -- | 3 | 5 | 125 |
| | HUM015 | Energy and human development | 2 | -- | -- | 2 | 3 | 75 | BAS025 | Algebra and Geometry | 2 | 2 | -- | 3 | 5 | 125 |
| | HUM017 | Engineering Ethics and Communications | 2 | 1 | -- | 2 | 4 | 100 | HUM026 | English language | 2 | -- | -- | 2 | 3 | 75 |
| | HUM016 | English language | 2 | -- | -- | 2 | 3 | 75 | | | | | | | | |
| | | | 13 | 5 | 7 | 16 | 30 | 750 | | | 12 | 10 | 3 | 17 | 30 | 750 |
| Year 1 | 1BAS112 | Calculus | 2 | 1 | -- | 2 | 4 | 100 | REN125 | Measurements Lab | 1 | -- | 3 | 2 | 3 | 75 |
| | 1BES113 | Materials Science | 2 | 2 | 1 | 3 | 6 | 150 | 1BES122 | Thermodynamics (1) | 2 | 2 | 1 | 3 | 6 | 150 |
| | 1BES117 | Electrical circuits | 2 | 2 | 1 | 3 | 6 | 150 | 1HUM126 | Computer programming | 1 | -- | 3 | 2 | 3 | 75 |
| | 1BES111 | Introduction to Mechatronics & Measurements | 2 | 1 | -- | 2 | 4 | 100 | 1BES124 | Electrical Machines (1) | 2 | 2 | -- | 3 | 6 | 150 |
| | 1BAS116 | Physical Chemistry | 2 | 1 | -- | 2 | 4 | 100 | 1BAS123 | Differential Equations | 2 | 2 | -- | 3 | 6 | 150 |
| | REN115 | Introduction to Renewable Energy Systems | 2 | -- | -- | 2 | 3 | 75 | 1BAS121 | Physics 3 | 2 | 2 | 1 | 3 | 6 | 150 |
| | 1HUM114 | Technical Report Writing and Communication | 2 | -- | 1 | 2 | 3 | 75 | | | | | | | | |
| | | | 14 | 7 | 3 | 16 | 30 | 750 | | | 10 | 8 | 8 | 16 | 30 | 750 |
| Year 2 | 1BES214 | Fundamentals of Heat and Mass Transfer | 2 | 2 | -- | 3 | 5 | 125 | REN221 | Storage Energy Technologies | 2 | 2 | 1 | 3 | 6 | 150 |
| | 1BES216 | Fluid Mechanics | 2 | 2 | 1 | 3 | 6 | 150 | 1BES222 | Electronics | 2 | 2 | -- | 3 | 5 | 125 |
| | 1BAS213 | Probability and Statistics | 2 | 2 | -- | 3 | 5 | 125 | 1HUM223 | Project Management and Economics | 2 | 1 | -- | 2 | 4 | 100 |
| | 1BAS212 | Energy & Environmental Issues | 2 | 1 | -- | 2 | 4 | 100 | 1HUMXXX | Elective course | 2 | 2 | -- | 3 | 6 | 150 |
| | REN211 | Theory and Applications of Automatic Control | 2 | 2 | 2 | 3 | 6 | 150 | 1BAS225 | Numerical Methods | 2 | 2 | 1 | 3 | 6 | 150 |
| | 1HUM217 | Foundation of Marketing | 2 | 1 | -- | 2 | 4 | 100 | 1HUM224 | Fundamentals of Management | 2 | 1 | -- | 2 | 3 | 75 |
| | | | | | | | | | ENGG03I | Industrial Training | -- | -- | -- | -- | -- | -- |
| | | | 12 | 10 | 3 | 16 | 30 | 750 | | | 12 | 10 | 2 | 16 | 30 | 750 |
| Year 3 | RENE311 | Electrical Power Transmission | 2 | 2 | -- | 3 | 6 | 150 | 1BES321 | Modelling and Simulation for Renewable Energy Systems | 1 | -- | 3 | 2 | 3 | 75 |
| | RENE312 | Solar Energy: Photovoltaic (PV) Systems | 2 | -- | 1 | 2 | 3 | 75 | REN322 | Data Acquisition and Sensors | 2 | 2 | -- | 3 | 6 | 150 |
| | REN313 | Solar Thermal Energy Systems | 2 | 2 | 1 | 3 | 6 | 150 | RENE323 | Power system analysis | 2 | 1 | -- | 2 | 4 | 100 |
| | REN314 | Wind energy systems | 2 | 2 | 1 | 3 | 6 | 150 | RENE324 | Network Interfacing of Renewable Resources | 2 | 2 | -- | 3 | 6 | 150 |
| | 1BES317 | Signals & Systems | 2 | 1 | 1 | 2 | 4 | 100 | 1BES325 | Design, control, and maintenance of PV plants | 2 | 2 | -- | 3 | 5 | 125 |
| | REN315 | Hydraulic, Geothermal and Bio Energy | 2 | 2 | -- | 3 | 5 | 125 | RENE326 | Power Generation and Conversion Systems | 2 | 2 | 2 | 3 | 6 | 150 |
| | | | | | | | | | ENGG07 | Industrial Training | -- | -- | -- | -- | -- | -- |
| | | | 12 | 9 | 4 | 16 | 30 | 750 | | | 11 | 9 | 5 | 16 | 30 | 750 |
| Year 4 | REN401 | Graduation Research Project | -- | -- | -- | 2 | 4 | 100 | REN401 | Graduation Research Project | -- | -- | -- | 2 | 4 | 100 |
| | REN402 | Design Project | -- | -- | -- | 2 | 4 | 100 | REN402 | Design Project | -- | -- | -- | 2 | 4 | 100 |
| | RENE411 | Power systems protection | 2 | 2 | -- | 3 | 6 | 150 | 1BES429 | Electrical Machines (2) | 2 | 2 | -- | 3 | 6 | 150 |
| | RENE413 | High Voltage Engineering | 2 | 2 | -- | 3 | 6 | 150 | RENXXX | Elective course | 2 | 2 | -- | 3 | 5 | 125 |
| | 1BES414 | Power Electronics | 2 | 2 | -- | 3 | 5 | 125 | RENXXX | Elective course | 2 | 2 | -- | 3 | 5 | 125 |
| | RENXXX | Elective course | 2 | 2 | -- | 3 | 5 | 125 | 1BES426 | Environmental Risk Analysis | 2 | 2 | -- | 3 | 6 | 150 |
| | | | 8 | 8 | 0 | 16 | 30 | 750 | | | 8 | 8 | 0 | 16 | 30 | 750 |

# (Biochemical Engineering)

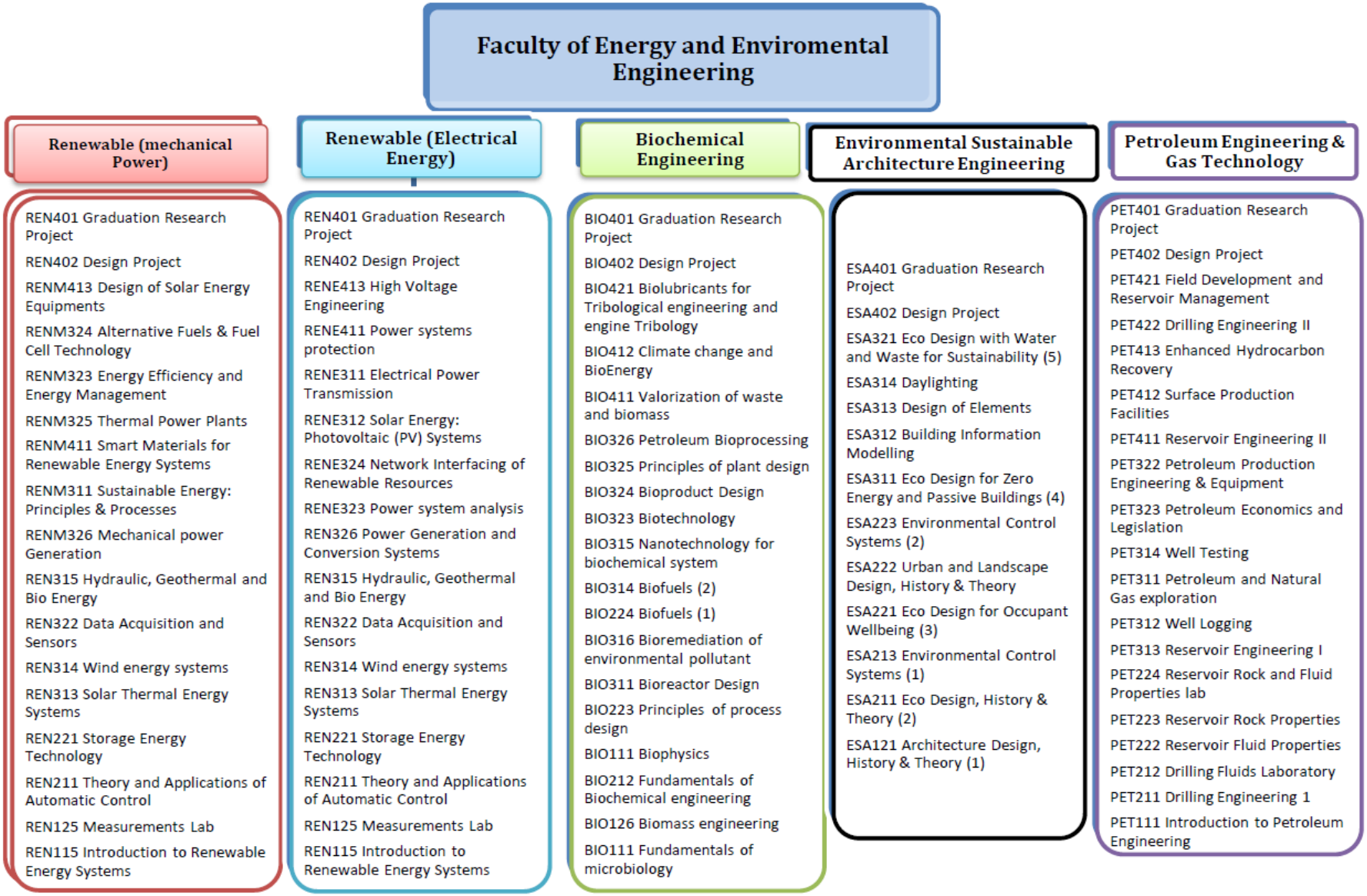
| | | Semester 1 | Lec | Tut | Lab | Cr | ECTS | SWL | | Semester 2 | Lec | Tut | Lab | Cr | ECTS | SWL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preparatory Year | BAS011 | Mathematics (1) | 2 | 2 | -- | 3 | 6 | 150 | BAS021 | Mathematics (2) | 2 | 2 | -- | 3 | 5 | 125 |
| | BAS012 | Physics 1 | 2 | 2 | 2 | 3 | 6 | 150 | BAS022 | Physics 2 | 2 | 2 | 1 | 3 | 6 | 150 |
| | BES013 | Workshop technology | 1 | -- | 3 | 2 | 4 | 100 | BAS023 | Chemistry | 2 | 2 | 2 | 3 | 6 | 150 |
| | BES014 | Engineering design and graphics | 2 | -- | 2 | 2 | 4 | 100 | BES024 | engineering mechanics (1) | 2 | 2 | -- | 3 | 5 | 125 |
| | HUM015 | Energy and human development | 2 | -- | -- | 2 | 3 | 75 | BAS025 | Algebra and Geometry | 2 | 2 | -- | 3 | 5 | 125 |
| | HUM017 | Engineering Ethics and Communications | 2 | 1 | -- | 2 | 4 | 100 | HUM026 | English language | 2 | -- | -- | 2 | 3 | 75 |
| | HUM016 | English language | 2 | -- | -- | 2 | 3 | 75 | | | | | | | | |
| | | | 13 | 5 | 7 | 16 | 30 | 750 | | | 12 | 10 | 3 | 17 | 30 | 750 |
| Year 1 | 2HUM114 | Technical Report Writing and Communication | 2 | -- | 1 | 2 | 3 | 75 | 2BAS121 | Inorganic Chemistry | 2 | 2 | 1 | 3 | 6 | 150 |
| | 2BAS112 | Advanced Mathematics (1) | 2 | 1 | -- | 2 | 4 | 100 | 2BES122 | Structural and Stress Analysis | 2 | 2 | -- | 3 | 5 | 125 |
| | 2BES113 | Materials Science | 2 | 2 | 1 | 3 | 6 | 150 | 2BAS123 | Advanced Mathematics (2) | 2 | 1 | -- | 2 | 3 | 75 |
| | BIO111 | Fundamentals of microbiology | 2 | 1 | 1 | 2 | 4 | 100 | 2BES125 | Energy Sources | 2 | 1 | -- | 2 | 4 | 100 |
| | 2BAS116 | Physical Chemistry | 2 | 1 | -- | 2 | 4 | 100 | 2BES124 | Fundamentals of biochemistry | 2 | 2 | 2 | 3 | 6 | 150 |
| | 2BAS115 | Organic Chemistry | 2 | 2 | 1 | 3 | 6 | 150 | BIO126 | Biomass engineering | 2 | 2 | -- | 3 | 6 | 150 |
| | 2HUM117 | Computer programming | 1 | -- | 3 | 2 | 3 | 75 | | | | | | | | |
| | | | 13 | 7 | 7 | 16 | 30 | 750 | | | 12 | 10 | 3 | 16 | 30 | 750 |
| Year 2 | 2BES211 | Fundamentals of corrosion science | 1 | 2 | 1 | 2 | 4 | 100 | BIO221 | Biophysics | 2 | 1 | -- | 2 | 4 | 100 |
| | BIO212 | Fundamentals of Biochemical engineering | 2 | 2 | 1 | 3 | 6 | 150 | 2BES222 | Thermodynamics | 2 | 2 | 1 | 3 | 6 | 150 |
| | 2BES216 | Fluid Mechanics | 2 | 2 | 1 | 3 | 6 | 150 | BIO223 | Principles of process design | 2 | 2 | -- | 3 | 6 | 150 |
| | 2BES213 | Mass and energy balances | 2 | 1 | -- | 2 | 3 | 75 | BIO224 | Biofuels (1) | 2 | 2 | 1 | 3 | 6 | 150 |
| | 2BAS215 | Numerical Methods | 2 | 2 | 1 | 3 | 6 | 150 | 2BES225 | Fundamentals of Heat and Mass Transfer | 2 | 2 | -- | 3 | 5 | 125 |
| | 2BES214 | Electrical and Electronic Engineering | 2 | 2 | 1 | 3 | 5 | 125 | 2BES226 | Unit Operation | 2 | 1 | -- | 2 | 3 | 75 |
| | | | | | | | | | ENGG03I | Industrial Training | -- | -- | -- | -- | -- | -- |
| | | | 11 | 11 | 5 | 16 | 30 | 750 | | | 12 | 10 | 2 | 16 | 30 | 750 |
| Year 3 | BIO311 | Bioreactor Design | 2 | 1 | -- | 2 | 4 | 100 | 2BES321 | Economics of BioEnergy | 2 | 1 | | 2 | 3 | 75 |
| | BIO316 | Bioremediation of environmental pollutant | 2 | 1 | 1 | 2 | 4 | 100 | 2HUM322 | Business skills for engineers and technologies | 2 | 1 | -- | 2 | 3 | 75 |
| | BIO314 | Biofuels (2) | 2 | 2 | 1 | 3 | 6 | 150 | BIO323 | Biotechnology | 2 | 2 | -- | 3 | 6 | 150 |
| | BIO315 | Nanotechnology for biochemical system | 2 | 2 | 1 | 3 | 6 | 150 | BIO324 | Bioproduct Design | 2 | 2 | -- | 3 | 6 | 150 |
| | 2BES313 | Environmental Legislation and Regulations | 2 | 1 | -- | 2 | 3 | 75 | BIO325 | Principles of plant design | 2 | 2 | -- | 3 | 6 | 150 |
| | 2HUM317 | Fundamentals of Management for Engineers | 2 | 1 | -- | 2 | 4 | 100 | BIO326 | Petroleum Bioprocessing | 2 | 2 | -- | 3 | 6 | 150 |
| | 2BES312 | Modelling and simulation | 1 | -- | 3 | 2 | 3 | 75 | ENGG07 | Industrial Training | -- | -- | -- | -- | -- | -- |
| | | | 13 | 8 | 6 | 16 | 30 | 750 | | | 12 | 10 | 0 | 16 | 30 | 750 |
| Year 4 | BIO401 | Graduation Research Project | -- | -- | -- | 2 | 4 | 100 | BIO401 | Graduation Research Project | -- | -- | -- | 2 | 4 | 100 |
| | BIO402 | Design Project | -- | -- | -- | 2 | 4 | 100 | BIO402 | Design Project | -- | -- | -- | 2 | 4 | 100 |
| | BIO411 | Valorization of waste and biomass | 2 | 2 | -- | 3 | 6 | 150 | BIO421 | Biolubricants for Tribological engineering and engine Tribology | 2 | 2 | -- | 3 | 5 | 125 |
| | BIO412 | Climate change and BioEnergy | 2 | 2 | -- | 3 | 6 | 150 | 2BES426 | Environmental Risk Analysis | 2 | 2 | -- | 3 | 6 | 150 |
| | BIOXXX | Elective course | 2 | 2 | -- | 3 | 5 | 125 | 2HUMXXX | Elective course | 2 | 2 | -- | 3 | 6 | 150 |
| | BIOXXX | Elective course | 2 | 2 | -- | 3 | 5 | 125 | BIOXXX | Elective course | 2 | 2 | -- | 3 | 5 | 125 |
| | | | 8 | 8 | 0 | 16 | 30 | 750 | | | 8 | 8 | 0 | 16 | 30 | 750 |

# (Petroleum Engineering & Gas Technology)

| | | Semester 1 | Lec | Tut | Lab | Cr | ECTS | SWL | | Semester 2 | Lec | Tut | Lab | Cr | ECTS | SWL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preparatory Year | BAS011 | Mathematics (1) | 2 | 2 | -- | 3 | 6 | 150 | BAS021 | Mathematics (2) | 2 | 2 | -- | 3 | 5 | 125 |
| | BAS012 | Physics 1 | 2 | 2 | 2 | 3 | 6 | 150 | BAS022 | Physics 2 | 2 | 2 | 1 | 3 | 6 | 150 |
| | BES013 | Workshop technology | 1 | -- | 3 | 2 | 4 | 100 | BAS023 | Chemistry | 2 | 2 | 2 | 3 | 6 | 150 |
| | BES014 | Engineering design and graphics | 2 | -- | 2 | 2 | 4 | 100 | BES024 | engineering mechanics (1) | 2 | 2 | -- | 3 | 5 | 125 |
| | HUM015 | Energy and human development | 2 | -- | -- | 2 | 3 | 75 | BAS025 | Algebra and Geometry | 2 | 2 | -- | 3 | 5 | 125 |
| | HUM017 | Engineering Ethics and Communications | 2 | 1 | -- | 2 | 4 | 100 | HUM026 | English language | 2 | -- | -- | 2 | 3 | 75 |
| | HUM016 | English language | 2 | -- | -- | 2 | 3 | 75 | | | | | | | | |
| | | | 13 | 5 | 7 | 16 | 30 | 750 | | | 12 | 10 | 3 | 17 | 30 | 750 |
| Year 1 | 3HUM114 | Technical Report Writing and Communication | 2 | -- | 1 | 2 | 3 | 75 | 3BES122 | Structural and Stress Analysis | 2 | 1 | -- | 2 | 4 | 100 |
| | 3BAS112 | Calculus | 2 | 2 | -- | 3 | 6 | 150 | 3BAS123 | Differential Equations | 2 | 2 | -- | 3 | 6 | 150 |
| | 3BES113 | Materials Science for Petroleum Engineering | 2 | 2 | 2 | 3 | 6 | 150 | 3HUM124 | Fundamentals of Management | 2 | 1 | -- | 2 | 4 | 100 |
| | PET111 | Introduction to Petroleum Engineering | 2 | 1 | -- | 2 | 4 | 100 | 3BES125 | Fundamentals of Thermodynamics | 2 | 2 | 1 | 3 | 6 | 150 |
| | 3BAS116 | Physical Chemistry for Petroleum Engineering | 2 | 2 | -- | 3 | 5 | 125 | 3BES126 | Geological Principles of Petroleum | 2 | 2 | -- | 3 | 5 | 125 |
| | 3BES115 | Fundamentals of Fluid Mechanics | 2 | 2 | 1 | 3 | 6 | 150 | 3BAS121 | Physics for Petroleum Engineers | 2 | 2 | 1 | 3 | 5 | 125 |
| | | | 12 | 9 | 4 | 16 | 30 | 750 | | | 12 | 10 | 2 | 16 | 30 | 750 |
| Year 2 | PET211 | Drilling Engineering 1 | 2 | 1 | -- | 2 | 4 | 100 | 3BES221 | Surveying for Petroleum Engineers | 2 | 2 | 1 | 3 | 6 | 150 |
| | 3BES214 | Fundamentals of Heat and Mass Transfer | 2 | 2 | -- | 3 | 5 | 125 | 3BAS225 | Numerical Methods | 2 | 2 | 1 | 3 | 6 | 150 |
| | 3BES216 | Machine Design for Petroleum Engineering | 2 | 2 | 1 | 3 | 6 | 150 | PET222 | Reservoir Fluid Properties | 2 | 2 | 1 | 3 | 6 | 150 |
| | PET212 | Drilling Fluids Laboratory | 1 | -- | 3 | 2 | 4 | 100 | PET223 | Reservoir Rock Properties | 2 | 2 | -- | 3 | 5 | 125 |
| | 3BAS213 | Engineering Probability and Statistics | 2 | 2 | -- | 3 | 6 | 150 | PET224 | Reservoir Rock and Fluid Properties lab | 1 | -- | 3 | 2 | 3 | 75 |
| | 3BAS215 | Organic Chemistry | 2 | 2 | 1 | 3 | 5 | 125 | 3BAS226 | Introduction to Analytical Chemistry | 2 | 1 | -- | 2 | 4 | 100 |
| | | | | | | | | | ENGG03I | Industrial Training | -- | -- | -- | -- | -- | -- |
| | | | 11 | 9 | 5 | 16 | 30 | 750 | | | 11 | 9 | 6 | 16 | 30 | 750 |
| Year 3 | 3HUM315 | Engineering Project Management | 2 | 1 | -- | 2 | 4 | 100 | 3HUM321 | Computer Applications in Petroleum | 1 | -- | 3 | 2 | 3 | 75 |
| | PET313 | Reservoir Engineering I | 2 | 2 | 1 | 3 | 6 | 150 | PET326 | Corrosion in Oil & Gas Industry | 2 | 2 | -- | 3 | 5 | 125 |
| | PET312 | Well Logging | 2 | 2 | 1 | 3 | 6 | 150 | PET323 | Petroleum Economics and Legislation | 2 | 1 | -- | 2 | 4 | 100 |
| | PET311 | Petroleum and Natural Gas exploration | 2 | 2 | -- | 3 | 5 | 125 | PET322 | Petroleum Production Engineering & Equipment | 2 | 2 | 1 | 3 | 6 | 150 |
| | PET314 | Field Courses | 1 | -- | 3 | 2 | 4 | 100 | 3BES324 | Reservoir Modelling and Simulation | 2 | -- | 3 | 3 | 6 | 150 |
| | PET316 | Well Testing | 2 | -- | 3 | 3 | 5 | 125 | 3BES325 | Petroleum Development Geology | 2 | 2 | 1 | 3 | 6 | 150 |
| | | | | | | | | | ENGG07 | Industrial Training | -- | -- | -- | -- | -- | -- |
| | | | 11 | 7 | 8 | 16 | 30 | 750 | | | 11 | 7 | 8 | 16 | 30 | 750 |
| Year 4 | PET401 | Graduation Research Project | -- | -- | -- | 2 | 4 | 100 | PET401 | Graduation Research Project | -- | -- | -- | 2 | 4 | 100 |
| | PET402 | Design Project | -- | -- | -- | 2 | 4 | 100 | PET402 | Design Project | -- | -- | -- | 2 | 4 | 100 |
| | PET411 | Reservoir Engineering II | 2 | 2 | -- | 3 | 6 | 150 | PET421 | Field Development and Reservoir Management | 2 | 2 | -- | 3 | 6 | 150 |
| | PET412 | Surface Production Facilities | 2 | 2 | -- | 3 | 5 | 125 | PET422 | Drilling Engineering II | 2 | 2 | -- | 3 | 5 | 125 |
| | PET413 | Enhanced Hydrocarbon Recovery | 2 | 2 | -- | 3 | 6 | 150 | 3BES423 | Safety& Environment in Petroleum Industry | 2 | 2 | -- | 3 | 6 | 150 |
| | PET418 | Gas Condensate Reservoir Engineering | 2 | 2 | -- | 3 | 5 | 125 | PETXXX | Elective course | 2 | 2 | -- | 3 | 5 | 125 |
| | | | 8 | 8 | 0 | 16 | 30 | 750 | | | 8 | 8 | 0 | 16 | 30 | 750 |

# (Environmental Sustainable Architecture Engineering)

| | | Semester 1 | Lec | Tut | Lab | CR | ECTS | SWL | | Semester 2 | Lec | Tut | Lab | Cr | ECTS | SWL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preparatory Year | BAS011 | Mathematics (1) | 2 | 2 | -- | 3 | 6 | 150 | BAS021 | Mathematics (2) | 2 | 2 | -- | 3 | 5 | 125 |
| | BAS012 | Physics 1 | 2 | 2 | 2 | 3 | 6 | 150 | BAS022 | Physics 2 | 2 | 2 | 1 | 3 | 6 | 150 |
| | BES013 | Workshop technology | 1 | -- | 3 | 2 | 4 | 100 | BAS023 | Chemistry | 2 | 2 | 2 | 3 | 6 | 150 |
| | BES014 | Engineering design and graphics | 2 | -- | 2 | 2 | 4 | 100 | BES024 | engineering mechanics (1) | 2 | 2 | -- | 3 | 5 | 125 |
| | HUM015 | Energy and human development | 2 | -- | -- | 2 | 3 | 75 | BAS025 | Algebra and Geometry | 2 | 2 | -- | 3 | 5 | 125 |
| | HUM017 | Engineering Ethics and Communications | 2 | 1 | -- | 2 | 4 | 100 | HUM026 | English language | 2 | -- | -- | 2 | 3 | 75 |
| | HUM016 | English language | 2 | -- | -- | 2 | 3 | 75 | | | | | | | | |
| | | | 13 | 5 | 7 | 16 | 30 | 750 | | | 12 | 10 | 3 | 17 | 30 | 750 |
| Year 1 | 4BES111 | Introduction to Environmental and Sustainable Design | 2 | -- | 3 | 3 | 5 | 125 | ESA121 | Architecture Design, History & Theory (1) | 4 | -- | 3 | 5 | 9 | 225 |
| | 4BES112 | Sustainable Construction Technologies and Materials (1) | 2 | 1 | -- | 2 | 4 | 100 | 4BES122 | Sustainable Construction Technologies and Materials (2) | 2 | 2 | 1 | 3 | 6 | 150 |
| | 4BES113 | Architecture Surveying and Drawing | 2 | -- | 3 | 3 | 6 | 150 | 4BES123 | Visual Design and Graphics (2) | 2 | -- | 3 | 3 | 5 | 125 |
| | 4BES114 | Visual Design and Graphics (1) | 2 | -- | 3 | 3 | 6 | 150 | 4BAS124 | Structural and Stress Analysis | 2 | 1 | -- | 2 | 4 | 100 |
| | 4BAS115 | Thermo-Fluids | 3 | 2 | 3 | 5 | 9 | 225 | 4HUM125 | Technical Writing and Digital Communication | 2 | 2 | 1 | 3 | 6 | 150 |
| | | | 11 | 3 | 12 | 16 | 30 | 750 | | | 12 | 5 | 8 | 16 | 30 | 750 |
| Year 2 | ESA211 | Eco Design, History & Theory (2) | 4 | -- | 3 | 5 | 9 | 225 | ESA221 | Eco Design for Occupant Wellbeing (3) | 4 | -- | 3 | 5 | 9 | 225 |
| | 4BES212 | Sustainable Construction Technologies and Materials (3) | 2 | 2 | 1 | 3 | 6 | 150 | ESA222 | Urban and Landscape Design, History & Theory | 2 | -- | 3 | 3 | 6 | 150 |
| | ESA213 | Environmental Control Systems (1) | 2 | 1 | -- | 2 | 3 | 75 | ESA223 | Environmental Control Systems (2) | 2 | 1 | -- | 2 | 4 | 100 |
| | 4BAS214 | Geotechnics | 2 | 2 | 1 | 3 | 6 | 150 | 4BES224 | Air-Conditioning and Heat Pump Engineering | 2 | -- | 3 | 3 | 5 | 125 |
| | 4HUM215 | Building Regulations and Rating Systems | 2 | 2 | 1 | 3 | 6 | 150 | 4BAS225 | Statistics, Numerical Methods and Computers | 2 | 2 | 1 | 3 | 6 | 150 |
| | | | | | | | | | ENGG03I | Industrial Training | -- | -- | -- | -- | -- | -- |
| | | | 12 | 7 | 6 | 16 | 30 | 750 | | | 12 | 3 | 10 | 16 | 30 | 750 |
| Year 3 | ESA311 | Eco Design for Zero Energy and Passive Buildings (4) | 3 | 2 | 3 | 5 | 9 | 225 | ESA321 | Eco Design with Water and Waste for Sustainability (5) | 3 | 2 | 3 | 5 | 9 | 225 |
| | 4BES312 | Building Information Modelling | 2 | -- | 3 | 3 | 6 | 150 | 4BES322 | Modelling and Simulation for Sustainable Architecture | 2 | -- | 3 | 3 | 6 | 150 |
| | 4BES313 | Design of Elements | 2 | 1 | -- | 2 | 4 | 100 | 4BES323 | Integrated Building Design | 1 | -- | 3 | 2 | 4 | 100 |
| | ESA314 | Daylighting | 2 | -- | 3 | 3 | 5 | 125 | ESAXXX | Elective Course | 2 | 2 | -- | 3 | 6 | 150 |
| | ESAXXX | Elective Course | 2 | 2 | -- | 3 | 6 | 150 | 4HUM324 | Sustainable Project Management and Costing | 2 | 2 | -- | 3 | 5 | 125 |
| | | | | | | | | | ENGG07 | Industrial Training | -- | -- | -- | -- | -- | -- |
| | | | 11 | 5 | 9 | 16 | 30 | 750 | | | 10 | 6 | 9 | 16 | 30 | 750 |
| Year 4 | ESA401 | Graduation Research Project | -- | -- | -- | 2 | 4 | 100 | ESA401 | Graduation Research Project | -- | -- | -- | 2 | 4 | 100 |
| | ESA402 | Design Project | -- | -- | -- | 3 | 5 | 125 | ESA402 | Design Project | -- | -- | -- | 6 | 11 | 275 |
| | ESAXXX | Elective course | 3 | 2 | 3 | 5 | 9 | 225 | ESAXXX | Elective course | 2 | 2 | 6 | 5 | 9 | 225 |
| | ESAXXX | Elective course | 2 | 2 | 1 | 3 | 6 | 150 | ESAXXX | Elective Course | 2 | 2 | -- | 3 | 6 | 150 |
| | 4HUMXXX | Elective course | 2 | 2 | -- | 3 | 6 | 150 | | | | | | | | |
| | | | 7 | 6 | 4 | 16 | 30 | 750 | | | 4 | 4 | 6 | 16 | 30 | 750 |


Faculty of Energy and Enviromental Engineering
Renewable (mechanical Power)
REN401 Graduation Research Project
REN402 Design Project
RENM413 Design of Solar Energy Equipments
RENM324 Alternative Fuels & Fuel Cell Technology
RENM323 Energy Efficiency and Energy Management
RENM325 Thermal Power Plants
RENM411 Smart Materials for Renewable Energy Systems
RENM311 Sustainable Energy: Principles & Processes
RENM326 Mechanical power Generation
REN315 Hydraulic, Geothermal and Bio Energy
REN322 Data Acquisition and Sensors
REN314 Wind energy systems
REN313 Solar Thermal Energy Systems
REN221 Storage Energy Technology
REN211 Theory and Applications of Automatic Control
REN125 Measurements Lab
REN115 Introduction to Renewable Energy Systems
Renewable (Electrical Energy)
REN401 Graduation Research Project
REN402 Design Project
RENE413 High Voltage Engineering
RENE411 Power systems protection
RENE311 Electrical Power Transmission
RENE312 Solar Energy: Photovoltaic (PV) Systems
RENE324 Network Interfacing of Renewable Resources
RENE323 Power system analysis
REN326 Power Generation and Conversion Systems
REN315 Hydraulic, Geothermal and Bio Energy
REN322 Data Acquisition and Sensors
REN314 Wind energy systems
REN313 Solar Thermal Energy Systems
REN221 Storage Energy Technology
REN211 Theory and Applications of Automatic Control
REN125 Measurements Lab
REN115 Introduction to Renewable Energy Systems
Biochemical Engineering
BIO401 Graduation Research Project
BIO402 Design Project
BIO421 Biolubricants for Tribological engineering and engine Tribology
BIO412 Climate change and BioEnergy
BIO411 Valorization of waste and biomass
BIO326 Petroleum Bioprocessing
BIO325 Principles of plant design
BIO324 Bioproduct Design
BIO323 Biotechnology
BIO315 Nanotechnology for biochemical system
BIO314 Biofuels (2)
BIO224 Biofuels (1)
BIO316 Bioremediation of environmental pollutant
BIO311 Bioreactor Design
BIO223 Principles of process design
BIO111 Biophysics
BIO212 Fundamentals of Biochemical engineering
BIO126 Biomass engineering
BIO111 Fundamentals of microbiology
Environmental Sustainable Architecture Engineering
ESA401 Graduation Research Project
ESA402 Design Project
ESA321 Eco Design with Water and Waste for Sustainability (5)
ESA314 Daylighting
ESA313 Design of Elements
ESA312 Building Information Modelling
ESA311 Eco Design for Zero Energy and Passive Buildings (4)
ESA223 Environmental Control Systems (2)
ESA222 Urban and Landscape Design, History & Theory
ESA221 Eco Design for Occupant Wellbeing (3)
ESA213 Environmental Control Systems (1)
ESA211 Eco Design, History & Theory (2)
ESA121 Architecture Design, History & Theory (1)
Petroleum Engineering & Gas Technology
PET401 Graduation Research Project
PET402 Design Project
PET421 Field Development and Reservoir Management
PET422 Drilling Engineering II
PET413 Enhanced Hydrocarbon Recovery
PET412 Surface Production Facilities
PET411 Reservoir Engineering II
PET322 Petroleum Production Engineering & Equipment
PET323 Petroleum Economics and Legislation
PET314 Well Testing
PET311 Petroleum and Natural Gas exploration
PET312 Well Logging
PET313 Reservoir Engineering I
PET224 Reservoir Rock and Fluid Properties lab
PET223 Reservoir Rock Properties
PET222 Reservoir Fluid Properties
PET212 Drilling Fluids Laboratory
PET211 Drilling Engineering 1
PET111 Introduction to Petroleum Engineering

# Part D

# Details of the Offered Programs

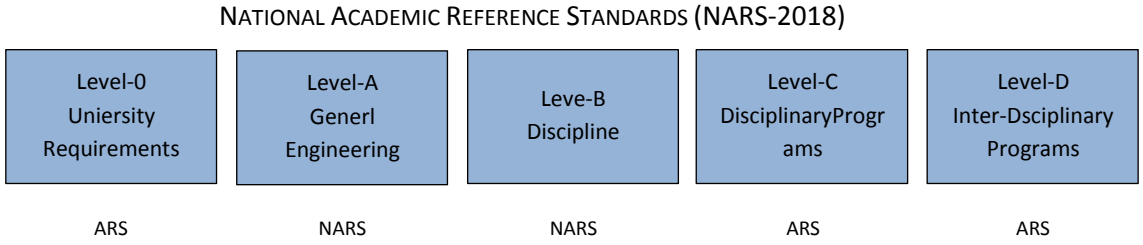
The British University in Egypt, upon the request of the Faculty of Energy and Environmental Engineering Council, awards the Bachelor of Science (B.Sc.) Degree in one of the Programs listed in the below table, which are the Programs offered by the Faculty of Energy and Environmental Engineering, The British University in Egypt. The programs are divided into Specialized and Inter-Disciplinary programs.

<table>
<tr><td rowspan="4">Energy & Environmental Engineering Programs Programs</td><td rowspan="3">Specialized Programs</td><td rowspan="2">Renewable Energy Engineering</td><td>Mechanical Power</td></tr>
<tr><td>Electrical Energy</td></tr>
<tr><td colspan="2">Biochemical Engineering</td></tr>
<tr><td colspan="2">Petroleum Engineering and Gas Technology</td></tr>
<tr><td>Inter-Disciplinary Programs</td><td colspan="2">Environmental Sustainable Architecture Engineering</td></tr>
</table>

According to the Supreme Council of Universities Terms of Reference for Undergraduate Engineering Programs, the courses in any program are divided into the following categories:

1. University requirements.
2. Faculty requirements.
3. Discipline requirements.
4. Program requirements.

The Figure below shows the different levels of competences as per National Academic Reference Standards (NARS-2018) as published by NAQAAE. These Levels of competences determine the allocation of courses in different competency level with respect to the level requirements.




The below table summarizes the overall data about the programs included in these bylaws. The rest of this Part D will show the list of standards for each level and the courses required to achieve these standards for each program.

| # | Program | NC | Credits and SWL | | | Total Contact Hours | | | | 4 Requirements % | | | | BS % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH | ECTS | SWL | Lec | Tut | Lab | TT | UR | FR | DR | PR | |
| 1 | Renewable Energy Engineering (Mechanical) | 60 | 161 | 300 | 7500 | 112 | 85 | 34 | 231 | 13 | 26.7 | 36 | 24.2 | 25.4 |
| 2 | Renewable Energy Engineering (Electrical) | 60 | 161 | 300 | 7500 | 112 | 84 | 35 | 231 | 13 | 26.7 | 36 | 24.2 | 25.4 |
| 3 | Biochemical Engineering | 61 | 161 | 300 | 7500 | 114 | 87 | 33 | 233 | 11.8 | 24.8 | 35.4 | 27.9 | 24.8 |
| 4 | Petroleum Engineering and Gas Technology | 59 | 161 | 300 | 7500 | 109 | 82 | 43 | 233 | 10 | 29.8 | 35.4 | 24.8 | 26.7 |
| 5 | Environmental Sustainable Architecture Engineering | 50 | 161 | 300 | 7500 | 104 | 54 | 73 | 232 | 12.4 | 23.6 | 36 | 27.9 | 20.5 |

| | | | |
|---|---|---|---|
| NC | Total number of Courses | UR | University Requirement |
| CH | Credit Hour | FR | Faculty Requirement |
| ECTS | European Credit Transfer System | DR | Discipline Requirement |
| SWL | Student Workload | PR | Program Requirement |
| Lec | Lectures | | |
| Tut | Tutorials | BS | Basic Sciences Percentage |
| Lab | Laboratory | | |
| TT | Total | | |

# Section-1

# University Requirements

The university is considered a core of Human Thinking at its highest level, and the source of investment and development of human resources. It is concerned with the rise of the Arabian Civilization and the Historical Heritage of the Egyptian Society, and its traditions. It is also concerned with the education of Religion, Morals and Nationalism (Egyptian National Law for Universities, Law 49 for Year 1972). Therefore, The British University in Egypt graduate should be (0-Level):

1. Aware of national, regional and international contemporary issues, to have an intellectual and enlightened personality and to interact effectively in the community through different communication skills.

To achieve this goal, The British University in Egypt has designed a number of courses planned to build the student personality, develop his skills, and increase his awareness of different topics. These courses are called University Requirements. The Faculty of Energy and Environmental Engineering has selected some of these courses to be offered within the Energy and Environmental Engineering Programs. These courses are listed in the table below.

A placement test in English Language will be conducted for some admitted students to the Faculty of Energy and Environmental Engineering. If the student passes this test, then he will be exempted from taking the Technical English Language Course. The Technical English Language course is a pre-requisite for all Faculty requirements courses.

# List of Courses

## Compulsory Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| All Programs | HUM016 | English language | -- | 2 | 3 | 75 | 2 | -- | -- | 2 |
| | HUM026 | English language | -- | 2 | 3 | 75 | 2 | -- | -- | 2 |
| | HUM015 | Energy and human development | 2 | 2 | 3 | 75 | 2 | -- | -- | 2 |
| | HUM017 | Engineering Ethics and Communications | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | Total | | | 8 | 13 | 325 | 8 | 1 | -- | 9 |
| Renewable (all) | HUMXXX | Elective Module | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | 1HUM126 | Computer Programming | 2 | 2 | 3 | 75 | 1 | -- | 3 | 4 |
| | 1HUM217 | Foundation of Marketing | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 1HUM224 | Fundamentals of Management | 2 | 2 | 3 | 75 | 2 | 1 | -- | 3 |
| | 1HUM223 | Project Management and Economics | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 1HUM114 | Technical Report Writing and Communication | -- | 2 | 3 | 75 | 2 | -- | 1 | 3 |
| | Total | | | 13 | 23 | 575 | 11 | 5 | 4 | 20 |
| Biochemical | HUMXXX | Elective Module | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | 2HUM117 | Computer Programming | 2 | 2 | 3 | 75 | 1 | -- | 3 | 4 |
| | 2HUM317 | Fundamentals of management for engineers | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 2HUM322 | Business skills for engineers and technologies | 2 | 2 | 3 | 75 | 2 | 1 | -- | 3 |
| | 2HUM114 | Technical Report Writing and Communication | -- | 2 | 3 | 75 | 2 | -- | 1 | 3 |
| | Total | | | 11 | 19 | 475 | 9 | 3 | 4 | 17 |
| Petroleum | 3HUM124 | Fundamentals of Management | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 3HUM321 | Computer Applications in Petroleum | -- | 2 | 3 | 75 | 1 | -- | 3 | 4 |
| | 3HUM315 | Engineering Project Management | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 3HUM114 | Technical Report Writing and Communication | -- | 2 | 3 | 75 | 2 | -- | 1 | 3 |
| | Total | | | 8 | 14 | 350 | 7 | 2 | 4 | 13 |
| Env. Sust. Arch. | HUMXXX | Elective Module | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | 4HUM215 | Building Regulations and Rating Systems | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 4HUM324 | Sustainable Project Management and Costing | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 4HUM125 | Technical Writing and Digital Communication | -- | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | Total | | | 12 | 23 | 575 | 8 | 8 | 2 | 18 |

## Elective Courses (Students chooses only one module from the following)

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| All Programs | HUM001 | Ethics and Legislation | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | HUM002 | Advanced Risk Management | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | HUM003 | Foreign Language | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | HUM004 | Marketing | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | HUM005 | Selections of Life-Long Skills | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | HUM006 | Business Communication | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | HUM007 | Service Management | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | HUM008 | Humanities for Engineering Students | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | HUM009 | Science – Technology – Society | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | HUM0010 | Professional Practice | -- | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | HUM0011 | Entrepreneurship | -- | 3 | 6 | 150 | 2 | 2 | -- | 4 |

# Section-2

# Faculty Requirements

## General Engineering Graduate Attributes:

1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations;

2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation;

3. Behave professionally and adhere to engineering ethics and standards;

4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance;

5. Recognize his/her role in promoting the engineering field and contribute in the development of the profession and the community;

6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles;

7. Use techniques, skills and modern engineering tools necessary for engineering practice;

8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies;

9. Communicate effectively using different modes and in different languages and audiences, use digital tools and media to deal with academic/professional challenges in a critical and creative manner;

10. Demonstrate leadership qualities, business administration and entrepreneurial skills.

# Lab Requirements for Faculty of Energy and Environmental Engineering, FEEE

## List of Courses with Labs:

| | |
|---|---|
| preparatory Year | Physics 1 |
| | Workshop Technology |
| | Chemistry |
| | Engineering design and graphics |
| | Physics 2 |
| Year 1 | Material science |
| | Computer programming |
| | Physics 3 |
| | Thermodynamics (1) |
| | Technical Report Writing |
| | Measurements Lab |
| | Electrical Circuits |
| | Fundamentals of microbiology for biochemical engineers |
| | Organic Chemistry |
| | Fundamentals of biochemistry |
| | Inorganic Chemistry |
| | Fundamentals of Fluid Mechanics |
| | Physics for petroleum engineers |
| | Fundamentals of Thermodynamics |
| | Geological Principles |
| | Introduction to Environmental and Sustainable Design |
| | Architecture Surveying and Drawing |
| | Visual Design and Graphics (1) |
| | Thermo-Fluids |
| | Architecture Design, History & Theory (1) |
| | Sustainable Construction Technologies and Materials (2) |
| | Visual Design and Graphics (2) |
| | Technical Writing and Digital Communication |

| | |
|---|---|
| Year 2 | Fluid mechanics |
| | Theory and Applications of Automatic Control |
| | Storage Energy Technologies |
| | Numerical Methods |
| | Thermodynamics (2) |
| | Fundamentals of corrosion science |
| | Fundamentals of Biochemical engineering |
| | Electrical and Electronic Engineering |
| | Fluid Mechanics |
| | Biofuel (1) |
| | Machine Design |
| | Drilling Fluids Laboratory |
| | Machine Design |
| | Surveying |
| | Reservoir Rock and Fluid Properties lab |
| | Eco Design, History & Theory(2) |
| | Sustainable Construction Technologies and Materials (3) |
| | Geotechnics |
| | Building Regulations and Rating Systems |
| | Eco Design for Occupant Wellbeing(3) |
| | Urban and Landscape Design, History & Theory |
| | Air-Conditioning and Heat Pump Engineering |
| | Statistics, Numerical Methods and Computers |
| Year 3 | Nanotechnology for biochemical system |
| | Biofuel (2) |
| | Mechanical power Generation |
| | Well Testing |
| | Computer Applications in Petroleum |
| | Petroleum Production Engineering & Equipment |
| | Reservoir Modelling and Simulation |
| | Petroleum Development Geology |
| | Solar Thermal Energy Systems |
| | Wind energy systems |
| | Modelling and Simulation |
| | Power Generation and Conversion Systems |
| | Solar Energy: Photovoltaic (PV) Systems |
| | Signals & Systems |
| | Bioremediation of environmental pollutant |
| | Eco Design for Zero Energy and Passive Buildings (4) |
| | Building Information Modelling |
| | Daylighting |
| | Eco Design with Water and Waste for Sustainability(5) |
| | Modelling and Simulation for Sustainable Architecture |
| | Integrated Building Design |

All the programs offered at the Faculty of Energy and Environmental Engineering, at the British University in Egypt are Engineering Programs. The graduates have the privilege of being Engineers and are automatically enrolled in the Egyptian Engineering Syndicate (EES).

According to the National Academic Reference Standards (NARS-2018), The Engineering Graduate must be able to (A-Level):

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.
A2. Develop and conduct appropriate experimentation and/or simulation, analyse and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.
A3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.
A4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.
A5. Practice research techniques and methods of investigation as an inherent part of learning.
A6. Plan, supervise and monitor implementation of engineering projects.
A7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.
A8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.
A9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.
A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

To achieve these Intended Learning Outcomes, a set of courses must be completed as a Faculty Requirement. These courses are divided into Basic Applied Science Courses and Basic Engineering Science Courses. These courses are listed in the table below.

*References:*

*A: NAQAAE-NARS 2018 Engineering Graduate Competencies*

# Faculty Requirements List of Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| All Programs | BAS011 | Mathematics (1) | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | BAS021 | Mathematics (2) | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BAS012 | Physics 1 | 2 | 3 | 6 | 150 | 2 | 2 | 2 | 6 |
| | BAS022 | Physics 2 | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | BAS023 | Chemistry | 2 | 3 | 6 | 150 | 2 | 2 | 2 | 6 |
| | BAS025 | Algebra and Geometry | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BES014 | Engineering design and graphics | 3 | 2 | 4 | 100 | 2 | -- | 2 | 4 |
| | BES013 | Workshop technology | 2 | 2 | 4 | 100 | 1 | -- | 3 | 4 |
| | BES024 | Engineering mechanics 1 | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | ENGG03I | Industrial Training | -- | -- | | | -- | -- | -- | -- |
| | ENGG07 | Industrial Training | -- | -- | | | -- | -- | -- | -- |
| | Total | | | 25 | 47 | 1175 | 17 | 14 | 10 | 41 |
| Renewable | 1BAS112 | Calculus | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 1BAS121 | Physics 3 | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 1BAS123 | Differential Equations | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | 1BAS213 | Probability and Statistics | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 1BAS225 | Numerical Methods | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 1BAS116 | Physical Chemistry | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 1BAS212 | Energy & Environmental Issues | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | Total | | | 18 | 35 | 875 | 14 | 11 | 2 | 27 |
| Biochemical | 2BAS215 | Numerical Methods | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 2BAS112 | Advanced Mathematics (1) | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 2BAS123 | Advanced Mathematics (2) | 2 | 2 | 3 | 75 | 2 | 1 | -- | 3 |
| | 2BAS115 | Organic Chemistry | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 2BAS121 | Inorganic Chemistry | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 2BAS116 | Physical Chemistry | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | Total | | | 15 | 29 | 725 | 12 | 9 | 3 | 24 |
| Petroleum | 3BAS112 | Calculus | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | 3BAS123 | Differential Equations | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | 3BAS213 | Engineering Probability and Statistics | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | 3BAS215 | Organic Chemistry | 2 | 3 | 5 | 125 | 2 | 2 | 1 | 5 |
| | 3BAS225 | Numerical Methods | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 3BAS121 | Physics for Petroleum Engineers | 2 | 3 | 5 | 125 | 2 | 2 | 1 | 5 |
| | 3BAS116 | Physical Chemistry for Petroleum Engineering | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 3BAS226 | Introduction to Analytical Chemistry | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | Total | | | 23 | 43 | 1075 | 16 | 15 | 2 | 34 |
| Env. Sust. Arch. | 4BAS225 | Statistics, Numerical Methods and Computers | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 4BAS115 | Thermo-Fluids | 3 | 5 | 9 | 225 | 3 | 2 | 3 | 8 |
| | 4BAS124 | Structural and Stress Analysis | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 4BAS214 | Geotechnics | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | Total | | | 13 | 25 | 625 | 9 | 7 | 5 | 21 |

# Section-3

# Discipline Requirements

# 1.1-Renewable Energy Engineering-Mechanical Power

According to the National Academic Reference Standards (NARS-2018), each discipline graduate has to meet specific competences.

In addition to the Competencies for all Engineering Programs (A-Level) the Basic Mechanical Engineering graduate must be able to (B-Level):

B1. Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics and Vibrations.

B2. Plan, manage and carry out designs of mechanical systems and machine elements using appropriate materials both traditional means and computer-aided tools and software contemporary to the mechanical engineering field.

B3. Select conventional mechanical equipment according to the required performance.

B4. Adopt suitable national and international standards and codes; and integrate legal, economic and financial aspects to: design, build, operate, inspect and maintain mechanical equipment and systems.

To achieve these Intended Learning Outcomes, a set of courses must be completed as a Basic Mechanical Engineering Requirement**.** These courses are listed in the table below

*References:*

*B: NAQAAE 2018 basic Mechanical Engineering Competencies*

# Renewable Energy Engineering - Mechanical Power Discipline List of Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Renewable All | 1BES111 | Introduction to Mechatronics & Measurements | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 1BES113 | Materials Science | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 1BES222 | Electronics | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 1BES321 | Modelling and Simulation for Renewable Energy Systems | 3 | 2 | 3 | 75 | 1 | -- | 3 | 4 |
| | 1BES124 | Electrical Machines (1) | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | 1BES122 | Thermodynamics (1) | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 1BES117 | Electrical Circuits | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 1BES214 | Fundamentals of Heat and Mass Transfer | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 1BES216 | Fluid Mechanics | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 1BES426 | Environmental Risk Analysis | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | REN125 | Measurements Lab | 2 | 2 | 3 | 75 | 1 | -- | 3 | 4 |
| | REN115 | Introduction to Renewable Energy Systems | 2 | 2 | 3 | 75 | 2 | -- | -- | 2 |
| | REN211 | Theory and Applications of Automatic Control | 2 | 3 | 6 | 150 | 2 | 2 | 2 | 6 |
| | REN221 | Storage Energy Technology | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | REN322 | Data Acquisition and Sensors | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | REN313 | Solar Thermal Energy Systems | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | REN314 | Wind energy systems | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | Total | | | 47 | 89 | 2225 | 32 | 27 | 15 | 74 |
| Ren Mechanical | 1BES312 | Structural and Stress Analysis | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 1BES226 | Thermodynamics (2) | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 1BES412 | Turbo Machinery | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 1BES316 | Combustion and Fuels | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | Total | | | 11 | 20 | 500 | 8 | 7 | 1 | 16 |

# 1.2-Renewable Energy Engineering-Electrical Energy

According to the National Academic Reference Standards (NARS-2018), each discipline graduate has to meet specific competences.

In addition to the Competencies for all Engineering Programs (A-Level) the Basic Electrical Engineering graduate must be able to (B-Level):

B1. Select, model and analyze electrical power systems applicable to the specific discipline by applying the concepts of: generation, transmission and distribution of electrical power systems.
B2. Design, model and analyze an electrical/electronic/digital system or component for a specific application; and identify the tools required to optimize this design.
B3. Design and implement: elements, modules, sub-systems or systems in electrical/electronic/digital engineering using technological and professional tools.
B4. Estimate and measure the performance of an electrical/electronic/digital system and circuit under specific input excitation, and evaluate its suitability for a specific application.
B5. Adopt suitable national and international standards and codes to: design, build, operate, inspect and maintain electrical/electronic/digital equipment, systems and services.

To achieve these Intended Learning Outcomes, a set of courses must be completed as a Basic Electrical Engineering Requirement**.** These courses are listed in the table below.

*References:*

*B: NAQAAE 2018 basic Electrical Engineering Competencies*

# Renewable Energy Engineering - Electrical Power Discipline List of Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Renewable All | 1BES111 | Introduction to Mechatronics & Measurements | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 1BES113 | Materials Science | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 1BES222 | Electronics | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 1BES321 | Modelling and Simulation for Renewable Energy Systems | 3 | 2 | 3 | 75 | 1 | -- | 3 | 4 |
| | 1BES124 | Electrical Machines (1) | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | 1BES122 | Thermodynamics (1) | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 1BES117 | Electrical Circuits | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 1BES214 | Fundamentals of Heat and Mass Transfer | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 1BES216 | Fluid Mechanics | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 1BES426 | Environmental Risk Analysis | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | REN125 | Measurements Lab | 2 | 2 | 3 | 75 | 1 | -- | 3 | 4 |
| | REN115 | Introduction to Renewable Energy Systems | 2 | 2 | 3 | 75 | 2 | -- | -- | 2 |
| | REN211 | Theory and Applications of Automatic Control | 2 | 3 | 6 | 150 | 2 | 2 | 2 | 6 |
| | REN221 | Storage Energy Technology | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | REN322 | Data Acquisition and Sensors | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | REN313 | Solar Thermal Energy Systems | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | REN314 | Wind energy systems | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | Total | | | 47 | 89 | 2225 | 32 | 27 | 15 | 74 |
| Ren Electrical | 1BES317 | Signals & Systems | 2 | 2 | 4 | 100 | 2 | 1 | 1 | 4 |
| | 1BES414 | Power Electronics | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 1BES325 | Design, control, and maintenance of PV plants | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 1BES429 | Electrical Machines (2) | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | Total | | | 11 | 20 | 500 | 8 | 7 | 1 | 16 |

# 2-Biochemical Energy Engineering

According to the National Academic Reference Standards (NARS-2018), each discipline graduate has to meet specific competences.

In addition to the Competencies for all Engineering Programs (A-Level) the Basic Chemical Engineering graduate must be able to (B-Level):

B1. Model, analyse and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics and Vibrations.

B2. Carry out designs of mechanical systems and machine elements using appropriate materials both traditional means and computer-aided tools and software contemporary to the mechanical engineering field.

B3. Select conventional mechanical equipment according to the required performance.

B4. Adopt suitable national and international standards and codes to: design, build, operate, inspect and maintain mechanical equipment and systems.

To achieve these Intended Learning Outcomes, a set of courses must be completed as a Basic Chemical Engineering Requirement**.** These courses are listed in the table below.

*References:*

*B: NAQAAE 2018 basic Chemical Engineering Competencies*

# Biochemical Energy Engineering Discipline List of Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Biochemical | 2BES122 | Structural and Stress Analysis | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 2BES113 | Materials Science | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 4 |
| | 2BES312 | Modelling and simulation | 3 | 2 | 3 | 75 | 1 | -- | 3 | 3 |
| | 2BES222 | Thermodynamics | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 2BES225 | Fundamentals of Heat and Mass Transfer | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 2BES125 | Energy Sources | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 2BES124 | Fundamentals of biochemistry | 2 | 3 | 6 | 150 | 2 | 2 | 2 | 6 |
| | 2BES211 | Fundamentals of corrosion science | 2 | 2 | 4 | 100 | 1 | 2 | 1 | 4 |
| | 2BES213 | Mass and energy balances | 2 | 2 | 3 | 75 | 2 | 1 | -- | 3 |
| | 2BES214 | Electrical and Electronic Engineering | 2 | 3 | 5 | 125 | 2 | 2 | 1 | 5 |
| | 2BES226 | Unit Operation | 2 | 2 | 3 | 75 | 2 | 1 | -- | 3 |
| | 2BES313 | Environmental Legislation and Regulations | 2 | 2 | 3 | 75 | 2 | 1 | -- | 3 |
| | 2BES216 | Fluid Mechanics | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 2BES426 | Environmental Risk Analysis | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | 2BES321 | Economics of Bioenergy | 2 | 2 | 3 | 75 | 2 | 1 | -- | 3 |
| | BIO111 | Fundamentals of microbiology | 2 | 2 | 4 | 100 | 2 | 1 | 1 | 5 |
| | BIO212 | Fundamentals of Biochemical engineering | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | BIO223 | Principles of process design | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | BIO325 | Principles of plant design | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | BIO412 | Climate change and BioEnergy | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | BIO221 | Biophysics | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | BIO126 | Biomass engineering | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | **Total** | | | 57 | 106 | 2650 | 42 | 35 | 12 | 88 |

# 3-Petroleum Engineering and Gas Technology Programme

According to the National Academic Reference Standards (NARS-2018), each discipline graduate has to meet specific competences.

In addition to the Competencies for all Engineering Programs (A-Level) the Basic Petroleum Engineering graduate must be able to (B-Level):

B1. Analyze geological data, interpret well-logs, estimate hydrocarbon reserves and evaluate reservoir performance by applying the principles and basic concepts of: geology, geophysics and reservoir engineering.

B2. Plan and construct oil wells, develop oilfield production programs, design early surface facilities plants and field evacuation plans by applying the principles and basic concepts of: drilling engineering, production engineering, phase equilibrium, fluid mechanics and flow through porous media.

B3. Use specialist computer applications and mathematical models to maximize the performance of all petroleum engineering stages.

B4. Apply the concepts of project economics and resources evaluation methods for design and decision making under conditions of risk and uncertainty.

To achieve these Intended Learning Outcomes, a set of courses must be completed as a Basic Petroleum Engineering Requirement**.** These courses are listed in the table below.

*References:*

*B: NAQAAE 2018 basic Petroleum Engineering Competencies*

# Petroleum Engineering and Gas Technology Discipline List of Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Petroleum | 3BES115 | Fundamentals of Fluid Mechanics | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 3BES113 | Materials Science for Petroleum Engineering | 2 | 3 | 6 | 150 | 2 | 2 | 2 | 6 |
| | 3BES122 | Structural and Stress Analysis | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 3BES125 | Fundamentals of Thermodynamics | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 3BES214 | Fundamentals of Heat and Mass Transfer | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 3BES216 | Machine Design for Petroleum Engineering | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 3BES423 | Safety & Environment in Petroleum Industry | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | 3BES325 | Petroleum Development Geology | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 3BES221 | Surveying for Petroleum Engineers | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 3BES126 | Geological Principles of Petroleum | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | 3BES324 | Reservoir Modelling and Simulation | 2 | 3 | 6 | 150 | 2 | -- | 3 | 5 |
| | PET111 | Introduction to Petroleum Engineering | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | PET222 | Reservoir Fluid Properties | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | PET223 | Reservoir Rock Properties | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET224 | Reservoir Rock and Fluid Properties lab | -- | 2 | 3 | 75 | 1 | -- | 3 | 4 |
| | PET323 | Petroleum Economics and Legislation | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | PET311 | Petroleum and Natural Gas exploration | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET421 | Field Development and Reservoir Management | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | PET211 | Drilling Engineering 1 | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | PET212 | Drilling Fluids Laboratory | -- | 2 | 4 | 100 | 1 | -- | 3 | 4 |
| | PET313 | Reservoir Engineering I | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | **Total** | | | 57 | 109 | 2725 | 40 | 32 | 18 | 90 |

# 4- Environmental Sustainable Architecture Engineering Programme

According to the National Academic Reference Standards (NARS-2018), each discipline graduate has to meet specific competences.

In addition to the Competencies for all Engineering Programs (A-Level) the Basic Architectural Engineering graduate must be able to (B-Level):

B1. Create architectural, urban and planning designs that satisfy both aesthetic and technical requirements, using adequate knowledge of: history and theory, related fine arts, local culture and heritage, technologies and human sciences.
B2. Produce designs that meet building users' requirements through understanding the relationship between people and buildings, and between buildings and their environment; and the need to relate buildings and the spaces between them to human needs and scale.
B3. Generate ecologically responsible, environmental conservation and rehabilitation designs; through understanding of: structural design, construction, technology and engineering problems associated with building designs.
B4. Transform design concepts into buildings and integrate plans into overall planning within the constraints of: project financing, project management, cost control and methods of project delivery; while having adequate knowledge of industries, organizations, regulations and procedures involved.
B5. Prepare design project briefs and documents, and understand the context of the architect in the construction industry, including the architect's role in the processes of bidding, procurement of architectural services and building production.

To achieve these Intended Learning Outcomes, a set of courses must be completed as a Basic Architectural Engineering Requirement**.** These courses are listed in the table below.

*References:*

*B: NAQAAE 2018 basic Architectural Engineering Competencies*

# Environmental Sustainable Architecture Engineering Discipline List of Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Env. Sust. Arch. | 4BES111 | Introduction to Environmental and Sustainable Design | 3 | 3 | 5 | 125 | 2 | -- | 3 | 5 |
| | 4BES112 | Sustainable Construction Technologies and Materials (1) | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 4BES113 | Architecture Surveying and Drawing | 3 | 3 | 6 | 150 | 2 | -- | 3 | 5 |
| | 4BES114 | Visual Design and Graphics (1) | 3 | 3 | 6 | 150 | 2 | -- | 3 | 5 |
| | 4BES122 | Sustainable Construction Technologies and Materials (2) | 3 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 4BES123 | Visual Design and Graphics (2) | 3 | 3 | 5 | 125 | 2 | -- | 3 | 5 |
| | 4BES212 | Sustainable Construction Technologies and Materials (3) | 3 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | 4BES224 | Air-Conditioning and Heat Pump Engineering | 3 | 3 | 5 | 125 | 2 | -- | 3 | 5 |
| | 4BES312 | Building Information Modelling | 6 | 3 | 6 | 150 | 2 | -- | 3 | 6 |
| | 4BES313 | Design of Elements | 3 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | 4BES322 | Modelling and Simulation for Sustainable Architecture | -- | 3 | 6 | 150 | 2 | -- | 3 | 5 |
| | 4BES323 | Integrated Building Design | 6 | 2 | 4 | 100 | 1 | -- | 3 | 4 |
| | ESA121 | Architecture Design, History & Theory (1) | 6 | 5 | 9 | 225 | 4 | -- | 3 | 7 |
| | ESA213 | Environmental Control Systems (1) | 3 | 2 | 3 | 75 | 2 | 1 | -- | 3 |
| | ESA222 | Urban and Landscape Design, History & Theory | 6 | 3 | 6 | 150 | 2 | -- | 3 | 5 |
| | ESA314 | Daylighting | 3 | 3 | 5 | 125 | 2 | -- | 3 | 5 |
| | ESAXXX | Elective course | -- | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESAXXX | Elective course | -- | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESAXXX | Elective course | -- | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESAXXX | Elective Course | -- | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | **Total** | | | 58 | 110 | 2750 | 41 | 15 | 35 | 92 |

| | Code | Elective Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Elective | ESA301 | Urban Planning, History & Theory | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA302 | Structures and Design (1) | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA303 | Forensic Engineering | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA304 | Electrical services in buildings | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA305 | Environmental Interior Design & Refurbishment (1) | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA306 | Sustainable Landscapes (1) | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA307 | Life Cycle and Supply Chain Environmental Assessment | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA308 | Introduction to Renewable Energy Systems | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA309 | Water and Waste Management | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA403 | Sustainable Advanced Construction Technologies and Materials (4) | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA404 | Sustainable Advanced Construction Technologies and Materials (5) | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA405 | Structures and Design (2) | 3 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | ESA406 | Structures and Design (3) | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA407 | Power Systems and Design(1) | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA408 | Power Systems and Design(2) | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA409 | Energy Systems(1) | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | ESA4010 | Energy Systems(2) | 3 | 3 | 6 | 150 | 2 | 2 | -- | 4 |

# Section-4

# Programme Requirements

# 1.1-Renewable Energy Engineering - Mechanical Power

# Renewable Energy Engineering – Mechanical Power Programme

## Graduate attributes:

In addition to the general Engineering attributes mentioned above, the Renewable Energy Mechanical Power engineer should be able to:

1. Apply his knowledge in Combustion and Fuels, Turbo Machinery, Storage Energy Technologies and Solar Energy Systems.
2. Apply/Adopt system analysis tools in Renewable Energy Engineering, Wind energy systems, Thermal Power Plants and Power Generation and Conversion Systems
3. Use and/or develop computer software, necessary for design, communication and visualization of industrial systems and projects.
4. Analyze, synthesize, and design open–ended Renewable Energy Engineering systems, understand the associated uncertainties, and evaluate the economic impact.
5. Contribute in the activities of Modelling and Simulation for Renewable Energy Systems, Energy Harvesting Technologies, Network Interfacing of Renewable Resources, Energy Markets, Laws and Economics.
6. Use and/or develop computer software, necessary for the design, analysis, interpretation, and solving problems in Special Topics in Renewable Energy, & Renewable Energy System.
7. Find better lower-cost methods used in Process Design and Simulation.
8. Lead or supervise a group of designers or technicians and other work force.

According to the National Academic Reference Standards (NARS-2018), each discipline graduate has to meet specific competences.

In addition to the Competencies for all Engineering Programs (A-Level) and the competencies for the General Mechanical Engineering Discipline (B-Level), the Renewable Energy - Mechanical Power Engineering Program graduate must be able to (C-Level):

C1. Select and apply appropriate systematic analysis methods to critically evaluate and solve complex renewable energy engineering problems.
C2. Analyse different energy resources and conversion processes using analytical modelling, experimental techniques and numerical simulations.
C3. Critically access the use of renewable energy systems to mitigate climate change and improve the environment and social welfare.
C4. Make and justify decisions for selecting and optimising renewable energy products and systems based on technical, environmental, economic, risk and social criteria.
C5. Develop innovative solutions to meet the current global sustainability and renewable energy challenges.
C6. Demonstrate the application of legal and ethical requirements associated with renewable energy in an industrial environment.

To achieve these Intended Learning Outcomes, a set of courses must be completed as a Renewable Engineering - Mechanical Power Requirement**.** These courses are listed in the table below.

*Reference: Coventry University MSc Renewable Energy Engineering*

# Renewable Energy Engineering - Mechanical Power Programme List of Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Renewable Mechanical | RENM326 | Mechanical power Generation | 2 | 3 | 6 | 150 | 2 | 2 | 2 | 6 |
| | REN315 | Hydraulic, Geothermal and Bio Energy | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENM311 | Sustainable Energy: Principles & Processes | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | RENM411 | Smart Materials for Renewable Energy Systems | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | RENM325 | Thermal Power Plants | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENM323 | Energy Efficiency and Energy Management | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | RENM324 | Alternative Fuels & Fuel Cell Technology | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | RENM413 | Design of Solar Energy Equipment | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | RENXXX | Elective Course | -- | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENXXX | Elective Course | -- | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENXXX | Elective Course | -- | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN401 | Graduation Research Project | -- | 4 | 8 | 200 | -- | -- | -- | -- |
| | REN402 | Design Project | -- | 4 | 8 | 200 | -- | -- | -- | -- |
| | Total | | | 39 | 73 | 1825 | 22 | 20 | 2 | 44 |

| | Code | Elective Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Elective | REN415 | Sustainable Enterprise Economy | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN417 | Wind energy convertors | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN418 | Life cycle assessment | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN421 | Renewable Energy Policy | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN422 | Feasibility studies and economics of Energy Projects | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENM416 | The politics of climate change | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENM419 | Biomass | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENM423 | Integration of and transmission of energies | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENM424 | Internal Combustion Engines | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENM425 | Solar thermal energy design | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENM427 | Design of Hydraulic and Wind Energy Equipment | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENM428 | Advanced Wind Energy | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |

# 1.2-Renewable Energy Engineering – Electrical Energy

# Renewable Energy Engineering- Electrical Energy Programme

## Graduate attributes:

In addition to the general Engineering attributes mentioned above, the Renewable Energy - Electrical Energy engineer should be able to:

1. Apply his knowledge in Electrical Machinery Energy & Storage Techniques and Solar Energy Systems.
2. Apply/Adopt system analysis tools in Renewable Energy Engineering, Electrical Power Plants and Power Generation and Conversion Systems
3. Use and/or develop computer software, necessary for design, communication and visualization of industrial systems and projects.
4. Analyze, synthesize, and design open–ended Renewable Energy Engineering systems, understand the associated uncertainties, and evaluate the economic impact.
5. Contribute in the activities of Modelling and Simulation for Renewable Energy Systems, Energy Harvesting Technologies, Network Interfacing of Renewable Resources, Energy Markets, Laws and Economics.
6. Use and/or develop computer software, necessary for the design, analysis, interpretation, and solving problems in Special Topics in Renewable Energy, Design of Electrical & Renewable Energy System.
7. Find better lower-cost methods used in Process Design and Simulation.
8. Lead or supervise a group of designers or technicians and other work force.

According to the National Academic Reference Standards (NARS-2018), each discipline graduate has to meet specific competences.

In addition to the Competencies for all Engineering Programs (A-Level) and the competencies for the General Electrical Engineering Discipline (B-Level), the Renewable Energy - Electrical Energy Engineering Program graduate must be able to (C-Level):

C1. The scientific and engineering principles underpinning energy and sustainability in the context of electrical power engineering.
C2. Advanced concepts in specialist areas of electric power networks, such as energy generation, transmission and distribution engineering.
C3. Specify and design aspects of electrical power systems with attention to a wide range of outcomes, including technical, practical, efficiency/sustainability and security.
C4. Evaluate energy and sustainability projects with regard to environmental Impact, safety and reliability.
C5. Find, read, understand and explain literature related to advanced and specialised areas of electrical power engineering, including scientific publications, industrial documentation, standards, ethical, legal and environmental guidance.
C6. Plan and manage a research project involving an advanced and specialised aspect of electrical power engineering, using appropriate state of the art techniques, technologies and/or tools.
C7. Use specialist tools for the design, realisation and evaluation of electrical power systems.

To achieve these Intended Learning Outcomes, a set of courses must be completed as a Renewable Engineering Electrical Energy Requirement**.** These courses are listed in the table below.

*Reference: University of Southampton MSc Energy and Sustainability with Electrical Power Engineering*

# Renewable Energy Engineering - Electrical Energy Programme List of Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Renewable Electrical | RENE326 | Power Generation and Conversion Systems | 2 | 3 | 6 | 150 | 2 | 2 | 2 | 6 |
| | REN315 | Hydraulic, Geothermal and Bio Energy | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENE323 | Power system analysis | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | RENE324 | Network Interfacing of Renewable Resources | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | RENE312 | Solar Energy: Photovoltaic (PV) Systems | 2 | 2 | 3 | 75 | 2 | -- | 1 | 3 |
| | RENE311 | Electrical Power Transmission | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | RENE411 | Power systems protection | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | RENE413 | High Voltage Engineering | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | RENXXX | Elective Course | -- | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENXXX | Elective Course | -- | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENXXX | Elective Course | -- | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN401 | Graduation Research Project | -- | 4 | 8 | 200 | -- | -- | -- | -- |
| | REN402 | Design Project | -- | 4 | 8 | 200 | -- | -- | -- | -- |
| | Total | | | 39 | 73 | 1825 | 22 | 19 | 3 | 44 |

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Elective | RENE412 | Power Quality | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN415 | Sustainable Enterprise Economy | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENE416 | Advanced Power System Protection | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN417 | Wind energy convertors | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN418 | Life cycle assessment | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN4E19 | Switchgear Engineering and Substation | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN421 | Renewable Energy Policy | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | REN422 | Feasibility studies and economics of Energy Projects | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENE423 | Electric Drives | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENE424 | Electric Power Distribution Systems | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENE425 | Energy Harvesting Technologies | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENE427 | Advanced Photovoltaics | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENE428 | Micro Grid and Grid Connect PV Solar Systems | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | RENE429 | Power electronics for energy application | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |

# 2-Biochemical Engineering Programme

# Biochemical Engineering Programme Graduate attributes:

In addition to the general Engineering attributes mentioned above, the Biochemical engineer should be able to:

1. Apply his knowledge in Fundamentals of microbiology, Biomass and Bioremediation of environmental pollutant.
2. Apply/Adopt system analysis tools in Biochemical Engineering, Green Fuel and Biofuel and Nano-biotechnology and Energy.
3. Use and/or develop computer software, necessary for design, communication and visualization of industrial systems and projects.
4. Analyze, synthesize, and design open–ended Nanotechnology Biochemical systems, understand the associated uncertainties, and evaluate the economic impact.
5. Contribute in the activities of Bioenergy Modeling and Simulation, Climate Change and Bioenergy, Economics of Bioenergy, Management for Technology and projects.
6. Use and/or develop computer software, necessary for the design, analysis, interpretation, and solving problems in Special Topics in Bioenergy, Principles of process plant design and Bioreactor Design.
7. Find better lower-cost methods used in Process Design and Simulation.
8. Lead or supervise a group of designers or technicians and other work force.

According to the National Academic Reference Standards (NARS-2018), each discipline graduate has to meet specific competences.

In addition to the Competencies for all Engineering Programs (A-Level) and the competencies for the General Electrical Engineering Discipline (B-Level), the Biochemical Engineering Program graduate must be able to (C-Level):

C1. Knowledge of the principles and practice of biochemical engineering in the industrial biotechnology and biopharmaceutical industries.
C2. Understand strategy design and development, techniques and frameworks for crafting strategic options, competitive challenges of a global market environment, implementation of strategy and change.
C3. Professional and ethical responsibilities including the regulatory framework and the global and social context of biochemical engineering.
C4. Hands-on experience of facility and process design for either the industrial biotechnology and biopharmaceutical industries.
C5. Produce solutions to problems through the application of biological and engineering knowledge and understanding.

To achieve these Intended Learning Outcomes, a set of courses must be completed as a Biochemical Engineering Requirement**.** These courses are listed in the table below.

*Reference: University of Sheffield MSc Biochemical Engineering*

# Biochemical Engineering Programme List of Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Biochemical | BIO311 | Bioreactor Design | 2 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | BIO316 | Bioremediation of environmental pollutant | 2 | 2 | 4 | 100 | 2 | 1 | 1 | 4 |
| | BIO224 | Biofuels (1) | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | BIO314 | Biofuels (2) | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | BIO315 | Nanotechnology for biochemical system | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | BIO323 | Biotechnology | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | BIO324 | Bioproduct Design | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | BIO326 | Petroleum Bioprocessing | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | BIO411 | Valorization of waste and biomass | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | BIO421 | Biolubricants for Tribological engineering and engine Tribology | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BIOXXX | Elective Course | -- | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BIOXXX | Elective Course | -- | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BIOXXX | Elective Course | -- | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BIO401 | Graduation Research Project | -- | 4 | 8 | 200 | -- | -- | -- | -- |
| | BIO402 | Design Project | -- | 4 | 8 | 200 | -- | -- | -- | -- |
| | Total | | | 45 | 86 | 2150 | 26 | 24 | 4 | 54 |

| | Code | Elective Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Elective | BIO413 | Process Design and Simulation | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BIO415 | Circular Economy | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BIO416 | Food Processing Equipment | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BIO422 | Process Plant Operation | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BIO423 | Advanced Control Systems | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BIO424 | Occupational, Health, Safety Engineering and Environmental Management Systems | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | BIO425 | Principles of Fermentation Technology | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |

# 3-Petroleum Engineering and Gas Technology Programme

# Petroleum Engineering and Gas Technology Programme

## Graduate attributes:

In addition to the general Engineering attributes mentioned above, the Petroleum Engineering and Gas Technology engineer should be able to:

1. Apply his/her knowledge in petroleum exploration and well construction (drilling and completion) production and reservoir engineering, well services and enhanced oil recovery methods.
2. Apply/Adopt system analysis tools in well design, reservoir simulation, production optimization and well services interpretation, and drilling optimization.
3. Use and/or develop computer software, necessary for design, communication and visualization of industrial systems and projects.
4. Analyze, synthesize, and design open–ended petroleum engineering systems, understand the associated uncertainties, and evaluate the economic impact.
5. Contribute in the activities of petroleum exploration and drilling, production and reservoir engineering, formation evaluation and well logging (well services) enhanced oil recovery methods, and projects.
6. Use and/or develop computer software, necessary for the design, analysis, interpretation, and solving problems in petroleum exploration and drilling, production and reservoir engineering, well services, management services.
7. Find better lower-cost methods used in enhanced oil recovery (EOR).
8. Lead or supervise a group of designers or technicians and other work force.

According to the National Academic Reference Standards (NARS-2018), each discipline graduate has to meet specific competences.

In addition to the Competencies for all Engineering Programs (A-Level) and the competencies for the General Electrical Engineering Discipline (B-Level), the Petroleum Engineering and Gas Technology Program graduate must be able to (C-Level):

C1. Operate effectively as petroleum engineer.
C2. Students promote the ethos of synergy within the integrated, multidisciplinary teams of petroleum engineers and petroleum geoscientists in the exploration and development of oil and gas resources.
C3. Students are trained in best current industry workflows and work practices, in order to be able to work effectively, either independently or as a member of an integrated team.
C4. The obtaining of oil from an oil reservoir - a quantitative demonstration of porosity, permeability, relative permeability, entrapment etc.
C5. Porosity and permeability determinations - a demonstration of the processes and difficulties involved in measuring these parameters.
C6. Rock resistivity - shows the basic principles of rock resistivity using saline solutions.
C7. Phase Flow - a study of horizontal, vertical and inclined 2- phase flow patterns.

To achieve these Intended Learning Outcomes, a set of courses must be completed as a Petroleum Engineering and Gas Technology Requirement**.** These courses are listed in the table below.

*Reference: Imperial College London MSc Petroleum Engineering*

# Petroleum Engineering and Gas Technology Programme List of Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Petroleum | PET312 | Well Logging | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | PET316 | Well Testing | 2 | 3 | 5 | 125 | 2 | -- | 3 | 5 |
| | PET322 | Petroleum Production Engineering & Equipment | 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 |
| | PET411 | Reservoir Engineering II | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET412 | Surface Production Facilities | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET413 | Enhanced Hydrocarbon Recovery | 2 | 3 | 6 | 150 | 2 | 2 | -- | 4 |
| | PET422 | Drilling Engineering II | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET314 | Field Courses | -- | 2 | 4 | 100 | 1 | -- | 3 | 4 |
| | PET326 | Corrosion in Oil and Gas Industry | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET418 | Gas Condensate Reservoir Engineering | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PETXXX | Elective Course | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET401 | Graduation Research Project | -- | 4 | 8 | 200 | -- | -- | -- | -- |
| | PET402 | Design Project | -- | 4 | 8 | 200 | -- | -- | -- | -- |
| | Total | | | 40 | 74 | 1850 | 21 | 18 | 8 | 46 |

| | Code | Elective Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Elective | PET424 | Rock Mechanics for Drilling and Completion | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET425 | Advanced Production Logging | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET426 | Reservoir Stimulation | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET427 | Well Intervention & Stimulation | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET428 | Petroleum Refining Engineering | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |
| | PET429 | Special Topics in Advanced Drilling | 2 | 3 | 5 | 125 | 2 | 2 | -- | 4 |

# 4- Environmental Sustainable Architecture Engineering Programme

# Environmental Sustainable Architecture Engineering Programme

## Graduate attributes:

In addition to the general Engineering attributes mentioned above, the Environmental Sustainable Architecture engineer should be able to:

1. Apply his knowledge in Structural and Stress Analysis, Sustainable Construction Technologies and Materials and Thermo-Fluids.
2. Apply/Adopt system analysis tools in Design of Elements, Integrated Building Design, Air-Conditioning and Heat Pump Engineering and Urban and Landscape Design.
3. Use and/or develop computer software, necessary for Environmental Sustainable Architecture engineering system design, communication and visualization of industrial systems and projects.
4. Analyze, synthesize, and design open–ended Environmental Sustainable Architecture engineering systems, understand the associated uncertainties, and evaluate the economic impact.
5. Contribute in the activities of Modelling and Simulation: Architecture Design, Visual Design and Graphics, Eco Design and Integrated Building Design.
6. Use and/or develop computer software, necessary for the design, analysis, interpretation, and solving problems in Special Topics in Environmental Sustainable Architecture Engineering.
7. Find better lower-cost methods used in Building Information Modelling.
8. Lead or supervising different work force.

According to the National Academic Reference Standards (NARS-2018), each discipline graduate has to meet specific competences.

In addition to the Competencies for all Engineering Programs (A-Level) and the competencies for the General Electrical Engineering Discipline (B-Level), the Environmental Sustainable Architecture Engineering Program graduate must be able to (D-Level):

D1. Demonstrate a detailed knowledge of the theories, concepts and principles of architecture and environmental design with specific reference to the design process, climatic context and historical development.
D2. Demonstrate a detailed knowledge of energy systems and fluxes in the built environment and the relationship between conventional building services, low-energy practices and climatic applicability of passive design strategies for the provision of comfort in buildings.
D3. Develop more sophisticated techniques for the conceptualization and embedding of bioclimatic, cultural and social theories and practices in the architectural design and refinement of the design process and representation.
D4. Demonstrate fluent and systematic knowledge of the theories, concepts and principles of architecture and environmental design with specific reference to the application and integration of such principles to the architectural design process.
D5. Demonstrate systematic and proficient knowledge of the architectural integration of environmental strategies and low-energy systems towards energy demand reduction and of methods for the quantification of building performance.
D6. Formulate and articulate briefs and design proposals which embed principles of environmental and bioclimatic design conceptualising a variety of physical and socio- cultural contexts and being able to communicate and exemplify design through a number of representation and making skills.

To achieve these Intended Learning Outcomes, a set of courses must be completed as a Environmental Sustainable Architecture Requirement**.** These courses are listed in the table below.

*Reference: University of Westminster BSc Architecture and Environmental Design*

# Environmental Sustainable Architecture Engineering Programme List of Courses

| | Code | Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Env. Sust. Architecture | ESA211 | Eco Design, History & Theory (2) | 6 | 5 | 9 | 225 | 4 | -- | 3 | 7 |
| | ESA221 | Eco Design for Occupant Wellbeing (3) | -- | 5 | 9 | 225 | 4 | -- | 3 | 7 |
| | ESA311 | Eco Design for Zero Energy and Passive Buildings (4) | -- | 5 | 9 | 225 | 3 | 2 | 3 | 8 |
| | ESA321 | Eco Design with Water and Waste for Sustainability (5) | -- | 5 | 9 | 225 | 3 | 2 | 3 | 8 |
| | ESA223 | Environmental Control Systems (2) | 3 | 2 | 4 | 100 | 2 | 1 | -- | 3 |
| | ESAXXX | Elective course | -- | 5 | 9 | 225 | 3 | 2 | 3 | 8 |
| | ESAXXX | Elective course | -- | 5 | 9 | 225 | 2 | 2 | 6 | 10 |
| | ESA401 | Graduation Research Project | -- | 4 | 8 | 200 | -- | -- | -- | -- |
| | ESA402 | Graduation Design Project | -- | 9 | 16 | 400 | -- | -- | -- | -- |
| | Total | | | 45 | 82 | 2050 | 21 | 11 | 21 | 51 |

| | Code | Elective Course Title | Exam Time (H) | Cr & SWL | | | Contact Hours | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CH | ECTS | SWL | Lec | Tut | Lab | TT |
| Elective | ESA4011 | Architectural design and technology | -- | 5 | 9 | 225 | 2 | 2 | 6 | 10 |
| | ESA4012 | Electrical Installation Equipment & Lighting | 3 | 5 | 9 | 225 | 3 | 2 | 3 | 8 |
| | ESA4013 | Heat Transfer in Building Services Engineering | 3 | 5 | 9 | 225 | 3 | 2 | 3 | 8 |
| | ESA4014 | Geotechnical design | 3 | 5 | 9 | 225 | 3 | 2 | 3 | 8 |
| | ESA4015 | Energy management and controls | 3 | 5 | 9 | 225 | 3 | 4 | -- | 7 |
| | ESA4016 | Advanced Eco Design and Visualization (6) | 3 | 5 | 9 | 225 | 3 | -- | 6 | 9 |
| | ESA4017 | Specialized Eco Design and Visualization (7) | 3 | 5 | 9 | 225 | 2 | 2 | 6 | 10 |

# Part E

# Course Pool

All the programs use courses from the Faculty Departments. There are 5 departments at the Faculty of Energy and Environmental Engineering, The British University in Egypt. They are listed in the following table:

| Field | # | Department | Courses |
|---|---|---|---|
| Basic Science | 1 | Basic Science | 54 |
| Mechanical Engineering | 2 | Renewable Energy Engineering | 85 |
| Electrical Engineering | | | |
| Chemical Engineering | 3 | Biochemical Engineering | 36 |
| Petroleum Engineering | 4 | Petroleum Engineering & Gas Technology | 34 |
| Architectural Engineering | 5 | Environmental Sustainable Architecture Engineering | 49 |
| Total number of courses | | | 258 |

# 1-Modules Delivered by the Basic Science Department

| | Code | Course Title | Cr & SWL | | | Contact Hours | | | | Classification | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH | ECTS | SWL | Lec | Tut | Lab | TT | UR | FR | DR | PR |
| All Programs | HUM016 | English language | 2 | 3 | 75 | 2 | -- | -- | 2 | X | | | |
| | HUM026 | English language | 2 | 3 | 75 | 2 | -- | -- | 2 | X | | | |
| | HUM015 | Energy and human development | 2 | 3 | 75 | 2 | -- | -- | 2 | X | | | |
| | HUM017 | Engineering Ethics and Communications | 2 | 4 | 100 | 2 | 1 | -- | 3 | X | | | |
| | BAS011 | Mathematics (1) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | X | | |
| | BAS021 | Mathematics (2) | 3 | 5 | 125 | 2 | 2 | -- | 4 | | X | | |
| | BAS012 | Physics 1 | 3 | 6 | 150 | 2 | 2 | 2 | 6 | | X | | |
| | BAS022 | Physics 2 | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | X | | |
| | BAS023 | Chemistry | 3 | 6 | 150 | 2 | 2 | 2 | 6 | | X | | |
| | BAS025 | Algebra and Geometry | 3 | 5 | 125 | 2 | 2 | -- | 4 | | X | | |
| | | | | | | | | | | | | | |
| Renewable | HUMXXX | Elective Module | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | 1HUM217 | Foundation of Marketing | 2 | 4 | 100 | 2 | 1 | -- | 3 | X | | | |
| | 1HUM224 | Fundamentals of Management | 2 | 3 | 75 | 2 | 1 | -- | 3 | X | | | |
| | 1HUM223 | Project Management and Economics | 2 | 4 | 100 | 2 | 1 | -- | 3 | X | | | |
| | 1HUM114 | Technical Report Writing and Communication | 2 | 3 | 75 | 2 | -- | 1 | 3 | X | | | |
| | 1BAS112 | Calculus | 2 | 4 | 100 | 2 | 1 | -- | 3 | | X | | |
| | 1BAS121 | Physics 3 | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | X | | |
| | 1BAS123 | Differential Equations | 3 | 6 | 150 | 2 | 2 | -- | 4 | | X | | |
| | 1BAS213 | Probability and Statistics | 3 | 5 | 125 | 2 | 2 | -- | 4 | | X | | |
| | 1BAS225 | Numerical Methods | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | X | | |
| | 1BAS116 | Physical Chemistry | 2 | 4 | 100 | 2 | 1 | -- | 3 | | X | | |
| | | | | | | | | | | | | | |
| Biochemical | HUMXXX | Elective Module | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | 2HUM317 | Fundamentals of management for engineers | 2 | 4 | 100 | 2 | 1 | -- | 3 | X | | | |
| | 2HUM322 | Business skills for engineers and technologies | 2 | 3 | 75 | 2 | 1 | -- | 3 | X | | | |
| | 2HUM114 | Technical Report Writing and Communication | 2 | 3 | 75 | 2 | -- | 1 | 3 | X | | | |
| | 2BAS215 | Numerical Methods | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | X | | |
| | 2BAS112 | Advanced Mathematics (1) | 2 | 4 | 100 | 2 | 1 | -- | 3 | | X | | |
| | 2BAS123 | Advanced Mathematics (2) | 2 | 3 | 75 | 2 | 1 | -- | 3 | | X | | |
| | 2BAS115 | Organic Chemistry | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | X | | |
| | 2BAS121 | Inorganic Chemistry | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | X | | |
| | 2BAS116 | Physical Chemistry | 2 | 4 | 100 | 2 | 1 | -- | 3 | | X | | |
| | | | | | | | | | | | | | |
| Petroleum | 3HUM124 | Fundamentals of Management | 2 | 4 | 100 | 2 | 1 | -- | 3 | X | | | |
| | 3HUM315 | Engineering Project Management | 2 | 4 | 100 | 2 | 1 | -- | 3 | X | | | |
| | 3HUM114 | Technical Report Writing and Communication | 2 | 3 | 75 | 2 | -- | 1 | 3 | X | | | |
| | 3BAS112 | Calculus | 3 | 6 | 150 | 2 | 2 | -- | 4 | | X | | |
| | 3BAS123 | Differential Equations | 3 | 6 | 150 | 2 | 2 | -- | 4 | | X | | |
| | 3BAS213 | Engineering Probability and Statistics | 3 | 6 | 150 | 2 | 2 | -- | 4 | | X | | |
| | 3BAS215 | Organic Chemistry | 3 | 5 | 125 | 2 | 2 | 1 | 5 | | X | | |
| | 3BAS225 | Numerical Methods | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | X | | |
| | 3BAS121 | Physics for Petroleum Engineers | 3 | 5 | 125 | 2 | 2 | 1 | 5 | | X | | |
| | 3BAS116 | Physical Chemistry for Petroleum Engineering | 3 | 5 | 125 | 2 | 2 | -- | 4 | | X | | |
| | 3BAS226 | Introduction to Analytical Chemistry | 2 | 4 | 100 | 2 | 1 | -- | 3 | | X | | |
| | | | | | | | | | | | | | |
| ESA | HUMXXX | Elective Module | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | 4HUM125 | Technical Writing and Digital Communication | 3 | 6 | 150 | 2 | 2 | 1 | 5 | X | | | |
| | 4BAS225 | Statistics, Numerical Methods and Computers | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | X | | |
| | | | | | | | | | | | | | |
| Humanities Electives | HUM001 | Ethics and Legislation | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | HUM002 | Advanced Risk Management | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | HUM003 | Foreign Language | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | HUM004 | Marketing | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | HUM005 | Selections of Life-Long Skills | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | HUM006 | Business Communication | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | HUM007 | Service Management | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | HUM008 | Humanities for Engineering Students | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | HUM009 | Science – Technology – Society | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | HUM0010 | Professional Practice | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |
| | HUM0011 | Entrepreneurship | 3 | 6 | 150 | 2 | 2 | -- | 4 | X | | | |

# Course Description of Modules Delivered by the Basic Science Department to All Programs

| HUM015 | Energy and Human Development | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 0 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |
| Engineering and technology in society; the engineering profession; energy engineering; the engineer as a problem solver presented through consideration of specific topics such as: safety requirements, energy and the environment, service failure of systems and components, low cost automation, development of industry and energy in Europe and the Middle East with Special reference to Egypt and UK and power generation. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| University Requirement | | 0 | |
| Assessment Criteria | | | |
| Group project | Group presentation | Practical Exam | Final Exam |
| 20% | 20% | 0% | 60% |

| HUM017 | Engineering Ethics and Communications | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |
| Engineering profession: Ethical issues in engineering practice. Conflicts between business demands and professional ideals. Social and ethical Responsibilities of Technologists. Codes of professional ethics. Case studies. Value Crisis in contemporary society. Nature of values: Psychological values, Societal values, Aesthetic values, Moral and ethical values. Work ethics and professional ethics.<br>The legal rule: Mandatory and complementary. Sources of Law. Formal sources: Statutory Law, Custom, the Principles of natural Law and rules of justice. Informal sources: Jurisprudence, Doctrine. Application of Law. Holders of right; Natural persons, Juristic persons. Theory of Obligation; definition, forms. Sources of Obligations. The contract; Parties, Formation, Validity, Effect, and compensation of Damage. Introduction to Engineering Contracts. Contracting Contract. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |

| University Requirement | | | 0 |
|---|---|---|---|
| Assessment Criteria | | | |
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 20% | 20% | 0% | 60% |

| BAS011 | Mathematics (1) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Functions: definition and algebra of functions; rational functions and trigonometric functions; trigonometric identities; graphs of functions; The limit of a function: definition and techniques for finding limits; one-sided limits, limits at infinity; infinite limits; Continuity of a function: definition; types of discontinuity; The derivative of a function: definition; the power rule; algebra of derivatives; the chain rule; derivatives of trigonometric functions; the mean value theorem; increasing and decreasing functions; local extreme values; Definite integral: definition, area and integration; properties of the definite integral; the fundamental theorem of integral calculus, substitution in definite integrals; Transcendental functions: the logarithm and exponential functions and their derivatives; inverse trigonometric and hyperbolic functions and their derivatives and integrals; Techniques of integration: integration by parts; trigonometric integrals; integrals of rational functions; reduction formulae. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Faculty Requirement | | 0 | |
| Assessment Criteria | | | |
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 40% | 0% | 60% |

| BAS021 | Mathematics (2) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Conic sections. Polar coordinates; area in polar coordinates; curves given parametrically. Arc length. The area of a surface of revolution; volume of solids of revolution. Indeterminate forms; improper integrals. Sequences; convergent or divergent series; positive terms series; convergence tests; alternating series and absolute convergence; power series. Maclaurin and Taylor series. Partial derivatives; | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Faculty Requirement | | 0 | |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 40% | 0% | 60% |

| BAS012 | Physics 1 | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | Laboratory | |
| 2 | | 2 | 2 | |
| Required SWL | 150 | Equivalent ECTS | 6 | |
| Course Content | | | | |
| Measurements and fundamental quantities, Units and dimensions. Accuracy, precision and errors dimensional analysis, Newton's Three Laws of Motion, Newton's Law of Gravitation, Work and Conservation of Energy. Sates of matter; solids, liquids, and gases, simple harmonic motion, wave motion. Mechanical waves, Electromagnetic waves. Heat; temperature, thermometers, thermal expansion, heat transfer. Thermodynamics; first law, heat engines and the second law of thermodynamics. Kinetic theory of gases. Wave optics, Nature of light and laws of geometric optics | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Faculty Requirement | | | 0 | |
| Assessment Criteria | | | | |
| Lab report | Mid-Term Exam | Practical Exam | Final Exam | |
| 20% | 20% | 0% | 60% | |

| BAS022 | Physics 2 | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | Laboratory | |
| 2 | | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 | |
| Course Content | | | | |
| Introduction to electricity and magnetism covering the electric field, Coulomb's law, the idea of scalar and vector field and the electric field, Gauss's law, electrostatic potential, electric energy, capacitors and dielectrics, DC circuit and resistance, Kirchhoff's rules, combination of resistors, magnetic fields, Ampere's law, Faraday's law of induction, inductors Applications. AC circuits-LC, LR, and LCR circuits. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Faculty Requirement | | | 0 | |
| Assessment Criteria | | | | |
| Lab coursework | Mid-Term Exam | Practical Exam | Final Exam | |
| 20% | 20% | 0% | 60% | |

| BAS023 | Chemistry | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 2 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Introduction to general chemistry; atomic structures and chemical bonding, intermetallic forces, phase diagrams, gas laws. States of matter, chemical reactions and principles of electrochemistry. principles of physical chemistry | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Faculty Requirement | | 0 | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Practical Exam | Final Exam |
| 20% | 20% | 0% | 60% |

| BAS025 | Algebra and Geometry | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Basic algebra: algebraic expressions and fractional exponents; Matrices: algebraic operations on matrices; powers of a matrix; transpose of a matrix; the identity matrix and the null matrix; determinants and their properties; inverse of a matrix; eigenvalues and eigenvectors of a matrix; diagonalization theorem; linear operators on vectors and their geometric interpretation; the inverse operator; systems of linear equations and their solutions; applications of linear systems; algebraic operations on complex numbers; powers of a complex number and De Moivre's theorem; the nth roots of unity; Coordinate geometry in a space: plane; straight line; sphere; quadratic surfaces, Complex numbers: Cartesian and polar coordinate forms of a complex number; its modulus, argument and conjugate; development environment, syntax, values and variables, operators, program structure, data structures, pointers, streams and files. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Faculty Requirement | | 0 | |
| Assessment Criteria | | | |
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 40% | 0% | 60% |

# Course Description of Modules Delivered by the Basic Science Department to the Renewable Energy Engineering Program

| 1HUM217 | Foundation of Marketing | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |
| Introduction. The Field of Sales; Strategic Sales Force Management, The Personal Selling Process and Sales Force Organization. Profiling and Recruiting Salespeople; Selecting and Hiring Applicants, Developing the Sales Program, Sales Force Motivation, Sales Force Compensation, Expenses and Transportation; Leadership of a Sales Force, Forecasting Sales and Developing Budgets; Sales Territories, Analysis of Sales Volume, Marketing Cost & Profitability Analysis, Performance Evaluation; Ethical and Legal Responsibilities tender writing. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable University Requirement | | 2 | |
| Assessment Criteria | | | |
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 40% | 0% | 60% |

| 1HUM224 | Fundamentals of Management | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |

- Introduction to Management
- Historical view and evolution of concepts.
- Basic Managerial Functions:
- Planning-Basic Terminology (Mission, Vision...) Essentials of planning- Basic Terminology (Mission, Vision….), Essentials of planning, Strategies. Objectives, MBO; Premising,
- Decision Making. Organizing: Types of Organizations (Flat and Tall and Requirements), Depart mentation,
- Job Description.
- Elements of Human Resource Management: Staffing (Definitions and Steps), Directing, controlling (Measures, Appraisals). Behavioural Types. Managers or Leader?

| |
|---|
| • Leadership Styles.<br>• Total Quality Management,<br>• Continuous Improvement |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable University Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| 1HUM223 | Project Management and Economics | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |
| Economic Theory, theories of supply and demand and their application, price and cost analysis, break-even analysis. The theory and techniques of management including, motivation, delegation, team working and presentational skills. Responsibilities of managers in the working environment. Project Management, techniques and methodologies, decision analysis, risk and uncertainty, critical path analysis, decision trees and rollback analysis. | | | |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable University Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| 1HUM114 | Technical Report Writing and Communication | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 1 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |
| • Introduction to technical reports<br>• Identification of the problem<br>• Identification of audiences and readers<br>• Mechanisms of technical writing, and how to write good technical reports<br>• What is technical writing<br>• Relation between sender and receiver<br>• Ethical considerations | | | |

- How to write an effective paragraph
- How to develop ideas
- Technical definitions
- Description of a mechanism
- Description of a process
- Analysis of written paragraphs
- Writing proposals
- Laboratory and project reports.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable University Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Individual report | Practical Exam | Final Exam |
| 40% | 60% | 0% | 0% |

| 1BAS112 | Calculus | 2 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 1 | 0 |

| Required SWL | 100 | Equivalent ECTS | 4 |
|---|---|---|---|

Course Content

- Functions of several variables
- Partial derivatives
- Directional derivatives
- Tangent planes
- Normal lines
- Double integrals
- Triple integrals
- Cylindrical and spherical coordinates systems
- Jacobian of a transformation
- Differentiation of vector functions
- Surfaces gradient fields
- Divergence and curl of vector fields
- Line integrals
- Green's theorem
- Surface integrals
- Flux of a vector field
- Gauss divergence theorem
- Stoke's theorem

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |

| | | | |
|---|---|---|---|
| 0% | 30% | 0% | 70% |

| 1BAS121 | Physics 3 | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

- State of matter: tension compression, shear pressure, ideal fluid motion, viscosity.
- Wave: motion, superposition, standing wave, sound interface, resonance, Doppler Effect.
- Fluid Mechanics: pressure, variation of pressure with depth, buoyant forces and Bernoulli's equation.
- Kinematics and dynamics of particles and rigid bodies, gravitation, equilibrium, conditions for equilibrium, elastic properties of solids, examples of rigid objects, Bonding in solids, conduction in solids.
- Introduction to diffraction, the diffraction grating, diffraction of X-rays by crystals, interference and polarisation of light waves, vibrations,
- Basic nuclear structure, nuclear models, radioactivity, nuclear reactions, radiation damage, radiation detectors, radiation safety and uses of radiation

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Practical Exam | Final Exam |
| 20% | 10% | 0% | 70% |

| 1BAS123 | Differential Equations | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

- First order differential equations
- linear equations
- Separable equations
- Exact equations and integrating factors
- Bernoulli equations
- Second order linear differential equations
- Homogeneous equations with constant coefficients
- Non-homogeneous equations using the method of differential operators and the method of variation of parameters
- Second order linear differential equations with variable coefficients

- Cauchy-Euler equations
- Series solution of differential equations
- Special functions: Gamma functions; Bessel functions
- Laplace transform and inverse Laplace transform
- Convolution Theorem
- Solution of initial and boundary value problems using Laplace transform.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| 1BAS213 | Probability and Statistics | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

Course Content

- Statistics: The Collection, organization and representation of numerical data, measures of central tendency, dispersion, kurtosis and skewing, Elements of probability, main probability distributions (continuous, normal, binomial, exponential and Poisson), significance testing and confidence intervals, quality control, chi square and F distributions, curve fitting, regression and correlation, mathematical expectation, analysis of variance.
- Theory of probability: theory of sets, conditional probabilities, random variables, probability distribution functions, random distribution functions, continuous and discrete distribution functions.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Faculty Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 15% | 15% | 0% | 70% |

| 1BAS225 | Numerical Methods | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Types of errors
- Algorithms and convergence

- Solution of nonlinear equations in one variable using bisection and Newton-Raphson
- Solution of linear systems using iteration methods, the Jacobi, and the Gauss-seidel;
- Interpolation and polynomial approximation using Lagrange
- Newton divided differences
- Newton forward and backward
- Central differences
- least square regression
- Numerical integration using trapezoidal and Simpson
- Numerical solution of ordinary differential

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Faculty Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Individual project | Mid-Term Exam | Practical Exam | Final Exam |
| 20% | 10% | 0% | 70% |

| 1BAS116 | Physical Chemistry | 2 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 1 | 0 |

| Required SWL | 100 | Equivalent ECTS | 4 |
|---|---|---|---|

Course Content

- Properties of gases
- Kinetic theory and transport properties of gases and its applications
- Spontaneity criteria of processes
- Stoichiometry and limiting reactant calculations,
- Colligative properties of solutions,
- Chemical kinetics and rate of reactions
- Phase diagrams,

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

# Course Description of Modules Delivered by the Basic Science Department to the Biochemical Engineering Program

| 2HUM317 | Fundamentals of Management for Engineers | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |

- Introduction to Management
- Historical view and evolution of concepts.
- Basic Managerial Functions:
- Planning-Basic Terminology (Mission, Vision...) Essentials of planning- Basic Terminology (Mission, Vision….), Essentials of planning, Strategies. Objectives, MBO; Premising,
- Decision Making. Organizing: Types of Organizations (Flat and Tall and Requirements), Depart mentation,
- Job Description.
- Elements of Human Resource Management: Staffing (Definitions and Steps), Directing, controlling (Measures, Appraisals). Behavioural Types. Managers or Leader?
- Leadership Styles.
- Total Quality Management,
- Continuous Improvement

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical University Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| 2HUM322 | Business skills for engineers and technologies | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |

- **Fundamentals of Management**
  - Introduction to Management
  - Historical view and evolution of concepts.
  - Basic Managerial Functions:

- Planning-Basic Terminology (Mission, Vision...) Essentials of planning-Basic Terminology (Mission, Vision….), Essentials of planning, Strategies. Objectives, MBO; Premising,
- Decision Making. Organizing: Types of Organizations (Flat and Tall and Requirements), Depart mentation,
- Job Description.
- Elements of Human Resource Management: Staffing (Definitions and Steps), Directing, controlling (Measures, Appraisals). Behavioural Types. Managers or Leader?
- Leadership Styles.
- Total Quality Management.
- Continuous Improvement

- **Foundation of Marketing**
  - Introduction.
  - The Field of Sales; Strategic Sales Force Management, The Personal Selling Process and Sales Force Organization. Profiling and Recruiting Salespeople; Selecting and Hiring Applicants, Developing the Sales Program, Sales Force Motivation, Sales Force Compensation, Expenses and Transportation; Leadership of a Sales Force, Forecasting Sales and Developing Budgets; Sales Territories, Analysis of Sales Volume, Marketing Cost & Profitability Analysis, Performance Evaluation; Ethical and Legal Responsibilities tender writing.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical University Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Individual report | Mid-Term Exam | Practical Exam | Final Exam |
| 20% | 20% | 0% | 60% |

| 2HUM114 | Technical Report Writing and Communication | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 1 | |
| Required SWL | 75 | Equivalent ECTS | 3 |

Course Content

- Introduction to technical reports
- Identification of the problem
- Identification of audiences and readers
- Mechanisms of technical writing, and how to write good technical reports
- What is technical writing
- Relation between sender and receiver
- Ethical considerations
- How to write an effective paragraph
- How to develop ideas
- Technical definitions

- Description of a mechanism
- Description of a process
- Analysis of written paragraphs
- Writing proposals
- Laboratory and project reports.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical University Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Individual project | Practical Exam | Final Exam |
| 40% | 60% | 0% | 0% |

| 2BAS215 | Numerical Methods | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Types of errors
- Algorithms and convergence
- Solution of nonlinear equations in one variable using bisection and Newton-Raphson
- Solution of linear systems using iteration methods, the Jacobi, and the Gauss-seidel;
- Interpolation and polynomial approximation using Lagrange
- Newton divided differences
- Newton forward and backward
- Central differences
- least square regression
- Numerical integration using trapezoidal and Simpson
- Numerical solution of ordinary differential equations using Euler's method, Runge–Kutta, and multi-step methods.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Faculty Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Group project | Lab coursework | Practical Exam | Final Exam |
| 20% | 10% | 0% | 70% |

| 2BAS112 | Advanced Mathematics (1) | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |

| Course Content |
|---|
| • First order differential equations<br>• linear equations<br>• Separable equations<br>• Exact equations and integrating factors<br>• Bernoulli equations<br>• Second order linear differential equations<br>• Homogeneous equations with constant coefficients<br>• Non-homogeneous equations using the method of differential operators and the method of variation of parameters<br>• Second order linear differential equations with variable coefficients<br>• Cauchy-Euler equations<br>• Series solution of differential equations<br>• Special functions: Gamma functions; Bessel functions<br>• Laplace transform and inverse Laplace transform<br>• Convolution Theorem<br>• Solution of initial and boundary value problems using Laplace transform. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| 2BAS123 | Advanced Mathematics (2) | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 75 | Equivalent ECTS | 3 |

| Course Content |
|---|
| • Introduction of vector space; Metric, Norm, Inner Product space; Examples<br>• Onto, into, one to one function, completeness of space<br>• Vectors: Linear combination of vectors, dependent/independent vectors; Orthogonal and orthonormal vectors; Gram-Schmidt orthogonalization.<br>• Contraction Mapping: Definition; Applications in Chemical Engineering; Examples Matrix, determinants and properties<br>• Eigenvalue Problem: Various theorems; Solution of a set of algebraic equations; Solution of a set of ordinary differential equations; Solution of a set of nonhomogeneous first order ordinary differential equations (IVPs)<br>• Applications of eigenvalue problems: Stability analysis; Bifurcation theory; Examples<br>• Partial Differential equations: Classification of equations; Boundary conditions; Principle of Linear superposition |

- Special ODEs and Adjoint operators: Properties of adjoint operator; Theorem for eigenvalues and eigenfunctions.
- Solution of linear, homogeneous PDEs by separation of variables: Cartesian coordinate system & different classes of PDEs; Cylindrical coordinate system; Spherical Coordinate system
- Solution of non-homogeneous PDEs by Green's theorem
- Solution of PDEs by Similarity solution method
- Solution of PDEs by Integral method
- Solution of PDEs by Laplace transformation
- Solution of PDEs by Fourier transformation

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| 2BAS115 | Organic Chemistry | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Chemical Bonding, Organic Structures, and Alkanes
- Acids, Bases, and Arrows - Writing Organic Mechanisms
- More on Frontier Molecular Orbitals (FMO)
- Chemistry of Alkenes
- Stereochemistry
- Cyclic Compounds and Stereochemistry of Reactions
- Introduction to Alkyl Halides, Alcohols, Ethers, Thiols, and Sulfides
- Chemistry of Alkyl Halides
- Infrared, Mass, and Nuclear Magnetic Resonance Spectroscopy
- Nuclear Magnetic Resonance Spectroscopy
- Chemistry of Alcohols, Glycols, Thiols, Ethers, Epoxides, and Sulfides
- Alkyne Chemistry and Organic Synthesis
- Aromaticity and Electrophilic Aromatic Substitution
- Electrophilic and Nucleophilic Aromatic Substitution
- Aldehydes and Ketones - Carbonyl Addition
- Chemistry of Carboxylic Acids and their Derivatives
- Introduction to carbohydrates, peptides, and proteins
- Chemistry of Amines
- **Organic Chemistry Lab. Three labs (2 hr) every other week**

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |

| | |
|---|---|
| Biochemical Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Practical Exam | Final Exam |
| 15% | 15% | 0% | 70% |

| 2BAS121 | Inorganic chemistry | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 2 | 1 |

| Required SWL | 150 | Equivalent ECTS | 6 |
|---|---|---|---|

Course Content

- **Atomic Theory:** Introduction to Quantum theory; Bohr theory; wave theory; periodic classification; properties of electronic configuration
- **Nuclear Chemistry:** Introductory theory; radioactivity and nuclear reactions; radionuclides and their applications; kinetics of nuclear decay; calculation of nuclear binding energy and mass defect
- **Structures of Inorganic compounds:** Unit cells; close packing of spheres; Structures of ionic and covalent crystals; crystals of nonmetallic elements
- **Chemical bonding and intermolecular attractions:** Bonding theories (ionic,covalent,metallic), conductors/semiconductors, alloys; Born Haber Cycle; lattice energy; introduction to molecular orbital theory; shapes of molecules and ions; Intermolecular forces
- **Coordination Complexes:** Warner Theory; nature of metal-ligand bond; complex charges, coordination number, and geometry; ligands; naming of complexes
- **Main Group Chemistry:** Non transition elements (s and p - block), comparison of their physical and chemical properties, reactions
- **Practical Programme:** Selection of practicals in aqueous chemistry and complex formation **Water analysis Lab. <u>Three labs (2 hr) every other week</u>**

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Biochemical Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Practical Exam | Final Exam |
| 15% | 15% | 0% | 70% |

| 2BAS116 | Physical Chemistry | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 1 | 0 |

| Required SWL | 100 | Equivalent ECTS | 4 |
|---|---|---|---|

Course Content

- Properties of gases
- Kinetic theory and transport properties of gases and its applications

- Spontaneity criteria of processes
- Stoichiometry and limiting reactant calculations,
- Colligative properties of solutions,
- Chemical kinetics and rate of reactions
- phase diagrams,

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

# Course Description of Modules Delivered by the Basic Science Department to the Petroleum Engineering & Gas Technology Program

| 3HUM124 | Fundamentals of Management | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 1 | | 0 |
| Required SWL | 100 | Equivalent ECTS | | 4 |
| Course Content | | | | |

- Introduction to Management
- Historical view and evolution of concepts.
- Basic Managerial Functions:
- Planning-Basic Terminology (Mission, Vision...) Essentials of planning- Basic Terminology (Mission, Vision….), Essentials of planning, Strategies. Objectives, MBO; Premising,
- Decision Making. Organizing: Types of Organizations (Flat and Tall and Requirements), Depart mentation,
- Job Description.
- Elements of Human Resource Management: Staffing (Definitions and Steps), Directing, controlling (Measures, Appraisals). Behavioural Types. Managers or Leader?
- Leadership Styles.
- Total Quality Management,
- Continuous Improvement

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum University Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| 3HUM315 | Engineering Project Management | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 1 | | 0 |
| Required SWL | 100 | Equivalent ECTS | | 4 |
| Course Content | | | | |

- To introduce and develop the skills and knowledge associated with delivering a successful engineering project.
- Good project management and the practical skills for designing and making any relevant hardware and software components.

- The group work component will be delivered interactively in the form of a weekly board meeting with a team of academic supervisors.
- Project management: project definition and scope, costs, benefits and risks; project planning - activities, milestones, Gantt charts, CPA; resource allocation and levelling; project implementation – record systems and decision risk analysis; project control - gap analysis (cost, time, progress), corrective methods;
- Project outcome evaluation, expert systems; health and safety.
- Project practical and technical skills: effective use of departmental resources; prototyping; computer modelling and computer-aided design; modular design of systems and software; research methods and application to R & D projects. Humane side of PM; project communications, tracking and reporting; project quality assurance.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum University Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 10% | 20% | 70% |

| 3HUM114 | Technical Report Writing and Communication | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 0 | 1 |

| Required SWL | 75 | Equivalent ECTS | 3 |
|---|---|---|---|

Course Content

- Introduction to technical reports
- Identification of the problem
- Identification of audiences and readers
- Mechanisms of technical writing, and how to write good technical reports
- What is technical writing
- Relation between sender and receiver
- Ethical considerations
- How to write an effective paragraph
- How to develop ideas
- Technical definitions
- Description of a mechanism
- Description of a process
- Analysis of written paragraphs
- Writing proposals
- Laboratory and project reports.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum University Requirement | 3 |

Assessment Criteria

| Lab coursework | Mid-Term | Lab Report | Final Exam |
|---|---|---|---|
| 40% | 30% | 30% | 0% |

| 3BAS112 | Calculus | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Functions of several variables
- Partial derivatives
- Directional derivatives
- Tangent planes
- Normal lines
- Double integrals
- Triple integrals
- Cylindrical and spherical coordinates systems
- Jacobian of a transformation
- Differentiation of vector functions
- Surfaces gradient fields
- Divergence and curl of vector fields
- Line integrals
- Green's theorem
- Surface integrals
- Flux of a vector field
- Gauss divergence theorem
- Stoke's theorem

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| 3BAS123 | Differential Equations | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- First order differential equations
- linear equations
- Separable equations
- Exact equations and integrating factors

- Bernoulli equations
- Second order linear differential equations
- Homogeneous equations with constant coefficients
- Non-homogeneous equations using the method of differential operators and the method of variation of parameters
- Second order linear differential equations with variable coefficients
- Cauchy-Euler equations
- Series solution of differential equations
- Special functions: Gamma functions; Bessel functions
- Laplace transform and inverse Laplace transform
- Convolution Theorem
- Solution of initial and boundary value problems using Laplace transform.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| 3BAS213 | Engineering Probability and Statistics | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Elements of Probability.
- Conditional Probability.
- Discrete and Continuous Random Variables.
- Discrete and Continuous Distribution.
- Jointly Distributed Random Variables.
- Descriptive Statistics.
- Parameter Estimation.
- Interval Estimates.
- Hypothesis Testing.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Faculty Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 15% | 15% | 70% |

| 3BAS215 | Organic Chemistry | 3 |
|---|---|---|
| Prerequisites | N/A | |
| Number of weekly Contact Hours | | |
| Lecture | Tutorial | Laboratory |

| | | | |
|---|---|---|---|
| 2 | 2 | 1 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

Course Content

- Initially, A Survey Of Major Functional Classes Of Organic Compounds Will Be Provided.
- Topics May Include: Nomenclature, Structure, Properties, Selected Synthetic Routes, Chemical Reactions And Mechanisms Of Hydrocarbons, Alcohols, Aromatic Compounds, Carbonyl Compounds As Well As Other Major Functional Classes Of Organic Compounds.
- Further Topics Such As: Isomerism, Stereochemistry, An Introduction To Polymers And Multi-Functional Molecules Such As Carbohydrates, Amino Acids, And Application Of Organic Chemistry In Petroleum Engineering Will Be Also Briefly Covered.
- **Organic Chemistry Lab. Three labs (2 hr) every other week**

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Faculty Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 20% | 10% | 0% | 70% |

| 3BAS225 | Numerical Methods | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |

Number of weekly Contact Hours

| Lecture | Tutorial | Laboratory | |
|---|---|---|---|
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Types of errors
- Algorithms and convergence
- Solution of nonlinear equations in one variable using bisection and Newton-Raphson
- Solution of linear systems using iteration methods, the Jacobi, and the Gauss-seidel;
- Interpolation and polynomial approximation using Lagrange
- Newton divided differences
- Newton forward and backward
- Central differences
- least square regression
- Numerical integration using trapezoidal and Simpson
- Numerical solution of ordinary differential equations using Euler's method, Runge–Kutta, and multi-step methods.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Faculty Requirement | 2 |

Assessment Criteria

| Lab coursework | Mid-Term Exam | Group project | Final Exam |
|---|---|---|---|
| 0% | 10% | 20% | 70% |

| 3BAS121 | Physics for Petroleum Engineers | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |

- State of matter: tension compression, shear pressure, ideal fluid motion, viscosity.
- Wave: motion, superposition, standing wave, sound interface, resonance, Doppler Effect.
- Fluid Mechanics: pressure, variation of pressure with depth, buoyant forces and Bernoulli's equation.
- Kinematics and dynamics of particles and rigid bodies, gravitation, equilibrium, conditions for equilibrium, elastic properties of solids, examples of rigid objects, Bonding in solids, conduction in solids.
- Introduction to diffraction, the diffraction grating, diffraction of X-rays by crystals, interference and polarisation of light waves, vibrations,
- Basic nuclear structure, nuclear models, radioactivity, nuclear reactions, radiation damage, radiation detectors, radiation safety and uses of radiation

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Report | Mid-Term Exam | Group project | Final Exam |
| 20% | 10% | 0% | 70% |

| 3BAS116 | Physical Chemistry for Petroleum Engineering | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |

- Properties of gases
- Kinetic theory and transport properties of gases and its applications
- Spontaneity criteria of processes
- Stoichiometry and limiting reactant calculations,
- Colligative properties of solutions,
- Chemical kinetics and rate of reactions
- Phase diagrams,

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |

| | |
|---|---|
| Petroleum Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| 3BAS226 | Introduction to Analytical Chemistry | 2 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 1 | 0 |

| Required SWL | 100 | Equivalent ECTS | 4 |
|---|---|---|---|

Course Content

- Introduction to Analytical Science
- Analytical Technique and Skills
- Significant Figures
- Errors, Statistics, and Statistical Control
- Sampling and Sample Preparation
- Stoichiometry and limiting reactant calculations,
- Acids and bases and acid-base equilibria
- Titrations and pH Curves
- Gravimetric Analysis
- Introduction to Titrimetric Analysis (acid-base and redox titrations )
- Applications of Titrimetric Analysis

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Petroleum Faculty Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Report | Mid-Term Exam | Group project | Final Exam |
| 15% | 15% | 0% | 70% |

# Course Description of Modules Delivered by the Basic Science Department to the Environmental Sustainable Architecture Engineering Program

| 4HUM125 | Technical Writing and Digital Communication | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 1 |
| Required SWL | 150 | Equivalent ECTS | | 6 |
| Course Content | | | | |
| • What is technical writing and digital communication;<br>• Identification of audiences and readers;<br>• Relation between sender and receiver;<br>• Mechanisms of technical writing, and how to write research paper and technical proposal;<br>• Professional e-mail, letter, and CV writing;<br>• Visual communication through charts, histograms, tables, organizational charts, images and schematic drawings;<br>• Theory of CAD (AUTOCAD); 2D construction and editing commands; Drawing 2D shapes, modifying 2D objects; Transformation concepts; CAD Layers; Rendering 2D drawings; Creating reference objects; Multiple linked drawings management; AutoCAD and the Internet; model space and paper space plotting using templates;<br>• How to prepare professional portfolio. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Environmental University Requirement | | | 1 | |
| Assessment Criteria | | | | |
| Lab coursework | Individual report | Practical Exam | | Final Exam |
| 40% | 60% | 0% | | 0% |

| 4BAS225 | Statistics, Numerical Methods and Computers | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 1 |
| Required SWL | 150 | Equivalent ECTS | | 6 |
| Course Content | | | | |
| • Introduce statistics and computer science as a tool for manipulating field data in architectural and planning problem solving processes;<br>• Statistics, probability, random variables, distribution functions, estimation and significant tests;<br>• Computer science software and hardware, programmes and programming, computer languages and applications; | | | | |

| | | | |
|---|---|---|---|
| • Introduction to linear programming. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Faculty Requirement | | 2 | |
| Assessment Criteria | | | |
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 15% | 15% | 0% | 70% |

# Electives Course Description of Modules Delivered by the Basic Science Department to all the Faculty Programs

| HUM001 | Ethics and Legislation | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Engineering profession: Ethical issues in engineering practice. Conflicts between business demands and professional ideals. Social and ethical Responsibilities of Technologists. Codes of professional ethics. Case studies. Value Crisis in contemporary society. Nature of values: Psychological values, Societal values, Aesthetic values, Moral and ethical values. Work ethics and professional ethics.<br>The legal rule: Mandatory and complementary. Sources of Law. Formal sources: Statutory Law, Custom, the Principles of natural Law and rules of justice. Informal sources: Jurisprudence, Doctrine. Application of Law. Holders of right; Natural persons, Juristic persons. Theory of Obligation; definition, forms. Sources of Obligations. The contract; Parties, Formation, Validity, Effect, and compensation of Damage. Introduction to Engineering Contracts. Contracting Contract | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| University Requirement Elective | | 0 | |
| Assessment Criteria | | | |
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 15% | 15% | 0% | 70% |

| HUM002 | Advanced Risk Management | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Review of the Basic Risk Axioms and Concepts. Evolution of Risk Concepts and Terminology. Financial and Industrial Risk: Comparison and Contrast. Probabilistic Nature of Risk.. System Decomposition. Legal and Regulatory Risks. Tools for Risk Assessment: Probability and Consequences: Event Tree, Fault Tree, FMECA, FEMEA, MOSAR (The French Approach), Simulation, Optimization and Operations Research. HACCP: principles and applications. HAZOP.Qualitative and Quantitative Risk Assessments (QRA). Quantitative Risk Assessment: Qualitative Aspects of System Analysis (Quantification of Basic Events. Confidence Interval. Quantitative Aspects of System Analysis. System Quantification for Dependent Events. Human Reliability. Uncertainty Quantification). Operational Risk. Reporting Risk | | | |

| |
|---|
| Operations. Sectoral Risk Management. Specific Risk Topics: Risk Specific to Confined Spaces. The Special Case of BLEVE and Explosive Mixtures. Social and Psychological Risk. Social Risk Management and Social Protection. Disaster Risk Management and Vulnerability Reduction. Can Risk be a Management Style? |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| University Requirement Elective | 0 |

| Assessment Criteria | | | |
|---|---|---|---|
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 20% | 10% | 0% | 70% |

| HUM003 | Foreign Language | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

| Course Content |
|---|
| Emphasizing the development of student's communicative skills to speak, listen, read and write in languages other than Arabic and English, such as French, German, Spanish, Italian, Japanese, Chinese, etc, and to study cultural characteristics of such foreign languages from historical, geographical, literature, economic, and social viewpoints. Topics include, but not limited to, the basics of language grammar and mechanics, writing effective sentences and paragraphs, vocabulary building, writing technical engineering documents and writing technical forms: letters, memos, reports, scientific articles, job description, resumes and curriculum vitas. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| University Requirement Elective | 0 |

| Assessment Criteria | | | |
|---|---|---|---|
| Individual Report | In-class assessment | Practical Exam | Final Exam |
| 50% | 50% | 0% | 0% |

| HUM004 | Marketing | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

| Course Content |
|---|
| Introduction. The Field of Sales; Strategic Sales Force Management.<br>The Personal Selling Process and Sales Force Organization. Profiling and Recruiting Salespeople; Selecting and Hiring Applicants, Developing the Sales Program, Sales Force Motivation, Sales Force Compensation, Expenses and Transportation; Leadership of a Sales Force, Forecasting Sales and Developing Budgets; Sales |

| | | | |
|---|---|---|---|
| Territories, Analysis of Sales Volume, Marketing Cost & Profitability Analysis, Performance Evaluation; Ethical and Legal Responsibilities tender writing. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| University Requirement Elective | | 0 | |
| Assessment Criteria | | | |
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| | | | |
|---|---|---|---|
| HUM005 | Selections of Life-Long Skills | | 3 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Communicating Clearly - Managing Time and Resources - Making Decisions - Delegating Successfully - Motivating People - Managing Teams - Negotiating Successfully - Minimizing Stress - Getting Organized - Managing Changes - Interviewing People - Managing Your Career - Balancing Work and Life - Thinking Creativity and Innovation -Influencing People – Systems Thinking – Interpersonal Management Skills – Entrepreneurial Skills. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| University Requirement Elective | | 0 | |
| Assessment Criteria | | | |
| Individual Projects | In-class assesment | Practical Exam | Final Exam |
| 50% | 50% | 0% | 0% |

| | | | |
|---|---|---|---|
| HUM006 | Business Communication | | 3 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Skills for effective communication in the workplace; constructing and delivering persuasive business presentations; theoretical and experiential knowledge of argumentation and debate for informal and formal presentations; style, layout, and convention of business writing; writing business proposals, progress reports, and feasibility reports; common areas of miscommunication. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| University Requirement Elective | | 0 | |
| Assessment Criteria | | | |
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 30% | 0% | 0% | 70% |

| HUM007 | Service Management | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Role of services in the economy, The nature of services, Service quality, Service Strategy, Developing new services, The role of technology in supporting service delivery, Design of services, Capacity planning and managing queues, Quantitative methods for service management. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| University Requirement Elective | | 0 | |
| Assessment Criteria | | | |
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| HUM008 | Humanities for Engineering Students | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| • Introduction to Humanities<br>• Locating Humans in the Universe<br>• Geography of Egypt<br>• History of Egypt<br>• Cairo: History, Places and Art<br>• Readings in Abdel Wahab El-Messiary Work on Jews, Judaism and Zionism<br>• Arabic language and Literature<br>• Arabic Music<br>• Introduction to Sociology and Anthropology<br>• How Values Shape Human Progress<br>• The Egyptian Legal System<br>• The Process of decision Making<br>• Challenges Facing Engineers in a Changing World<br>• Scientific Thinking and Problem Solving | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| University Requirement Elective | | 0 | |
| Assessment Criteria | | | |
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 15% | 15% | 0% | 70% |

| HUM009 | Science – Technology – Society | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

- Introduction
- What is science and prospects
- Classes of science story
- Possession of scientific alphabet
- Technology .. that disease and medicine
- Reflections on the position of man in the universe
- A lesson in history
- A lesson in literature
- A lesson in ethics

A lesson in art

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| University Requirement Elective | 0 |

| Assessment Criteria | | | |
|---|---|---|---|
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 15% | 15% | 0% | 70% |

| HUM0010 | Professional Practice | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

- Introduction to professional practice;
- Interrelationships between industry, professional bodies and education;
- Professional practices and regulations;
- Key professional and research requirements;
- Manage and appraise work by students and others;
- Roadmap for professional career;
- Preparing a CV, portfolio and search for work;
- Visit firms in preparation for working in practice.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| University Requirement Elective | 0 |

| Assessment Criteria | | | |
|---|---|---|---|
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 30% | 0% | 0% | 70% |

| HUM0011 | Entrepreneurship | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| • Design, innovation and entrepreneurship processes in engineering and manufacturing industry;<br>• Value proposition and Business model innovation;<br>• Market analysis;<br>• Competitor studies;<br>• Resource management;<br>• IPRs and commercialization;<br>• Fund raising. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| University Requirement Elective | | 0 | |
| Assessment Criteria | | | |
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 30% | 0% | 0% | 70% |

# 2-Modules Delivered by the Renewable Energy Engineering Department

| | Code | Course Title | Cr & SWL | | | Contact Hours | | | | Classification | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH | ECTS | SWL | Lec | Tut | Lab | TT | UR | FR | DR | PR |
| All | BES014 | Engineering design and graphics | 2 | 4 | 100 | 2 | -- | 2 | 4 | | X | | |
| | BES013 | Workshop technology | 2 | 4 | 100 | 1 | -- | 3 | 4 | | X | | |
| | BES024 | Engineering mechanics 1 | 3 | 5 | 125 | 2 | 2 | -- | 4 | | X | | |
| | | | | | | | | | | | | | |
| Renewable All | 1HUM126 | Computer Programming | 2 | 3 | 75 | 1 | -- | 3 | 4 | X | | | |
| | 1BAS212 | Energy & Environmental Issues | 2 | 4 | 100 | 2 | 1 | -- | 3 | | X | | |
| | 1BES111 | Introduction to Mechatronics & Measurements | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | X | |
| | 1BES113 | Materials Science | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | 1BES222 | Electronics | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | X | |
| | 1BES321 | Modelling and Simulation for Renewable Energy Systems | 2 | 3 | 75 | 1 | -- | 3 | 4 | | | X | |
| | 1BES124 | Electrical Machines (1) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | 1BES122 | Thermodynamics (1) | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | 1BES117 | Electrical Circuits | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | 1BES214 | Fundamentals of Heat and Mass Transfer | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | X | |
| | 1BES216 | Fluid Mechanics | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | 1BES426 | Environmental Risk Analysis | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | REN125 | Measurements Lab | 2 | 3 | 75 | 1 | -- | 3 | 4 | | | X | |
| | REN115 | Introduction to Renewable Energy Systems | 2 | 3 | 75 | 2 | -- | -- | 2 | | | X | |
| | REN211 | Theory and Applications of Automatic Control | 3 | 6 | 150 | 2 | 2 | 2 | 6 | | | X | |
| | REN221 | Storage Energy Technology | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | REN322 | Data Acquisition and Sensors | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | REN313 | Solar Thermal Energy Systems | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | REN314 | Wind energy systems | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | REN315 | Hydraulic, Geothermal and Bio Energy | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | REN401 | Graduation Research Project | 4 | 8 | 200 | -- | -- | -- | -- | | | | X |
| | REN402 | Design Project | 4 | 8 | 200 | -- | -- | -- | -- | | | | X |
| | ENGG03I | Industrial Training | -- | -- | -- | -- | -- | -- | -- | | X | | |
| | ENGG07 | Industrial Training | -- | -- | -- | -- | -- | -- | -- | | X | | |
| | | | | | | | | | | | | | |
| Ren Mechanical | 1BES312 | Structural and Stress Analysis | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | X | |
| | 1BES226 | Thermodynamics (2) | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | 1BES412 | Turbo Machinery | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | X | |
| | 1BES316 | Combustion and Fuels | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | X | |
| | RENM326 | Mechanical power Generation | 3 | 6 | 150 | 2 | 2 | 2 | 6 | | | | X |
| | RENM311 | Sustainable Energy: Principles & Processes | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | | X |
| | RENM411 | Smart Materials for Renewable Energy Systems | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | RENM325 | Thermal Power Plants | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENM323 | Energy Efficiency and Energy Management | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | | X |
| | RENM324 | Alternative Fuels & Fuel Cell Technology | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | RENM413 | Design of Solar Energy Equipments | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | | | | | | | | | | | | | |
| Ren Electrical | 1BES317 | Signals & Systems | 2 | 4 | 100 | 2 | 1 | 1 | 4 | | | X | |
| | 1BES414 | Power Electronics | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | X | |
| | 1BES325 | Design, control, and maintenance of PV plants | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | X | |
| | 1BES429 | Electrical Machines (2) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | RENE326 | Power Generation and Conversion Systems | 3 | 6 | 150 | 2 | 2 | 2 | 6 | | | | X |
| | RENE323 | Power system analysis | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | | X |
| | RENE324 | Network Interfacing of Renewable Resources | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | RENE312 | Solar Energy: Photovoltaic (PV) Systems | 2 | 3 | 75 | 2 | -- | 1 | 3 | | | | X |
| | RENE311 | Electrical Power Transmission | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | RENE411 | Power systems protection | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | RENE413 | High Voltage Engineering | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Biochemical | 2BES122 | Structural and Stress Analysis | 3 | 3 | 5 | 2 | 2 | -- | 4 | | | X | |
| | 2BES113 | Materials Science | 2 | 3 | 6 | 2 | 1 | 1 | 4 | | | X | |
| | 2BES222 | Thermodynamics | 3 | 3 | 6 | 2 | 2 | 1 | 5 | | | X | |
| | 2BES225 | Fundamentals of Heat and Mass Transfer | 3 | 3 | 5 | 2 | 2 | -- | 4 | | | X | |
| | 2BES214 | Electrical and Electronic Engineering | 3 | 3 | 5 | 2 | 2 | 1 | 5 | | | X | |
| | 2BES216 | Fluid Mechanics | 3 | 3 | 6 | 2 | 2 | 1 | 5 | | | X | |
| | | | | | | | | | | | | | |
| Petroleum | 3BES115 | Fundamentals of Fluid Mechanics | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | 3BES113 | Materials Science for Petroleum Engineering | 3 | 6 | 150 | 2 | 2 | 2 | 6 | | | X | |
| | 3BES122 | Structural and Stress Analysis | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | X | |
| | 3BES125 | Fundamentals of Thermodynamics | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | 3BES214 | Fundamentals of Heat and Mass Transfer | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | X | |
| | 3BES216 | Machine Design for Petroleum Engineering | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | | | | | | | | | | | | | |
| ESA | 4BAS115 | Thermo-Fluids | 5 | 5 | 9 | 3 | 2 | 3 | 8 | | X | | |
| | 4BAS124 | Structural and Stress Analysis | 2 | 2 | 4 | 2 | 1 | -- | 3 | | X | | |
| | 4BAS214 | Geotechnics | 3 | 3 | 6 | 2 | 2 | 1 | 5 | | X | | |
| | | | | | | | | | | | | | |
| Renewable Electives | REN415 | Sustainable Enterprise Economy | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | REN417 | Wind energy convertors | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | REN418 | Life cycle assessment | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | REN421 | Renewable Energy Policy | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | REN422 | Feasibility studies and economics of Energy Projects | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENM416 | The politics of climate change | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENM419 | Biomass | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENM423 | Integration of and transmission of energies | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENM424 | Internal Combustion Engines | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENM425 | Solar thermal energy design | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENM427 | Design of Hydraulic and Wind Energy Equipment | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENM428 | Advanced Wind Energy | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENE412 | Power Quality | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENE416 | Advanced Power System Protection | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | REN4E19 | Switchgear Engineering and Substation | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENE423 | Electric Drives | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENE424 | Electric Power Distribution Systems | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENE425 | Energy Harvesting Technologies | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENE427 | Advanced Photovoltaics | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENE428 | Micro Grid and Grid Connect PV Solar Systems | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | RENE429 | Power electronics for energy application | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |

# Course Description of Modules Delivered by the Renewable Energy Engineering Department to all the Faculty Programs

| BES014 | Engineering Design and Graphics | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 2 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |
| Engineering Drawing Techniques, Geometrical Constructions, Principles of Descriptive Geometry, Introduction to AutoCAD Software, Projection, Views and Sectional Views, Intersections, Dimensioning, Introduction to Steel Structural Drawings. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Faculty Requirement | | 0 | |
| Assessment Criteria | | | |
| Individual report | Mid-Term Exam | Practical Exam | Final Exam |
| 30% | 20% | 0% | 50% |

| BES013 | Workshop Technology | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 1 | 0 | 3 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |
| Engineering materials, primary production processes, cutting and non-cutting processes, inspection, measuring equipment, industrial organization and safety. Workshop: Identification and application of tools for: marking out a measuring, cutting, shaping, drilling, threading, tapping, finishing, dismantling, assembling, soldering and welding, casting, and forging. Using tools: hazards, techniques, and safety procedures. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Faculty Requirement | | 0 | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Practical Exam | Final Exam |
| 15% | 15% | 0% | 70% |

| BES024 | Engineering Mechanics (1) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |

| | | | |
|---|---|---|---|
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Introduction to engineering mechanics. Vector analysis. Forces on particles. Equilibrium of particles. Forces and moments. Applications. Kinematics of particles. Displacement, velocity and acceleration using scalar and vector methods. Coordinate systems. Kinetics of particles. Newton's law. Work and Energy. Impulse and momentum. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Faculty Requirement | | 0 | |
| Assessment Criteria | | | |
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 40% | 0% | 60% |

# Course Description of Modules Delivered by the Renewable Energy Engineering Department to both the Renewable Energy Engineering Programs

| 1HUM126 | Computer programming | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 1 | 0 | 3 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |
| The aim of this module is to understand the basics of computer science and its applications in engineering practices.<br>• Apply computer science as applied to engineering.<br>• Using computer software in obtaining reliable results.<br>• Identify different software solutions for specific problems.<br>• Provide systematic approach of computer programming<br>• Interpret real time computer-processed data.<br>• Select and use appropriate software and available input and output data in problem solving in order to make successful modification and improvement in specific situations;<br>• Use electronic resources to communicate and handle data.<br>• Prepare relevant data for further analysis. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable University Requirement | | 1 | |
| Assessment Criteria | | | |
| Group project | Lab coursework | Practical Exam | Final Exam |
| 20% | 20% | 0% | 60% |

| 1BAS212 | Energy & Environmental Issues | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |
| The energy-environment problem. Global energy issues, global warming, air pollution issues, water quality issues, waste. Introduction to environmental impact assessment. Environmental law. Environmental audits. The impact of the process industries on human health and the environment. Sources of pollution, methods of control. Cost of energy systems production from the environmental point of view. Waste minimization and pollution prevention strategies will be considered. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |

| | |
|---|---|
| Renewable Faculty Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 15% | 15% | 0% | 70% |

| 1BES111 | Introduction to Mechatronics & Measurements. | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |
| Introduction to mechanical control; Control systems principles, servomechanisms, Control block diagrams, Analogue and digital controllers, Units, standards and definitions, Sensor time response, Significance and statistics.<br>Analogue and Digital signal conditioning; Principles of signal conditioning, Passive circuits, Op Amps circuits and instrumentation, Design guidelines.<br>Thermal sensors; Thermal Energy, Temperature, Metal resistance, Thermistors, Thermocouples, Solid state.<br>Mechanical Sensors; Displacement, location and position sensors, Strain sensors, motion sensors, pressure sensor and flow sensors.<br>Optical Sensors; Fundamentals of EM radiation, Photodetectors, Pyrometry, Optical sources and applications.<br>Final Control; Final control operation, signal conversion, Power electronics, Electrical Actuators, pneumatic actuators.<br>Practical sensing and control and C-programming using the Arduino Uno board | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Discipline Requirement | | 1 | |

| Assessment Criteria | | | |
|---|---|---|---|
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 20% | 20% | 0% | 60% |

| 1BES113 | Materials Science | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| • Brief introduction on: atomic structure of matter and crystal structure for all types of materials.<br>• Comparison between structure of metals and alloys, polymers, and ceramics; iron carbon.<br>• Diagrams and types of steels: carbon steels, alloy steels, cast iron; some types of non-ferrous. | | | |

| |
|---|
| • Metals and alloys; ceramics and composite materials; correlating materials properties with data learnt from phase diagrams and microstructure identification; basic mechanical properties and testing (tension, impact toughness, and hardness); basics of corrosion with relevance to type of material; case studies on materials used in petroleum engineering applications. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Practical Exam | Final Exam |
| 15% | 15% | 0% | 70% |

| 1BES222 | Electronics | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 150 | Equivalent ECTS | | 5 |
| Course Content | | | | |
| Semiconductors and pn junctions; diodes and applications; operation and characteristics of bipolar junction transistors (BJT); field effect transistors (FET) and MOSFET; BJT Transistor Modeling; simple class A BJT and FET amplifiers: DC biasing, small-signal analysis; voltage gain, input and output resistances; Operational Amplifiers; | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | | Study Level |
| Renewable Discipline Requirement | | | | 2 |
| Assessment Criteria | | | | |
| Group project | Mid-Term Exam | | Practical Exam | Final Exam |
| 0% | 30% | | 0% | 70% |

| 1BES321 | Modelling and Simulation for Renewable Energy Systems | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 1 | | 0 | | 3 |
| Required SWL | 75 | Equivalent ECTS | | 3 |
| Course Content | | | | |
| This course will provide an applied introduction to modeling, simulation and optimization techniques for various renewable energy systems, finite element and finite difference time domain, isoparametic concept, one-, two- and three- dimensional problems, energy and Galerkin approaches, stiffness and load matrices and governing equations, modeling of renewable energy problems, boundary conditions. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | | Study Level |

| Renewable Discipline Requirement | | | 3 |
|---|---|---|---|
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Practical Exam | Final Exam |
| 20% | 10% | 0% | 70% |

| 1BES124 | Electrical Machines (1) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

D.C. machines: Theory and design: The generation of e.m.f., Work, Power, Force torque, The magnetic circuit of the dc machine, Armature windings, Armature reaction, Inductance, Energy in magnetic field, Commutation, Methods of excitation, Load characteristics of dc generators and motors, Efficiency, Testing of dc machines, Construction of dc machines, Mechanical details, Design, Main dimensions, The armature, Design of poles and inter-poles, Design of commutator, Calculation of efficiency.
Transformers : Theory and design : Fundamental concepts, Mutual inductance, Electric and magnetic circuits, Power transformers, Phasor diagrams, Magnetizing current and core loss, Equivalent circuits, Transformers at load, Efficiency, Voltage regulation, Three phase transformers, Three phase transformer connections, Three phase to two phase connections, Auto transformer, Voltage regulation in auto transformers, Tap changers, On load tap changers, Harmonics, Transformers testing, Transformer design, Main dimensions, Magnetic cores, Transformer windings, Insulation, Cooling, Calculation of transformer characteristics.

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | | Study Level |
| Renewable Discipline Requirement | | | 1 |
| Assessment Criteria | | | |
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| 1BES122 | Thermodynamics (1) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

Scope of module, terminology of thermodynamics. Thermodynamic properties, temperature scales and measurement, properties of pure substances. 1st, 2nd and 3rd laws of thermodynamics, reversible and irreversible processes, Carnot cycles, heat engines and thermal efficiency, First law applied to flow processes. **Three labs (2 hr) every other week**

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Renewable Discipline Requirement | | 1 | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Practical Exam | Final Exam |
| 10% | 20% | 0% | 70% |

| 1BES117 | Electrical Circuits | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Basic definitions of current, voltage and power. Circuit theory assumptions and circuit diagrams. DC and AC circuits: Voltage and current sources; resistors, inductors, capacitors, reactance and impedance; Ohm's law, Kirchhoff's laws, combining resistors, combining capacitors and combining inductors; star-delta transformations, voltage and current source transformation; sinusoidal waveforms, impedance, rms values, phasors and complex numbers; Thevenin's and Norton's theorems, superposition theorem, voltage and current divider circuits; mesh and nodal analysis; maximum power transfer. Transient circuits: Producing a step function; RC, RL and RLC circuits; general methods for solving RC and RL circuits; circuits with multiple transients. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Discipline Requirement | | 1 | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Practical Exam | Final Exam |
| 10% | 20% | 0% | 70% |

| 1BES214 | Fundamentals of Heat and Mass Transfer | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| | | | |
| -The principles of conduction, convection and radiation;<br>-The basic principles of fluid flow and heat transfer;<br>-Laminar and turbulent flows and the properties of fluids.<br>-Integrate the knowledge acquired and apply it to a range of new situations;<br>-Understand open and closed heat systems<br>-Practice solutions to relevant problems<br>-Become familiar with the analysis of practical problems of fluid flow and heat transfer in a number of applications in process and related areas relevant to each topic; | | | |

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| -Adopt an analytical approach to problem solving;<br>-Conduct research and collect relevant information. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| 1BES216 | Fluid Mechanics | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Fluid Mechanics: Fluid Properties, Fluid Statics, Basic Fluid Flow, Laminar and Turbulent Flow in pipes Continuity and Momentum Equations. Pressure Losses. Pipe Lines. laminar and turbulent flow. Solution of the Navier- Stokes equations and Examples. Boundary layer flows | | | |
| Used in Program / Level | | | |
| Program Name or requirement | Study Level | | |
| Renewable Discipline Requirement | 2 | | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Practical Exam | Final Exam |
| 10% | 20% | 0% | 70% |

| 1BES426 | Environmental Risk Analysis | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

Hazard identification: Introduction to Hazard identification, Epidemiology, Toxicology, Classification of carcinogens, Evaluation of data. Dose-response assessment: Introduction to dose-response assessment, Toxic kinetics and toxic dynamics, Derivation of toxicity values. Exposure assessment: Introduction to exposure assessment, Characterization of exposure settings, Identification of exposure pathways, Quantification of exposure, Exposure modeling and monitoring. Risk characterization: Risk characterization, Uncertainty analysis, Chemical mixtures, Tiered approach. Ecological risk assessment: Problem formulation, Analysis, Risk characterization. Risk perceptions and risk communication: Risk perceptions, Risk communication. Risk management: Options appraisal, Risk control, Implementation and monitoring. Hazard identification: Introduction to Hazard identification, Epidemiology, Toxicology, Classification of carcinogens, Evaluation of data. Dose-response assessment: Introduction to dose-response assessment, Toxic kinetics and toxic dynamics, Derivation of toxicity values. Exposure assessment: Introduction to exposure assessment, Characterization of exposure settings, Identification of exposure pathways, Quantification of exposure, Exposure modeling and monitoring. Risk characterization: Risk characterization, Uncertainty analysis, Chemical mixtures, Tiered approach. Ecological risk assessment: Problem formulation, Analysis, Risk characterization. Risk perceptions and risk communication: Risk perceptions, Risk communication. Risk management: Options appraisal, Risk control, Implementation and monitoring, waste industry safety, reducing the risks.

The course also draws the student's attention to the following topics: Global energy usage and trends. Characteristics and properties of fossil fuels. New fuels. Fuel testing and specification of commercial fuels. Renewable Sources of Energy. Utilization of fuels in boilers and furnaces. Energy losses and optimization of performance. Pollutant emissions. Carbon dioxide issues

Flame propagation and explosions. Fire - Review of relevant concepts. Fire spread. Radiation from fires. Building and factory fires. Assessment of fire hazards and risk of explosions. Fire and explosion prevention. Standard fire tests.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Discipline Requirement | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| REN125 | Measurements Lab | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | Laboratory | |
| 1 | | 0 | 3 | |
| Required SWL | 75 | Equivalent ECTS | 3 | |

Course Content

Experiments include Measurements of temperature, pressure, flow rates, viscosity, flash points, force and torques, power, emissions. Evaluating the performance of different energy and environmental equipment such as internal combustion engines performance, boiler, pumps, turbine, compressor, etc…. Different Types of Errors,

| | | | |
|---|---|---|---|
| Accuracy, calibrations, Electromechanical forces. DC and AC Meters. DC & Ac bridges and strain gauges , Balance conditions of both types. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Discipline Requirement | | 1 | |
| Assessment Criteria | | | |
| Lab coursework | Individual report | Practical Exam | Final Exam |
| 20% | 20% | 0% | 60% |

| | | | |
|---|---|---|---|
| REN115 | Introduction to Renewable Energy Systems | | 2 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 0 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |
| history of energy usage, forms of energy, present energy consumption, environmental problems;<br>-conventional energy sources: energy and power; fossil fuel ;<br>-solar thermal energy: solar radiation resource, passive and active solar heating, solar concentrators.<br>-solar photovoltaics: basic PV operation, PV technologies, electrical characteristics;<br>-biomass: definitions, biomass resource, extracting biomass energy, fuel crops, anaerobic digestion, landfill gas, waste to energy, energy balances and economics;<br>-hydroelectricity: the resource, hydropower equation, turbines, large and small scale systems, pumped storage;<br>-tidal power: the tides, tidal resource, system operation, environmental factors;<br>-wave energy: the wave resource, the fundamental power equation; onshore and off-shore wave energy extraction systems;<br>-wind energy: generation of the winds, wind resource, basic aerodynamics (lift versus drag) and the fundamental power equations;<br>-Geothermal energy: basic physics, resource quantification, rock permeability, volcanic based systems | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Discipline Requirement | | 1 | |
| Assessment Criteria | | | |
| Group project | Mid-Term Exam | Practical Exam | Final Exam |
| 20% | 10% | 0% | 70% |

| | | | |
|---|---|---|---|
| REN211 | Theory and Applications of Automatic Control | | 3 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 2 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

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|---|
| Introduction to control systems: terms, concepts & examples, frequency and time domain analysis, block diagram, representations of control system, feedback and its effects, disturbance & sensitivity analysis, steady-state error analysis, time domain analysis, stability analysis, root locus analysis, Tuning of PID controller, state space representation.<br>Kinematic analysis of mechanisms and machines – Position, velocity and acceleration - static and dynamic force analysis – balancing – gears – servo and PID controllers - Applications in Internal combustion engines and turbo machinery. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Practical Exam | Final Exam |
| 20% | 10% | 0% | 70% |

| REN221 | Storage Energy Technologies | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 1 |
| Required SWL | 150 | Equivalent ECTS | | 6 |
| Course Content | | | | |
| Fundamental concepts about energy storage. Energy storage: electrical, mechanical, hydraulic, compressed air, thermal, and chemical approaches. Selection of storage systems. Cost analysis. Advantages and disadvantages of each system. Techniques for conversion between different systems.Supper Capacitors: structure, ratings, characteristics, use with the wind power plant, fuel cells, and photovoltaic interface, Superconducting magnetic energy storage (SMES): structure, operation, Batteries: types, characteristics and operation, charge and discharge, Fuel cell: types, electrochemical model, performance, Flywheels energy storage. | | | | |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Group project | Practical Exam | Final Exam |
| 10% | 20% | 0% | 70% |

| REN322 | Data Acquisition and Sensors | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 150 | Equivalent ECTS | | 6 |
| Course Content | | | | |
| Types of sensor devices used in measurement, operations monitoring and condition monitoring tasks, actuators and control systems used to control equipment, methods used to relay data from equipment installed at a remote site to a centralized data | | | | |

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| assimilation and monitoring station, practical limits to accuracy and repeatability of practical observation, design, assembly and deployment of sensing and data logging systems used in the assessment of renewable energy, data transmission systems for remote monitoring and control tasks. |
| Used in Program / Level |

| Program Name or requirement | Study Level |
|---|---|
| Renewable Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Assignments & Projects | Mid-Term Exam | Practical Exam | Final Exam |
| 0% | 30% | 0% | 70% |

| REN313 | Solar Thermal Energy Systems | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | Laboratory | |
| 2 | | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 | |
| Course Content | | | | |
| Introduction and basic concepts; Sun and earth relations, Angles of interest, Solar Irradiation, availability of Solar Energy, Estimation of the incoming radiation.<br>Solar Thermal systems, collectors and concentrators (types, design criteria, performance calculations, maintenance and their economic impact), Solar thermal applications, power generation, heating, desalination, drying..etc. Hydraulic and thermal analysis. Solar energy plants design and performance. Storage systems. (3 Lab sessions). | | | | |
| Used in Program / Level | | | | |

| Program Name or requirement | Study Level |
|---|---|
| Renewable Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Group project | Practical Exam | Final Exam |
| 10% | 20% | 0% | 70% |

| REN314 | Wind Energy Systems | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | Laboratory | |
| 2 | | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 | |
| Course Content | | | | |
| Introduction to wind energy, basic concepts and definitions. Availability of wind energy. Economics of wind energy. Estimation of wind energy. Site selection for wind energy. Wind energy equipment selection and specification. Design criteria. Design of wind energy plant components (rotor blades, gearbox, tower). Performance evaluation for wind energy power plants. Aerodynamics of wind turbines, speed control, and frequency modulation. Computer applications. (3 Lab sessions). | | | | |
| Used in Program / Level | | | | |

| Program Name or requirement | | | Study Level |
|---|---|---|---|
| Renewable Discipline Requirement | | | 3 |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 15% | 0% | 15% | 70% |

| REN315 | Hydraulic, Geothermal and Bio Energy | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Hydroelectricity: the resource, hydropower equation, turbines, large and small scale systems, pumped storage.<br>Tidal power: the tides, tidal resource, system operation, environmental factors.<br>Wave energy: the wave resource, the fundamental power equation; onshore and off-shore wave energy extraction systems.<br>Geothermal energy: basic physics, resource quantification, rock permeability, volcanic based systems, HDR systems, case study-the CSM HDR geothermal energy project, geothermal heat pumps.<br>Biomass: definitions, biomass resource, extracting biomass energy, fuel crops, anaerobic digestion, landfill gas, waste to energy, energy balances and economics. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | | Study Level |
| Renewable Program Requirement | | | 3 |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| REN401 | Graduation Research Project | | 4 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 0 | 0 | 0 | |
| Required SWL | 200 | Equivalent ECTS | 8 |
| Course Content | | | |
| Students will carry out a substantially based industrial research project on an individual basis. The topic and content will be relevant to their degree programme. The project will be supervised by an individual member of academic staff and may involve experimental test work, field work, design work and possibly work based at an industrial organisation. Each student will be responsible for the planning, execution and interpretation of their own work. Each student will present individual written reports including a project plan, an interim report at the end of the first semester and a final report at the end of the second semester together with an oral presentation | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | | Study Level |

| Renewable Program Requirement | | | 4 |
|---|---|---|---|
| Assessment Criteria | | | |
| Individual report | Dissertation | Oral exam | Individual presentation |
| 15% | 60% | 15% | 10% |

| REN402 | Design Project | | 4 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 0 | 0 | 0 | |
| Required SWL | 200 | Equivalent ECTS | 8 |
| Course Content | | | |
| Students will work together in a team, a process plant or other industrial operation. Each project will be supervised by a member of academic staff who will act as project coordinator and will be responsible for the organization and assessment of that project. Students will meet with the coordinator on a regular basis to ensure good communications within the project; they will also attend a series of lectures and seminars dealing with relevant aspects of the planning, design and evaluation of the project. Students will be responsible for the organization and delivery of relevant aspects required in the project, as prescribed. Each individual student or team will be required to produce a project plan detailing the planning and execution of the project, an interim report covering basic aspects and relevant literature in the field, and a final report covering detailed technical, financial and environmental aspects of the project. Other reports may be required by the project coordinator. Students will also be required to make a verbal presentation on their findings at the end of the project. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Individual Project | Dissertation | Practical Exam | Group Presentation |
| 20% | 50% | 20% | 10% |

# Course Description of Modules Delivered by the Renewable Energy Engineering Department to the Renewable Energy Engineering – Mechanical Power Program

| 1BES312 | Structural and Stress Analysis | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | Laboratory | |
| 2 | | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 | |
| Course Content | | | | |
| Equilibrium, stress-strain diagram - Normal force, shearing force, bending and twisting moment diagrams - Stresses in simply loaded elastic bars: axial loading, bending and torsion, deformation, stiffness, strain energy. Combined loading, eccentric normal load, combined bending and torsion. Two-dimensional stresses, principal stresses, maximum shear stress, allowable stresses, Mohr's circle representation. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Renewable (Mechanical) Discipline Requirement | | | 3 | |
| Assessment Criteria | | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam | |
| 0% | 30% | 0% | 70% | |

| 1BES226 | Thermodynamics (2) | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | Laboratory | |
| 2 | | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 | |
| Course Content | | | | |
| Thermodynamic cycles, Entropy, the entropy and directional law of nature. Causes of entropy changes. Entropy changes in various thermodynamic processes. The third law of thermodynamics. Chemical equilibrium, phase equilibrium, thermodynamics of solutions, Gibbs energy, equilibrium diagrams. Chemical reaction in combustion systems. Applications on the second law of thermodynamics. **Three labs (2 hr) every other week** | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Renewable (Mechanical) Discipline Requirement | | | 2 | |
| Assessment Criteria | | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam | |
| 0% | 20% | 20% | 60% | |

| 1BES412 | Turbo Machinery | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Basic Concepts and Laws of Fluid Mechanics - Similarity in Fluid Machines - 1-D Flow in Turbo machines - 2-D Flow in Blade Groups - 3-D Flow in Axial Turbo machines.<br>Energy transfer considerations. Theory and design of pumps, turbines, and compressors performance characteristics. Selection criteria. Operations and system. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Mechanical) Discipline Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 0% | 30% | 70% |

| 1BES316 | Combustion and Fuels | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Calculation of the composition of the products from the combustion of gaseous, liquid and solid fuels.Thermo chemical calculations: sources of data, equilibrium composition of combustion products and other relevant mixtures, flame temperatures including effects of preheat and dissociation. Heat and mass balances for furnaces and reactors. Major factors influencing the production of pollutants from combustion processes. The role of excess air, fuel type and combustor temperature on NOx emissions. Fire and explosion stoichiometry, air requirement for fires, gaseous and dust explosion flammability, influence of pressure and temperature, flash point, fuel tank vapor explosions, ventilation, inerting, limited oxygen, ignition energy, quenching distance, flame traps, burning velocity, flame speeds, closed vessel explosions and the Kg parameter | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Mechanical) Discipline Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 15% | 15% | 70% |

| RENM326 | Mechanical power Generation | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 2 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Applications of thermodynamics and heat transfer to power stations, cogeneration in industrial plants. Emphasis is given to energy planning and economic utilization. Advanced vapor and gas cycles. Different components design, analysis and selection. Overall power plant design and analysis. Power plant performance. Detailed Combined cycle analysis. Integration between Renewable and non-renewable systems. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Mechanical) Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 10% | 0% | 20% | 70% |

| RENM311 | Sustainable Energy: Principles and Processes | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |
| This course aims to establish a basic understanding of global patterns of energy use and systems of energy supply, in the context of their sustainability: social, environmental and economic. It is structured so as to familiarize students with the wide range of literature on sustainability, and will develop independent study and analysis skills, Primary Energy, Global Climate change, Environmental impacts of energy use, Energy, resources and reserves, Costing energy, Lifecycle assessment, Transitional technologies (I), Transitional technologies (II), Energy scenarios | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Mechanical) Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 10% | 20% | 70% |

| RENM411 | Smart Materials for Renewable Energy Systems | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

| |
|---|
| Materials used in different systems. Phase change materials. Recovery of stored energy and exchangers. Applications of nanomaterials in storage systems. Energy storage control concepts. Mechanical properties, opto-electronic properties, hydrogen storage materials; knowledge about available materials; material selection, classification of smart materials, piezoelectric and thermoelectric materials, introduction to plasmonics in semiconductors, photovoltaic conversion, introduction to hydrogen storage materials |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable (Mechanical) Program Requirement | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| RENM325 | Thermal Power Plants | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |

| Course Content |
|---|
| • Introduction to energy generation<br>• Thermodynamic basics of steam cycles<br>• Gas tubines Combined Cycles (gaseous and solid fuels)<br>• Combined heat and power plants<br>• Alternative concepts<br>• Waste to energy concepts<br>• Nuclear power plants |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable (Mechanical) Program Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| RENM323 | Energy Efficiency and Energy Management | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 1 | | 0 |
| Required SWL | 100 | Equivalent ECTS | | 4 |

| Course Content |
|---|
| Basic concepts. Terms and definitions. Estimating the loads for different buildings in summer and winter. Heating, ventilation and air-conditioning of buildings. Energy efficiency for systems in residential and industrial buildings. How to improve energy utilization. |
| Used in Program / Level |

| Program Name or requirement | | | Study Level |
|---|---|---|---|
| Renewable (Mechanical) Program Requirement | | | 3 |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| RENM324 | Alternative Fuels & fuel cell Technology | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| This course will focus on fuel cell conversion devices and other hydrogen based technologies. The history of hydrogen and fuel cell technologies, their application, instrumentation, specifications, types, codes, system designs and materials. Basic thermodynamics and heat/mass transfer. Specific licensing, permits, and safety issues. Fuel cells based on other fuels and bio-fuels, practical fuel cells. Different applications of fuel cells.<br>Alternative fuels: hydrogen, alcohol additives, biofuels; production, storage, combustion and applications in combustion. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | | Study Level |
| Renewable (Mechanical) Program Requirement | | | 3 |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| RENM413 | Design of Solar Energy Equipment | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Basic concepts. Design criteria. Design of solar collectors. Design of different parts of solar energy plants. Performance. Solar energy, terms and definitions, applications. Solar energy: (thermal): solar radiation, collection, storage, industrial thermal applications, desalination, drying, system design and optimization. (Electrical): PV principles, PV system design and optimization. PV on and off grid concepts. Solar power systems. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | | Study Level |
| Renewable (Mechanical) Program Requirement | | | 4 |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

# Course Description of Modules Delivered by the Renewable Energy Engineering Department to the Renewable Energy Engineering –Electrical Energy Program

| 1BES317 | Signals & Systems | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 1 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |
| Introduction to meaning and terminology of signals and systems. Resonant circuits, Continuous-time and discrete-time signals, mathematical representation, energy versus power, transformations of independent variables, periodicity, odd/even signals, exponential and sinusoidal signals (continuous and discrete, and their important differences), unit impulse and unit step functions, continuous-time and discrete-time systems, basic system properties, Linear Time-Invariant (LTI) systems, convolution sums and integrals, impulse responses, LTI system properties. Fourier representations, sampling, basics of MATLAB; variables, arithmetic, vectors and arrays, mathematical programming. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Electrical) Discipline Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 15% | 15% | 0% | 70% |

| 1BES414 | Power Electronics | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Introduction to power electronics, Power electronics devices: power diodes, thyristors, power transistors, Characteristics, Firing circuits and gate requirements, rectifier circuits, Line frequency converters: single-phase and three-phase circuits. Static switches. AC voltage controllers: The single phase ac thyristor controller, Three phase controller, Phase control of ac controllers, Integral cycle control.<br>DC choppers: buck, boost, buck-boost, Cuk dc/dc converters. DC/AC converters (Inverters): Single phase circuits, three-phase inverter, modulation techniques. PWM rectifiers (Active rectifiers), Inerter and rectifier mode of operations of converters. Cyclo-converters and Matrix converters. | | | |

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Renewable (Electrical) Discipline Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 10% | 20% | 70% |

| 1BES325 | Design, Control, and Maintenance of PV Plants | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Different techniques to design a PV plant. Obtaining the required data, components. Effect of design methodology on the cost, performance. Control methods, softwares, SCADA used for control. Plants performance. Problems, errors, and maintenance of PV plants. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Electrical) Discipline Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 0% | 30% | 70% |

| 1BES429 | Electrical Machines (2) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Synchronous machines: Theory and design : Introduction, Cylindrical-rotor and salient-pole synchronous machines, Types of windings in ac machines, Winding coefficients, Generator performance, Motor performance, Phasor diagrams in three phase synchronous machines, Synchronous impedance steady state operation, Voltage regulation, Parallel operation, Synchronous machine to an infinite bus, The synchronization process, The V curves, power angle characteristics, The two reaction theory, Open circuit characteristics, Short circuit characteristics, Zero-power-factor characteristic, Damper bars, Testing of synchronous machines, Construction, Design, Main dimensions.<br>Induction machines: Theory and design: Introduction, Construction of three-phase induction motors, The magnetic circuit, Slip ring induction motors, Cage motors, Performance at constant flux, Electromotive force, Currents, Torque, Equivalent circuits, Torque speed curves, Phasor diagrams, The circle diagram, Starting methods, Classification of induction motors, High starting torque types, Performance with higher harmonics, Testing of induction motors. | | | |

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Renewable (Electrical) Discipline Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| RENE326 | Power Generation and Conversion Systems | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 2 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Applications of thermodynamics and heat transfer to power stations, cogeneration in industrial plants. Emphasis is given to energy planning and economic utilization. Advanced vapor and gas cycles. Different components design, analysis and selection. Overall power plant design and analysis. Power plant performance. Detailed Combined cycle analysis. Integration between Renewable and non-renewable systems. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Electrical) Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 10% | 0% | 20% | 70% |

| RENE323 | Power system analysis | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |
| Symmetrical components: Synthesis of unsymmetrical phasor diagrams from their symmetrical components, The symmetrical components of unsymmetrical systems, Power in terms of symmetrical components, Positive, negative and zero phase sequence networks, Unsymmetrical faults : Shunt faults, Series faults, Network matrices: Network topology, System admittance and system impedance matrices, Load flow solutions and control: Load flow equations, The Gauss-Seidel method, Newton-Raphson method and approximations, De-coupled methods, Regulating transformers. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Electrical) Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| RENE324 | Network Interfacing of Renewable Resources | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Concept of distributed generation, interconnection standards, type of interface, static synchronous generators, control of active power and voltage regulation, current control mode vs. voltage control mode, wind power interface: direct connection, back to back converters, matrix converters, fuel cell and photovoltaic interface topologies. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Electrical) Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 15% | 15% | 70% |

| RENE312 | Solar Energy: Photovoltaic (PV) Systems | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 1 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |
| Design of photovoltaic systems, such as utility scale solar farms or residential scale systems (on/off the grid). The function and operation of various components including inverters, batteries, DC-DC converters and the grid. After learning about the components, you will gain an understanding of the main design decisions to be taken when planning a real PV installation with excellent performance and reliability. Practice modelling the performance of a PV system for different solar energy applications, and estimating the energy production of a client's potential system. Cover all physics and engineering aspects of photovoltaics: photovoltaic energy conversion, technologies and systems. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Electrical) Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 15% | 15% | 0% | 70% |

| RENE311 | Electrical Power Transmission | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |

| Required SWL | 150 | Equivalent ECTS | 6 |
|---|---|---|---|
| Course Content | | | |
| Introduction, Two port networks, Representation of power systems, Parameters of transmission lines, Models of transmission lines, Series impedance, Electrical capacitance,<br>Representation of capacitance in parallel with transmission lines, Voltage and current relationships in transmission lines, Operation characteristics, Symmetrical components, Unsymmetrical faults on transmission lines, Introduction to underground cables, Design of transmission lines, Mechanical design, High-voltage dc overhead transmission lines, Insulated electrical cables, Determination of faults in underground cables, Design of electrical distribution systems, Substations,<br>Introduction to power system planning. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Electrical) Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| RENE411 | Power Systems Protection | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Protection engineering: Introduction, Effects of short-circuits on power systems, Basic elements of protective gear, Current and potential transformers, Protective relays, Electromechanical and static relays, Different types of electromechanical relays, Types of protection in electrical power systems, Differential protection of power systems, Protection of ring main systems, Protection of parallel feeders. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Electrical) Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| RENE413 | High Voltage Engineering | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Phenomenon of over-voltages in power systems, lightning and lightning protection, over- voltages in HV systems caused by switching operations, HV, circuit breakers, | | | |

| | | | |
|---|---|---|---|
| digital protection, faults/short-circuit analysis, short-circuit calculations, protection operation, types of relays. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable (Electrical) Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

# Course Description of Modules Delivered by the Renewable Energy Engineering Department to the Biochemical Engineering Program

| 2BES122 | Structural and Stress Analysis | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |
| Course Content | | | | |
| Equilibrium, stress-strain diagram - Normal force, shearing force, bending and twisting moment diagrams - Stresses in simply loaded elastic bars: axial loading, bending and torsion, deformation, stiffness, strain energy. Combined loading, eccentric normal load, combined bending and torsion. Two-dimensional stresses, principal stresses, maximum shear stress, allowable stresses, Mohr's circle representation. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Biochemical Discipline Requirement | | | 1 | |
| Assessment Criteria | | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam | |
| 0% | 30% | 0% | 70% | |

| 2BES113 | Materials Science | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 1 |
| Required SWL | 150 | Equivalent ECTS | | 6 |
| Course Content | | | | |
| • Brief introduction on: atomic structure of matter and crystal structure for all types of materials.<br>• Comparison between structure of metals and alloys, polymers, and ceramics; iron carbon.<br>• Diagrams and types of steels: carbon steels, alloy steels, cast iron; some types of non-ferrous.<br>• Metals and alloys; ceramics and composite materials; correlating materials properties with data learnt from phase diagrams and microstructure identification; basic mechanical properties and testing (tension, impact toughness, and hardness); basics of corrosion with relevance to type of material; case studies on materials used in petroleum engineering applications. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Biochemical Discipline Requirement | | | 1 | |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 15% | 15% | 0% | 70% |

| 2BES222 | Thermodynamics | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

- Introductory Concepts of Thermodynamic Systems and variables, Work, Heat, Internal Energy, Thermodynamic Equilibrium, Reversible and Irreversible Processes; Phase-Rule; Significance of Chemical Engineering Thermodynamics.
- Equations of State and Generalized Correlations for Prediction of Volumetric Properties of Fluids
- First Law: Closed and Open Systems, Steady and Transient Flow Processes
- Second law and Entropy; Entropy Balance and Availability, Isentropic Efficiency
- Maxwell Relations and Fluid Properties Estimation, Application to Flow Processes
- Single Phase Mixtures and Solutions; Ideal Solutions; Partial molar quantities; Gibbs-Duhem Equation; Criteria for Thermodynamic Equilibrium; Phase Equilibrium Criteria, Nonideal Solutions; Residual and Excess Properties; Fugacity and Activity Coefficient models
- Pure Component Phase Equilibria, Vapour-Liquid Equilibria (VLE), Raoult's Law and Modified Raoult's Law; High-Pressure VLE; Henry's law
- Chemical Reaction Equilibrium: Homogeneous and Heterogeneous reactions; Multi-reaction Equilibria
- Liquid-Liquid Equilibria
- Solid – Liquid Equilibria
- Solid – Vapour Equilibria

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 15% | 15% | 0% | 70% |

| 2BES225 | Fundamentals of Heat and Mass Transfer | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |

| |
|---|
| - Heat transfer operation: The principles of conduction, convection and radiation; The basic principles of fluid flow and heat transfer; Laminar and turbulent flows and the properties of fluids. Integrate the knowledge acquired and apply it to a range of new situations; Understand open and closed heat systems; Practice solutions to relevant problems; Modes of heat transfer operation: conduction - Fourier's law, heat transfer resistance and conductance, thermal conductivity, steady state conduction, heat flow through plane wall, composite wall, cylindrical surface and sphere; convection; individual heat transfer coefficient and overall heat transfer coefficient. Heat exchangers: shell and tube and double pipe heat exchangers, flow arrangements in heat exchangers, energy balance and LMTD. Become familiar with the analysis of practical problems of fluid flow and heat transfer in a number of applications in process and related areas relevant to each topic; Adopt an analytical approach to problem solving; Conduct research and collect relevant information.<br>- Mass transfer operation: Diffusion: Molecular diffusion, Fick's law of diffusion, steady state molecular diffusion in gases and liquids, mass transfer coefficients, penetration and surface renewal theories, diffusivity and flux calculations; Simple distillation, Continuous rectification - binary systems, McCabe Thiele analysis and calculations. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| 2BES214 | Electrical and Electronic Engineering | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |

- Basic definitions of current, voltage and power. Circuit theory assumptions and circuit diagrams. DC and AC circuits: Voltage and current sources; resistors, inductors, capacitors, reactance and impedance; Ohm's law, Kirchhoff's laws, combining resistors, combining capacitors and combining inductors; star-delta transformations, voltage and current source transformation; sinusoidal waveforms, impedance, rms values, phasors and complex numbers; Thevenin's and Norton's theorems, superposition theorem, voltage and current divider circuits; mesh and nodal analysis; maximum power transfer. Transient circuits: Producing a step function; RC, RL and RLC circuits; general methods for solving RC and RL circuits; circuits with multiple transients.
- Biosensors
- Liquid biofuels combustion engines
- Gas-fired boilers
- Gas turbines
- Spark ignition (SI) engines
- Dual-fuel engines
- Compressors
- Engine test

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Individual project | Final Exam |
| 10% | 0% | 20% | 70% |

| 2BES216 | Fluid Mechanics | 3 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 2 | 1 |

| Required SWL | 150 | Equivalent ECTS | 6 |
|---|---|---|---|

Course Content

Fluid Mechanics: Fluid Properties, Fluid Statics, Basic Fluid Flow, Laminar and Turbulent Flow in pipes Continuity and Momentum Equations. Pressure Losses. Pipe Lines. laminar and turbulent flow. Solution of the Navier- Stokes equations and Examples. Boundary layer flows

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 15% | 15% | 0% | 70% |

# Course Description of Modules Delivered by the Renewable Energy Engineering Department to the Petroleum Engineering and Gas Technology Program

| 3BES115 | Fundamentals of Fluid Mechanics | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| • Fluid Properties, Fluid Static, Manometers, Fluid Kinematics, Fundamentals of Flow Visualization; Fluid Dynamics (Equations of Fluid Motion), The Energy Principle (Bernoulli's Equation);.<br>• Measurements of Thermo-Fluid Parameters: Pressure, and Flow Rate. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Petroleum Discipline Requirement | | 1 | |
| Assessment Criteria | | | |
| Lab Report | Mid-Term Exam | Group project | Final Exam |
| 10% | 20% | 0% | 70% |

| 3BES113 | Materials Science for Petroleum Engineering | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 2 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| • Brief introduction on: atomic structure of matter and crystal structure for all types of materials.<br>• Comparison between structure of metals and alloys, polymers, and ceramics; iron carbon.<br>• Diagrams and types of steels: carbon steels, alloy steels, cast iron; some types of non-ferrous.<br>• Metals and alloys; ceramics and composite materials; correlating materials properties with data learnt from phase diagrams and microstructure identification; basic mechanical properties and testing (tension, impact toughness, and hardness); basics of corrosion with relevance to type of material; case studies on materials used in petroleum engineering applications. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Petroleum Discipline Requirement | | 1 | |
| Assessment Criteria | | | |

| Lab Report | Mid-Term Exam | Group project | Final Exam |
|---|---|---|---|
| 15% | 15% | 0% | 70% |

| 3BES122 | Structural and Stress Analysis | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |

Course Content

- Equilibrium (2D, 3D, FBD).
- Trusses (Joint And Section Methods).
- Geometrical Properties of Sections.
- Stress, Strain, and Axial Loading.
- Analysis of Beams.
- Bending Stresses.
- Shearing Stresses; (Transverse and Torsional).
- Combined Stresses.
- Deflection.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| 3BES125 | Fundamentals of Thermodynamics | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Properties of Pure Substances, First Law of Thermodynamics for Closed And Open Systems, Second Law Of Thermodynamics For Reversible And Irreversible Cycles And Processes, Entropy Generation.
- Measurements of Thermo-Fluid Parameters: Temperature, Saturation Properties, Specific Heat Ratio.
- **Three labs (2 hr) every other week**

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group Report | Final Exam |
| 0% | 20% | 10% | 70% |

| 3BES214 | Fundamentals of Heat and Mass Transfer | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

Course Content

- Fundamentals of Heat Transfer by Conduction.
- Fundamentals of Convection.
- Internal and External Forced Convection.
- Heat Exchangers.
- Radiation.
- Mass Transfer Fundamentals.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| 3BES216 | Machine Design for Petroleum Engineering | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Fundamental Principles.
- Materials in Machine Design.
- Static Failure Theories.
- Design of Shafts.
- Design of Fasteners.
- Design of Gears.
- Design and Selection Of Bearings.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

# Course Description of Modules Delivered by the Renewable Energy Engineering Department to the Environmental Sustainable Architecture Engineering Program

| 4BAS115 | Thermo-Fluids | | | 5 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 3 | | 2 | | 3 |
| Required SWL | 225 | Equivalent ECTS | | 9 |
| Course Content | | | | |
| **Thermodynamics and Heat Transfer:** Terminology of thermodynamics; Thermodynamic properties, temperature scales and measurement; properties of pure substances; 1st, 2nd and 3rd laws of thermodynamics; reversible and irreversible processes; Carnot cycles, heat engines and thermal efficiency; The principles of conduction, convection and radiation; Understand open and closed heat systems; Modes of heat transfer operation: conduction - Fourier's law, heat transfer resistance and conductance, thermal conductivity, steady state conduction, heat flow through plane wall, composite wall, cylindrical surface and sphere; convection; individual heat transfer coefficient and overall heat transfer coefficient. Heat exchangers: shell and tube and double pipe heat exchangers, flow arrangements in heat exchangers, energy balance and LMTD. **Six labs (2 hrs) every other week**<br>**Fluid Mechanics and Mass Transfer:** Fluid Properties, Fluid Statics; Basic Fluid Flow; Laminar and Turbulent Flow in pipes; Continuity and Momentum Equations; Pressure Losses; Pipe Lines; laminar and turbulent flow; First law applied to flow processes; Boundary layer flows; Become familiar with the analysis of practical problems of fluid flow and heat transfer in a number of applications related to buildings environment. **Six labs (2 hrs) every other week** | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Environmental Faculty Requirement | | | 1 | |
| Assessment Criteria | | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam | |
| 20% | 20% | 0% | 60% | |

| 4BAS124 | Structural and Stress Analysis | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 1 | | 0 |
| Required SWL | 100 | Equivalent ECTS | | 4 |
| Course Content | | | | |
| • Relationship between architectural and structural design;<br>• Introduction to structural design, safety measures | | | | |

- Types of structural elements: cables, trusses, beams, frames, arches, plates, and shells;
- Equilibrium, stress-strain diagram - Normal force, shearing force, bending and twisting moment diagrams;
- Stresses in simply loaded elastic bars: axial loading, bending and torsion, deformation, stiffness, strain energy;
- Combined loading, eccentric normal load, combined bending and torsion;
- Two-dimensional stresses, principal stresses, maximum shear stress, allowable stresses, Mohr's circle representation

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Faculty Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| 4BAS214 | Geotechnics | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 2 | 1 |

| Required SWL | 150 | Equivalent ECTS | 6 |
|---|---|---|---|

Course Content

- Introduction to the geology and geomaterials of Egypt and the UK;
- Nature of soils and their variability; and the state and behaviour of a soil.
- Basic engineering properties of soils and rock masses and their classifications;
- Vertical stress and shear strength of soils,
- Flow of water through soils;
- Introduction to consolidation theory;
- Common ground engineering problems, techniques and technologies for soil improvement.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Faculty Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

# Elective Course Description of Modules Delivered by the Renewable Energy Engineering Department to both the Renewable Energy Programs

| REN415 | Sustainable Enterprise Economy | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| The module aims to provide an understanding of the values that frame a model for sustainable enterprise and specifically the potential to shape future managerial practice. The module will encourage you to reflect on your own understanding of, and responses to this UN initiative in the context of sustainable patterns of globalisation. You will be expected to apply this knowledge and understanding, systematically and creatively to the challenges facing firms both locally and globally. The module's post-contemporary perspective of the interrelationships between Business, Society and the Environment will encourage you to think holistically about implementing transformative change. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| REN417 | Wind Energy Convertors | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| This course will cover the principles of wind energy and wind power, as well as the design and operation of different types of wind energy converters. It will include machines for water pumping, remote area power supply and grid electricity generation. It will cover issues of site selection, monitoring and analysing wind data, estimating output from wind generators, integrating wind generators into hybrid power systems or the grid, economics, standards and environmental impacts.. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 10% | 20% | 70% |

| REN418 | Life Cycle Assessment | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |
| Course Content | | | | |
| This course will deal with life cycle analysis and its use for life cycle assessment of energy systems. Methodologies, boundary issues, data bases and applications will be studied. The uses of LCA will be illustrated with industrial case studies and with studies aimed at quantifying externalities associated with different electricity generation technologies. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Renewable Elective Program Requirement | | | 4 | |
| Assessment Criteria | | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam | |
| 0% | 10% | 20% | 70% | |

| REN421 | Renewable Energy Policy | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |
| Course Content | | | | |
| This course will review objectives and strategies of renewable energy policy, focussing on sustainable energy transitions, and the integration of renewable energy into electricity markets. The course will introduce the context in terms of policy drivers, policy processes and relevant aspects of energy market structure and regulation. Selection and design of policy instruments, including regulation, taxation, tariffs, targets, incentives and market-based schemes will be explored. Specific policy and regulatory approaches, the views of different stakeholders and interaction with the broader policy regulatory environment will be examined for specific policy case studies. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Renewable Elective Program Requirement | | | 4 | |
| Assessment Criteria | | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam | |
| 0% | 30% | 0% | 70% | |

| REN422 | Feasibility Studies and Economics of Energy Projects | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | | Laboratory |
| | | | |

| Required SWL | 125 | Equivalent ECTS | 5 |
|---|---|---|---|
| Course Content | | | |
| Introduction. Basic concepts and definitions. Economics of energy and environmental projects. Case studies from energy projects in Egypt and worldwide. Case studies from environmental projects in Egypt and worldwide. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 10% | 20% | 70% |

| RENM416 | The Politics of Climate Change | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| | | | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| What is climate change, why is it important, and what are people doing about it? Why is energy so central in the climate change debate, and how will climate policy shape the future of energy systems in the UK? How do we balance the need for new low carbon technologies with broader social, political and economic requirements of energy systems?. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| RENM423 | Integration of and Transmission of Energies | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Hybrid energy systems, conventional and non-conventional integration systems. Design, selection, performance. Power transmission and distribution, optimization, utilization, availability. Energy planning policy and economy | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Mechanical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 30% | 70% |

| RENM424 | Internal Combustion Engines | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Introduction to ICE types and designs. Different systems used in ICE, fuel, ignition, cooling, lubrication and control systems.<br>Combustion in internal engines, normal and abnormal combustion, engines performance and emissions.<br>Diesel, gasoline and natural gas fuels, properties, fuel blends, alternate fuels, biofuels performance. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Mechanical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 30% | 70% |

| RENM425 | Solar Thermal Energy Design | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Characteristics of solar radiation and solar collectors-concentrators. Collector efficiency evaluation and prediction of long term performance. System modelling, energy storage; computer simulation and modelling of performance and economic worth. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Mechanical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 30% | 70% |

| RENM419 | Biomass | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |

| |
|---|
| This course will introduce a range of biomass energy sources, including forestry, wastes and crops, as well as various technologies for their conversion into useful fuels or power. The course will cover liquid and gaseous fuels, including ethanol, however, the emphasis will be on electricity generation technologies, including combustion and gasification systems, biogas and landfill gas systems, combined heat and power production. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Mechanical Elective Program Requirement | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| RENM427 | Design of Hydraulic and Wind Energy Equipment | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |

| Course Content |
|---|
| Basic concepts, design criteria. Performance. Hydraulic energy, the water hydrologic cycle, hydraulics, hydraulic power plants, types of hydropower plants, types of hydropower turbines. Design of different parts of wind energy plants. Matching. Performance.<br>Wind energy: wind energy principles, wind energy applications, aerodynamics of wind turbines, structural design, speed control, and frequency modulation, wind form, generator systems. Material and manufacturing techniques of blades. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Renewable Mechanical Elective Program Requirement | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Research Project | Final Exam |
| 0% | 0% | 30% | 70% |

| RENM428 | Advanced Wind Energy | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |

| Course Content |
|---|
| This course will cover the principles of wind energy and wind power, as well as the design and operation of different types of wind energy converters. It will include machines for water pumping, remote area power supply and grid electricity generation. It will cover issues of site selection, monitoring and analyzing wind data, estimating output from wind generators, integrating wind generators into hybrid power systems or the grid, economics, standards and environmental impacts.. |

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Renewable Mechanical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 30% | 70% |

| RENE412 | Power Quality | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Power and Voltage Quality: General, classes of Power Quality Problems, Power quality terms, Power frequency variations, the power quality evaluation procedure. Voltage quality: Transients, long and short duration Voltage variations, Voltage imbalance, waveform distortion, Voltage Flicker. Sags and Interruptions, Fundamentals of Harmonics. Distributed Generation and Power Quality. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Electrical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 15% | 15% | 70% |

| RENE416 | Advanced Power System Protection | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Fundamentals of electromechanical relays and digital protective Relaying. Introduction to Digital Relays. Overcurrent protection and coordination. Protection of Series Compensated Transmission Line. Differential protection, Distance protection. Definition of wide-area protection, Architectures of wide-area protection, concept of synchronized sampling, wide area phasor measurement technology, concept of Adaptive relaying, advantageous of adaptive relaying and its application | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Electrical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 15% | 15% | 70% |

| RENE419 | Switchgear Engineering and Substation | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Switchgear equipment and schemes, circuit interrupts and fuses types & applications. Function of substations, Substation and Maintenance. Voltage levels in HVAC and HVDC substations. Feeders, insulators and Bus-Bars schemes, types, selection. Grounding system including the effect of current on human body and components of grounding system. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Electrical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 15% | 15% | 70% |

| RENE423 | Electric Drives | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Basics of industrial motor control, Criteria for selecting drive components, Dc motor drives, Equivalent circuit of dc motors, Permanent magnet dc motors, Dc servomotors, Adjustable speed dc drives, Industrial examples, Electric traction examples, Induction motor drives, Slip power recovery from an induction motor, Forced commutated, Variable frequency ac motor drives, Injection braking of induction motors, Synchronous motor drives, Stepper motor drives, Computer controlled drives. AC and Brushless DC permanent magnet motor drives, the vector control concepts applied to AC PM machines, salient and non-salient AC PM machines, vector control using maximum torque per amp control strategies, field weakening control of both non-salient and salient PM. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Electrical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 10% | 20% | 70% |

| RENE424 | Electric Power Distribution Systems | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |

| | | | |
|---|---|---|---|
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Distribution System Fundamentals, load Characteristics, load modeling and demand response, substations & primary feeders, underground distribution, voltage regulation, capacitor applications, introduction to protection system. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Electrical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 15% | 15% | 70% |

| | | |
|---|---|---|
| RENE425 | Energy Harvesting Technologies | 3 |
| Prerequisites | N/A | |
| Number of weekly Contact Hours | | |
| Lecture | Tutorial | Laboratory |
| 2 | 2 | 0 |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Introduction of energy sources for mechatronics, energy harvesting technologies, energy harvesting from vibration, electro-mechanical conversion – analysis of ambient energy, electro-mechanical conversion – physical principles, electromagnetic principle, design of electromagnetic generators, piezoelectric principle, piezoelectric materials and other SMART materials, other alternative sources of energy harvesting, solar cells and thermo-generators, electronics – power management and MEMS. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Electrical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 10% | 20% | 70% |

| | | |
|---|---|---|
| RENE427 | Advanced Photovoltaics | 3 |
| Prerequisites | N/A | |
| Number of weekly Contact Hours | | |
| Lecture | Tutorial | Laboratory |
| 2 | 2 | 0 |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| The grand energy challenge. Different methods for solar energy utilization. Review of solar cell physics. Wafer silicon photovoltaic technology. Survey of other photovoltaic technologies. Optical/electrical loss mechanisms and remedies. Multijunction tandem cells and concentrating systems. Efficiency limits. Resource limitations to terawatt photovoltaics. Potential Earthabundant materials for photovoltaics. Approaches to low-cost thin-film and 3-dimensional photovoltaics. Terawatt low-cost wafer silicon | | | |

| | | | |
|---|---|---|---|
| photovoltaics. It is intended to expose students to some of current focuses in photovoltaic research and commercialization. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Electrical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| | | | |
|---|---|---|---|
| RENE428 | Micro Grid and Grid Connect PV Solar Systems | | 3 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| Power conditioning and maximum power point tracking (MPPT) algorithms, inverter control topologies, feasible operating region of inverter at different power factor values, consumer applications: residential, PV water pumping, PV powered lighting, … etc., grid-connected (utility interactive) PV systems, active power filtering with real power injection, modelling and simulation of complete micro grid and grid connected PV systems. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Electrical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| | | | |
|---|---|---|---|
| RENE429 | Power electronics for energy application | | 3 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| DC-DC converters for solar PV, buck/boost/buck-boost /flyback /forward/cuk, bidirectional converters, Interleaved and multi-input converters. Grid connected Inverters, single and three phase inverter. Synchronous generator with back to back controlled/ uncontrolled converter. PWM rectifiers, cyclo and matrix converters. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Renewable Electrical Elective Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 15% | 15% | 70% |

# 3-Modules Delivered by the Biochemical Engineering Department

| | Code | Course Title | Cr & SWL | | | Contact Hours | | | | Classification | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH | ECTS | SWL | Lec | Tut | Lab | TT | UR | FR | DR | PR |
| Biochemical | 2HUM117 | Computer Programming | 2 | 3 | 75 | 1 | -- | 3 | 4 | X | | | |
| | 2BES312 | Modelling and simulation | 2 | 3 | 75 | 2 | 1 | -- | 3 | | | X | |
| | 2BES125 | Energy Sources | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | X | |
| | 2BES124 | Fundamentals of biochemistry | 3 | 6 | 150 | 2 | 2 | 2 | 6 | | | X | |
| | 2BES211 | Fundamentals of corrosion science | 2 | 4 | 100 | 1 | 2 | 1 | 4 | | | X | |
| | 2BES213 | Mass and energy balances | 2 | 3 | 75 | 2 | 1 | -- | 3 | | | X | |
| | 2BES226 | Unit Operation | 2 | 3 | 75 | 2 | 1 | -- | 3 | | | X | |
| | 2BES313 | Environmental Legislation and Regulations | 2 | 3 | 75 | 2 | 1 | -- | 3 | | | X | |
| | 2BES426 | Environmental Risk Analysis | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | 2BES321 | Economics of Bioenergy | 2 | 3 | 75 | 2 | 1 | -- | 3 | | | X | |
| | BIO111 | Fundamentals of microbiology | 3 | 4 | 100 | 2 | 2 | 1 | 5 | | | X | |
| | BIO212 | Fundamentals of Biochemical engineering | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | BIO223 | Principles of process design | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | BIO325 | Principles of plant design | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | BIO412 | Climate change and BioEnergy | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | BIO221 | Biophysics | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | X | |
| | BIO126 | Biomass engineering | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | BIO311 | Bioreactor Design | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | | X |
| | BIO316 | Bioremediation of environmental pollutant | 2 | 4 | 100 | 2 | 1 | 1 | 4 | | | | X |
| | BIO224 | Biofuels (1) | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | | X |
| | BIO314 | Biofuels (2) | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | | X |
| | BIO315 | Nanotechnology for biochemical system | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | | X |
| | BIO323 | Biotechnology | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | BIO324 | Bioproduct Design | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | BIO326 | Petroleum Bioprocessing | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | BIO411 | Valorization of waste and biomass | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | BIO421 | Biolubricants for Tribological engineering and engine Tribology | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | BIO401 | Graduation Research Project | 4 | 8 | 200 | -- | -- | -- | -- | | | | X |
| | BIO402 | Design Project | 4 | 8 | 200 | -- | -- | -- | -- | | | | X |
| | ENGG03I | Industrial Training | -- | -- | -- | -- | -- | -- | -- | | X | | |
| | ENGG07 | Industrial Training | -- | -- | -- | -- | -- | -- | -- | | X | | |
| | | | | | | | | | | | | | |
| Electives | BIO413 | Process Design and Simulation | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | BIO415 | Circular Economy | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | BIO416 | Food Processing Equipment | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | BIO422 | Process Plant Operation | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | BIO423 | Advanced Control Systems | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | BIO424 | Occupational, Health, Safety Engineering and Environmental Management Systems | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | BIO425 | Principles of Fermentation Technology | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |

# Course Description of Modules Delivered by the Biochemical Engineering Department to the Biochemical Engineering Program

| 2HUM117 | Computer programming | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 1 | 0 | 3 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |
| The aim of this module is to understand the basics of computer science and its applications in engineering practices.<br>• Apply computer science as applied to engineering.<br>• Using computer software in obtaining reliable results.<br>• Identify different software solutions for specific problems.<br>• Provide systematic approach of computer programming<br>• Interpret real time computer-processed data.<br>• Select and use appropriate software and available input and output data in problem solving in order to make successful modification and improvement in specific situations.<br>• Use electronic resources to communicate and handle data.<br>• Prepare relevant data for further analysis. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Biochemical University Requirement | | 1 | |
| Assessment Criteria | | | |
| Group project | Lab coursework | Practical Exam | Final Exam |
| 20% | 20% | 0% | 60% |

| 2BES312 | Modelling and Simulation | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 1 | 0 | 3 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |

- The first part of this course will include revision and completion of the math required in the following topics: numerical methods, linear and nonlinear system analysis, finite element analysis, chaos, Markov chain, Monte Carlo with the use of a selected software (Matlab, simulink, Berkeley Madonna, Comsol...).
- The second part will include the Modelling fundamentals in chemical and petrochemicals engineering and formulation of dynamic model with examples in the equations of state, steady and unsteady mass, energy and momentum balances, chemical kinetics, multistage modelling.
- The student(s) will select a chemical process, and present a model that simulate the process with the aid of a computer software with a certain level of complexity that is chosen by the instructor

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 15% | 0% | 15% | 70% |

| 2BES125 | Energy Sources | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | Laboratory | |
| 2 | | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 | |

Course Content

- History of energy usage, forms of energy, present energy consumption, environmental problems.
- Conventional energy sources: energy and power; fossil fuel and nuclear, the grid.
- Solar thermal energy: solar radiation resource, passive and active solar heating, solar concentrators.
- Solar photovoltaics: basic PV operation, PV technologies, electrical characteristics.
- Biomass: definitions, biomass resource, extracting biomass energy, fuel crops, anaerobic digestion, landfill gas, waste to energy, energy balances and economics.
- Hydroelectricity: the resource, hydropower power equation, turbines, large and small scale systems, pumped storage.
- Tidal power: the tides, tidal resource, system operation, environmental factors.
- Wind energy: generation of the winds, wind resource, basic aerodynamics (lift versus drag) and the fundamental power equation, fundamental design concepts.
- Wave energy: the wave resource, the fundamental power equation; onshore and off-shore wave energy extraction systems.
- Geothermal energy: basic physics, resource quantification, rock permeability,

volcanic based systems, HDR systems, case study-the CSM HDR geothermal energy project, geothermal heat pumps.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| 2BES124 | Fundamentals of Biochemistry | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 2 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

Role of microorganisms in biochemical engineering.

**Enzymes and kinetics**: Enzyme nomenclature and classification, enzyme kinetics: Enzyme catalysis, order of reaction, progress of reaction. Mechanism and kinetics of enzymatic reactions: Fischer's template theory, Koshland's model, substrate strain theory, Integral Michaelis - Menten equation. Evaluation of kinetic parameters: Line weaverBurk, Eadie - Hofstee, Hanes-Woolf methods. Inhibition and Inhibition kinetics: Reversible, substrate, Irreversible, allosteric and product inhibitions.

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

**Reaction kinetics in bioprocess**: Reaction kinetics for biological systems- M.M kinetics, enzyme deactivation kinetics; heterogenous reactions in bioprocessing-concentration gradients and reaction rates in solid catalysts, internal mass transfer in heterogenous reactions; Thiele modules - solid – liquid mass transfer correlations, minimizing mass transfer effects.

**Modeling and simulation of bioprocesses**: Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

**Simulation methods**: Simulation: Introduction, Iterative convergence methods like interval halving, Newton-Raphson and explicit convergence methods. Numerical integration of ordinary differential equation and explicit numerical integration algorithm.

**Biochemistry Lab. Three labs (2 hr) every other week**

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 1 |

Assessment Criteria

| Lab coursework | Mid-Term Exam | Group project | Final Exam |
|---|---|---|---|
| 15% | 15% | 0% | 70% |

| 2BES211 | Fundamentals of Corrosion Science | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 1 | 2 | 1 | |
| Required SWL | 100 | Equivalent ECTS | 4 |

Course Content

- Corrosion chemistry.
- Types of chemical corrosion.
- Application of electrochemistry in corrosion protection in chemical and petrochemical plants.
- Microbial influenced corrosion.
- Sulfate reducing bacteria
- Biofilm formation and biofouling.
- Corrosion monitoring
- Chemical and green biocides.
- Cathodic protection.
- **Corrosion Microbiology Lab. <u>Three labs (2 hr) every other week</u>**

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 15% | 15% | 0% | 70% |

| 2BES213 | Mass and Energy Balances | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 75 | Equivalent ECTS | 3 |

Course Content

Fundamentals of material and energy balances. Steady state and unsteady state considerations. Black box approach. Process flow diagrams and flow sheets. Mass and energy balance diagrams and tables. Mass balances for non-reacting systems.
- Mass balances for reacting systems: Law of conservation of mass, Classification of material balance, solving material balance problems without chemical reactions, Energy balance: procedure, sensible heat and heat capacities. Relationship between $C_p$ and $C_v$, Empirical equations for heat capacities.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| 2BES226 | Unit operation | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |

- Dimensional Analysis: Units and Dimensions, dimensional homogeneity and dimensionless numbers and similitude.
- Fluid Mechanics: Definition and classification, types of fluids, types of flow. Equations for flow, Continuity equation, Bernoulli equation, Hagen-Pouseuille equation. Flow over particles and through stagnant fluids, settling and sedimentation.
- Fluid flow: Fluid flow measuring devices, pumps, energy calculations and characteristic of pumps
- Mechanical Operations: Size reduction, sieve analysis. Fluid mixing and power consumption in mixing. Fluid solid interactions, sedimentation, filtration and design of filtration equipment.
- Heat Transfer: Heat conduction, conduction through single and multi-layers walls, insulations.
- Heat Transfer: Convective heat transfer, forced and natural convection, condensation. Design of heat exchangers. Sterilization operations.
- Mass transfer: Basics, modes of mass transfer, Fick's law of Diffusion, mass transfer correlations.
- Mass transfer operations: Distillation, extraction and drying.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| 2BES313 | Environmental Legislation and Regulations | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |

- Work legislation.
- Environmental legislation.
- Air regulation.
- Water regulation.
- Waste regulation.
- Biotechnology, ethics and society
- Basic foundation in the economic, legal, and political aspects of energy regulation, renewable energy, and energy efficiency.
- Theories and applied technologies for production and conversion of biomass into energy and co-products

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Individual project | Final Exam |
| 0% | 15% | 15% | 70% |

| 2BES426 | Environmental Risk Analysis | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

Hazard identification: Introduction to Hazard identification, Epidemiology, Toxicology, Classification of carcinogens, Evaluation of data. Dose-response assessment: Introduction to dose-response assessment, Toxic kinetics and toxic dynamics, Derivation of toxicity values. Exposure assessment: Introduction to exposure assessment, Characterization of exposure settings, Identification of exposure pathways, Quantification of exposure, Exposure modeling and monitoring. Risk characterization: Risk characterization, Uncertainty analysis, Chemical mixtures, Tiered approach. Ecological risk assessment: Problem formulation, Analysis, Risk characterization. Risk perceptions and risk communication: Risk perceptions, Risk communication. Risk management: Options appraisal, Risk control, Implementation and monitoring. Hazard identification: Introduction to Hazard identification, Epidemiology, Toxicology, Classification of carcinogens, Evaluation of data. Dose-response assessment: Introduction to dose-response assessment, Toxic kinetics and toxic dynamics, Derivation of toxicity values. Exposure assessment: Introduction to exposure assessment, Characterization of exposure settings, Identification of exposure pathways, Quantification of exposure, Exposure modeling and monitoring. Risk characterization: Risk characterization, Uncertainty analysis, Chemical mixtures, Tiered approach. Ecological risk assessment: Problem formulation, Analysis, Risk characterization. Risk perceptions and risk communication: Risk perceptions, Risk communication. Risk management: Options appraisal, Risk control, Implementation and monitoring, waste industry safety, reducing the risks.

The course also draws the student's attention to the following topics: Global energy usage and trends. Characteristics and properties of fossil fuels. New fuels. Fuel testing

| |
|---|
| and specification of commercial fuels. Renewable Sources of Energy. Utilization of fuels in boilers and furnaces. Energy losses and optimization of performance. Pollutant emissions. Carbon dioxide issues.<br>Flame propagation and explosions. Fire - Review of relevant concepts. Fire spread. Radiation from fires. Building and factory fires. Assessment of fire hazards and risk of explosions. Fire and explosion prevention. Standard fire tests. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Essay | Mid-Term Exam | Group project | Final Exam |
| 10% | 20% | 0% | 70% |

| 2BES321 | Economics of Bioenergy | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 75 | Equivalent ECTS | 3 |

Course Content

- Techno-economic analysis for bioenergy systems.
- Bioenergy economy, reliability and risk.
- Economic, social and environmental impacts of bioenergy
- Quantitative risk assessment.
- Quality assurance, accreditation, certification and Norms.
- Issues and opportunities associated with bioenergy development.
- Analyzing the economics of bioenergy crop production.
- Bioenergy crop impacts on water quality and quantity.
- Challenges and barriers to bioenergy development.
- Energy balance and life cycle assessment on bioenergy production system.
- Biomass harvesting and handling scenarios and relevant cost analysis and systematic considerations.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Essay | Mid-Term Exam | Group project | Final Exam |
| 10% | 20% | 0% | 70% |

| BIO111 | Fundamentals of Microbiology | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 1 | |
| Required SWL | 100 | Equivalent ECTS | 4 |

Course Content

- Fundamentals of microbiology
- Introduction to: origin of life & forms of life
- Cultivation of microbes
- Structures of bacteria
- Fungi
- Viruses
- Growth of microbes and its measurement
- Microbial control through physical and chemical agents
- Catabolic energy yielding and anabolic energy consuming metabolic reactions
- Special features of microbial metabolism
- Microbial genetics
- Microbes of importance in environment, agriculture, soil, water, industry, and medical field
- **Microbiology Lab. Three labs (2 hr) every other week**

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 15% | 0% | 15% | 70% |

| BIO212 | Fundamentals of Biochemical Engineering | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 2 | 1 |

| Required SWL | 150 | Equivalent ECTS | 6 |
|---|---|---|---|

Course Content

- Basics of Biology, Overview of Biotechnology, Diversity in Microbial Cells, Cell Constituents, Chemicals for Life.
- Kinetics of Enzyme Catalysis.
- Immobilized Enzymes: effects of intra and inter-phase mass transfer on enzyme kinetics.
- Major Metabolic Pathways: Bioenergetics, Glucose Metabolism, Biosynthesis.
- Microbial Growth: Continuum and Stochastic Models.
- Design, Analysis and Stability of Bioreactors.
- Kinetics of Receptor-Ligand Binding.
- Receptor-mediated Endocytosis.
- Multiple Interacting Microbial Population: Prey-Predator Models.
- Bio-product Recovery & Bio-separations, Manufacture of Biochemical Products.
- **Fermentor Lab. Three labs (2 hr) every other week**

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 2 |
| Assessment Criteria | |

| Lab report | Mid-Term Exam | Group project | Final Exam |
|---|---|---|---|
| 15% | 0% | 15% | 70% |

| BIO223 | Principles of process design | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- terminology of design
- hierarchy of process design
- block flow diagrams (BFDs)
- process flow diagrams (PFDs)
- input-output structures of flowsheets
- choice of reactors and separators
- reaction, separation and recycle systems
- hot and cold utility systems
- energy utilisation to minimise utility and overall capital costs
- retrofit design
- batch process design

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| BIO325 | Principles of Plant Design | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- **Induction**
- **Site Survey & Selection:** Information required to select a site; Transportation Issues; Utilities; Electrical & Communication Systems; Environmental Quality Control; Fire safety & security; site deatures
- **Readings siting and risk:** Magnitude of the problem; statement of the problem; Bridging the gap between land use planning (LUP) and risk assessment (RM).
- **Plant layout:** General factors in planning layout; Data requirements for the preparation of conceptual layout; Methods of planning layout; Layout economic and technical factors; Sources of information

- **Plant layout 2:** plot plans; input data; project design data; vendor data; internally generated engineering data.
- **Plant layout 3:** Drums & Drum types; location of drums; methods of support; pump locations; reactor location; pipe rack.
- **Introduction to project management:** what is a project; defining the project; the triple constraint; project framework; integration management; time & quality management.
- **Engineering contracts:** What is a contract; contract types
- **Project deliver system:** PDS selection methods; risk mitigation
- **Project planning:** objective of project planning; sources of planning data; activity definition; gantt charts; milestones.
- **Quality management:** quality and business needs; principles for a quality system; principles for quality management
- **Startup & commissioning:** preparation prior to initial start up; normal start-up procedures
- **Asset management**

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| BIO412 | Climate change and Bioenergy | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Global environmental problems: Greenhouse effect, acid rain, El Niño, Ozone depletion, deforestation, desertification, salination, biodiversity loss; chemical and radiation hazards.
- Environmental pollution and degradation: Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies; noise pollution; environmental damage by agriculture, perspectives of pollution in urban, industrial and rural areas.
- Environmental protection act: Environmental laws, national movements, sustainable development, environmental policies, environmental economics, environmental ethics; holistic approach of environmental protection and conservation, IUCN-role in environmental protection. Concept with reference to UN–declaration, aim and objectives of human right policies with reference to Egypt on the priorities of implementation, Environmental Protection Agency (EPA).
- Climate change and greenhouse gas (GHG) emissions.
- Greenhouse gas rules and regulations.
- Environmental aspects of bioenergy.

- Bioenergy and petroleum bioprocessing options and social challenges over GHG reduction measures.
- Bioenergy emissions and health impacts
- Students engage in literature searches and review climate change policy options

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Biochemical Discipline Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| BIO221 | Biophysics | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |

Course Content

- Macromolecular Structure
- Primary Through Quaternary Structure
- Covalent stereochemistry & Force fields
- Non-bonded interactions & Force fields
- Thermodynamics & Kinetics
- Illustrated with applications to Membrane Transport.
- Energy, Entropy, Free energy
- Activation energy & transition states
- Hydrophobic effect
- Statistical mechanics
- Equilibria
- Reactions
- Binding
- Conformation
- Calorimetry
- Membrane proteins, ion channels & pumps
- Transport & Diffusion
- Action potentials / measurement / synapses
- Crystallographic theory
- X-ray Diffraction
- Phasing methods - MIR & MAD
- Maps, Models & Refinement
- Quality assessment & Biochemical interpretation
- Spectroscopy - Visible & UV
- Quantum mechanical foundation
- Absorption
- Polarization - CD

- Fluorescence
- Fluorescence anisotropy
- FRET
- Introduction to Magnetic Resonance
- Spin interactions & relaxation
- Magnetic Resonance Imaging
- Biomolecular Structure (Introduction)

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| BIO126 | Biomass Engineering | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 2 | 0 |

| Required SWL | 150 | Equivalent ECTS | 6 |
|---|---|---|---|

Course Content

- Biomass: definitions, biomass resource, extracting biomass energy, fuel crops, anaerobic digestion, landfill gas, waste to energy, energy balances and economics.
- Biomass as feedstock for biofuel and biogas production:
  - Biomass for first generation bioenergy production: Sugar crops; grains; oilseeds. These will be considered in terms of their potential for production; land use; competition with food and other industrial crops; energy inputs in production; and transport logistics
  - Biomass for second generation biofuel production: Dedicated planation; forestry and agricultural residues; secondary biomass feedstock (agricultural, industrial, commercial, and municipal organic wastes). These will be considered in terms of their production, composition, purity, conversion potential and environmental impacts.
  - Biomass for third generation biofuel production: Micro and macro algae for production of bulk chemicals and biofuels. These will be considered in terms of development of new biomass feedstock and technical constrains.
  - Biosludge and other feedstock for biogas production.
- Biomass logistics: Harvesting or collection; densification; transport; storage.
  - Applications of chemical, biochemical, thermochemical, and bioseparation technologies for production of biofuel.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |

| | | | |
|---|---|---|---|
| 0% | 30% | 0% | 70% |

| BIO311 | Bioreactor Design | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |

Course Content

- Introduction to bioprocess: Type of fermentation, Measurement of microbial growth: Total cell number, Viable cell number, Cell dry weight, Absorbance, Packed cell volume, Viscosity, ATP, Heat evaluation, Specific growth rate, Product formation rate, Productivity, Chemostst theory, Dilution rate, Fed- batch culture.
- Mixing and mass transfer: Mass transfer: oxygen transfer, KLa measurement: Steady state, Dynamic methods, Correlation of KLa for stirred tanks and Airlift reactors, Gas hold up, Liquid mixing, Characterization of agitation, Power consumption, Rheological properties: Newtonian and Non-Newtonian fluids, Laminar and turbulent shear, Shear in ALR.
- Design and scale up: Types of bioreactor; Stirred tank bioreactor, Airlift bioreactor, Heat transfer, Scale up of STB and ALR, ALR design: Construction, Hydrodynamics, Three phase flow, Mixing, Oxygen transfer: Isobaric and Non-isobaric method.
- Strategies for fermentation control: The control loop, Analogue, Digital, PID, Time-proportioned control, Physical control: Temperature, Airflow, Pressure, Agitation, pH, Dissolved oxygen, Fermented content, Feeding, Vent gas analysis, DDC, Estimation of biomass, Fault diagnosis.
- Some examples of bioreactors:
- Photobioreactor for production of biodiesel and other valuable byproducts from algae.
- Biogas reactor.
- Fermentor for bioethanol production from sugar solution.
- Open ponds cultivation of algae for production of biodiesel and other valuable byproducts from algae.
- Bioreactors for petroleum bioprocessing.
- Bioreactors for bioremediation of petroleum hydrocarbons polluted water

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Program Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 10% | 20% | 70% |

| BIO316 | Bioremediation of Environmental Pollutant | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 1 | |

| Required SWL | 100 | Equivalent ECTS | 4 |
|---|---|---|---|

Course Content

- Pollutant biodegradation (Biological principles and intrinsic kinetics): Microbial nutrition and metabolism; microbial growth and energy; enzymes and their structures; effect of environment on enzyme activity; microbial growth and substrate utilization kinetics; biokinetic models; batch and continuous chemostat studies; determination of biokinetic parameters.
- Recognize pollutants, characterize the extent and consequences of pollution in the environment, identify and evaluate alternatives for remediation and prevention, and evaluate the economic and political viability of alternatives.
- Environmental factors and chemical/physical properties of pollutants affecting biodegradation kinetics; and extrapolation to bioremediation strategies.
- Bioremediation for water environment: Biochemical, molecular, and ecological foundations of bioremediation; contaminants in groundwater; in-situ and ex-situ decontamination of groundwater; selecting the bioremediation option (bioaugmentation or biostimulation); process optimization; factors affecting bioremediation; delivery systems for oxygen, nutrients, and inoculation; landfill leachate; industrial wastewater biotreatment technologies; biotreatment of surface waters; biosoption and wastewater treatment.
- Bioremediation for air environment: Air Pollution, Acid rain, Effect of Air pollution, Control measures of air pollution. Atmospheric environment for microorganisms; microbial degradation of contaminants in gas phase; biological filtration processes for decontamination of air stream (biofiltration; biotrickling filtration; bioscrubbers).
- Biotreatment of metals: Microbial transformation of metals; biological treatment technologies for metals remediation; bioleaching and biobeneficiation; bioaccumulation; oxidation/reduction processes; biological methylation.
- Bioremediation for soil environment: Environment of soil microorganisms; Soil organic matter and characteristics; Soil microorganisms' association with plants; pesticides and microorganisms; petroleum hydrocarbons and microorganisms; industrial solvents and microorganisms; biotechnologies for in-situ and ex-situ remediation of soil; phytoremediation technology for soil decontamination.
- Global application of bioremediation technologies.
- This module includes a laboratory demonstrations of the measurement of biodegradation kinetics and their analysis to select a mathematical model.
- Bioremediation Lab. Three labs (2 hr) every other week

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Biochemical Program Requirement | 3 |

Assessment Criteria

| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
|---|---|---|---|
| 20% | 10% | 0% | 70% |

| BIO224 | Biofuels(1) | 3 |
|---|---|---|
| Prerequisites | N/A | |

Number of weekly Contact Hours

| Lecture | Tutorial | Laboratory |
|---|---|---|
| 2 | 2 | 1 |

| Required SWL | 150 | Equivalent ECTS | 6 |
|---|---|---|---|

Course Content

- Renewable diesel or Sun Diesel
  - Hydro-processing of triglycerides.
  - Thermal Depolymerization of biomass.
  - Renewable diesel standard specifications
- Biomass-to-Liquid (BTL) and Fischer-Tropsche (FT)
  - FT chemistry.
  - FT reaction mechanism.
  - FT catalysts.
  - FT reactors.
  - FT products.
  - Pilot plant design and performance.
  - Fuels preparation and engine testing.
- A range of biodiesel production routes.
- Algal biodiesel.
- Kinetics of biodiesel transesterification reaction.
- Biodiesel standard specifications.
- **Biodiesel Lab. <u>six labs (1 hr) every other week</u>**
- Field visit to an industrial sector

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Biochemical Program Requirement | 2 |

Assessment Criteria

| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
|---|---|---|---|
| 20% | 10% | 0% | 70% |

| BIO314 | Biofuels (2) | 3 |
|---|---|---|
| Prerequisites | N/A | |

Number of weekly Contact Hours

| Lecture | Tutorial | Laboratory |
|---|---|---|
| 2 | 2 | 1 |

| Required SWL | 150 | Equivalent ECTS | 6 |
|---|---|---|---|

Course Content

- Biofuel context: The need for bioenergy; problem and debate on first generation biofuel production; biofuel framework and roadmap.
- Biofuel use: Electricity; heat; transport fuel.
- Bioethanol and biobutanol production from lignocellulosic wastes.
- Algal Bioethanol.
- Energy balance and thermodynamics in biomass conversion.
- Kinetics of bioethanol fermentation process.
- Bioelectrochemical systems (e.g. microbial fuel cell) for bioenergy production.
- Biojet.
- Biogas.
- The above technologies will be discussed with regard to: Application of biofuel/bioenergy, market prominence, and adaptation of the current fuel

infrastructure; biomass choice and supply; principle of conversion process; unit process, operation consideration, and conversion efficiency; co-products, their usage and disposal routes; state-of-the-art of the application of technology around the world.

- Exploring the exploitation of microalgae for waste water remediation and production of bioenergy and other valuable bio-products.
- **Bioethanol Lab. Three labs (2 hr) every other week**
- Filed visit to an industrial sector

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Biochemical Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 15% | 15% | 0% | 70% |

| BIO315 | Nanotechnology for Biochemical Systems | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Introduction to nanotechnology.
- Nanoparticles: types and properties, fullerenes, carbon nano-tubes, quantum dots, nano-core, nano-shells and nano-composites.
- **Synthesis and characterization of nanomaterials**:
- Top down and bottom up approach, physical methods, ball milling, plasma arcing, laser abalation method, chemical method, sol-gels, chemical vapour deposition, electrodeposition.
- **Biological methods of synthesis**: Use of bacteria, fungi, and algae for nanoparticle synthesi. Magnetotactic bacteria for natural synthesis of magnetic nanoparticles, and mechanism of formation. Viruses as components for the formation of nanostructured materials, synthesis process and application. Role of plants in nanoparticle synthesis.
- Need of quantum mechanics, nanobiology concepts, biological nanoobjects, ,
- **Environmental nanotechnology research**: Nanotechnology for bioremediation of Heavy metals and polluted water. Biosensor technology for monitoring pollutants.
- **General applications of bioscience and nanostructured catalyst systems** in oil and gas refining, nano-membranes, nano-separators, nano-adsorbent, corrosion inhibitors, nano-additives for clean fuel, nano-materials from petrochemicals.
- **Application of nano-biotechnology in medicine:** Biocompatible inorganic devices, implant coatings, stents, seeds, drug delivery, cancer treatment, bioconjugated silica nanoparticles for bioanalytical applications, dye doped, biofunctionalization of silica nanoparticles, cellular labeling/detection, DNA analysis, small molecules protein interactions, microarray and genome chips, nano-biosensors and nano-biochips.

| | | | |
|---|---|---|---|
| • **Green- and bio- syntheses of NPs Lab. <u>Three labs (2 hr) every other week</u>**<br>• Filed visit to a nanotechnology center (EPRI) | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Biochemical Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 15% | 15% | 0% | 70% |

| | | | |
|---|---|---|---|
| BIO323 | Biotechnology | | 3 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| • **The Definition of Biotechnology:** Introduction; Contemporary Definitions of Biotechnology; Categories of Biotechnology<br>• **Basic Science of Biotechnology:** Chemistry and Physics of Biotechnology**;** Basic Biology of Biotechnology<br>• **The Tools of Biotechnology:** Amino Acid Analyzer, Amino Acid Sequencer; Balance; Bioreactor; Blotting Apparatus; Centrifuge; Chromotography; Gytometer; DNA Sequencer;etc…<br>• **Biotechnology Innovations:** The Generation of Innocations; History of Biotechnology Innovations; Biotechnology Innovations; Production of Genetically Modified Organisms.<br>• **Principal People of Biotechnology:** Contributors to Biotechnology | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Biochemical Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| | | | |
|---|---|---|---|
| BIO324 | Bioproduct Design | | 3 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| • Introduction to Bioproduct design<br>• Visual design tools<br>• Process equipment (1) design & costing, (2) separation processes & chemical reactors, (3) heat transfer & fluid transport<br>• Capital & operating cost estimation methods | | | |

- Computational tools in Bioproduct design & costing
- Principles of flow sheet stimulation
- Physical & thermodynamic properties = VLE
- Design economic optimization

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Program Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| BIO326 | Petroleum Bioprocessing | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- **Process calculations:** Basic concepts. Fundamentals of material and energy balance for processes with/without chemical reaction. Simultaneous mass and energy balance in flow and without flow conditions.
- **Microbial nutrition:** Nutritional requirements for growth and product formation. Medium design and optimization with statistical analysis (ANOVA), Placket-Burman and Central Composite Design technique. Pre-treatment of industrial raw materials.
- **Sterilization:** Types of sterilization, thermal death kinetics of microorganism. Heat sterilization of liquid medium in batch and continuous mode. Air sterilization.
- **Bioreactor operations:** Different types of bioreactors, configuration of Bioreactors and their main components. Modes of bioreactor operation. Important bioreactor accessories.
- **Fermentation overview:** Inoculum development. Various types of Fermentation, submerged fermentation, aerobic and anaerobic fermentation. Overview of biosynthetic mechanisms. Metabolic stoichiometry. Case studies.
- **Petroleum Bioprocessing Lab. Three labs (2 hr) every other week**

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Program Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| BIO411 | Valorization of waste and biomass | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |

| | | | |
|---|---|---|---|
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- The difference between recycling, upcycling and downcycling.
- How can we reach to zero waste?

**Valorization of waste and biomass** (municipal ,wastewater, industrial ,electronic, wood and paper, bio and oil sludge, agro-industrial, construction and demolition, plastic, mining) for the production of:

- Energy and fuels such as; ethanol, hydrogen ,biogas ,biofuel ,refuse-derived Fuel/Oil (RD, RDO), and thermal processes products.
- Materials from biomass and waste:
  - Silage and animal fodder.
  - Secondary materials-(such as sorbents, enzymes, polymers, fertilizers, biocide, corrosion inhibitor, nano-materials)
  - Recycled materials
  - Construction materials

**Valorization of clean gas**

- clean gas conversion to energy
- clean gas conversion to added value products and speciality products,

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Biochemical Program Requirement | 4 |

Assessment Criteria

| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
|---|---|---|---|
| 0% | 30% | 0% | 70% |

| BIO421 | Biolubricants for Tribological Engineering and Engine Tribology | 3 |
|---|---|---|
| Prerequisites | N/A | |

Number of weekly Contact Hours

| Lecture | Tutorial | Laboratory |
|---|---|---|
| 2 | 2 | 0 |

| | | | |
|---|---|---|---|
| Required SWL | 125 | Equivalent ECTS | 5 |

Course Content

- Introduction to tribology and real surfaces fundamental concepts: major factors that affect tribological performance, Hertzian analysis of the contact of smooth surfaces, the complex nature of real rough surfaces, measurement and characterization of rough surfaces, contact between rough surfaces.
- Friction and wear of surfaces: Laws of friction, theories of friction, frictional properties of engineering materials, static and dynamic friction, stick-slip, wear mechanisms, laws of wear, analysis of wear, wear properties of engineering materials, oxides and surface films, experimental methods.
- Lubrication regimes: hydrodynamic lubrication, hydrostatic lubrication, squeeze films, elastohydrodynamic lubrication, mixed and boundary lubrication, practical application of these types of lubrication; plain bearings, rolling element bearings, gears.

- Lubricant types and lubrication: Types of lubricants (solid, liquid and gas), lubrication regimes, Stribeck curve, boundary lubrication, fluid film lubrication, the Reynolds equation, mixed lubrication, elastohydrodynamic lubrication, analysis of common bearing types.
- Biolubricants: sources, preparation, composition, properties, testing and specifications, condition monitoring, health, safety and environment.
- Advantages and disadvantages of biolubricants.
- Biodegradation of biolubricants
- The prospects of biolubricants as alternatives in automotive applications.
- Current and future status of the biolubricant market.
- Engine tribology: lubrication of components, tribological testing, advanced materials.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Program Requirement | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| BIO401 | Graduation Research Project | | 4 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 0 | 0 | 0 | |
| Required SWL | 200 | Equivalent ECTS | 8 |

Course Content

Students will be required to carry out an individual research project in biofuels, industrial biotechnology, biorefining, crop sciences, pre-treatment or life cycle analysis.
The project could be carried out either in a university laboratory or in an industry partner's lab

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Program Requirement | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Individual report | Dissertation | Oral exam | Individual presentation |
| 15% | 60% | 15% | 10% |

| BIO402 | Design Project | | 4 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 0 | 0 | 0 | |
| Required SWL | 200 | Equivalent ECTS | 8 |

Course Content

Students will be required to design of a sustainable biotechnological process.

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Biochemical Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Individual Project | Dissertation | Practical Exam | Group Presentation |
| 20% | 50% | 20% | 10% |

# Electives Course Description of Modules Delivered by the Biochemical Engineering Department to the Biochemical Engineering Program

| BIO413 | Process Design and Simulation | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |

**Course Content**

- Process Design
  - Overview: Conceptual process design. Process flowsheeting.
  - Process synthesis: Overview of a process system. Recycle structure of the flowsheet. Design of reaction and separation systems.
  - Process integration: Basic concepts of process integration for heat exchanger network design.
  - Process economic analysis: Equipment capital cost estimation. Process profitability analysis.
- Process Modelling, Simulation and Optimization
  - Modelling and simulation: Basic concepts of process modelling. General concepts of simulation. Introduction to steady and dynamic process simulation. Introduction to commercial simulation software packages (ie, Aspen HYSYS) for process flowsheeting, design and analysis.
  - Process optimisation techniques: Basic principles of optimisation. Nonlinear and linear programming. Model building in mathematical programming. Introduction to algebraic modelling languages (ie, GAMS). Presentation of a number of industrial case studies.
- **Case Studies**: A number of process simulation and optimisation case studies will be carried out using Aspen HYSYS and GAMS. Process modelling and simulation with gPROMS will be demonstrated.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Program Requirement-Elective | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| BIO422 | Process Plant Operation | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |

| Course Content |
|---|
| • Overview of process plant operations: equipment for resource recovery; raw material preparation; reactions; downstream processing; effluent control and services.<br>• Contactors: Stirred vessels (impeller design, flow patterns; flow and turbulence; power input; mixing; gas-liquid and liquid-liquid contact; non-Newtonian fluids); fluidized beds; packed beds; bubbling columns; two-phase flow; pulsed columns; rotating disc; rushton-oldshue columns.<br>• Evaporators: Design of heating calandria; climbing film; boiling heat fluxes; multiple effect; scraped film; vapour recompressions.<br>• Crystallisers: Cooling and evaporative; solubilities; primary and secondary nucleation; crystal growth; size distributions; precipitation.<br>• Dryers: Batch drying; constant and falling rates; diffusion in pores; adiabatic saturation; continuous drying; pneumatic dryers; spray dryers; evaporation from single drop; droplet trajectories; freeze dryers.<br>• Thickeners: Design of sedimentation basins; motion of particles in fluids; stoke's law; hindered settling; size of basing.<br>• Filters: Review of designs; darcy's and ruth's equations; incompressible and compressible cakes constant rate and constant pressure.<br>• Centrifugal separators: Centrifugal principles; basket; disc stack; horizontal bowl; batch and continuous operations.<br>• Effluent control: Gas absorption; packed columns; hydraulics; flooding; mass transfer; solubility; cyclones and hydrocyclones; coalescer designs for liquid-liquid separation; de-misters.<br>• Services: Simultaneous heat and mass transfer in humidification and water cooling; design of water cooling towers.<br>• Scale-up: General rules and specific procedures<br>• Distillation: Vapour-liquid equilibrium; types of distillation; distillation with reflux; distillation column design and operation.<br>• Case Study. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Program Requirement-Elective | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Individual Report | Mid-Term Exam | Group Project | Final Exam |
| 20% | 10% | 0% | 70% |

| BIO423 | Advanced Control Systems | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | Laboratory | |
| 2 | | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 | |
| Course Content | | | | |
| • System dynamics: Modelling of typical physical systems; operating point; linearization; differential equation representation. state space representation of systems; laplace transforms; transfer functions; block diagrams; SISO and | | | | |

MIMO systems; time and frequency domain responses of systems.

- Feedback control: Positive and negative feedback; stability; methods for stability analysis; closed loop performance specification; PID controllers; Ziegler-Nichols; self-tuning methods.
- Enhanced controllers: Cascade control; feedforward control; control of non-linear systems; control of systems with delay.
- Digital controllers: Effects of sampling; implementation of PID controller; stability and tuning.
- Advanced control topics: Hierarchical control; Kalman filter; system identification; model predictive control; statistical process control; the use of expert systems and neural networks in industrial control.
- Design packages for process control systems: Examples including Simulink and MATLAB.
- Case studies: Examples will be chosen from a range of industrial systems including mechanical, chemical and fluid systems.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Program Requirement-Elective | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| BIO424 | Occupational, Health, Safety Engineering and Environmental Management Systems | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

Course Content

- Introduction to management systems
  - Basic elements of health, safety and environmental management systems.
  - The main components of management systems and how they can benefit an organization.
  - The key steps in a management system certification process.
- Elements of an occupational health and safety management system
  - How a management system can benefit the organization?
  - The commitment and resources that will be need in order to successfully implement a management system.
  - How the management system can be adapted to suit the specific needs of an organization?
  - What is the OHSAS 18001?
  - How to create the procedures, policies and other related documents needed to implement an OHSMS that conforms to the 18001:2007 standard?
- Elements of an Environmental Management System (EMS)

- How to design an EMS to continually identify and control environmental hazards and decrease their associated risks at the workplace?
- What is ISO?
- What is ISO 14001:2004?
- The benefits of implementing a management system.
- How to develop an ENS that meets ISO 14001?
- What is the difference between a program and a management system?
- The plan–do–check–act or plan–do–check–adjust (PDCA) approach used in management system standards.

- Environmental auditing and the main components of the environmental auditing process.
- Methods of auditing specific environmental issues associated with the activities of an organization.
- Practical environmental auditing skills to identify and evaluate the environmental effects of an organization.
- ISO14011 for environmental auditing

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Program Requirement-Elective | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 10% | 20% | 70% |

| BIO415 | Circular Economy | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

Course Content

- Introduction to the concept of circular economy
- the practical application of sustainability principles to organizations, communities and consumers
- Theories of sustainability, resource and material flows,
- examples of existing circular economies in society,
- current developments in the field,
- factors that limit the development of circular systems
- relationship between industrial ecology, business, policy and innovation
- an understanding of the core concepts of circular economy
- supply chains and waste
- use of critical thinking in practical applications of circular economy concepts in business settings
- provide experience in the expectations of a business environment

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |

| Program Requirement-Elective | | | 4 |
|---|---|---|---|
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| BIO416 | Food Processing Equipment | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 2 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

Course Content

- Introduction to material handling and transportation - selection of material handling machines and conveyors, belt conveyor; belt conveyor idlers, idler spacing, belt tension.
- Bucket elevator: head section, boot section, elevator legs, elevator belts, buckets, drive mechanism, hp requirement.
- screw conveyor: screw conveyor details, various shapes of screw conveyor trough, capacity and horse power
- pneumatic conveyor, limitations of pneumatic conveying, chain conveyor
- pretreatment unit operations : cleaning, sorting: fixed aperture sorting
- sorting: variable aperture screens, image processing, color sorting, weight sorting and grading
- peeling, dehulling, dehusking
- mixing : introduction, agitation, agitated vessels, mixing of liquids
- forming-bread moulders, pie and biscuit formers, confectionery moulders
- equipment for size reduction: cutters & grinders, crushers, gyratory crusher, hammer mill, ball mill, tumbling mill
- separation by centrifugation and filtration
- membrane concentration
- co-efficient of external friction, co-efficient of internal friction, colour of food materials
- the need to consider hygienic design, hazards, how to approach hygienic design, hygienic design priorities, hygienic design principles, some general design pointers
- Some basic concepts of rheology, biological systems and mechanical properties, astm standard definition of terms related to mechanical properties
- Other definitions related to mechanical properties
- Physical states of a material, classical ideal materials, ideal elastic behavior (hookean body), ideal plastic behavior (st. Venant body), ideal viscous behavior (newtonian liquid(
- Rheological models, electrical equivalence of mechanical models
- Aero and hydrodynamic properties, drag coefficient and terminal velocity
- Evaporation, boiling point elevation, types of evaporators, batch type pan evaporator, natural circulation evaporators
- Rising film evaporator, falling film evaporator, rising and falling film

evaporator, forced-circulation evaporator plate evaporator
- Design of a single effect evaporator, material and energy balances, evaporator efficiency, boiling point elevation, methods of improving evaporator efficiency
- Sizing of multiple effect evaporators
- Thin layer drying, moisture content, equilibrium moisture content, hysteresis, drying curves, constant - rate period, falling - rate period
- Tray and cabinet dryer, tunnel dryer, puff-drying, fluidized - bed drying, spray drying, freeze - drying
- Introduction to heat processing - blanching, pasteurization, sterilization
- Kinetics of microbial death, decimal reduction time and thermal resistance constant, process lethality

**Practical Class Outlines**

- Determination of engineering properties of food materials
- Study of Plate type of heat exchangers used in Dairy and Food Industry
- Study of Shell and Tube type of heat exchangers used in Dairy and Food industry
- Determination of thermal conductivity of milk, solid dairy and food products
- Determination of overall heat transfer co-efficient of Shell and tube, Plate heat exchangers, Jacketed kettle used in Dairy and Food Industry - I
- Determination of overall heat transfer co-efficient of Shell and tube, Plate heat exchangers, Jacketed kettle used in Dairy and Food Industry - II
- Determination of overall heat transfer co-efficient of Shell and tube, Plate heat exchangers, Jacketed kettle used in Dairy and Food Industry - III
- Studies on heat transfer through extended surfaces
- Studies on temperature distribution and heat transfer in HTST pasteurizer
- Design problems on heat exchangers – I
- Design problems on heat exchangers - II
- Design problems on heat exchangers - III
- Determination of viscosity of different food materials
- Design problems on heat exchangers
- Study of evaporators and their material and enthalpy balances
- Study of evaporators and their material and enthalpy balances

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Program Requirement-Elective | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| BIO425 | Principles of Fermentation Technology | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

| Course Content |
|---|
| • An Introduction to Fermentation Process<br>• Microbial Growth Kinetics<br>• The Isolation Preservation and Improvement of Industrially important micro-organisms.<br>• Media for industrial fermentations<br>• Sterilization<br>• The development of Inocula for industrial fermentations<br>• Design of a Fermenter<br>• Instrumentation and control<br>• Aeration and agitation<br>• The recovery and Purification of Fermentation Products<br>• Effluent treatment<br>• Fermentation economics |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Biochemical Program Requirement-Elective | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

# 4-Modules Delivered by the Petroleum Engineering & Gas Technology Department

| | Code | Course Title | Cr & SWL | | | Contact Hours | | | | Classification | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH | ECTS | SWL | Lec | Tut | Lab | TT | UR | FR | DR | PR |
| Petroleum | 3HUM321 | Computer Applications in Petroleum | 2 | 3 | 75 | 1 | -- | 3 | 4 | X | | | |
| | 3BES423 | Safety & Environment in Petroleum Industry | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | 3BES325 | Petroleum Development Geology | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | 3BES221 | Surveying for Petroleum Engineers | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | 3BES126 | Geological Principles of Petroleum | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | X | |
| | 3BES324 | Reservoir Modelling and Simulation | 3 | 6 | 150 | 2 | -- | 3 | 5 | | | X | |
| | PET111 | Introduction to Petroleum Engineering | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | X | |
| | PET222 | Reservoir Fluid Properties | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | PET223 | Reservoir Rock Properties | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | X | |
| | PET224 | Reservoir Rock and Fluid Properties lab | 2 | 3 | 75 | 1 | -- | 3 | 4 | | | X | |
| | PET323 | Petroleum Economics and Legislation | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | X | |
| | PET311 | Petroleum and Natural Gas exploration | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | X | |
| | PET421 | Field Development and Reservoir Management | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | PET211 | Drilling Engineering 1 | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | X | |
| | PET212 | Drilling Fluids Laboratory | 2 | 4 | 100 | 1 | -- | 3 | 4 | | | X | |
| | PET313 | Reservoir Engineering I | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | PET312 | Well Logging | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | | X |
| | PET316 | Well Testing | 3 | 5 | 125 | 2 | -- | 3 | 5 | | | | X |
| | PET322 | Petroleum Production Engineering & Equipment | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | | X |
| | PET411 | Reservoir Engineering II | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | PET412 | Surface Production Facilities | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | PET413 | Enhanced Hydrocarbon Recovery | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | | X |
| | PET422 | Drilling Engineering II | 2 | 5 | 125 | 2 | 1 | -- | 3 | | | | X |
| | PET314 | Field Courses | 3 | 4 | 100 | 2 | 2 | -- | 4 | | | | X |
| | PET326 | Corrosion in Oil and Gas Industry | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | PET418 | Gas Condensate Reservoir Engineering | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | PET401 | Graduation Research Project | 4 | 8 | 200 | -- | -- | -- | -- | | | | X |
| | PET402 | Design Project | 4 | 8 | 200 | -- | -- | -- | -- | | | | X |
| | ENGG03I | Industrial Training | -- | -- | -- | -- | -- | -- | -- | | X | | |
| | ENGG07 | Industrial Training | -- | -- | -- | -- | -- | -- | -- | | X | | |
| | | | | | | | | | | | | | |
| Electives | PET424 | Rock Mechanics for Drilling and Completion | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | PET327 | Corrosion in Oil and Gas Industry | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | PET415 | Advanced Production Logging | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | PET416 | Well Intervention and Stimulation | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | PET417 | Petroleum Refining Engineering | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |
| | PET426 | Special Topics in Advanced Drilling | 3 | 5 | 125 | 2 | 2 | -- | 4 | | | | X |

# Course Description of Modules Delivered by the Petroleum Engineering and Gas Technology Department to the Petroleum Engineering and Gas Technology Program

| 3HUM321 | Computer Applications in Petroleum | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 1 | 0 | 3 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |

- Review of Computer Programming Languages.
- Petroleum Engineering Problems.
- Simulation of Drilling and Completion Processes.
- Geological/Geophysical Mapping and Data Evaluation.
- Computational Processing and Analysis of Logs.
- Reservoir Engineering Problem Including: Physical Properties of Hydrocarbon Fluids; Permeability Relationships and Liquid Saturations; Hydrocarbon In Place Calculations (Volumetric And Material Balance); Performance Prediction Decline Analysis And History Matching; Reservoir Modelling And Simulation.
- Production Engineering Problems: Computer-Assisted Well Test Analysis; Computer-Generated Pressure-Temperature Phase Diagrams; Petroleum Production Systems.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum University Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 50% | 0% | 50% | 0% |

| 3BES423 | Safety & Environment in Petroleum Industry | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

- importance of safety and environmental issues in field practice;
- fundamentals of safety measures and actions;
- safety performance and lost time incidents;
- techniques to improve safety performance;
- commitment and safety awareness;
- hazard and operability studies (HAZOP);
- the safety triangle and procedures;
- safety management systems (SMS);
- environmental Impact Assessment (EIA);
- the EIA process;
- Gas venting and planning;
- oil-in-water emissions;
- chlorofluorohydrocarbons (CFC) gases;
- Waste disposal.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 0% | 30% | 70% |

| 3BES325 | Petroleum Development Geology | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | Laboratory | |
| 2 | | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 | |

Course Content

- Introduction to petroleum development geology,
- Impact of geological factors on field development strategy,
- Identification of reservoir characteristics and seals,
- Importance of log correlation, cross section and subsurface maps in oil and gas fields development plans,
- Depositional and digenetic controls on reservoir rocks, barriers, and hydrocarbon distribution, Aquifer characterisation, distribution and mapping,
- Geologic reservoir modelling,
- Preserve estimation and evaluation,
- Geological/petro-physical studies for infill drilling and recovery enhancement,
- Assessment of case histories.
- 1 hour lab every week learning static model creation on industrial software

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |

| | | | |
|---|---|---|---|
| 0% | 30% | 0% | 70% |

| 3BES221 | Surveying for Petroleum Engineers | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Maps, charts and plans;
- Length and distance measurements;
- Levels and leveling;
- Theodolite and angular measurements;
- Total stations;
- Control surveys and reference frames;
- Tacheometry and contouring
- Area computation;
- Volume computation;
- GPS techniques;
- Hydrographic survey

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Practical assessment | Mid-Term Exam | Group project | Final Exam |
| 10% | 20% | 0% | 70% |

| 3BES126 | Geological Principles of Petroleum | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

Course Content

- fundamentals of sedimentology, and structural geology as applied to petroleum related concepts;
- the earth structure;
- the geologic time;
- origin of oil and gas;
- hydrocarbon generation and migration;
- oil and gas traps;
- reservoir rocks;
- oil and gas exploration techniques;
- cross sections and contour maps;
- Integrated data analysis and interpretation

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Petroleum Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 0% | 30% | 70% |

| 3BES324 | Reservoir Modelling and Simulation | 3 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 0 | 3 |

| Required SWL | 150 | Equivalent ECTS | 6 |
|---|---|---|---|

Course Content

- Reservoir modelling and simulation infield practice.
- Analysis of geological, geophysical and production data.
- Construction of 3-D geological models.
- Spatial analysis and geostatistics.
- Incorporation of well log and core data into geological models.
- Scaling of geological models for numerical simulation.
- Reservoir simulation and management.
- Basic input data and equations for reservoir dynamic model.
- Model and grid selection.
- Treatment of wells in simulators.
- Compositional reservoir simulator equations.
- Fractured reservoir models.
- History matching.
- Planning and executing a reservoir simulation study.

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Petroleum Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 0% | 30% | 70% |

| PET111 | Introduction to Petroleum Engineering | 2 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 1 | 0 |

| Required SWL | 100 | Equivalent ECTS | 4 |
|---|---|---|---|

Course Content

- Global occurrence of petroleum and other natural resources ;
- Basic concepts in petroleum exploration and exploitation;
- Petroleum geological aspects;
- Exploration techniques;
- Drilling engineering;

| |
|---|
| • Basics of formation evaluation<br>• Basics of reservoir engineering ;<br>• Basics of production engineering;<br>• Storage and evacuation of oil and gas;<br>• Risk assessments of oil industry |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 15% | 15% | 70% |

| PET222 | Reservoir Fluid Properties | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 1 |
| Required SWL | 150 | Equivalent ECTS | | 6 |

| Course Content |
|---|
| • Behaviour of gases;<br>• Phase behaviour of liquids;<br>• Qualitative phase behaviour of hydrocarbon systems;<br>• Quantitative phase behaviour;<br>• Reservoir fluid characteristics;<br>• Applications of reservoir fluid characteristics;<br>• Five different reservoir fluids<br>• PVT analysis and reservoir fluid study.<br>• 1 hour lab every other week using industrial PVT software |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| PET223 | Reservoir Rock Properties | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |

| Course Content |
|---|
| Rock porosity (primary, secondary, total, effective);<br>Fluid saturation; the fluid content of reservoir rocks;<br>Rock permeability (absolute, effective, relative and average permeability's for both |

| |
|---|
| Flow system (linear flow system and radial flow system in parallel and series bed Connection); application of relative permeability-saturation curve in hydrocarbon recovery<br>Capillary pressure ;( factors affecting of capillary pressure, capillary pressure in reservoir condition and application of capillary pressure)<br>Rock wettability; methods will be used to determine rock wettability<br>Pretrophysics for clean rock, Relation between porosity, permeability, tortuosity and pore radius, Kozeny equation<br>Electrical resistivity of subsurface reservoirs; Archie's Law water saturation calculation from electrical rock properties, and tortuosity determination for fully and partially saturated rocks. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| PET224 | Reservoir Rock and Fluid Properties lab | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 1 | | 0 | | 3 |
| Required SWL | 75 | Equivalent ECTS | | 3 |
| Course Content | | | | |
| The aim of this module is to: to understand the importance of the reservoir rock and fluid properties in petroleum engineering practice. Rock properties laboratory measurements will be performed to determine electrical resistivity, porosity, permeability, capillary pressure and wettability. Also, this module is to introduce students to the various properties of petroleum reservoir fluids, lab and field identification of reservoir fluids, and produce a PVT report. Petrographical studies of petroleum rocks (source, reservoir and cap rocks) | | | | |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Report | Mid-Term Exam | Group project | Final Exam |
| 50% | 0% | 50% | 0% |

| PET323 | Petroleum Economics and Legislation | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 1 | | 0 |
| Required SWL | 100 | Equivalent ECTS | | 4 |
| Course Content | | | | |

- Role of petroleum economist;
- Cash flows; discounting; profitability indicators; inflation; unit cost and tariffs; production profiles;
- Oil and gas prices;
- Technical costs;
- Contract terms and fiscal regimes;
- Risk analysis; decision making; sensitivity analysis;
- Local legislation and worldwide business operations: concessions, licenses, production, sharing contracts, joint ventures;
- International organizations: OPEC and OAPEC.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 20% | 10% | 70% |

| PET311 | Petroleum and Natural Gas exploration | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |

Course Content

Essentials of petroleum geology;
Tools and techniques for effective petroleum exploration;
Surface and subsurface geological methods;
Prospective geophysical methods: seismic, gravity and magnetic;
Data acquisition and processing;
Geophysical interpretation techniques;
Stratigraphic and structural interpretation using integrated geological/geophysical data;
Examples and case history interpretation from around the world;
Geochemical techniques in petroleum prospecting;
Geological controls of oil and gas occurrence: their impact on exploration risk and success;
Safety and environmental geophysical aspects

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 10% | 20% | 70% |

| PET421 | Field Development and Reservoir Management | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

- reservoir management: an integrated interdisciplinary team effort;
- goal setting, planning, implementing, monitoring and evaluating reservoir performance;
- field development and operating plans to optimize profitability;
- efficient monitoring of reservoir performance;
- minimizing the drilling of unnecessary wells;
- wellbore and surface production systems;
- economic impact of operating plans;
- identifying and acquiring critical data, data acquisition and analysis;
- monitoring economic recovery and maximizing capital and operating expenses;
- timing of field implementation of reservoir management plan;
- case histories and analysis;
- Responsibilities for team members.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 0% | 30% | 70% |

| PET211 | Drilling Engineering 1 | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |

- Introduction to drilling Engineering, Well types, Rig types, Basic Rig components**.**
- Rig Systems & Design; Hoisting system, Circulation system, Power System**.**
- Engineering pressures; Formation pressure, fracture pressure, overburden pressure**.**
- Prediction of abnormal pressure before, while and after drilling**.**
- Drill String Design; Drill pipe design, Drill collar design, BHA accessories, BHA design for Vertical well**.**
- Casing Design; Selection of Casing setting depth, Selection of Casing sizes and selection of casing grades**.**

- Casing design loads; Collapse, burst, tension, Bending and Shock loads, Graphical methods of casing design**.**
- Cementing; Classification, Process, Types of cementing, Equipment of cementing**.**
- Cementing Program Design; Slurry Density, Slurry yield, Thickening time, Displacement time and Job time**.**
- Well Control: BOP Equipment, Kick indications, Kick detections, well control Methods, Calculation and design of killing operation (Kill sheet**.(**
- Drill Bits; Types, Design factors; IADC Classification & Dual Grading and selection of Bit Performance**.**
- Introduction of directional drilling; Reasons of directional drilling, types of well profile, Directional drilling terminologies

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 10% | 20% | 70% |

| PET212 | Drilling Fluids Laboratory | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 1 | 0 | 3 | |
| Required SWL | 100 | Equivalent ECTS | 4 |

Course Content

- Introductions to drilling fluids; Importance, Functions, types, Selection data requirement.
- Physical &Chemical Characteristics of drilling fluid
- Drilling Fluid Additives
- Water Based Mud; types, composition, applications and Field Tests.
- Oil Based Mud; types, composition, applications and Field Tests.
- Pneumatic Mud; types, composition, applications and Field Tests.
- Well Completion & workover drilling fluid; types, compositions, selection criteria and compatibility.
- Drilling mud Program & calculations; Volume and Capacities of pit and hole; mud Weigh Up, Dilution ,Mixing Two Fluids ,System Building ,Solids Analysis
- Drilling Fluid Hydraulics; Flow regime & Reynolds number, determination of laminar or turbulent boundary, rheological models & select the best rheological model; Fractional pressure drop across the drill pipe, annulus and bit.
- Optimization of the Hydraulic of the circulation system.
- Troubleshooting of drilling problems; Lost circulation and hole cleaning.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Lab Report | Group project | Final Exam |
| 50% | 50% | 0% | 0% |

| PET313 | Reservoir Engineering I | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Review of reservoir rock and fluid properties;
- Primary recovery mechanisms (fluid and rock expansion, solution gas drive, water drive, gas-cap drive); volumetric (oil and gas in place);
- Theory and assumptions of material balance equation (MBE);
- Calculation of oil in place by material balance for under-saturated and saturated reservoirs; Production forecasting using material balance equation;
- Faults and imaginary wells;
- Aquifers and derivation of the diffusivity equation, dimensionless variables, solutions of the diffusivity equation and radius of investigation, multiple wells, line source solution, principles of superposition theory.
- Water influx; water coning;
- Introduction to Secondary and tertiary oil recovery.
- 1 hour lab every other week using industrial reserve estimation and prediction software

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab coursework | Mid-Term Exam | Group project | Final Exam |
| 0% | 30% | 0% | 70% |

| PET312 | Well Logging | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Well logging objectives;
- Invasion profile
- Passive electrical properties of earth minerals
- Self-potential log;
- Resistivity measuring tools
- Reservoir and non-reservoir discrimination

- Matrix sensitive logs
- Depth measurements. Pore hole callipers
- Porosity mineralogy logs, density, neutron, sonic, EPT
- Nuclear magnetic resonance
- Porosity determination in clean formation
- Formation resistivity factor
- Gamma ray log
- Conductivity of shales
- Mineralogy identification
- Saturation and Archie equation
- Linear movable oil plot
- Porosity – resistivity cross plots and cross plot techniques
- Permeability relationship
- Use of pressure measurements
- Computerized log evaluation and use all log measurements to estimate various rock
- Properties and initial hydrocarbon in place
- Sidewall coring
- Logging programs
- Cased hole logs
- Well correlation
- Logging interpretation using actual logs
- 1 hour lab every other week using industrial well logging software

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Program Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| PET316 | Well Testing | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | Laboratory | |
| 2 | | 0 | 3 | |
| Required SWL | 125 | Equivalent ECTS | 5 | |

Course Content

- Role of well testing in formation evaluation.
- Well test design.
- Pressure drawdown test - single rate test, skin factor, wellbore storage.
- Pressure build-up test.
- Injection and fall-off tests.
- Multi-rate tests.
- Repeat formation tester.
- Horizontal wells testing.
- Bounded reservoirs; determination of distance to no flow boundaries, reservoir limit tests and determination of average reservoir pressure.
- Type curve matching (interference test).

| |
|---|
| • Computer assisted well test analysis.<br>• 2 hours lab every week using industrial well testing software |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Program Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| PET322 | Petroleum Production Engineering & Equipment | 3 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 2 | 1 |

| Required SWL | 150 | Equivalent ECTS | 6 |
|---|---|---|---|

| Course Content |
|---|
| • Inflow performance relationships,<br>• Well completion design,<br>• Well completion fluids,<br>• Well completion tools<br>• Perforation techniques,<br>• Types of perforation guns<br>• Underbalance perforation<br>• Formation damage characteristics,<br>• Well stimulation techniques,<br>• Well deliverability,<br>• Chock bean performance,<br>• Work over operation and sand control,<br>• Artificial lift system,<br>• Wellhead equipment and flow control devices,<br>• Production packers,<br>• Gas lift equipment,<br>• Pumping systems equipments,<br>• Pumping units and prime movers for pumping,<br>• Oil and gas separators, Gas measurement and regulation,<br>• Automation of lease equipment and safety systems,<br>• Safety and environment related to production equipments and facilities<br>• 1 hour lab every other week using industrial production software |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Program Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 30% | 70% |

| PET411 | Reservoir Engineering II | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| •Properties of natural gases: typical compositions, heating values; reservoir gas volume factor, densities and gas gradient. Calculation of static bottom-hole pressure.<br>•Gas reservoirs ; material balance estimates, pressure decline curve P/Z method, material<br>•Balance equation straight line method. Reservoir size, calculation of water influx.<br>•Gas equivalent of produced condensate and water. Gas reserve estimate from volumetric and water drive reservoir<br>•Basic condensate reservoirs. Reservoir types defined with reference to phase diagrams calculation of original gas and condensate in place for volumetric reservoirs Wet Gas reservoirs.<br>•Apply decline curve analysis for oil wells.<br>•inhibitors to suppress hydrate formation;<br>•fundamentals of gas flow in porous media;<br>•Gas Well Testing. Deliverability testing of gas wells. Fundamental equation in deliverability testing, flow after flow test, isochronal testing and modified isochronal testing. Use of pseudo pressure in deliverability testing. Real gas pseudo pressure analysis, Transient testing.<br>•Problems in gas well testing liquid loading. Hydrate formation, wet gas stream.<br>•Use of computer in Gas Reserves estimation and well test analysis. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Petroleum Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 30% | 0% | 70% |

| PET412 | Surface Production Facilities | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| •techniques of oil and natural gas processing;<br>•task and responsibilities of process and facilities engineers;<br>•process design: description of wellhead fluids, products specification, process model, process flow schemes;<br>•oil processing: separation, separation design, separator types, dehydration and water treatment, de-oiling; | | | |

| |
|---|
| •upstream gas processing: pressure reduction, gas dehydration, heavy hydrocarbon removal, contaminant removal, pressure evaluation (gas compression);<br>•downstream gas processing: contaminant removal, natural gas liquid recovery, liquid natural gas or liquid petroleum gas;<br>•Facilities and production support system.<br>•safety and environment pollution aspects , production gathering stations;<br>•equations of oil and gas flow in pipes and restrictions;<br>•types of storage tanks; corrosion in tanks and preventive actions; tank grades; tank battery<br>•offshore production platforms; floating production systems (FPSO);<br>•Pipeline design and inspection; offshore loading; Distribution network and terminals.<br>•Impact of oil and gas transportation and storage on environment. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Program Requirement | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 30% | 70% |

| PET413 | Enhanced Hydrocarbon Recovery | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

| Course Content |
|---|
| •Revision of Primary recovery<br>•Secondary recovery; fractional flow and frontal advance equations,<br>•Waterflood recovery calculations in homogeneous and stratified reservoir;<br>•Factors Influencing waterflood performance,<br>•factors affecting production performance; wettability, oil and water viscosities, formation dip and Rate, Initial Gas Saturation, Stabilized and Variable Zones, Areal Sweep Efficiencies, Vertical and volumetric sweep efficiencies,<br>•fundamentals of enhanced oil recovery;<br>•Enhanced Hydrocarbon Recovery Methods;<br>•Chemical Methods ( Polymer flooding, Alkaline flooding, Surfactant flooding and Alkaline Surfactant Polymer flooding approaches, design and performance and new techniques in chemical methods;<br>•Thermal Methods ( Steam injection , cyclic steam, and in-situ-combustion and new techniques in thermal methods )<br>•Microbial Enhanced Hydrocarbon Recovery<br>•miscible displacement of CH4 by CO2 in depleted gas reservoirs;<br>•Screening and selection of EOR methods and environmental factors associated with oil recovery.<br>•Evaluating and monitoring of EOR projects, design a pilot project and example of case studies. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |

| Petroleum Program Requirement | | | 4 |
|---|---|---|---|
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Presentation | Final Exam |
| 0% | 10% | 15% | 70% |

| PET422 | Drilling Engineering II | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |

•Introduction to directional drilling; applications of directional drilling and terminologies; azimuth, inclination, Dogleg, MD.
•Deftection Tools and Techniques; Rotary assemblies; Building assembly, holding assemblies, Dropping assemblies, Whipstocks, Jet deflection, Downhole motor & bent sub and downhole motor and Rotary steerable system.
•Directional Well Planning; General considerations; Reference points and coordinates, Target zone, Formation characteristics, Deflecting tools available, Location of adjacent wellbores, Choice of build-up rate
•Types of profile; Type I (build and hold), Type II (build, hold and drop), Type III (deep kick-off and build), Horizontal wells
•Geometrical planning; Geometrical planning for Type I profile, Geometrical planning for Type II profile, Geometrical planning for Type III profile Through equations and software.
•Highly deviation and Horizontal well; applications & geometrical planning.
•Directional Surveying tools; Single shot, multi shot, MWD, LWD; Directional Survey calculations; Tangential method, Balanced tangential method, Average angle method, Radius of curvature method and Minimum curvature method.
•Directional Drilling Problems; Control over borehole trajectory, Intersections, Dog-leg severity, Torque and drag, Keyseating, Wellbore instability.
•Stuck pipe; Differential sticking, mechanical sticking, Freeing stuck pipe
•Baking-off the drill string, Parting the drill string, Fishing
•Drilling Hydraulics; annular pressure during well control operations, nonstatic well conditions, jet bit nozzle selections and rheological models

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Petroleum Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 20% | 70% |

| PET314 | Field Courses | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |

| | | | |
|---|---|---|---|
| 1 | 0 | 3 | |
| Required SWL | 100 | Equivalent ECTS | 4 |
| Course Content | | | |
| •Topographic contour map, wireframe map and 3D surface map of the area (using Surfer software);<br>•Structure contour map on the top of the reservoir;<br>•Structure contour map on the bottom of the reservoir;<br>•Isochore map;<br>•Isoporosity map;<br>•Isosaturation map<br>•Three cross sections generated from the topographic contour and the reservoir structural contour. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Petroleum Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Group Report | Mid-Term Exam | Group Project | Final Exam |
| 20% | 30% | 50% | 0% |

| | | |
|---|---|---|
| PET326 | Corrosion in Oil and Gas Industry | 3 |
| Prerequisites | N/A | |
| Number of weekly Contact Hours | | |
| Lecture | Tutorial | Laboratory |
| 2 | 2 | 0 |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | |
| •Overview of corrosion in oil and gas production;<br>•Economics of corrosion damage;<br>•Corrosion mechanism: how and why metals corrode<br>•Control methodology: inhibitors, cathodic protection, coatings and plastics, gas removal, metals (properties, cracking processes, design, and handling considerations);<br>•Specific control procedures: drilling, casing, internal subsurface, surface equipment, water injection systems, gas processing, offshore operations;<br>•Detecting and monitoring corrosion activity;<br>•Various corrosion-oriented software.<br>•Safety issues related corrosions of pipe lines | | |
| Used in Program / Level | | |
| Program Name or requirement | Study Level | |
| Petroleum Program Requirement | 3 | |
| Assessment Criteria | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 15% | 15% | 70% |

| | | |
|---|---|---|
| PET418 | Gas Condensate Reservoir Engineering | 3 |
| Prerequisites | N/A | |
| Number of weekly Contact Hours | | |
| Lecture | Tutorial | Laboratory |

| | | | |
|---|---|---|---|
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

Course Content

•Introduction
•Type of Gas Condensate Reservoirs
•Basic Definitions and Concepts
•Condensate Production Pattern in Gas Condensate Reservoirs
•Species Distribution in Gas Condensate Reservoirs
•Recovery Issues in Gas Condensate Reservoirs – Gas Recycling, Blowout, Fast Blowout,
•Specific Requirements for Compositional Modelling in Gas Condensate Reservoirs
•Well Deliverability in Gas Condensate Reservoirs – Liquid Bank Accumulation (both water
•Blocking and hydrocarbon blocking) and Vaporization around the Wellbore
•Effect on Well Deliverability
•Methods for Improving Well Deliverability in Gas-Condensate Reservoir

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Petroleum Program Requirement | 4 |

Assessment Criteria

| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
|---|---|---|---|
| 0% | 0% | 30% | 70% |

| PET401 | Graduation Research Project | 4 |
|---|---|---|
| Prerequisites | N/A | |

Number of weekly Contact Hours

| Lecture | Tutorial | Laboratory |
|---|---|---|
| 0 | 0 | 0 |

| | | | |
|---|---|---|---|
| Required SWL | 200 | Equivalent ECTS | 8 |

Course Content

Students will carry out a substantially based industrial research project on an individual basis. The topic and content will be relevant to their degree programme. The project will be supervised by an individual member of academic staff and may involve experimental test work, field work, design work and possibly work based at an industrial organisation. Each student will be responsible for the planning, execution and interpretation of their own work. Each student will present individual written reports including a project plan, an interim report at the end of the first semester and a final report at the end of the second semester together with an oral presentation.

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Petroleum Program Requirement | 4 |

Assessment Criteria

| Lab Coursework | Mid-Term Exam | Group Project | Dissertation |
|---|---|---|---|
| 0% | 0% | 0% | 100% |

| PET402 | Design Project | 4 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | | |
|---|---|---|---|
| Lecture | Tutorial | Laboratory | |
| 0 | 0 | 0 | |
| Required SWL | 200 | Equivalent ECTS | 8 |

**Course Content**

Students will work together in a team, a process plant or other industrial operation. Each project will be supervised by a member of academic staff who will act as project coordinator and will be responsible for the organization and assessment of that project. Students will meet with the coordinator on a regular basis to ensure good communications within the project; they will also attend a series of lectures and seminars dealing with relevant aspects of the planning, design and evaluation of the project. Students will be responsible for the organization and delivery of relevant aspects required in the project, as prescribed. Each individual student or team will be required to produce a project plan detailing the planning and execution of the project, an interim report covering basic aspects and relevant literature in the field, and a final report covering detailed technical, financial and environmental aspects of the project. Other reports may be required by the project coordinator. Students will also be required to make a verbal presentation on their findings at the end of the project.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Program Requirement | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Dissertation |
| 0% | 0% | 0% | 100% |

# Electives Course Description of Modules Delivered by the Petroleum Engineering and Gas Technology Department to the Petroleum Engineering and Gas Technology Program

| PET424 | Rock Mechanics for Drilling and Completion | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| •In-situ stresses and formation pressures – the basics<br>•Rock mechanical properties – what they are and how to find them<br>•Wellbore stability – fundamentals of borehole collapse and lost circulation, causes and effects, practical guidelines, software examples, case histories<br>•Bit/formation interaction – log-based methods for strength estimation<br>•Sand production and its control – theory, sanding prediction and solutions<br>•Cold heavy oil production with sand (CHOPS) – basic mechanics and practical examples<br>•Reservoir monitoring: microseismics, well logging. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Petroleum Program Requirement-Elective | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 30% | 70% |

| PET425 | Advanced Production Logging | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| •Principles of Production Logging<br>•Applications of production logging in low flow rate and high flow rate wells spinner<br>•Flow meter analysis<br>•Gradiomanometer Analysis<br>•Packer flow meter<br>•Completion Evaluation<br>•Cement Quality Logging ; Cement Bond Logging ; Ultrasonic-Pulse- Echo- Logs<br>•Noise Logging ; tools and Operations ; guidelines for running and interpretation of noise logging | | | |

| |
|---|
| •Cased-hole Formation Evaluation; Thermal Decay Time Log (TDT), Reservoir Resistivity Tool (RST)<br>•Cased Hole Formation Resistivity Tool (CHFR)<br>•Horizontal Wells Production Logging ; Flow Regime in Horizontal Wells<br>•Flo -Sac Imager (FSI) Tool ; Flow – Caliper Imaging (FCI) Tool ; Gradiomanometer Tool<br>•Cased – Hole Formation Evaluation Logs<br>•Overview of artificial lift technology<br>•Criteria for selection of artificial lift system<br>•Reservoir performance: inflow and outflow relationships<br>•Artificial lift screening<br>•Introduction to rod-pumping, gas lift, and ESP systems<br>•Rod-pump design: pumping unit, rods, pump, prime movers, gas anchor, pump-off controls<br>•Gas lift design: mandrels, valves, injection gas requirements, temperature, chokes, spacing, equilibrium curve, continuous flow design<br>•ESP design: pump performance curves, pump intake curves, typical problems, installation, troubleshooting<br>•Best practices for installation and maintenance<br>•Economic analysis |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Program Requirement-Elective | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 30% | 70% |

| PET427 | Well Intervention & Stimulation | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |

| Course Content |
|---|
| • Well intervention techniques:<br>• Coil tubing<br>• Snubbing unit<br>• Slik and E lines<br>• Formation Damage:<br>• Skin: completion and production<br>• Sources of formation damage<br>• Formation damage during workover<br>• Well inflow and stimulation<br>• Candidate stimulation selection<br>• Matrix acidizing:<br>• Selection of chemical treatment type<br>• Formation damage caused by matrix stimulation fluids<br>• Selection of matrix stimulation fluids |

| |
|---|
| • acidizing physics;<br>• matrix acidizing of sandstones;<br>• fluid placement and diversion in sandstone acidizing;<br>• matrix acidizing treatment evaluation;<br>• Hydraulic Fracturing:<br>• Fracturing stimulation treatments types<br>• Brief review of rock mechanical issues related to hydraulic fracturing<br>• Creation of a propped hydraulic fracture<br>• Optimization of hydraulic fracture dimensions<br>• Propped fracture conductivity<br>• Fracturing fluids |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Program Requirement-Elective | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 30% | 70% |

| PET428 | Petroleum Refining Engineering | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 125 | Equivalent ECTS | | 5 |

| Course Content |
|---|
| Crude oil fractionation, Details of design of Atmospheric and Vacuum distillation Columns, Basic petroleum fractions from AD/AV complex, Refinery Gases, Gasoline Specifications & use in Internal Combustion Engines, ignition quality of gasoline, Pre-ignition and Detonation, Mechanism of Detonation, Naphtha Specification and uses, Aviation Turbine Fuel, Kerosene specifications (uses & production of Linear Alkyl Benzene LAB), Gas Oil and Diesel Fuel, Fuel oil and Asphalt specifications & uses, Wax distillates production, Manufacture of lubricating oils, Theory of friction and Lubrication, Manufacture of grease, Complex refinery schemes for processing of Natural Gas and crude oil, dehydration, desulphurization, Cracking & reforming Operations. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Petroleum Program Requirement-Elective | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 30% | 70% |

| PET429 | Special Topics in Advanced Drilling | 3 |
|---|---|---|
| Prerequisites | N/A | |
| Number of weekly Contact Hours | | |

| Lecture | Tutorial | Laboratory |
|---|---|---|
| 2 | 2 | 0 |

| Required SWL | 125 | Equivalent ECTS | 5 |
|---|---|---|---|

Course Content

- High Pressure / High Temperature wells Techniques and Equipment
- Deepwater Techniques and considerations
- Underbalanced Drilling
- Through tubing rotary drilling
- Managed pressure drilling
- Advanced well control equipment for offshore drilling.
- Casing while drilling; vertical and directional wells
- Extended Reach, Multilateral and Designer Design considerations

Technology

- Workover, Intervention and Well Management Techniques .
- QRA based well programming.
- New Techniques in drilling operations.
- Factors affecting rate of penetration.

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Petroleum Program Requirement-Elective | 4 |

Assessment Criteria

| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
|---|---|---|---|
| 0% | 0% | 30% | 70% |

| PET426 | Reservoir Stimulation | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |

Number of weekly Contact Hours

| Lecture | Tutorial | Laboratory |
|---|---|---|
| 2 | 2 | 0 |

| Required SWL | 125 | Equivalent ECTS | 5 |
|---|---|---|---|

Course Content

- justification of stimulation treatments.
- elements of rock mechanics.
- modelling of hydraulic fractures.
- fracturing fluid chemistry.
- fracturing fluid propant and Characterization.
- Pre-treatment data requirements.
- pressure analysis during fracturing.
- design of propped fracture treatments.
- considerations in fracture design.
- fracture-height predictions and post-treatment measurements.
- post-treatment evaluation and fractured well performance.
- nature of formation damage.
- acidizing physics.
- matrix acidizing of sandstones.
- fluid placement and diversion in sandstone acidizing.
- matrix acidizing treatment evaluation.
- principles of acid fracturing.
- Selected field examples.

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Petroleum Program Requirement-Elective | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 0% | 30% | 70% |

# 5-Modules Delivered by the Environmental Sustainable Architecture Engineering Department

| | Code | Course Title | Cr & SWL | | | Contact Hours | | | | Classification | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH | ECTS | SWL | Lec | Tut | Lab | TT | UR | FR | DR | PR |
| Environmental Sustainable Architecture | 4HUM215 | Building Regulations and Rating Systems | 3 | 6 | 150 | 2 | 2 | 1 | 5 | X | | | |
| | 4HUM324 | Sustainable Project Management and Costing | 3 | 5 | 125 | 2 | 2 | -- | 4 | X | | | |
| | 4BES111 | Introduction to Environmental and Sustainable Design | 3 | 5 | 125 | 2 | -- | 3 | 5 | | | X | |
| | 4BES112 | Sustainable Construction Technologies and Materials (1) | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | X | |
| | 4BES113 | Architecture Surveying and Drawing | 3 | 6 | 150 | 2 | -- | 3 | 5 | | | X | |
| | 4BES114 | Visual Design and Graphics (1) | 3 | 6 | 150 | 2 | -- | 3 | 5 | | | X | |
| | 4BES122 | Sustainable Construction Technologies and Materials (2) | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | 4BES123 | Visual Design and Graphics (2) | 3 | 5 | 125 | 2 | -- | 3 | 5 | | | X | |
| | 4BES212 | Sustainable Construction Technologies and Materials (3) | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | 4BES224 | Air-Conditioning and Heat Pump Engineering | 3 | 5 | 125 | 2 | -- | 3 | 5 | | | X | |
| | 4BES312 | Building Information Modelling | 3 | 6 | 150 | 3 | -- | 3 | 6 | | | X | |
| | 4BES313 | Design of Elements | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | X | |
| | 4BES322 | Modelling and Simulation for Sustainable Architecture | 3 | 6 | 150 | 2 | -- | 3 | 5 | | | X | |
| | 4BES323 | Integrated Building Design | 2 | 4 | 100 | 1 | -- | 3 | 4 | | | X | |
| | ESA121 | Architecture Design, History & Theory (1) | 5 | 9 | 225 | 4 | -- | 3 | 7 | | | X | |
| | ESA213 | Environmental Control Systems (1) | 2 | 3 | 75 | 2 | 1 | -- | 3 | | | X | |
| | ESA222 | Urban and Landscape Design, History & Theory | 3 | 6 | 150 | 2 | -- | 3 | 5 | | | X | |
| | ESA314 | Daylighting | 3 | 5 | 125 | 2 | -- | 3 | 5 | | | X | |
| | ESA211 | Eco Design, History & Theory (2) | 5 | 9 | 225 | 4 | -- | 3 | 7 | | | | X |
| | ESA221 | Eco Design for Occupant Wellbeing (3) | 5 | 9 | 225 | 4 | -- | 3 | 7 | | | | X |
| | ESA311 | Eco Design for Zero Energy and Passive Buildings (4) | 5 | 9 | 225 | 3 | 2 | 3 | 8 | | | | X |
| | ESA321 | Eco Design with Water and Waste for Sustainability (5) | 5 | 9 | 225 | 3 | 2 | 3 | 8 | | | | X |
| | ESA223 | Environmental Control Systems (2) | 2 | 4 | 100 | 2 | 1 | -- | 3 | | | | X |
| | ENGG03I | Industrial Training | -- | -- | -- | -- | -- | -- | -- | | X | | |
| | ENGG07 | Industrial Training | -- | -- | -- | -- | -- | -- | -- | | X | | |
| | ESA401 | Graduation Research Project | 4 | 8 | 200 | -- | -- | -- | -- | | | | X |
| | ESA402 | Graduation Design Project | 9 | 16 | 400 | -- | -- | -- | -- | | | | X |
| | | | | | | | | | | | | | |
| Electives | ESA301 | Urban Planning, History & Theory | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA302 | Structures and Design (1) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA303 | Forensic Engineering | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA304 | Electrical services in buildings | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA305 | Environmental Interior Design & Refurbishment (1) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA306 | Sustainable Landscapes (1) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA307 | Life Cycle and Supply Chain Environmental Assessment | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA308 | Introduction to Renewable Energy Systems | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA309 | Water and Waste Management | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA403 | Sustainable Advanced Construction Technologies and Materials (4) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA404 | Sustainable Advanced Construction Technologies and Materials (5) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA405 | Structures and Design (2) | 3 | 6 | 150 | 2 | 2 | 1 | 5 | | | X | |
| | ESA406 | Structures and Design (3) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA407 | Power Systems and Design(1) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA408 | Power Systems and Design(2) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA409 | Energy Systems(1) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA4010 | Energy Systems(2) | 3 | 6 | 150 | 2 | 2 | -- | 4 | | | X | |
| | ESA4011 | Architectural design and technology | 5 | 9 | 225 | 2 | 2 | 6 | 10 | | | | X |
| | ESA4012 | Electrical Installation Equipment & Lighting | 5 | 9 | 225 | 3 | 2 | 3 | 8 | | | | X |
| | ESA4013 | Heat Transfer in Building Services Engineering | 5 | 9 | 225 | 3 | 2 | 3 | 8 | | | | X |
| | ESA4014 | Geotechnical design | 5 | 9 | 225 | 3 | 2 | 3 | 8 | | | | X |
| | ESA4015 | Energy management and controls | 5 | 9 | 225 | 3 | 4 | -- | 7 | | | | X |
| | ESA4016 | Advanced Eco Design and Visualization (6) | 5 | 9 | 225 | 3 | -- | 6 | 9 | | | | X |
| | ESA4017 | Specialized Eco Design and Visualization (7) | 5 | 9 | 225 | 2 | 2 | 6 | 10 | | | | X |

# Course Description of Modules Delivered by the Environmental Sustainable Architecture Department

| 4HUM215 | Building Regulations and Rating Systems | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

**Course Content**

- Introduction to property and urban laws in Egypt and UK;
- Urban strategies, policies, programs, and planning approaches;
- Land management, types, and infrastructure facilities;
- Introduction to standard forms of contract and ownership key challenges;
- Strategic urban plans for small and large cities in Egypt;
- Strategic development plans for greater Cairo region, etc;
- Achieving sustainable urban development priorities;
- Central institutions relevant to urban planning and affiliates in Egypt and UK;
- Institutions and regional and local administrative involved in land management in Egypt and UK;
- Egyptian building law;
- High-Performance Green Building (green technology, processes and principles);
- Green Pyramid Rating System and International Green Construction Code;
- Sustainable Design Certificate Program (LEED);
- Ecological design practices and rating systems worldwide and locally;
- Sustainable building materials and practices, Low carbon buildings,
- Economy of resources and life cycle design;

Water and waste management and engineering.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental University Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| 4HUM324 | Sustainable Project Management and Costing | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

| Course Content |
|---|
| • Preparing project bids and proposals<br>• Negotiating contracts<br>• Project planning and initiation<br>• Scheduling construction<br>• Estimating, budgeting and cost control<br>• Project organization and control<br>• Construction project execution<br>• BIM and electronic information exchange<br>• Green building and sustainable construction<br>• Life cycle and supply chain sustainability assessment<br>• Managing human factors |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental University Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| 4BES111 | Introduction to Environmental and Sustainable Design | 3 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 0 | 3 |

| Required SWL | 125 | Equivalent ECTS | 5 |
|---|---|---|---|

| Course Content |
|---|
| • Inspire critical awareness of environmental and sustainable architecture, smart city, its concepts, language and representation.<br>• Introduction to climate, units of heat and energy; temperature, sensible and latent heat capacity.<br>• Introduction to the principles of sustainability.<br>• Economy of Resources Principle: Energy Conservation; Water Conservation; Materials Conservation.<br>• Life Cycle Design Principle: Pre-Building Phase; Building Phase; Post-Building Phase.<br>• Humane Design Principle: Preservation for Natural Conditions; Urban Design and Site Planning; Design for Human Comfort (thermal, visual and acoustics comfort). |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 20% | 0% | 20% | 60% |

| 4BES112 | Sustainable Construction Technologies and Materials (1) | 2 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 1 | 0 |

| Required SWL | 100 | Equivalent ECTS | 4 |
|---|---|---|---|

Course Content

- Introduction to common construction materials (e.g. natural stones, bricks, blocks, timber, gypsum, concrete constituent materials, reinforcing steel, etc) and their properties, testing and applications;
- Historical overview of traditional construction methods and sequences;
- Basic building elements: foundations, walls, columns, girders, slabs, openings, floors, roofs, stairs and lifts, finishing work, and building services;
- Interior & exterior enclosure systems;
- Types of structural systems of low-rise buildings;
- Construction types, procedures, and techniques of low-rise buildings;
- Construction procedures and elements of masonry and timber structures;
- Health and safety procedures in construction sites.

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Environmental Discipline Requirement | 1 |

Assessment Criteria

| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
|---|---|---|---|
| 0% | 30% | 0% | 60% |

| 4BES113 | Architecture Surveying and Drawing | 3 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 0 | 3 |

| Required SWL | 150 | Equivalent ECTS | 6 |
|---|---|---|---|

Course Content

- Maps and plans;
- Linear, area, and volume measurements and calculation;
- Levels, levelling and adjustment of level loops;
- Detailed survey;
- Architectural drawing tools and materials;
- Principle methods of architectural drawing and representation: orthographic (plan, elevation, section, layout), isometrics and axonometric;
- Human scale, architectural standards and zoning codes;
- Integrated design and representation of a simple architectural design.

Used in Program / Level

| Program Name or requirement | Study Level |
|---|---|
| Environmental Discipline Requirement | 1 |

Assessment Criteria

| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 20% | 20% | 0% | 60% |

| | | | |
|---|---|---|---|
| 4BES114 | Visual Design and Graphics(1) | | 3 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 3 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

- The language inherent in the four disciplines of: art production, art history, art criticism, and aesthetics;
- Colour theory and movement, and their application in Architectural Design;
- Observations and drawing of architectural elements and landscapes: line and shape, contour, positive and negative shapes and projections;
- Tone, texture and colour: colour, tone, scale, form, light and texture;
- Form and architecture: layering, volume, proportion and area;
- Space and depth: pictorial space, composition and multi-view drawing;
- Raster graphics editor (Photoshop): draw lines with simulated brushes, fill a region with colors/textures, select a color using different color models, remove imperfections, use layers, apply filters, convert between various image formats.

| | |
|---|---|
| Used in Program / Level | |
| Program Name or requirement | Study Level |
| Environmental Discipline Requirement | 1 |

| | | | |
|---|---|---|---|
| Assessment Criteria | | | |
| Course Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 40% | 0% | 0% | 60% |

| | | | |
|---|---|---|---|
| 4BES122 | Sustainable Construction Technologies and Materials(2) | | 3 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

- Green buildings materials and finishing materials properties and economics;
- Types of structural and roofing systems of medium-rise buildings;
- Doors, windows and finishing: types, construction techniques and schedules;
- Plumbing, HVAC, fire fighting, and electrical systems;
- Water effect on materials, insulation and water proofing;
- Construction types and techniques of medium-rise buildings;
- Construction procedure & elements of reinforced concrete and green buildings;
- Working drawings of concrete structures and building services;
- Health and safety procedures in construction sites.

| | |
|---|---|
| Used in Program / Level | |
| Program Name or requirement | Study Level |

| | |
|---|---|
| Environmental Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 20% | 30% | 0% | 50% |

| 4BES123 | Visual Design and Graphics(2) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 3 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

Course Content

- Shade and Shadow principles;
- Applying perspective drawing;
- Applying different architectural representation techniques;
- Architectural representation using experimental media;
- 3D CAD Modelling theory (AutoCAD/Sketchup): Digital Architecture; three-dimensional coordinates; wire frame; user coordinate system (UCS); model space view ports; 3D surface modelling techniques; solid model construction and features; editing three-dimensional objects; presentation graphics and rendering; CAD and the Internet; model space and paper space plotting.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Course Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 40% | 0% | 0% | 60% |

| 4BES212 | Sustainable Construction Technologies and Materials (3) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |

Course Content

- Design parameters, construction methods and management implications of environmental sustainable buildings;
- Types of structural systems of high-rise and long-span buildings;
- Construction types and techniques of high-rise and long-span buildings;
- Construction procedure and elements of steel and precast framed buildings;
- Movement, tolerances and fit: manufacturing, positioning and tolerances;
- Choice of appropriate frames, service and access cores;
- Working drawings of steel and precast framed structures;
- Sections & Elevations (including external and internal finishing materials);
- Life cycle and supply chain environmental assessment;
- Health and safety procedures in construction sites.

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement | | 2 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 20% | 0% | 30% | 50% |

| 4BES224 | Air-Conditioning and Heat Pump Engineering | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 3 | |
| Required SWL | 125 | Equivalent ECTS | 5 |
| Course Content | | | |
| •Fundamentals of HVAC systems in architecture, and practice the schematic design of such systems.<br>• Refrigeration cycle analysis, refrigerants, criteria for equipment design and selection, cold stores, cryogenics and liquefaction of gases;<br>•Analysis and selection of air conditioning systems (including renewable A/C systems), psychrometric processes, and performance;<br>•Heating and cooling load estimates;<br>•Analysis and design of heating and cooling systems for residential and industrial applications, design calculations are conducted for sizing of some components.<br>• Environmental implications in the use/design of HVAC systems. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement | | 2 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 15% | 25% | 0% | 60% |

| 4BES312 | Building Information Modelling | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 3 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| •Evolution of architectural representation: from CAD to BIM platform;<br>•BIM, definition and terms;<br>•BIM tools in design, parametric modeling, attribute and relationships;<br>•Design and construction process for BIM and interoperability;<br>•BIM strategies: the building project execution plan;<br>•Team working strategies and multidisciplinary collaboration;<br>•Theory and practical topics with Autodesk Revit;<br>•Introduction to Autodesk Revit: Definitions and terms – main interface, drawings and modify tools in Revit, import, main architectural elements, main structural elements, | | | |

| |
|---|
| advanced architectural and structural elements, parametric family component, controlling graphics of the elements, collaboration tools, documentations, rendering and quantity takeoff, export and printing.<br>•Producing a full set of Architectural working drawings of a structure using Revit for a given (preliminary design) project, including plans, sections, elevations, details, openings, fenestration, partitions, fixed furniture. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Individual Project | Final Exam |
| 20% | 0% | 30% | 50% |

| 4BES313 | Design of Elements | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 1 | | 0 |
| Required SWL | 100 | Equivalent ECTS | | 4 |
| Course Content | | | | |
| • Design principles of the design of concrete and steel structures;<br>• Design loads and load distribution, and statistically determined structures;<br>• Reinforced Concrete: fundamentals of reinforced concrete structures, analysis and design of sections subjected to bending, reinforcement details of beams, solid slabs, columns, stairs, ribbed and hollow slabs, paneled beam slabs, connections of precast concrete structural elements;<br>• Steel Structure: design of members subjected to axial forces, flexural or shear, design bolted and welded connections, details of connections. | | | | |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| 4BES322 | Modelling and Simulation for Sustainable Architecture | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 0 | | 3 |
| Required SWL | 150 | Equivalent ECTS | | 6 |
| Course Content | | | | |
| • Introduction of the role of modelling and simulation to study sustainable architecture: governing equations; formulation, discretization, loads, boundary and initial conditions, limitations/capabilities, and computational errors;<br>• Introduction of state-of-the-art computer simulation methods for ventilation (CFD), thermal/energy/renewable energy analysis, and daylighting; | | | | |

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|---|
| • Hands-on practical problems on real-life case studies using commercial software. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 50% | 0% | 50% | 0% |

| 4BES323 | Integrated Building Design | | | 2 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 1 | | 0 | | 3 |
| Required SWL | 100 | Equivalent ECTS | | 4 |

| Course Content |
|---|
| • Develop a fully integrated concept design for a building, starting from the briefing and master planning stage;<br>• Selected elements of the concept design will be developed to detailed design, including: choice of appropriate materials, buildings services, partition systems, raised floors and suspended ceiling, fittings, finishes, etc;<br>• The work will be carried out within the framework of BIM;<br>• Students will work on a project to focus on producing a full set of working and selective workshop drawings for technical building system details. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Individual Project | Final Exam |
| 20% | 0% | 30% | 50% |

| ESA121 | Architecture Design, History & Theory(1) | | | 5 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 4 | | 0 | | 3 |
| Required SWL | 225 | Equivalent ECTS | | 9 |

| Course Content |
|---|
| •Introduction to the theories of architecture, with emphasis on significant developments in the ancient Egyptian, classical, byzantine, medieval periods (the key spatial, functional and aesthetic elements of the built form);<br>•Theory of architecture: design methodology and strategic thinking;<br>•Architectural design elements: openings, entrances, horizontal & vertical circulation systems, services and space requirements for building's functions;<br>•How to develop design concepts and to select a suitable approach in solving design problems and overcoming constrains; |

| |
|---|
| •Design studio introduces students to percept and taste the effect of an architectural space, and develops the ability to prepare a design brief, design simple spaces and compositions; taking into consideration styles, methods of architectural representation in simple designs e.g. small residential units; |
| Used in Program / Level |

| Program Name or requirement | Study Level |
|---|---|
| Environmental Discipline Requirement | 1 |

| Assessment Criteria | | | |
|---|---|---|---|
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 10% | 10% | 30% | 50% |

| ESA213 | Environmental Control Systems (1) | | 2 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 1 | 0 | |
| Required SWL | 75 | Equivalent ECTS | 3 |
| Course Content | | | |
| •Climatic classifications: Examples of Egypt and UK's climate;<br>•Climatic control, thermal performance, energy conscious design, and their relation to architectural features (windows, doors, materials, etc);<br>•The influence of energy source, climate, heating, cooling, lighting, acoustics, and water and waste systems on design of buildings and sites;<br>•Environmental indicators and thermal comfort criteria and indices;<br>•Natural ventilation and air flow inside and around buildings;<br>•Heat transfer, storage and insulation;<br>•Mechanical means to manipulate thermal environment;<br>•Natural lighting, luminance design, artificial lighting mechanisms, and energy;<br>•Computer aided design and applications. | | | |
| Used in Program / Level | | | |

| Program Name or requirement | Study Level |
|---|---|
| Environmental Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| ESA222 | Urban and Landscape Design, History & Theory | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 3 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

- Introduction to urban, landscape, and housing area design;
- History and development of urban form and influence of religion, culture, socio-economic and technical aspects;
- Aesthetic, functional, environmental and economic factors of urban design;
- Introduction to site planning and design principles, elements, and processes;
- Image of place; Urban Character; Urban fabric; Urban spaces;
- Theories of urban and landscape design, including: walkable and new urbanism;
- Analytic methods in Urban design, developing and evaluation;
- Law and the Quality of Urban Life;
- Design Studio will focus on developing, upgrading, conservation and/or contextual design of an existing or new area/community, including a scheme design.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Discipline Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 10% | 10% | 30% | 50% |

| ESA314 | Daylighting | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 0 | 3 | |
| Required SWL | 125 | Equivalent ECTS | 5 |

Course Content

•Introduction to daylighting: maximizing daylight use versus electric light;
•The Source: daylight availability in Egypt and UK, where is the sun?
•The sensor: human eye, circadian effects, visual comfort and occupant behavior;
•High dynamic range imaging and glare analysis: Photometry & HDR workshop;
•Designing with the sun: daylighting control methods and techniques, physical model building, daylight simulations, envelope design;
•Electric lighting and integrating electric lighting & energy;
•Case studies and prediction techniques.

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Discipline Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 20% | 20% | 0% | 60% |

| ESA211 | Eco Design, History & Theory(2) | | 5 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 4 | 0 | 3 | |

| Required SWL | 225 | Equivalent ECTS | 9 |
|---|---|---|---|
| Course Content | | | |
| •Introduction to the contribution of architectural theory to an understanding of the phenomenon and practice of sustainability and environmental design throughout history with emphasis on significant developments in Islamic Architecture (ventilation, lighting, functionality, etc);<br>•Urban planning origins in Islamic urbanization and industrial revolution impact;<br>•Basic principles of Landscape Architecture and elements: Topography, pavement, plants, structures, water and walls;<br>•Vocabulary, elements of landscape, and building types in Islamic architecture;<br>•Design studio focuses on the design of sustainable and environmental friendly repetitive buildings in a differentiated context, taking into consideration internal and external space studies. Provision for natural lighting and ventilation.<br>•Examples to projects are schools, tourist recreational villages, retail parks etc. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Program Requirement | | 2 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Individual Project | Final Exam |
| 10% | 10% | 30% | 50% |

| ESA221 | Eco Design for Occupant Wellbeing(3) | | 5 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 4 | 0 | 3 | |
| Required SWL | 225 | Equivalent ECTS | 9 |
| Course Content | | | |
| •Overview on architectural links between East and West, Renaissance in Europe, and the industrial revolution;<br>•Introduction to the contribution of modern and post-modern International schools of architecture, including Space and Digital Architecture, Green Architecture, and Environmental Sustainable Architecture;<br>•Work of architectural pioneers of the 20th century architecture, as: Frank Lloyd Wright (organic architecture), Jacques Germaine Soufflet (neoclassicism), Gustave Effiel (pioneer of steel structures), Robert Maillart, (pioneer of concrete structures), William Le Baron Jenney (Chicago school of architecture), Mies van der Rohe (2nd Chicago school of architecture), Norman Foster (Hi-Tech architecture), Vladimir Tatlin (Russian constructivists), Hassan Fathy (architecture for the poors), Sim Van der Ryn (sustainable architecture);<br>•Design process: briefing and feasibility, site analysis, developing and evolving concept designs;<br>•How do designers think using precedent and design information?;<br>•Design studio focuses on the design of buildings in a differentiated context (such as dense urban fabric) to improve the occupant's wellbeing through enhancing accessibility and interaction with light, colour, sound, temperature and humidity, toxins and contaminants, plants and nature, and food and water;<br>•Examples to projects are High-rise and/or Hi-Tech Buildings. | | | |

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Environmental Program Requirement | | 2 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Project | Final Exam |
| 40% | 20% | 40% | 0% |

| ESA311 | Eco Design for Zero Energy and Passive Buildings(4) | | 5 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 3 | 2 | 3 | |
| Required SWL | 225 | Equivalent ECTS | 9 |
| Course Content | | | |

- Introduction to zero energy and passive buildings;
- History, future, characteristics, and technologies of Zero energy and passive buildings including energy dynamics and renewable system fundamentals;
- Energy economics, energy budgets, and site and source energy;
- Relevant policy, codes, financing, and incentive structures;
- State of practice in zero energy design and construction, for both residential scale and commercial/institutional scale;
- Case studies to demonstrate feasibility, key concepts, and lessons learned;
- Benefits and challenges zero energy imposes on the energy grid including advancing security and resilience;
- Design studio provides a comprehensive exploration of zero energy and passive buildings, including the design of large-span buildings, in a differentiated context such as dense urban fabric with complicated functional requirements, such as airports, theatres, conference centres, health/multi-use complexes, etc.

| Used in Program / Level | | | |
|---|---|---|---|
| Program Name or requirement | | Study Level | |
| Environmental Program Requirement | | 3 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Project | Final Exam |
| 40% | 20% | 40% | 0% |

| ESA321 | Eco Design with Water for Sustainability(5) | | 5 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 3 | 2 | 3 | |
| Required SWL | 225 | Equivalent ECTS | 9 |
| Course Content | | | |

•Understanding of water and its impact on landscape architecture, architecture, and planning;
•Protecting, improving, restoring, and sustaining water and other resources;
•Design methodology, techniques, and technologies for projects involving a wide range of interactions with water including coastlines, inland rivers, and lakes;

| |
|---|
| •Impact of ongoing global climate changes, urbanization, and the use of water for energy and food production;<br>•Watershed delineation, and stormwater best-management-practices/low-impact design (LID);<br>•Hydrologic estimation of runoff and groundwater infiltration and flow;<br>•Case studies and fieldtrips of urban in the context of five primary research areas: 1) Nile River and barrages, 2) Mediterranean coastlines and Northern Lakes, 3) Red Sea coastlines, 4) Western Desert (groundwater), 5) UK coastlines;<br>•Design Studio addresses these focus areas' design challenges, social issues, permitting, and the implementation process. Students will come away with a better understanding of how projects go from conceptual design to a constructed site, including: planning requirements, permissions, regulations, procurement, relationships, sustainability, innovation, role of architects, role of engineering designers, design Plans. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Program Requirement | 3 |

| Assessment Criteria | | | |
|---|---|---|---|
| Coursework Portfolio | Mid-Term Exam | Project | Final Exam |
| 40% | 20% | 40% | 0% |

| ESA223 | Environmental Control Systems(2) | 2 |
|---|---|---|
| Prerequisites | N/A | |

| Number of weekly Contact Hours | | |
|---|---|---|
| Lecture | Tutorial | Laboratory |
| 2 | 1 | 0 |

| Required SWL | 100 | Equivalent ECTS | 4 |
|---|---|---|---|

| Course Content |
|---|
| •Implications of acoustics, water and waste for architectural design;<br>•Comfort and noise indices;<br>•Nature of Acoustics, weighted pressure levels, sound analysis;<br>•Acoustics design and noise control;<br>•Introduction to water and waste management and engineering;<br>•Hydraulic Services: hot and cold water services, solar heating and cooling, water desalination and pumping;<br>•Sanitation Services: function and operation, fluid flow in waste systems, types of systems, soil pipes, discharge stacks, water treatment and reuse;<br>•Other Services: electrical supply, acoustics and distribution; gas supply; firefighting; and solid waste sorting/disposal/recycling/reuse;<br>•Costs, maintenance, and integrated building design. |

| Used in Program / Level | |
|---|---|
| Program Name or requirement | Study Level |
| Environmental Program Requirement | 2 |

| Assessment Criteria | | | |
|---|---|---|---|
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| ESA401 | Graduation Research Project | | 4 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 0 | 0 | 0 | |
| Required SWL | 200 | Equivalent ECTS | 8 |
| Course Content | | | |
| As defined by an agreed Project Definition Document, and reflecting knowledge gained in the previous two academic years of the BSc programme. The topic of choice for the research dissertation could be in any area that is related to architectural studies that may include theory of architecture, sustainability in architecture, urban design, Architectural design principles, as well as management. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Individual report | Dissertation | Oral exam | Individual presentation |
| 15% | 60% | 15% | 10% |

| ESA402 | Design Project | | 9 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 0 | 0 | 0 | |
| Required SWL | 400 | Equivalent ECTS | 16 |
| Course Content | | | |
| This will be specified by the project supervisor. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Program Requirement | | 4 | |
| Assessment Criteria | | | |
| Individual Project | Dissertation | Practical Exam | Group Presentation |
| 20% | 50% | 20% | 10% |

# Electives Course Description of Modules Delivered by the Environmental Sustainable Architecture Department

| ESA301 | Urban Planning, History & Theory | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| •History of urban settlements;<br>•Types of urban form and fabric;<br>•Quality of urban life;<br>•Theories of urban planning and planning Law;<br>•Tools for quantitative and qualitative urban analysis and fieldwork (mapping, surveys and data collection);<br>•Urban planning principles and their applications;<br>•Application through group urban planning studio. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 3 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 20% | 0% | 20% | 60% |

| ESA302 | Structures and Design (1) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| This module will further develop the analysis of determinate and indeterminate beams and frames. The student will study stress analysis including complex stress and will be introduced to structural analysis and design software. Use simple 3D models of buildings to learn load take-down | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| ESA303 | Forensic Engineering | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| Use of case studies to develop the principles of failures on the evolution of professional practice. Give an understanding of holistic design applications, conservation, and the role of regulations, develop observational, deductive, creative and communication skills. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| ESA304 | Electrical services in buildings | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| This module is divided into two major parts: the first part will deal with intermediate circuit theory and analysis, while the second part will study electrical installation and services in buildings | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 3 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| ESA305 | Environmental Interior Design & Refurbishment (1) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| •An introduction to the theories of interior design in architecture, with emphasis on significant developments in the modern and post-modern periods;<br>•Interior design elements: floors, walls, ceilings, columns, entrances, water features, colour techniques, interior-scape, furniture, curtains and sculpture;<br>•Principles of interior lighting design; | | | |

| | | | |
|---|---|---|---|
| •Application through individual design project | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 3 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 20% | 0% | 20% | 60% |

| | | | |
|---|---|---|---|
| ESA306 | Sustainable Landscapes (1) | | 3 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| •Site preparation; cut-fill estimation; construction machinery, Grading techniques;<br>•Hard-scape, soft-scape, and energy-scape elements and their construction;<br>•Construction of retaining walls, play courts, amenity gardens;<br>•Water features and their electro-mechanical work of fountains, cascades, swimming pools and ponds;<br>•Life cycle and supply chain environmental assessment;<br>•Integrating renewable energy and water/resource reuse in sustainable landscape;<br>•Costing and preparation of B.O.Q;<br>•Application through individual design project.. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 3 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 20% | 0% | 20% | 60% |

| | | | |
|---|---|---|---|
| ESA307 | Life Cycle and Supply Chain Environmental Assessment | | 3 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| •Introduction to life cycle assessment (LCA), which involves systems analysis of the full range of environmental impacts, product life cycles, and supply chains;<br>•Hands-on, in-depth understanding of LCA frameworks, principles, tools, and applications of life cycle assessment;<br>•Professional software tools and databases that address both social and environmental impacts in global supply chains;<br>•State of life cycle practice and current initiatives; | | | |
| Used in Program / Level | | | |

| Program Name or requirement | | | Study Level |
|---|---|---|---|
| Environmental Discipline Requirement Electives | | | 3 |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| ESA308 | Introduction to Renewable Energy Systems | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 150 | Equivalent ECTS | | 6 |
| Course Content | | | | |
| •The basics of electricity, power and energy, and relate that knowledge to both passive and active solar energy strategies and other renewable energy systems;<br>•Topics such as passive solar heating, photovoltaics, solar water heating and co-generation are examined, as well as costs and economic analysis;<br>•Design of hybrid (renewable) energy systems and smart grids. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Environmental Discipline Requirement Electives | | | 3 | |
| Assessment Criteria | | | | |
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam | |
| 0% | 20% | 20% | 60% | |

| ESA309 | Water and Waste Management | | | 3 |
|---|---|---|---|---|
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 0 |
| Required SWL | 150 | Equivalent ECTS | | 6 |
| Course Content | | | | |
| •Introduces unit operations and processes application for: domestic water supply, wastewater treatment, water desalination, and solid waste recycling/reuse;<br>•Introduce the physical, chemical and biological processes as a foundation to the current water and waste management practices;<br>•Introduce the main management processes and engineering concerns of water and waste recycling systems;<br>•Design basic processes of water and waste management systems. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | | Study Level | |
| Environmental Discipline Requirement Electives | | | 3 | |
| Assessment Criteria | | | | |
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam | |
| 0% | 20% | 20% | 60% | |

| ESA403 | Sustainable Advanced Construction Technologies and Materials (4) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| •Advanced Construction Technology: Innovative use of manufacturing techniques in construction: e.g. offsite production; robotics in construction; freeform construction;<br>•Advanced Envelope Technology: e.g. planar glazing; intelligent facades; fabric roofs;<br>•Advanced Construction Techniques: e.g. working on congested sites; top-down basement construction; retained facades; air-tight buildings; tall buildings; sustainability;<br>•Review of recent major construction projects. Advanced Construction Management: e.g. innovation; logistics; interface management, safety measures. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 4 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 30% | 50% |

| ESA404 | Sustainable Advanced Construction Technologies and Materials (5) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| •Nature and characteristics of the construction industry;<br>•Lean Theory; Lean Principles, Lean Construction, Lean Process Management, Lean tools and techniques;<br>•Benefits and challenges of Lean Construction;<br>•Integrating Lean Construction in design and construction processes. | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 4 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 30% | 50% |

| ESA405 | Structures and Design (2) | 3 |
|---|---|---|
| Prerequisites | N/A | |
| Number of weekly Contact Hours | | |
| Lecture | Tutorial | Laboratory |

| | | | |
|---|---|---|---|
| 2 | 2 | 1 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| This module will develop Structural Analysis of determinate and indeterminate beams and frames, building on the principles developed in the Structures and Construction Modules. The unit load and moment distribution methods of analyses will be introduced and developed, and the plastic theory of analysis for beams will be covered. The student will be introduced to calculations for column instability and to the usage of computer aided analysis using a commercial software | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 4 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| | | |
|---|---|---|
| ESA406 | Structures and Design (3) | 3 |
| Prerequisites | N/A | |
| Number of weekly Contact Hours | | |
| Lecture | Tutorial | Laboratory |
| 2 | 2 | 0 |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | |
| This module will extend the knowledge of steel and concrete material use, analysis of structural form, and ability in design in both qualitative and quantitative directions. Problems from the AMIStructE papers will be selected so that the student can develop his analytical confidence to choose appropriate solutions, and presentations will be given on a wider range of subjects and discussed in critical peer review | | |
| Used in Program / Level | | |
| Program Name or requirement | Study Level | |
| Environmental Discipline Requirement Electives | 4 | |
| Assessment Criteria | | |
| Coursework Portfolio | Mid-Term Exam | Individual Project | Final Exam |
| 0% | 20% | 20% | 60% |

| | | |
|---|---|---|
| ESA407 | Power Systems and Design (1) | 3 |
| Prerequisites | N/A | |
| Number of weekly Contact Hours | | |
| Lecture | Tutorial | Laboratory |
| 2 | 2 | 0 |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | |
| This module focuses on 11kV high voltage electrical power system and Low-Voltage Distribution and equipment, focussing on their application on electrical building services | | |
| Used in Program / Level | | |
| Program Name or requirement | Study Level | |

| | |
|---|---|
| Environmental Discipline Requirement Electives | 4 |

| Assessment Criteria | | | |
|---|---|---|---|
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| ESA408 | Power Systems and Design (2) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| This module focuses on 11kV high voltage electrical power system and Low-Voltage Distribution and equipment, focussing on their application on electrical building services | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 4 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Individual Project | Final Exam |
| 0% | 20% | 20% | 60% |

| ESA409 | Energy Systems (1) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |
| In relation to sustainable engineering, you'll develop a deep understanding of the principles that govern building services thermal energy systems and renewable and Low or Zero Carbon technologies | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 4 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 30% | 50% |

| ESA4010 | Energy Systems (2) | | 3 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 0 | |
| Required SWL | 150 | Equivalent ECTS | 6 |
| Course Content | | | |

| | | | |
|---|---|---|---|
| In relation to sustainable engineering, you'll develop a deep understanding of the principles that govern building services thermal energy systems and renewable and Low or Zero Carbon technologies | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 4 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Individual Project | Final Exam |
| 0% | 20% | 30% | 50% |

| | | | |
|---|---|---|---|
| ESA4011 | Architectural design and technology | | 5 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 2 | 2 | 6 | |
| Required SWL | 225 | Equivalent ECTS | 9 |
| Course Content | | | |
| This module focuses on: design principles, basic CAD technology and provides the elements of design and technology research in preparation for the main architectural | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 4 | |
| Assessment Criteria | | | |
| Coursework Portfolio | Mid-Term Exam | Individual Project | Final Exam |
| 0% | 0% | 100% | 0% |

| | | | |
|---|---|---|---|
| ESA4012 | Electrical Installation Equipment & Lighting | | 5 |
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 3 | 2 | 3 | |
| Required SWL | 225 | Equivalent ECTS | 9 |
| Course Content | | | |
| The module is designed to equip the student with up-to-date knowledge and skills to enable him to work in the design, installation, operation and maintenance of lighting and electrical systems in building services industries. Lighting will be covered as far as required to undertake design calculations and appreciate what is assumed in the use of proprietary design software packages | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 10% | 10% | 20% | 60% |

| ESA4013 | Heat Transfer in Building Services Engineering | | 5 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 3 | 2 | 3 | |
| Required SWL | 225 | Equivalent ECTS | 9 |
| Course Content | | | |
| This module provides an advanced study of heat and mass transfer, the design of heat transfer equipment, the application of heat transfer within a building envelope and the development of the CIBSE Admittance Method used for the assessment of cooling and heating loads. It also deals with the calculation of cooling loads using commercial software, and the strategies for the reduction of energy used for cooling including thermal mass, natural ventilation, night time cooling, evaporative cooling | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 10% | 20% | 20% | 50% |

| ESA4014 | Geotechnical design | | 5 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 3 | 2 | 3 | |
| Required SWL | 225 | Equivalent ECTS | 9 |
| Course Content | | | |
| This module is intended to provide an understanding to the application of theory to the analysis and design of geotechnical structures | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 10% | 10% | 20% | 60% |

| ESA4015 | Energy management and controls | | 5 |
|---|---|---|---|
| Prerequisites | N/A | | |
| Number of weekly Contact Hours | | | |
| Lecture | Tutorial | Laboratory | |
| 3 | 4 | 0 | |
| Required SWL | 225 | Equivalent ECTS | 9 |
| Course Content | | | |
| This module examines the controls and processes that are necessary for efficient and effective operation of buildings and their engineering services. It provides an understanding of control elements and building energy management systems, and the | | | |

| | | | |
|---|---|---|---|
| way that information from these systems can be used to manage energy. The module also presents tools for financial analysis and reporting | | | |
| Used in Program / Level | | | |
| Program Name or requirement | | Study Level | |
| Environmental Discipline Requirement Electives | | 4 | |
| Assessment Criteria | | | |
| Lab Coursework | Mid-Term Exam | Group Project | Final Exam |
| 0% | 20% | 20% | 60% |

| | | | | |
|---|---|---|---|---|
| ESA4016 | Advanced Eco Design and Visualization (6) | | | 5 |
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 3 | | 0 | | 6 |
| Required SWL | 225 | Equivalent ECTS | | 9 |
| Course Content | | | | |
| This module is based in the design studio and generates a detailed analysis of physical, cultural, social and economic context. It develops an understanding of the spatial organisation and form of buildings. The student will be asked to investigate an area of the city, from which you will develop a client brief, and will then select one of the sites proposed by the studio tutors, and develop a design for the site, responding to both the context and to the building programme. The module enables the student to become aware of design approaches, ideas and methodologies. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | Study Level | | |
| Environmental Discipline Requirement Electives | | 4 | | |
| Assessment Criteria | | | | |
| Lab Coursework | Mid-Term Exam | Indivudla Project | | Final Exam |
| 0% | 0% | 50% | | 50% |

| | | | | |
|---|---|---|---|---|
| ESA4017 | Specialized Eco Design and Visualization (7) | | | 5 |
| Prerequisites | N/A | | | |
| Number of weekly Contact Hours | | | | |
| Lecture | | Tutorial | | Laboratory |
| 2 | | 2 | | 6 |
| Required SWL | 225 | Equivalent ECTS | | 9 |
| Course Content | | | | |
| This module is designed to introduce you to the ambition and scope of design, set the philosophical and systemic context for the design investigations. | | | | |
| Used in Program / Level | | | | |
| Program Name or requirement | | Study Level | | |
| Environmental Discipline Requirement Electives | | | | |
| Assessment Criteria | | | | |
| Lab Coursework | Mid-Term Exam | Indivudla Project | | Final Exam |
| 0% | 0% | 50% | | 50% |

# Part F

# Mapping of Modules with NARS

# 1.1-Renewable Energy Engineering-Mechanical Power

# Renewable Energy Engineering –Mechanical Power

| | Code | Course Title | 0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UR | HUM016 | English language | X | | | | | | | | X | | | | | | | | | | | | |
| | HUM026 | English language | X | | | | | X | | | X | | | | | | | | | | | | |
| | HUM015 | Energy and human development | X | | | X | X | X | | | | X | X | | | | | | | | X | | |
| | HUM017 | Engineering Ethics and Communications | X | | | X | X | | X | X | X | | | | | | | | | | | | X |
| | HUMXXX | Elective Module | X | | X | | | | | | | X | | | | | | | | | | | |
| | 1HUM126 | Computer Programming | X | | X | | | | | | | | | | X | | | | | | | | |
| | 1HUM217 | Foundation of Marketing | X | | | X | | | X | | | X | | | | | X | | | | | | |
| | 1HUM224 | Fundamentals of Management | X | | | X | | | X | X | | X | | | X | | | | | | X | | |
| | 1HUM223 | Project Management and Economics | X | | | X | | | X | X | | X | | | X | | X | | | | X | | |
| | 1HUM114 | Technical Report Writing and Communication | X | | | | | | | X | X | | | | | | | | | | | | |
| FR | BAS011 | Mathematics (1) | | X | | | | | | | | | X | | | | | | | | | | |
| | BAS021 | Mathematics (2) | | X | | | | | | | | | X | | | | | | | | | | |
| | BAS012 | Physics 1 | | X | | | | | | X | X | | X | | | | | | | | | | |
| | BAS022 | Physics 2 | | X | | X | | | | X | X | | X | | | | | | | | | | |
| | BAS023 | Chemistry | | X | | X | | | | X | X | | X | | | | | | | | | | |
| | BAS025 | Algebra and Geometry | | X | X | | | | | | X | | X | | | | | | | | | | |
| | BES014 | Engineering design and graphics | | | | X | X | | | | | | X | | X | | | | | | | | |
| | BES013 | Workshop technology | | | | X | X | X | X | X | | | X | X | | | | | | | | | |
| | BES024 | Engineering mechanics 1 | | X | | X | | | X | | | | X | | | | | X | | | | | |
| | ENGG03I | Industrial Training | | | | X | X | | X | X | X | X | X | | | | | | | | | | |
| | ENGG07 | Industrial Training | | | | X | X | | X | X | X | X | X | | | | | | | | | | |
| | 1BAS112 | Calculus | | X | | | | | | | | | X | | | | | | | | | | |
| | 1BAS121 | Physics 3 | | X | | X | | | | | X | | X | | | | | | | | | | |
| | 1BAS123 | Differential Equations | | X | X | | | X | | | | | X | | | | | | | | | | |
| | 1BAS213 | Probability and Statistics | | | X | | X | | | | | | X | | | | | X | | | | | |
| | 1BAS225 | Numerical Methods | | | X | X | | X | X | | X | | X | | | | | X | | | | | |
| | 1BAS116 | Physical Chemistry | | X | | | | | | X | X | | X | | | | | | | | | | |
| | 1BAS212 | Energy & Environmental Issues | | | X | X | X | X | | X | X | | X | X | | | X | | | X | X | | X |
| DR | 1BES111 | Introduction to Mechatronics & Measurements | | | X | | | X | | | | | X | X | X | | | | | | | | |
| | 1BES113 | Materials Science | | X | | | X | | | | | | X | X | X | | X | | | | | | |
| | 1BES222 | Electronics | | | | | | | | | | | X | | | | X | | | | | | |
| | 1BES321 | Modelling and Simulation for Renewable Energy Systems | | X | X | | | | | | | | | X | X | | | X | X | | | | |
| | 1BES124 | Electrical Machines (1) | | | | | X | | | | | | X | | | X | X | | X | | | | |
| | 1BES122 | Thermodynamics (1) | | X | | | | | | | | | X | X | | | | | | | | | |
| | 1BES117 | Electrical Circuits | | | | | | | | | | | X | | | | X | | | | | | |
| | 1BES214 | Fundamentals of Heat and Mass Transfer | | X | | | | | | | | | X | X | | | | | | | | | |
| | 1BES216 | Fluid Mechanics | | X | | | | | | | | | X | X | | | | X | | | | | |
| | 1BES426 | Environmental Risk Analysis | | | | X | X | | | | | | X | | | | X | | X | X | X | | X |
| | REN125 | Measurements Lab | | | X | | | | | | | | | X | | | | | | | | | |
| | REN115 | Introduction to Renewable Energy Systems | | | | | X | X | | | | | X | X | | X | | | X | X | X | | |
| | REN211 | Theory and Applications of Automatic Control | | X | | X | | | | | | | | X | | | | | | | | | |
| | REN221 | Storage Energy Technology | | X | | X | | X | | | | | | | X | X | | X | X | | | X | |
| | REN322 | Data Acquisition and Sensors | | | X | | | | | | | | | X | | | | | | | | | |
| | REN313 | Solar Thermal Energy Systems | | | | | | | | | | | | X | X | | | X | X | X | | X | |
| | REN314 | Wind energy systems | | X | | | | | | | | | X | X | | | | X | X | X | | X | |
| | 1BES312 | Structural and Stress Analysis | | X | X | x | | X | | | | X | X | | X | X | X | | | | | | |
| | 1BES226 | Thermodynamics (2) | | | | | | | | | | | | X | | | | | | | | | |
| | 1BES412 | Turbo Machinery | | | | | | | | | | | | | X | X | X | | X | | | | |
| | 1BES316 | Combustion and Fuels | | | | | | | | | | | | X | | | | | X | | | | |

| | Code | Course Title | 0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PR | RENM326 | Mechanical power Generation | | X | | | | | | | | | X | X | | | | X | | | | | |
| | REN315 | Hydraulic, Geothermal and Bio Energy | | | | | | | | | | | | | X | X | | X | | X | | X | |
| | RENM311 | Sustainable Energy: Principles & Processes | | | | | | X | | | | | X | | X | | | | | | X | | X |
| | RENM411 | Smart Materials for Renewable Energy Systems | | | | X | X | | | | | X | | | X | | | | | | X | | |
| | RENM325 | Thermal Power Plants | | X | | | | | | | | | X | X | | X | | | X | | | X | |
| | RENM323 | Energy Efficiency and Energy Management | | | | X | X | | | | | | X | | | | | | | | X | | X |
| | RENM324 | Alternative Fuels & Fuel Cell Technology | | | | | | X | | | | X | | X | | | | | | X | | X | |
| | RENM413 | Design of Solar Energy Equipment | | X | | | | | | | | X | | | X | X | | X | X | | X | X | |
| | RENXXX | Elective Course | | | | | | | | | | | | | | | | | | | | | |
| | RENXXX | Elective Course | | | | | | | | | | | | | | | | | | | | | |
| | RENXXX | Elective Course | | | | | | | | | | | | | | | | | | | | | |
| | REN401 | Graduation Research Project | | X | X | X | X | X | X | X | X | X | X | | | | | X | | X | | X | |
| | REN402 | Design Project | | X | X | X | X | X | X | X | X | X | X | | X | | | | X | | X | X | |
| PR Electives | REN415 | Sustainable Enterprise Economy | | | | X | | | X | | | | X | | | | X | | | | | | X |
| | REN417 | Wind energy convertors | | | | | | | | | | | | | | | | | X | X | | X | |
| | REN418 | Life cycle assessment | | | X | X | X | | X | | | | X | | | X | | | | | | | X |
| | REN421 | Renewable Energy Policy | X | | | X | X | X | | | X | | X | | | | | | | | | | X |
| | REN422 | Feasibility studies and economics of Energy Projects | X | | | X | | | X | | X | | X | | | | X | | | | X | | X |
| | RENM416 | The politics of climate change | | | | X | X | | | | X | | X | | | | | | | | | | X |
| | RENM419 | Biomass | | | | | | | | | | | | X | | | | X | X | X | | X | |
| | RENM423 | Integration of and transmission of energies | | | | | | | | | | | | | | | | | | | | X | |
| | RENM424 | Internal Combustion Engines | | | | | | | | | | | | | | | | | | | | X | |
| | RENM425 | Solar thermal energy design | | X | | | | | | | | | | | X | X | | X | X | X | X | | |
| | RENM427 | Design of Hydraulic and Wind Energy Equipment | | X | | | | | | | | | X | | X | X | | X | X | X | X | X | |
| | RENM428 | Advanced Wind Energy | | | | | | | | | | | X | | X | X | | X | X | X | | X | |

## Competencies

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.

A2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

A3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

A5. Practice research techniques and methods of investigation as an inherent part of learning.

A6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.

A7. Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.

A8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

A9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

B1. Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics and Vibrations.
B2. Plan, manage and carry out designs of mechanical systems and machine elements using appropriate materials both traditional means and computer-aided tools and software contemporary to the mechanical engineering field.
B3. Select conventional mechanical equipment according to the required performance.
B4. Adopt suitable national and international standards and codes; and integrate legal, economic and financial aspects to: design, build, operate, inspect and maintain mechanical equipment and systems.

C1. Select and apply appropriate systematic analysis methods to critically evaluate and solve complex renewable energy engineering problems
C2. Analyse different energy resources and conversion processes using analytical modelling, experimental techniques and numerical simulations
C3. Critically access the use of renewable energy systems to mitigate climate change and improve the environment and social welfare
C4. Make and justify decisions for selecting and optimising renewable energy products and systems based on technical, environmental, economic, risk and social criteria
C5. Develop innovative solutions to meet the current global sustainability and renewable energy challenges
C6. Demonstrate the application of legal and ethical requirements associated with renewable energy in an industrial environment

*References:*

*A: NAQAAE-NARS 2018 Engineering Graduate Competencies*

*B: NAQAAE 2018 basic Mechanical Engineering Competencies*

*C: Coventry University MSc Renewable Energy Engineering*

# 1.2-Renewable Energy Engineering-Electrical Energy

# Renewable Energy Egineering – Electrical Energy

| | Code | Course Title | 0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | B5 | C1 | C2 | C3 | C4 | C5 | C6 | C7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UR | HUM016 | English language | X | | | | | | | | X | | | | | | | | | | | | | | |
| | HUM026 | English language | X | | | | | X | | | X | | | | | | | | | | | | | | |
| | HUM015 | Energy and human development | X | | | X | X | X | | | | X | X | | | | | | | | | X | | | |
| | HUM017 | Engineering Ethics and Communications | X | | | X | X | | X | X | X | | | | | | | | | | | | | | |
| | HUMXXX | Elective Module | X | | X | | | | | | | X | | | | | | | | | | | | | |
| | 1HUM126 | Computer Programming | X | | X | | | | | | | | | | | | | | | | | | | | |
| | 1HUM217 | Foundation of Marketing | X | | | X | | | X | | | X | | | | | | | | | | | | | |
| | 1HUM224 | Fundamentals of Management | X | | | X | | | X | X | | X | | | | | | | | | | | | X | |
| | 1HUM223 | Project Management and Economics | X | | | X | | | X | X | | X | | | | | | | | | | | | X | |
| | 1HUM114 | Technical Report Writing and Communication | X | | | | | | | X | X | | | | | | | | | | | | | | |
| FR | BAS011 | Mathematics (1) | | X | | | | | | | | | X | | | | | | | | | | | | |
| | BAS021 | Mathematics (2) | | X | | | | | | | | | X | | | | | | | | | | | | |
| | BAS012 | Physics 1 | | X | | | | | | X | X | | X | | | | | | | | | | | | |
| | BAS022 | Physics 2 | | X | | X | | | | X | X | | X | | | | | | | | | | | | |
| | BAS023 | Chemistry | | X | | X | | | | X | X | | X | | | | | | | | | | | | |
| | BAS025 | Algebra and Geometry | | X | X | | | | | | X | | X | | | | | | | | | | | | |
| | BES014 | Engineering design and graphics | | | | X | X | | | | | | X | | | | | | | | | | | | |
| | BES013 | Workshop technology | | | | X | X | X | X | X | | | X | | | | | | | | | | | | |
| | BES024 | Engineering mechanics 1 | | X | | X | | | X | | | | X | | | | | | | | | | | | |
| | ENGG03I | Industrial Training | | | | X | X | | X | X | X | X | X | | | | | | | | | | | | |
| | ENGG07 | Industrial Training | | | | X | X | | X | X | X | X | X | | | | | | | | | | | | |
| | 1BAS112 | Calculus | | X | | | | | | | | | X | | | | | | | | | | | | |
| | 1BAS121 | Physics 3 | | X | | X | | | | | X | | X | | | | | | | | | | | | |
| | 1BAS123 | Differential Equations | | X | X | | | X | | | | | X | | | | | | | | | | | | |
| | 1BAS213 | Probability and Statistics | | | X | | X | | | | | | X | | | | | | | | | | | | |
| | 1BAS225 | Numerical Methods | | | X | X | | X | X | | X | | X | | | | | | | | | | | | |
| | 1BAS116 | Physical Chemistry | | X | | | | | | X | X | | X | | | | | | | | | | | | |
| | 1BAS212 | Energy & Environmental Issues | | | X | X | X | X | | X | X | | X | | | | | | X | | | X | X | | |
| DR | 1BES111 | Introduction to Mechatronics & Measurements | | | X | | | X | | | | | X | | | | X | | | | | | | | |
| | 1BES113 | Materials Science | | X | | | X | | | | | | X | | | | | X | | | | | | | |
| | 1BES222 | Electronics | | | | | | | | | | | X | | X | X | X | | | | | | | | |
| | 1BES321 | Modelling and Simulation for Renewable Energy Systems | | X | X | | | | | | | | | X | X | | X | | | | | X | | | |
| | 1BES124 | Electrical Machines (1) | | | | | X | | | | | | X | X | X | X | | | | X | X | | | | |
| | 1BES122 | Thermodynamics (1) | | X | | | | | | | | | X | X | | | | | | | | | | | |
| | 1BES117 | Electrical Circuits | | | | | | | | | | | X | | X | X | X | | | | | | | | |
| | 1BES214 | Fundamentals of Heat and Mass Transfer | | X | | | | | | | | | X | X | | | | | | | | | | | |
| | 1BES216 | Fluid Mechanics | | X | | | | | | | | | X | X | | | | | | | | | | | |
| | 1BES426 | Environmental Risk Analysis | | | | X | X | | | | | | X | | | | | X | X | | | X | X | | |
| | REN125 | Measurements Lab | | | X | | | | | | | | | | | | X | | | | | | | | |
| | REN115 | Introduction to Renewable Energy Systems | | | | | X | X | | | | | X | X | | | | | X | | X | | | | |
| | REN211 | Theory and Applications of Automatic Control | | X | | X | | | | | | | | | X | X | X | | | | | | | | |
| | REN221 | Storage Energy Technology | | X | | X | | X | | | | | | | | X | X | | | | | | | | |
| | REN322 | Data Acquisition and Sensors | | | X | | | | | | | | | | | X | X | | | | | | | | |
| | REN313 | Solar Thermal Energy Systems | | | | | | | | | | | | X | | | | | | | | | | | |
| | REN314 | Wind energy systems | | X | | | | | | | | | X | X | X | | | | X | | X | | X | | |
| | 1BES317 | Signals & Systems | | | X | | | | | | | | | | X | X | X | | | | | | | | |
| | 1BES414 | Power Electronics | | X | | X | | | | | | | X | | X | X | | | | X | | | | | |
| | 1BES325 | Design, control, and maintenance of PV plants | | | | | | | | | | | | X | | X | X | | | | | | | | |
| | 1BES429 | Electrical Machines (2) | | | | X | | | | | | | X | x | X | X | | | | X | X | | | | |

| | Code | Course Title | 0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | B5 | C1 | C2 | C3 | C4 | C5 | C6 | C7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PR | RENE326 | Power Generation and Conversion Systems | | | | | | | | | | | | X | | | | | | x | | | | | X |
| | REN315 | Hydraulic, Geothermal and Bio Energy | | | | | | | | | | | | | | | | | | | | X | | | |
| | RENE323 | Power system analysis | | | | | X | | | | | | | X | | | X | X | | X | | | | | X |
| | RENE324 | Network Interfacing of Renewable Resources | | | | | X | | | | | | | | | | | X | | | X | | | X | |
| | RENE312 | Solar Energy: Photovoltaic (PV) Systems | | | | | | | | | | | X | X | | | | | X | | X | | | | |
| | RENE311 | Electrical Power Transmission | | | | | X | | | | | | | X | | | X | X | | X | | | | | |
| | RENE411 | Power systems protection | | | | | X | | | | | | | | | | | X | | X | | | | | |
| | RENE413 | High Voltage Engineering | | | | | | | | | | | | | | | X | X | | X | X | X | | | |
| | RENXXX | Elective Course | | | | | | | | | | | | | | | | | | | | | | | |
| | RENXXX | Elective Course | | | | | | | | | | | | | | | | | | | | | | | |
| | RENXXX | Elective Course | | | | | | | | | | | | | | | | | | | | | | | |
| | REN401 | Graduation Research Project | | X | X | X | X | X | X | X | X | X | X | | | | | | X | X | X | X | X | X | X |
| | REN402 | Design Project | | X | X | X | X | X | X | X | X | X | X | | | | | | X | X | X | X | X | X | X |
| PR Electives | RENE412 | Power Quality | | | | | X | | | | | | | | | | | X | | | | | X | | X |
| | REN415 | Sustainable Enterprise Economy | | | | X | | | X | | | | X | | | | | | | | | | X | X | |
| | RENE416 | Advanced Power System Protection | | | | | | | | | | | | | | | | X | | | X | | | X | X |
| | REN417 | Wind energy convertors | | | | | | | | | | | | X | | | | | X | | | | | | X |
| | REN418 | Life cycle assessment | | | X | X | X | | X | | | | X | | | | | | | | | X | X | | |
| | REN4E19 | Switchgear Engineering and Substation | | | | | | | | | | | X | | | | | | | | | | | X | |
| | REN421 | Renewable Energy Policy | X | | | X | X | X | | | X | | X | | | | | X | | | | X | X | X | |
| | REN422 | Feasibility studies and economics of Energy Projects | X | | | X | | | X | | X | | X | | X | | | | | | | X | | | |
| | RENE423 | Electric Drives | | X | | | | | | | | | | | | | | | | | | | | X | X |
| | RENE424 | Electric Power Distribution Systems | | | | | X | | | | | | | | | | | | | X | | | | | |
| | RENE425 | Energy Harvesting Technologies | | | | | | | | | | | | | | | | | X | | X | | | | |
| | RENE427 | Advanced Photovoltaics | | | | | | | | | | | X | | | | | | X | | X | | | | |
| | RENE428 | Micro Grid and Grid Connect PV Solar Systems | | | | | | | | | | | | X | | | | X | | X | | | | X | X |
| | RENE429 | Power electronics for energy application | | | | | | | | | | | | | | | X | | | | X | | | | X |

# Competencies

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.

A2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

A3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

A5. Practice research techniques and methods of investigation as an inherent part of learning.

A6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.

A7. Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.

A8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

A9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

B1. Select, model and analyze electrical power systems applicable to the specific discipline by applying the concepts of: generation, transmission and distribution of electrical power systems.
B2. Design, model and analyze an electrical/electronic/digital system or component for a specific application; and identify the tools required to optimize this design.
B3. Design and implement: elements, modules, sub-systems or systems in electrical/electronic/digital engineering using technological and professional tools.
B4. Estimate and measure the performance of an electrical/electronic/digital system and circuit under specific input excitation, and evaluate its suitability for a specific application.
B5. Adopt suitable national and international standards and codes to: design, build, operate, inspect and maintain electrical/electronic/digital equipment, systems and services.

C1. The scientific and engineering principles underpinning energy and sustainability in the context of electrical power engineering.
C2. Advanced concepts in specialist areas of electric power networks, such as energy generation, transmission and distribution engineering.
C3. Specify and design aspects of electrical power systems with attention to a wide range of outcomes, including technical, practical, efficiency/sustainability and security.
C4. Evaluate energy and sustainability projects with regard to environmental Impact, safety and reliability.
C5. Find, read, understand and explain literature related to advanced and specialised areas of electrical power engineering, including scientific publications, industrial documentation, standards, ethical, legal and environmental guidance.
C6. Plan and manage a research project involving an advanced and specialised aspect of electrical power engineering, using appropriate state of the art techniques, technologies and/or tools.
C7. Use specialist tools for the design, realisation and evaluation of electrical power systems.

*References:*

*A: NAQAAE-NARS 2018 Engineering Graduate Competencies*

*B: NAQAAE 2018 basic Electrical Engineering Competencies*

*C: University of Southampton MSc Energy and Sustainability with Electrical Power Engineering*

# 2-Biochemical Energy Engineering

# Biochemical Engineering

| | Code | Course Title | 0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 | C5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UR | HUM016 | English language | X | | | | | | | | X | | | | | | | | | | | |
| | HUM026 | English language | X | | | | | X | | | X | | | | | | | | | | | |
| | HUM015 | Energy and human development | X | | | X | X | X | | | | X | X | | X | | | | | | | |
| | HUM017 | Engineering Ethics and Communications | X | | | X | X | | X | X | X | | | | | | | | | X | | |
| | HUMXXX | Elective Module | X | | X | | | | | | | X | | | | | | | | | | |
| | 2HUM117 | Computer Programming | X | | X | | | | | | | | | | | X | | | | | | |
| | 2HUM317 | Fundamentals of management for engineers | X | | | X | | | X | X | | X | | | | | X | | | | | |
| | 2HUM322 | Business skills for engineers and technologies | X | | | | | | X | | | | | | | | | | | | | |
| | 2HUM114 | Technical Report Writing and Communication | X | | | | | | | X | X | | | | | | | | | | | |
| FR | BAS011 | Mathematics (1) | | X | | | | | | | | | X | | | | | | | | | |
| | BAS021 | Mathematics (2) | | X | | | | | | | | | X | | | | | | | | | |
| | BAS012 | Physics 1 | | X | | | | | | X | X | | X | | | | | | | | | |
| | BAS022 | Physics 2 | | X | | X | | | | X | X | | X | | | | | | | | | |
| | BAS023 | Chemistry | | X | | X | | | | X | X | | X | | | | | | | | | |
| | BAS025 | Algebra and Geometry | | X | X | | | | | | X | | X | | | | | | | | | |
| | BES014 | Engineering design and graphics | | | | X | X | | | | | | X | X | | | | | | | | |
| | BES013 | Workshop technology | | | | X | X | X | X | X | | | X | | | | | | | | | |
| | BES024 | Engineering mechanics 1 | | X | | X | | | X | | | | X | | | | | | | | | |
| | ENGG03I | Industrial Training | | | | X | X | | X | X | X | X | X | | | | | X | | | | |
| | ENGG07 | Industrial Training | | | | X | X | | X | X | X | X | X | | | | | X | | | | |
| | 2BAS215 | Numerical Methods | | | X | X | | X | X | | X | | X | | | | | | | | | |
| | 2BAS112 | Advanced Mathematics (1) | | X | | | | | | | | | X | | | X | | | | | | |
| | 2BAS123 | Advanced Mathematics (2) | | X | X | | | | | | | | X | | | X | | | | | | |
| | 2BAS115 | Organic Chemistry | | | | X | | | | | X | | X | X | | | | | | | | |
| | 2BAS121 | Inorganic Chemistry | | | | X | | | | | X | | X | X | | | | | | | | |
| | 2BAS116 | Physical Chemistry | | X | | | | | | X | X | | X | X | | | | | | | | |
| DR | 2BES122 | Structural and Stress Analysis | | X | X | x | | X | | | | X | X | X | | | | X | | | | |
| | 2BES113 | Materials Science | | X | | | X | | | | | | X | X | | | | X | | | | |
| | 2BES312 | Modelling and simulation | | | X | | | | | | | | | | | X | | | | | | |
| | 2BES222 | Thermodynamics | | X | | | | | | | | | X | X | | | | X | | | | |
| | 2BES225 | Fundamentals of Heat and Mass Transfer | | X | | | | | | | | | X | X | | | | | | | | |
| | 2BES125 | Energy Sources | | | | | | | | | | | | | X | | | | | | | |
| | 2BES124 | Fundamentals of biochemistry | | | | | | | | | | | | | | | | | | | | |
| | 2BES211 | Fundamentals of corrosion science | | X | | | | | | | | | | | | | X | | | | | |
| | 2BES213 | Mass and energy balances | | | | | | | | | | | | X | | | | | | X | | |
| | 2BES214 | Electrical and Electronic Engineering | | | | | | | | | | | | X | | | | | | | | X |
| | 2BES226 | Unit Operation | | X | | | | | | | | | | | | | | | | X | | X |
| | 2BES313 | Environmental Legislation and Regulations | | | | | | | | | | | | | | | X | | | X | | |
| | 2BES216 | Fluid Mechanics | | X | | | | | | | | | X | X | | | | | | | | |
| | 2BES426 | Environmental Risk Analysis | | | | X | X | | | | | | X | | | | X | | | X | | |
| | 2BES321 | Economics of Bioenergy | | | | | | | | | | | | | | | X | | X | | | |
| | BIO111 | Fundamentals of microbiology | | | | | | | | | | | | | | X | | | | | | |
| | BIO212 | Fundamentals of Biochemical engineering | | X | | | | | | | | | | | | X | | | | | X | |
| | BIO223 | Principles of process design | | X | | | | | | | | | | X | | | | | | | X | |
| | BIO325 | Principles of plant design | | X | | | | | | | | | | X | | | | | | | X | |
| | BIO412 | Climate change and BioEnergy | | | | | | | | | | | | | | | | | | | X | |
| | BIO221 | Biophysics | | X | | | | | | | | | | | X | | | | | | X | |
| | BIO126 | Biomass engineering | | X | | | | | | | | | | | X | | | | | | X | |

| | Code | Course Title | 0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 | C5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PR | BIO311 | Bioreactor Design | | X | | | | | | | | | | X | | | X | X | X | | X | |
| | BIO316 | Bioremediation of environmental pollutant | | X | | X | | | | | | | | | | | X | X | | | X | X |
| | BIO224 | Biofuels (1) | | X | | | | | | | | | | | X | | | X | X | | X | X |
| | BIO314 | Biofuels (2) | | X | | | | | | | | | | | X | | | X | X | | X | X |
| | BIO315 | Nanotechnology for biochemical system | | X | X | | | | | | | | | | X | | | X | X | | X | X |
| | BIO323 | Biotechnology | | X | | | | | | | | | | | | | | X | | | X | |
| | BIO324 | Bioproduct Design | | X | | | | | | | | | | | | | X | X | X | | X | X |
| | BIO326 | Petroleum Bioprocessing | | X | X | X | | | | | | | | | X | | | X | X | | X | X |
| | BIO411 | Valorization of waste and biomass | | X | | | | | | | | | | | | | | X | | | X | X |
| | BIO421 | Biolubricants for Tribological engineering and engine Tribology | | X | X | | | | | | | | | | X | | | X | | | X | X |
| | BIOXXX | Elective Course | | | | | | | | | | | | | | | | | | | | |
| | BIOXXX | Elective Course | | | | | | | | | | | | | | | | | | | | |
| | BIOXXX | Elective Course | | | | | | | | | | | | | | | | | | | | |
| | BIO401 | Graduation Research Project | | | | | X | | | | | | | X | | X | X | X | X | X | X | X |
| | BIO402 | Design Project | | | | | X | | | | | | | X | | X | X | X | X | X | X | X |
| PR Rlectives | BIO413 | Process Design and Simulation | | | | X | | | | | | | | X | | X | X | X | X | | X | |
| | BIO415 | Circular Economy | | | | | X | | | | | | | | | | | X | | X | | |
| | BIO416 | Food Processing Equipment | | | | X | | | | | | | | | | | X | X | X | | X | X |
| | BIO422 | Process Plant Operation | | | | X | | | | | | | | X | | | | X | X | | X | X |
| | BIO423 | Advanced Control Systems | | | | | | | | | | | | | | | | | X | | X | |
| | BIO424 | Occupational, Health, Safety Engineering and Environmental Management Systems | | | | X | | | | | | | | | | | | | | X | X | |
| | BIO425 | Principles of Fermentation Technology | | | | | | | X | | | | | | | | | X | | | X | X |

# Competencies

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.

A2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

A3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

A5. Practice research techniques and methods of investigation as an inherent part of learning.

A6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.

A7. Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.

A8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

A9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

B1. Design a practical chemical engineering system, component or process utilizing a full range of chemical engineering principles and techniques including: Mass and Energy Balance, Thermodynamics, Mass Transfer, Heat Transfer, Momentum Transfer, Kinetics of Chemical Reactions, Reactor Design, Instrumentation and Control of Chemical Processes, and Process and Plant Design.
B2. Engage in the recent technological changes and emerging fields relevant to chemical engineering to respond to the challenging role and responsibilities of a professional chemical engineer.
B3. Apply numerical modeling methods and/or computational techniques appropriate to chemical engineering.
B4. Adopt suitable national and international standards and codes to: design, operate, inspect and maintain chemical engineering systems.

C1. Knowledge of the principles and practice of biochemical engineering in the industrial biotechnology and biopharmaceutical industries.
C2. Understand strategy design and development, techniques and frameworks for crafting strategic options, competitive challenges of a global market environment, implementation of strategy and change.
C3. Professional and ethical responsibilities including the regulatory framework and the global and social context of biochemical engineering.
C4. Hands-on experience of facility and process design for either the industrial biotechnology and biopharmaceutical industries.
C5. Produce solutions to problems through the application of biological and engineering knowledge and understanding.

*References:*

*A: NAQAAE-NARS 2018 Engineering Graduate Competencies*

*B: NAQAAE 2018 basic Chemical Engineering Competencies*

*C: University of Sheffield MSc Biochemical Engineering*

# 3-Petroleum Engineering and Gas Technology Programme

# Petroleum Engineering & Gas Technology

| | Code | Course Title | 0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 | C5 | C6 | C7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UR | HUM016 | English language | X | | | | | | | | X | | | | | | | | | | | | | |
| | HUM026 | English language | X | | | | | X | | | X | | | | | | | | | | | | | |
| | HUM015 | Energy and human development | X | | | X | X | X | | | | X | X | | | | | | | | | | | |
| | HUM017 | Engineering Ethics and Communications | X | | | X | X | | X | X | X | | | | | | | | | | | | | |
| | 3HUM124 | Fundamentals of Management | X | | | X | | | X | X | | X | | | | | | | | | | | | |
| | 3HUM321 | Computer Applications in Petroleum | X | | X | | | | | | | | | | | X | | | | | | | | |
| | 3HUM315 | Engineering Project Management | X | | | | | | X | | | X | | | | | | | | | | | | |
| | 3HUM114 | Technical Report Writing and Communication | X | | | | | | | X | X | | | | | | | | | | | | | |
| FR | BAS011 | Mathematics (1) | | X | | | | | | | | | X | | | X | | | | | | | | |
| | BAS021 | Mathematics (2) | | X | | | | | | | | | X | | | X | | | | | | | | |
| | BAS012 | Physics 1 | | X | | | | | | X | X | | X | | | | | | | | | | | |
| | BAS022 | Physics 2 | | X | | X | | | | X | X | | X | | | | | | | | | | | |
| | BAS023 | Chemistry | | X | | X | | | | X | X | | X | | | | | | | | | | | |
| | BAS025 | Algebra and Geometry | | X | X | | | | | | X | | X | | | X | | | | | | | | |
| | BES014 | Engineering design and graphics | | | | X | X | | | | | | X | | | | | | | | | | | |
| | BES013 | Workshop technology | | | | X | X | X | X | X | | | X | | | | | | | | | | | |
| | BES024 | Engineering mechanics 1 | | X | | X | | | X | | | | X | | | | | | | | | | | |
| | ENGG03I | Industrial Training | | | | X | X | | X | X | X | X | X | | | | | | | | | | | |
| | ENGG07 | Industrial Training | | | | X | X | | X | X | X | X | X | | | | | | | | | | | |
| | 3BAS112 | Calculus | | X | | | | | | | | | X | | | | | | | | | | | |
| | 3BAS123 | Differential Equations | | X | X | | | X | | | | | X | | | X | | | | | | | | |
| | 3BAS213 | Engineering Probability and Statistics | | | X | | X | | | | | | X | | | X | | | | | | | | |
| | 3BAS215 | Organic Chemistry | | | | X | | | | | X | | X | | | | | | | | | | | |
| | 3BAS225 | Numerical Methods | | | X | X | | X | X | | X | | X | | | | | | | | | | | |
| | 3BAS121 | Physics for Petroleum Engineers | | X | | | | | | X | X | | X | | | | | | | | | | | |
| | 3BAS116 | Physical Chemistry for Petroleum Engineering | | X | | | | | | X | | | X | | | | | | | | | | | |
| | 3BAS226 | Introduction to Analytical Chemistry | | | | | | | | x | | | X | | | | | | | | | | | |
| DR | 3BES115 | Fundamentals of Fluid Mechanics | | x | | | | | | | | | x | | X | X | | | | | | | | |
| | 3BES113 | Materials Science for Petroleum Engineering | | X | | | X | | | | | | X | | X | | | | | | | | | |
| | 3BES122 | Structural and Stress Analysis | | X | X | x | | X | | | | X | X | | | | | | | | | | | |
| | 3BES125 | Fundamentals of Thermodynamics | | X | | | | | | | | | X | | X | X | | | | | | | | |
| | 3BES214 | Fundamentals of Heat and Mass Transfer | | X | | | | | | | | | X | | | | | | | | | | | |
| | 3BES216 | Machine Design for Petroleum Engineering | | | | | | | | | | | | | X | | | | | | | | | |
| | 3BES423 | Safety & Environment in Petroleum Industry | | | | | X | | | | | | | | | | X | | | | | | | |
| | 3BES325 | Petroleum Development Geology | | | | | | | | | | | | X | | | | | | | | | | |
| | 3BES221 | Surveying for Petroleum Engineers | | | | | | | | | | | | | | | | | | | | | | |
| | 3BES126 | Geological Principles of Petroleum | | | | | | | | | | | | X | | | | | | | | | | |
| | 3BES324 | Reservoir Modelling and Simulation | | | X | | | | | | | | | | | X | | | X | | | | | |
| | PET111 | Introduction to Petroleum Engineering | | | | | | | | | | | | | | | | | | | | | | |
| | PET222 | Reservoir Fluid Properties | | | | | | | | | | | | | X | | | | | | | | | X |
| | PET223 | Reservoir Rock Properties | | | | | | | | | | | | | X | | | | | | | X | X | |
| | PET224 | Reservoir Rock and Fluid Properties lab | | | | | | | | | | | | | | | | | | | | X | X | |
| | PET323 | Petroleum Economics and Legislation | | | | X | | | | | | | | | | | X | | X | | | | | |
| | PET311 | Petroleum and Natural Gas exploration | | | | | | | | | | | | | | | | | X | | | | | |
| | PET421 | Field Development and Reservoir Management | | | | | | | | X | | | | | | X | | | X | X | | | | |
| | PET211 | Drilling Engineering 1 | | | | | | | | | | | | | X | | | | | | X | | | X |
| | PET212 | Drilling Fluids Laboratory | | | | | | | | | | | | | | | | | | | | | | |
| | PET313 | Reservoir Engineering I | | | | | | | | | | | | X | X | | X | | | | X | X | | |

| | Code | Course Title | 0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 | C5 | C6 | C7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PR | PET312 | Well Logging | | | X | | | | | | | | | | | | | | X | | | X | X | |
| | PET316 | Well Testing | | | X | | | | | | | | | | | | | X | X | | | X | | X |
| | PET322 | Petroleum Production Engineering & Equipment | | | | | | | | | | | | | X | | | X | | X | X | | | X |
| | PET411 | Reservoir Engineering II | | X | | | | | | | | | | | | | | X | | | X | X | | |
| | PET412 | Surface Production Facilities | | | | | | | | | | | | | X | | | X | | | | | | |
| | PET413 | Enhanced Hydrocarbon Recovery | | | | X | | X | X | | | | | X | | | | X | | | X | | | |
| | PET422 | Drilling Engineering II | | | | | | | | | | | | | | | | X | | | | | | X |
| | PET314 | Field Courses | | X | | | | | | | | | | | | | | | | X | | X | | |
| | PET326 | Corrosion in Oil and Gas Industry | | X | | | | | | | | | | | | | | | X | | | | | |
| | PET418 | Gas Condensate Reservoir Engineering | | | | | | | | | | | | | | | | X | | | | X | | X |
| | PETXXX | Elective Course | | | | | | | | | | | | | | | | | | | | | | |
| | PET401 | Graduation Research Project | | | | X | | X | | | X | | | | | | | | | X | | | X | |
| | PET402 | Design Project | | | | X | | X | | | X | | | | | | | | | X | | | X | |
| PR Electives | PET424 | Rock Mechanics for Drilling and Completion | | X | | | | | | | | | | | | | | X | | | | | | |
| | PET327 | Corrosion in Oil and Gas Industry | | X | | | | | | | | | | | | | | | | | | | | |
| | PET415 | Advanced Production Logging | | | X | | | | | | | | | X | X | | | X | | | | | X | |
| | PET416 | Well Intervention and Stimulation | | | | | | | | | | | | X | | | | X | | | | | | |
| | PET417 | Petroleum Refining Engineering | | | | | | | | X | | | | | | | | | | | | | | |
| | PET426 | Special Topics in Advanced Drilling | | | | | | | | | | | | | | | | X | | | | | | |

## Competencies

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.

A2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

A3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

A5. Practice research techniques and methods of investigation as an inherent part of learning.

A6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.

A7. Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.

A8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

A9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

B1. Analyze geological data, interpret well-logs, estimate hydrocarbon reserves and evaluate reservoir performance by applying the principles and basic concepts of: geology, geophysics and reservoir engineering.
B2. Plan and construct oil wells, develop oilfield production programs, design early surface facilities plants and field evacuation plans by applying the principles and basic concepts of: drilling engineering, production engineering, phase equilibrium, fluid mechanics and flow through porous media.
B3. Use specialist computer applications and mathematical models to maximize the performance of all petroleum engineering stages.
B4. Apply the concepts of project economics and resources evaluation methods for design and decision making under conditions of risk and uncertainty.

C1. Operate effectively as petroleum engineer
C2. Students promote the ethos of synergy within the integrated, multidisciplinary teams of petroleum engineers and petroleum geoscientists in the exploration and development of oil and gas resources
C3. Students are trained in best current industry workflows and work practices, in order to be able to work effectively, either independently or as a member of an integrated team
C4. The obtaining of oil from an oil reservoir - a quantitative demonstration of porosity, permeability, relative permeability, entrapment etc.
C5. Porosity and permeability determinations - a demonstration of the processes and difficulties involved in measuring these parameters.
C6. Rock resistivity - shows the basic principles of rock resistivity using saline solutions.
C7. Phase Flow - a study of horizontal, vertical and inclined 2- phase flow patterns.

*References:*

*A: NAQAAE-NARS 2018 Engineering Graduate Competencies*

*B: NAQAAE 2018 basic Petroleum Engineering Competencies*

*C: Imperial College London MSc Petroleum Engineering*

# 4- Environmental Sustainable Architecture Engineering Programme

# Environmental Sustainable Architecture Engineering

| | Code | Course Title | 0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | B5 | D1 | D2 | D3 | D4 | D5 | D6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UR | HUM016 | English language | X | | | | | | | | X | | | | | | | | | | | | | |
| | HUM026 | English language | X | | | | | X | | | X | | | | | | | | | | | | | |
| | HUM015 | Energy and human development | X | | | X | X | X | | | | X | X | | | | | | | | | | | |
| | HUM017 | Engineering Ethics and Communications | X | | | X | X | | X | X | X | | | | | | | | | | | | | |
| | HUMXXX | Elective Module | X | | X | | | | | | | X | | | | | | | | | | | | |
| | 4HUM215 | Building Regulations and Rating Systems | X | | | X | X | | | | | | | | | X | | | X | X | X | X | X | |
| | 4HUM324 | Sustainable Project Management and Costing | X | | | X | | | X | X | | X | | | | | X | X | | | | | | |
| | 4HUM125 | Technical Writing and Digital Communication | X | | | | | | | X | X | | | | | | | | | | | | | |
| FR | BAS011 | Mathematics (1) | | X | | | | | | | | | X | | | | | | | | | | | |
| | BAS021 | Mathematics (2) | | X | | | | | | | | | X | | | | | | | | | | | |
| | BAS012 | Physics 1 | | X | | | | | | X | X | | X | | | | | | | | | | | |
| | BAS022 | Physics 2 | | X | | X | | | | X | X | | X | | | | | | | | | | | |
| | BAS023 | Chemistry | | X | | X | | | | X | X | | X | | | | | | | | | | | |
| | BAS025 | Algebra and Geometry | | X | X | | | | | | X | | X | | | | | | | | | | | |
| | BES014 | Engineering design and graphics | | | | X | X | | | | | | X | | | | | | | | | | | |
| | BES013 | Workshop technology | | | | X | X | X | X | X | | | X | | | | | | | | | | | |
| | BES024 | Engineering mechanics 1 | | X | | X | | | X | | | | X | | | | | | | | | | | |
| | ENGG03I | Industrial Training | | | | X | X | | X | X | X | X | X | | | | | | | | | | | |
| | ENGG07 | Industrial Training | | | | X | X | | X | X | X | X | X | | | | | | | | | | | |
| | 4BAS225 | Statistics, Numerical Methods and Computers | | X | X | X | X | | X | | X | X | X | | | | | | | | | | | |
| | 4BAS115 | Thermo-Fluids | | X | X | X | | | | | | | X | | | | | | | | | | | |
| | 4BAS124 | Structural and Stress Analysis | | X | X | x | | X | | | | X | X | | | X | | | | | | | | |
| | 4BAS214 | Geotechnics | | | X | | | X | | | X | | X | | | | | | | | | | | |
| DR | 4BES111 | Introduction to Environmental and Sustainable Design | | | | X | | X | | X | X | | X | X | | X | | | | | | | | |
| | 4BES112 | Sustainable Construction Technologies and Materials (1) | | | | | X | | | | X | | X | | | X | | | | | | | X | |
| | 4BES113 | Architecture Surveying and Drawing | | X | X | | | | | | X | | | | | | | X | | | | | | |
| | 4BES114 | Visual Design and Graphics (1) | | | | | | X | | | X | | | X | | | | | | | | | | |
| | 4BES122 | Sustainable Construction Technologies and Materials (2) | | | | | X | | | | X | | | | | X | | | | | | | X | |
| | 4BES123 | Visual Design and Graphics (2) | | | | | | X | | | X | | | X | | | | | | | | | | |
| | 4BES212 | Sustainable Construction Technologies and Materials (3) | | | | X | | | | | | | | | | X | | | | | | | X | |
| | 4BES224 | Air-Conditioning and Heat Pump Engineering | | X | | X | | X | X | | X | | | | X | X | | | | | | | | |
| | 4BES312 | Building Information Modelling | | | | | | X | | X | X | | | | | | X | X | | | | | | X |
| | 4BES313 | Design of Elements | | X | | | X | | | | X | | | | | X | | | | | | | | |
| | 4BES322 | Modelling and Simulation for Sustainable Architecture | | X | X | X | | | X | | X | | | | X | | | | | X | | X | X | |
| | 4BES323 | Integrated Building Design | | | X | | X | X | X | | X | | | | | | X | X | | | | | | X |
| | ESA121 | Architecture Design, History & Theory (1) | | | | | | X | | X | X | | | X | | | | | X | | | | | |
| | ESA213 | Environmental Control Systems (1) | | | | X | X | | | X | | | | | X | | X | | | X | | | X | |
| | ESA222 | Urban and Landscape Design, History & Theory | | | | | | X | | X | X | | | X | | | | | X | | | | | |
| | ESA314 | Daylighting | | X | | X | X | | | | | | | | X | X | | | | X | | | | |
| | ESAXXX | Elective course | | | | | | | | | | | | | | | | | | | | | | |
| | ESAXXX | Elective course | | | | | | | | | | | | | | | | | | | | | | |
| | ESAXXX | Elective course | | | | | | | | | | | | | | | | | | | | | | |
| | ESAXXX | Elective Course | | | | | | | | | | | | | | | | | | | | | | |
| PR | ESA211 | Eco Design, History & Theory (2) | | | | X | X | X | | X | X | | X | X | X | | | | X | | | X | X | X |
| | ESA221 | Eco Design for Occupant Wellbeing (3) | | | | X | X | X | | X | X | X | X | | X | | X | | | | X | X | X | |
| | ESA311 | Eco Design for Zero Energy and Passive Buildings (4) | | | X | X | X | | | X | | | X | | | X | | | X | X | | X | X | |
| | ESA321 | Eco Design with Water and Waste for Sustainability (5) | | | | | | X | | | X | | | | | X | | X | | X | X | X | X | X |
| | ESA223 | Environmental Control Systems (2) | | | X | | X | X | | | | | | | X | | X | | | X | | | X | |
| | ESAXXX | Elective course | | | | | | | | | | | | | | | | | | | | | | |
| | ESAXXX | Elective course | | | | | | | | | | | | | | | | | | | | | | |
| | ESA401 | Graduation Research Project | | X | | X | | X | | | X | X | X | X | X | X | X | X | X | X | X | | | X |
| | ESA402 | Design Project | | X | | X | | X | X | X | X | X | X | X | X | X | X | X | X | | | X | X | X |

| | Code | Course Title | 0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | B5 | D1 | D2 | D3 | D4 | D5 | D6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR Electives | ESA301 | Urban Planning, History & Theory | | | | X | | X | | X | X | | X | X | | | | | X | | X | X | | X |
| | ESA302 | Structures and Design (1) | | X | | | | | | | | | | | X | X | | | | | | | | |
| | ESA303 | Forensic Engineering | | | | | | | | | | | | | X | | | | | | | | | |
| | ESA304 | Electrical services in buildings | | X | | X | X | | | | | | | | | X | X | | | X | | | | |
| | ESA305 | Environmental Interior Design & Refurbishment (1) | | | | X | X | X | | X | | | | X | X | | | | X | | X | | | X |
| | ESA306 | Sustainable Landscapes (1) | | | | X | X | | | | X | | | | | X | X | | X | | | | | |
| | ESA307 | Life Cycle and Supply Chain Environmental Assessment | | | | X | X | X | | | X | | | X | | | X | X | X | | X | | | |
| | ESA308 | Introduction to Renewable Energy Systems | | | | | X | X | | | | | X | | | X | | | | X | X | | X | |
| | ESA309 | Water and Waste Management | | | | X | | | | | | | | | | X | | | | X | | | X | |
| | ESA403 | Sustainable Advanced Construction Technologies and Materials (4) | | | X | | X | X | | X | X | | | | | X | | X | | | X | | X | X |
| | ESA404 | Sustainable Advanced Construction Technologies and Materials (5) | | | | | X | X | | X | X | | X | | | X | | X | | | X | | X | X |
| | ESA405 | Structures and Design (2) | | X | | | | | | | | | | | X | | | | | | | | | |
| | ESA406 | Structures and Design (3) | | X | | | | | | | | | | | X | | | | | | | | | |
| | ESA407 | Power Systems and Design(1) | | X | | X | | | | | | | | | | | X | X | | X | | | X | |
| | ESA408 | Power Systems and Design(2) | | | X | | | | | | | | | | | | X | X | | X | | | X | |
| | ESA409 | Energy Systems(1) | | | | X | | | | | | | | | | X | X | | | X | | | X | |
| | ESA4010 | Energy Systems(2) | | | X | X | | | | | | | | | | X | X | | | X | | | X | |
| PR Electives | ESA4011 | Architectural design and technology | | | | X | | X | | X | X | | | X | X | X | | X | X | | | X | | |
| | ESA4012 | Electrical Installation Equipment & Lighting | | | X | | X | | | | | | | | | | X | X | | X | | X | | |
| | ESA4013 | Heat Transfer in Building Services Engineering | | X | | X | | | | | | | | | X | | | | | X | X | | X | X |
| | ESA4014 | Geotechnical design | | X | | X | | | | | | | | | | | | | | | | | | |
| | ESA4015 | Energy management and controls | | | X | | | | | | | | | | X | | | | | X | | | X | X |
| | ESA4016 | Advanced Eco Design and Visualization (6) | | | | X | X | X | | X | X | X | X | X | | | X | X | X | | | X | X | X |
| | ESA4017 | Specialized Eco Design and Visualization (7) | | | | X | | X | X | X | X | X | X | X | X | | X | X | X | | | X | X | X |

# Competencies

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.

A2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

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A9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

B1. Create architectural, urban and planning designs that satisfy both aesthetic and technical requirements, using adequate knowledge of: history and theory, related fine arts, local culture and heritage, technologies and human sciences.
B2. Produce designs that meet building users' requirements through understanding the relationship between people and buildings, and between buildings and their environment; and the need to relate buildings and the spaces between them to human needs and scale.
B3. Generate ecologically responsible, environmental conservation and rehabilitation designs; through understanding of: structural design, construction, technology and engineering problems associated with building designs.
B4. Transform design concepts into buildings and integrate plans into overall planning within the constraints of: project financing, project management, cost control and methods of project delivery; while having adequate knowledge of industries, organizations, regulations and procedures involved.
B5. Prepare design project briefs and documents, and understand the context of the architect in the construction industry, including the architect's role in the processes of bidding, procurement of architectural services and building production.

D1. Demonstrate a detailed knowledge of the theories, concepts and principles of architecture and environmental design with specific reference to the design process, climatic context and historical development
D2. Demonstrate a detailed knowledge of energy systems and fluxes in the built environment and the relationship between conventional building services, low-energy practices and climatic applicability of passive design strategies for the provision of comfort in buildings.
D3. Develop more sophisticated techniques for the conceptualization and embedding of bioclimatic, cultural and social theories and practices in the architectural design and refinement of the design process and representation.
D4. Demonstrate fluent and systematic knowledge of the theories, concepts and principles of architecture and environmental design with specific reference to the application and integration of such principles to the architectural design process.
D5. Demonstrate systematic and proficient knowledge of the architectural integration of environmental strategies and low-energy systems towards energy demand reduction and of methods for the quantification of building performance.
D6. Formulate and articulate briefs and design proposals which embed principles of environmental and bioclimatic design conceptualising a variety of physical and socio-cultural contexts and being able to communicate and exemplify design through a number of representation and making skills.

*References:*

*A: NAQAAE-NARS 2018 Engineering Graduate Competencies*

*B: NAQAAE 2018 basic Architectural Engineering Competencies*

*D: University of Westminster BSc Architecture and Environmental Design*