جامعة حائل
University of Ha'il

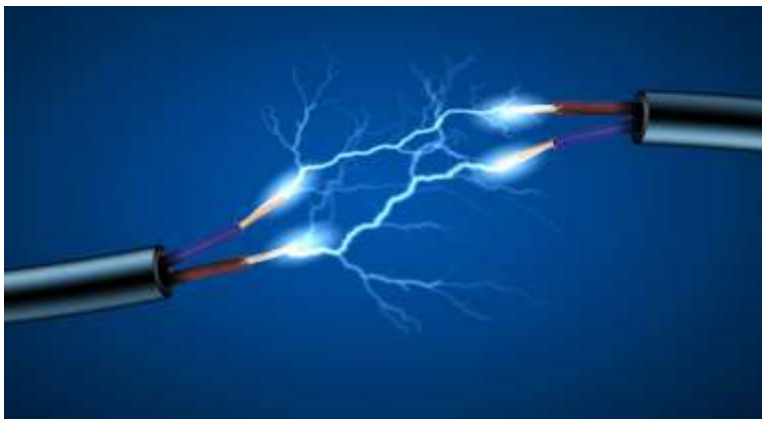
# RENEWABLE ENERGY ENGINEERING ACADEMIC PROGRAM

2025

# Contents

# Introduction

n response to a growing global interest in sustainable energy, the Renewable Energy Engineering program at the college of engineering began as a specialized track within the Electrical Engineering department, focusing on fundamental principles and technologies like olar, wind, and hydroelectric power. The program includes in its curriculum advanced topics uch as energy storage, smart grid technology, and energy management systems. The program mbraced an interdisciplinary approach, offering joint courses with other departments and, with strong emphasis on Photovoltaic Systems and Wind Energy, and sustainable practices. The rogram's graduates have significantly contributed to the renewable energy sector, and looking head, the program aims to incorporate emerging fields like green hydrogen and ocean energy, taying at the forefront of renewable energy research and education



## Program vision

Our vision is to be a globally recognized leader in renewable energy engineering education and research. We aim to pioneer advancements in renewable energy technologies and set new standards for sustainable engineering practices. Through our program, we aspire to inspire and empower a new generation of engineers who will innovate and lead the transition to a sustainable energy future. We envision our graduates as key contributors to addressing global energy challenges, shaping energy policy, and promoting environmental stewardship in communities around the world. Our ultimate goal is to significantly impact the way the world generates and uses energy, steering towards a cleaner, more sustainable future for all.

## Program mission

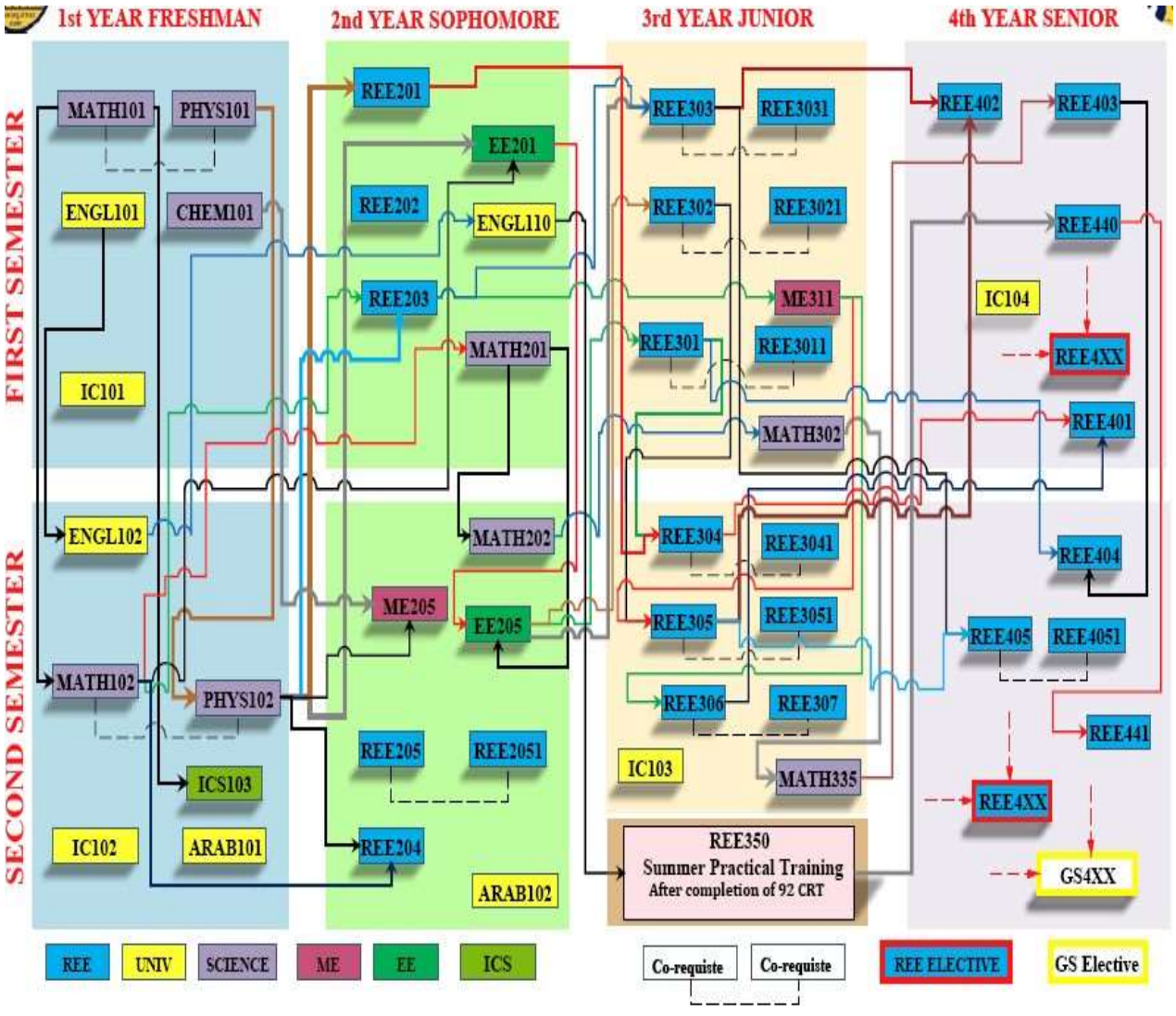
Our mission is to cultivate innovative, skilled engineers who are equipped to address the challenges of sustainable energy. Through a comprehensive curriculum that blends theoretical knowledge with practical skills, our program emphasizes the development of renewable energy technologies and sustainable practices. We strive to foster a collaborative learning environment where students engage with industry leaders and participate in cutting-edge research. Our commitment is to produce graduates who are not only proficient in renewable energy engineering but also dedicated to driving positive environmental change and advancing global sustainability goals

# Goals

The goals can be summarize into the following points:

1. Innovative Curriculum Development: Continuously update and innovate the curriculum to incorporate the latest advancements in renewable energy technologies and sustainable practices, ensuring that students are learning cutting-edge concepts and skills.
2. Research Excellence and Impact: Establish the department as a leader in renewable energy research, emphasizing projects that have a tangible impact on sustainable energy solutions and environmental stewardship.
3. Graduate Employability and Industry Readiness: Ensure that graduates are highly employable and ready to contribute effectively in the renewable energy sector. This includes equipping students with practical skills, industry-standard knowledge, and an understanding of real-world applications.
4. Entrepreneurship and Innovation in Students: Foster a spirit of entrepreneurship and innovation in students, encouraging them to develop new solutions and startups in the field of renewable energy, thereby contributing to the industry and society.
5. Ethical Leadership and Global Perspective: Instill in graduates a strong sense of ethical leadership and a global perspective on energy challenges, preparing them to make decisions that are environmentally responsible and socially beneficial in their professional careers.

# Organization chart of program Prequisites



# Admission requirements

## FIRST YEAR ADMISSION

Admission into the First year of all programs in the College follows the general admission requirements of UOH as following:

1. Students must be a Saudi National or born to a Saudi Mother.

2. Students must be a holder of grade 12th certificate or the equivalent.

3. All grade 12th certificates must be valid to a max of five years only.

4. Students must be must maintain a good conduct.

5. All girl students, scientific (Sc) and art (A) tracks must pass the Aptitude test and the achievement test as well.

6. All boy students, scientific (Sc) and art (A) tracks must pass the Aptitude test and the achievement test, only for Sc students in particular.

7. Students already admitted in other university will no longer have another change unless they present official resignation documents.

8. Students do not apply online on the do day do time, will automatically drop.

9. Selecting major or specialization upon finishing the preparatory year is subject to the faculties' rules and regulation

10. All students passed the Health sciences' preparatory year should be medically fit before selecting a major.

## CURRICULUM DESIGN

The curricula for the programs in the College are designed to satisfy regional and international accreditation requirements.

(a) Each program has a specified set of modules arranged into semesters and year of study.
(b) Modules may have pre- or co-requisite requirements.
(c) All combinations of modules are subject to the constraints of the time- table.

(d) The curriculum for each program shows the recommended sequence of courses. To meet graduation requirements, students are expected to follow the program structure in effect and pass each course.

Upon graduation, holders of the UOH Bachelor of Engineering degrees are expected to:

- possess an appropriate level of knowledge of engineering, mathematics and sciences fundamentals.
- have an appropriate level of knowledge of basic engineering skills and tools (laboratory, fields, and computers)
- be competent in engineering approaches to problem solving (hypotheses, design, testing ).
- be skilled in technical writing and oral presentation.
- have an understanding of social, economic, political, ethical, environmental and managerial context of engineering in society.
- recognize the importance of lifelong learning and the need to undertake advanced studies and continuing professional development.

## SEMESTER SYSTEM

The College follows the semester system of teaching. An academic year consists of two teaching semesters. Modules are offered in either the first semester, with final examinations normally in January, or in the second semester, with final examinations normally in May.Eachsemesternormallyhas15weeks. A limited number of modules may be offered during the summer vacation.

## CREDIT SYSTEM

Every module for a qualification has a credit rating. Credit ratings are given for each module in the Module section of this Handbook. Unless specially exempted, students obtain the credit points indicated for a module by passing the assessments for that module with an average mark of not less than 60%. Such credits are also known as Degree Credits as they accumulate towards the award of the Degree.

Each program is made up of a number of modules, and each module is given a credit rating based on the number of lectures, tutorials and practical in the module. One lecture hour equivalent is equal to 1 credit point. A lecture hour equivalent can be: one 2 or 3 hours of practical work; or industrial training.

# Graduation requirements

## Undergraduate Degree Requirements

A minimum of credits is required for a Bachelor of Engineering (BEng) degree for those that enter into First Year of the Five Year program. Some majors may, however impose different requirements and actual degree credit requirements for graduation are specified for each program. In their first year students take modules from the basic science disciplines, but at higher years students must select modules which are required for their particular program of study.

## Industrial Training (Co-operative work)

Engineering students at CoE undergo a phase of Industrial Training as part of graduation requirements. This component of industrial training requires all students to be exposed to some level of work experience by taking the practical 9-credit module; the module duration is 28 weeks.

## Overall Module Grade

Overall performance in a module shall be assessed on a percentage scale, a letter grade and a grade point (see Table 1):

## Cumulative Grade Point Average (CGPA)

A student's weighted GP score is calculated for a module by multiplying the credits with the grade point achieved from the percentage mark awarded. The cumulative GPA is given by the total weighted score (from the addition of the GP scores of all the modules) divided by the total number of credits. The GPA and CGPA are calculated to two decimal places.

| Mark (Out of 4) | Grade Code | Grade | Percentage |
|---|---|---|---|
| 4 | A+ | Exceptional | 95-100 |
| 3.75 | A | Excellent | 90- less than 95 |
| 3.5 | B+ | Superior | 85- less than 90 |
| 3 | B | Very Good | 80- less than 85 |
| 2.5 | C+ | Above Average | 75- less than 80 |
| 2 | C | Good | 70- less than 75 |
| 1.5 | D+ | High Pass | 65- less than 70 |
| 1 | D | Pass | 60- less than 65 |
| 0 | F | Fail | Less than 60 |

**General Regulations**

General regulations of all programs in the College follow the general regulations of UOH.

## DEFINITION OF TERMS

**Academic advisor :**A faculty member who is in charge to guide certain number of students in all matters related to their academic, social and health care affairs since their admission to the department.

**Academic exclusion :**means termination of a student's registration on academic grounds, resulting in exclusion from the university.

**Academic level :**It indicates the study level according to the approved study plan.

**Academic load:** It is the total credit hours that the student is allowed to register per semester. The minimum and maximum study load is determined by implementation rules of the University.

**Academic probation:** It is a notification given to the students with a cumulative GPA below the minimum acceptable limit mentioned in the University regulations.

**Academic semester:** It is a fifteen-week study-period excluding registration and final examination periods.

**Academic year:** It consists of two main regular studying semesters and a summer semester if any.

**Admission:** means the act by which the university admits a person to study, after acceptance by an applicant of an offer of a place at the university.

**Assessment:** means the evaluation and grading of work, supervised or unsupervised, carried out by a student in satisfying the requirements of a module, program or degree. A module maybe assessed through continuous assessment or a written examination or both.

**Co-requisite module:** means a module for which a student must register in the same semester as the proposed module.

**Course:** It is a subject of study within a certain academic level of the approved degree plan in each major. Each course has a number, code, title and a detailed description of its contents which distinguishes it from the other courses. A special file of each course is kept in the corresponding department for follow up, evaluation and updating purposes. Some of the courses may have pre-requisite or co-requisite requirement(s).

**Course grade:** It is the expressed result in percentage or letter grade of the final grade in any course

**Course work:** means assessable work produced by the student (also may be called classwork or continuous assessment)

**Credit hour:** It is a weekly theoretical lecture with a duration of not less than fifty minutes, or clinical session of not less than fifty minutes, or field, laboratory or practical lesson of not less than a hundred minutes.

**Credit point or credits:** means a value assigned to module to indicate its weighting within a qualification.

**Curriculum:** means the combination of modules which together comprise the program of study leading to a qualification. An individual student's curriculum refers to the specific selection of modules within the broad framework of the curriculum prescribed for a qualification, which enables the student to meet the requirements for the qualification.

**Degree plan:** It is a collection of general, core, compulsory, elective, internship, training, and preparatory courses whose total credit hours form the graduation requirements, that must be completed to obtain a scientific degree in a specified major.

**Elective:** a module which the student may choose

**Examination:** means a formal assessment, conducted within an officially designated examination session, usually invigilated, and bound by time constraints.

**External examination:** means examination by a person, external to the university.

**Internal examination:** means examination by a person or persons involved with the teaching of the relevant module in that semester or, in the case of postgraduate qualifications, is a member of the University academic staff including persons who hold honorary appointments in the University other than the supervisor(s).

**Major:** amajorinadisciplineconsistsofatleast12creditsattheexit-level

**Module:** means any separate course of study for which credits may be obtained.

**Qualification:** means a degree.

**Prerequisite module:** means a module which must have been passed, with at least the minimum mark required by the relevant College ,before registration for the proposed module is permitted.

**Project:** means a substantial assignment, whether comprising a single module or part of a module, and which requires research or equivalent independent work by a student.

**Registered student:** means a student who is registered to study in one or more modules offered by the University. Such registration will lapse on the date of the following registration session or earlier should the student cease to be an admitted student.

**Registration:** means completion by a student, and acceptance by the University, of a registration form, and compliance with such other conditions as are required for entitlement to a current student card.

**Student:** means a person who has been admitted to the University for the purpose of studying or who has registered for a qualification. A student remains a student until such time as that person graduates or otherwise completes studies, or withdraws from the University, or fails to attend or register in any semester, or is excluded and all appeal processes for readmission have been exhausted."

**Summer semester:** it is an intensive eight weeks study period excluding registration and final examination periods, in which course studying duration is doubled.

**The University:** means the university of Hail (UOH).

## Academic reference standards of program

The characteristics of the REE program graduates are:

1. Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. Ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. Ability to communicate effectively with a range of audiences.
4. Ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. Ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. Ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions.
7. Ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

University of Hail

# Study plan of program

## CURRICULUM

The typical study program for B.Sc. students in the Renewable Energy Engineering Department is distributed over 8 semesters as follows:

### FIRST YEAR OF (REE) PROGRAM (Freshman)

| FIRST SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| CODE | COURSE TITLE | CRED | LECT | LAB | PRE-REQUISITE | CO-REQUISITE |
| CHEM 101 | Chemistry I | 4 | 3 | 3 | | |
| ENGL 100 | English Language | 2 | 2 | 0 | | |
| MATH 101 | Calculus I | 4 | 4 | 0 | | PHYS 101 |
| PHYS 101 | Physics I | 4 | 3 | 3 | | MATH 101 |
| IC 111 | Intro. To Islamic Culture | 2 | 2 | 0 | | |
| TOTAL (CREDIT) | | 16 | | | | |

| SECOND SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| CODE | COURSE TITLE | CRED | LECT | LAB | PRE-REQUISITE | CO-REQUISITE |
| ENGL 102 | English Composition II | 3 | 3 | 0 | ENGL 100 or ENGL 101 | |
| ARB 100 | Arabic Languages Skills | 2 | 2 | 0 | | |
| MATH 102 | Calculus II | 4 | 4 | 0 | MATH 101 | PHYS 102 |
| PHYS 102 | Physics II | 4 | 3 | 3 | PHYS 101 | MATH 102 |
| ICS 103 | Computer Programming in C | 3 | 2 | 3 | MATH 101 | |

| TOTAL (CREDIT) | 16 |
|---|---|

## SECOND YEAR OF (REE) PROGRAM (Sophomore)

| FIRST SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| CODE | COURSE TITLE | CRED | LECT | LAB | PRE-REQUISITE | CO-REQUISITE |
| MATH 201 | Calculus III | 3 | 3 | 0 | MATH 102 | |
| ENGL 214 | Technical Report Writing | 3 | 3 | 0 | ENGL 102 | |
| EE 201 | Electric Circuits I | 4 | 3 | 3 | MATH 102 PHYS 102 | |
| REE 201 | Introduction to Renewable Energy Engineering | 3 | 3 | 0 | PHYS 102 | |
| REE 202 | Engineering Workshop | 2 | 0 | 6 | | |
| REE 203 | Applied Thermodynamics | 3 | 3 | 0 | MATH 102 PHYS 102 | |
| TOTAL (CREDIT) | | 18 | | | | |

| SECOND SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| CODE | COURSE TITLE | CRED | LECT | LAB | PRE-REQUISITE | CO-REQUISITE |
| MATH 202 | Elem. Diff. Equations | 2 | 3 | 0 | MATH 201 | |
| ETEC 115 | Computer and Information | 2 | 2 | 0 | | |
| REE 204 | Engineering Statics and Dynamics | 3 | 3 | 0 | MATH 102 PHYS 102 | |
| ME 205 | Materials Science | 3 | 2 | 3 | CHEM 101 PHYS 102 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| EE 205 | Electric Circuits II | 3 | 3 | 0 | EE 201<br>MATH 201 | |
| REE 205 | 3D-CAD and Modeling | 1 | 1 | 0 | | REE 2051 |
| REE 2051 | 3D-CAD and Modeling-Lab | 1 | 0 | 3 | | REE 205 |
| TOTAL (CREDIT) | | 15 | | | | |

## THIRD YEAR OF (REE) PROGRAM (Junior)

| FIRST SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| CODE | COURSE TITLE | CRED | LECT | LAB | PRE-REQUISITE | CO-REQUISITE |
| MATH 302 | Engineering Mathematics | 3 | 3 | 0 | MATH 202 | |
| ME 311 | Fluid Mechanics | 3 | 3 | 0 | REE 203 | |
| REE 301 | Power Electronics for REE | 3 | 3 | 0 | EE 205 | REE 3011 |
| REE 3011 | Power Electronics for REE Lab | 1 | 0 | 3 | | REE 301 |
| REE 302 | Power Systems Analysis | 3 | 3 | 0 | EE 205 | REE 3021 |
| REE 3021 | Power Systems Analysis Lab | 1 | 0 | 3 | | REE 302 |
| REE 303 | Measurement and Instrumentation | 3 | 3 | 0 | EE 205 REE 203 | REE 3031 |
| REE 3031 | Measurement and Instrumentation Lab | 1 | 0 | 3 | | REE 303 |
| TOTAL (CREDIT) | | 18 | | | | |

| SECOND SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| CODE | COURSE TITLE | CRED | LECT | LAB | PRE-REQUISITE | CO-REQUISITE |
| EDUC 115 | Work Values and Ethics | 2 | 2 | 0 | | |
| REE 304 | Solar PV | 3 | 3 | 0 | REE 301<br>REE 201 | REE 3041 |
| REE 3041 | Solar PV Lab | 1 | 0 | 3 | | REE 304 |
| MATH 335 | Numerical Analysis | 3 | 3 | 0 | MATH 302 | |
| REE 305 | Wind Energy Technology | 3 | 3 | 0 | ME 311<br>REE 302 | REE 3051 |
| REE 3051 | Wind Energy Technology Lab | 1 | 0 | 3 | | REE 305 |

| | | | | | | |
|---|---|---|---|---|---|---|
| REE 306 | Heat and Mass Transfer | 3 | 3 | 0 | ME 311 | REE 307 |
| REE 307 | Heat and Fluid Laboratory | 1 | 0 | 3 | | REE 306 |
| TOTAL (CREDIT) | | 17 | | | | |

## SUMMER SESSION

| CODE | COURSE TITLE | CRED | LECT | LAB | PRE-REQUISITE | CO-REQUISITE |
|---|---|---|---|---|---|---|
| REE 350 | Summer Practical Training | 0 | 0 | 0 | ENGL 214 completion of 92 CRT | |
| TOTAL (CREDIT) | | 0 | | | | |

## FOURTH YEAR OF (REE) PROGRAM (Senior)

FIRST SEMESTER

| CODE | COURSE TITLE | CRED | LECT | LAB | PRE-REQUISITE | CO-REQUISITE |
|---|---|---|---|---|---|---|
| REE 401 | Solar Thermal Energy | 3 | 3 | 0 | REE 304 REE 306 | |
| REE 402 | Energy Efficiency | 3 | 3 | 0 | REE 303 REE 305 | |
| REE 403 | Economics of Energy Applications | 3 | 3 | 0 | MATH 335 | |
| REE 440 | Senior Design Project I | 1 | 1 | 0 | REE 350 | |
| REE 4XX | REE Elective I | 3 | 3 | 0 | | |
| CRCL 115 | University Life Skills | 3 | 3 | 0 | | |
| TOTAL (CREDIT) | | 16 | | | | |

SECOND SEMESTER

| CODE | COURSE TITLE | CRED | LECT | LAB | PRE-REQUISITE | CO-REQUISITE |
|---|---|---|---|---|---|---|
| REE 404 | Energy Generation and Control Equipment | 3 | 3 | 0 | REE 301 REE 403 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| REE 405 | Energy Conversion and Storage Applications | 3 | 3 | 0 | REE 303<br>REE 305 | REE 4051 |
| REE 4051 | Energy Conversion and Storage Applications Lab | 1 | 0 | 3 | | REE 405 |
| REE 441 | Senior Design Project II | 2 | 0 | 6 | REE 440 | |
| REE 4XX | REE Elective II | 3 | 3 | 0 | | |
| GS 4XX | General Study Elective | 3 | 3 | 0 | | |
| EDUC 125 | Entrepreneurship | 2 | 2 | 0 | | |
| TOTAL (CREDIT) | | 17 | | | | |

# Courses description

## COURSES DESCRIPTIONS

The following section gives a brief description of the contents of core Renewable Energy Engineering courses.

**REE 201 - Introduction to Renewable Energy Engineering (3-3-0)**

ntroduction to Renewable Energy Engineering including survey of conventional energy resources; oil, gas, coal, and enewable energy resources; thermal solar energy, Principals of photo-voltage PV solar cells, wind mills, hydropower idal, wave, geothermal, hydrogen & bio-fuels, and nuclear. Conservation of energy, energy resources, energy efficiency nergy production, introduction to energy power plants.

**Prerequisite:** PHYS 102

**REE 202 – Engineering Workshop (2-0-6)**

Engineering workshop course introduces an engineering workshop, theory and practices, principal machine techniques afety precautions and standard steps during urgent and hazards situations, basic hand tools and equipment, Electroni Components, PCB Layout, Lathing, Milling, Drilling, Welding, Casting, Sheet metal forming. The course includes skill planning, designing, and construction of mechanical and electronic equipment.

**Prerequisite:** NA

**REE 203 – Applied Thermodynamics (3-3-0)**

Basic concepts of applied thermodynamics: temperature, work, heat, internal energy and enthalpy. First law o hermodynamics for closed and steady-flow open systems. Thermodynamic properties of pure substances; changes o phase; equation of state. Second law of thermodynamics: concept of entropy. Power and refrigeration cycles.

**Prerequisite:** MATH 102, PHYS 102

**REE 204 – Engineering Statics and Dynamics (3-3-0)**

Engineering Statics and Dynamics course includes the following topics: Introduction to principles of statics and free body liagrams, forces and moment analysis; Introduction to dynamics: kinematics of rectilinear and curvilinear motion o

particles, kinematics of rotation and plane motion of rigid bodies, dynamics of particles and systems o particles, work and energy relations, impulse and momentum principles, dynamics of rigid bodies i plane motion.

**Prerequisite:** MATH 102, PHYS 102

**REE 205 - 3D-CAD and Modelling (1-1-0)**

3D-CAD and Modelling course introduces the basics of engineering drawing and 3D-CAD; Topics include: Graphica nterpretation of orthographic projection to include auxiliary views, section views, dimensioning, translation of desig nstructions into detail and assembly drawings, drawing conventions including weldments, piping, referencing and surfac inish notation, election of tolerances based on design requirements.

**Prerequisite:** NA , **Co-requisite:** REE 2051

**REE 2051 - 3D-CAD and Modelling Lab (1-0-4)**

3D-CAD and Modelling Lab enables students to use an up to date version of 3D-CAD (SOLIDWORKS) to construc orthographic drawings during this course. Students will construct 3D-Parts, 3D-Assemblies and 2D-Drawings in additio o 3D-Motion study and simulation including stress analysis and life cycle assessment (LCA) of parts in order to introduc ustainable 3D-Design. Computer laboratory equipped with up to date software's are essential.

**Prerequisite:** NA , **Co-requisite:** REE 205

**REE 301 - Power Electronics for REE (3-3-0)**

Characteristics of power electronic (PE) semiconductor devices. Ideal and practical switches. Switching characteristics o levices. Power switch losses. Diode, thyristor, triac and power transistor. Firing angle control. High power devices. Powe lectronic converters in renewable energy applications: AC-DC Rectifiers and controlled rectifiers; DC-DC choppers uck, boost, buck-boost; AC -AC cycloconverters; DC-AC inverters. PWM control, SVM control. Power quality issues JPS and SMPS power supplies. DC adjustable speed drive systems. AC adjustable speed motor/drive combinations Multilevel converters and applications.

**Prerequisite:** EE 205 **Co-requisite:** REE 3011

**REE 3011 - Power Electronics for REE Lab (1-0-3)**

Operation, simulation and design of the standard switching power converter: diode, thyristor, triac and power transistor re used in power applications as switching devices. Application of high power converters in rectification, inversion requency conversion, DC and AC machine control, switch-mode power supplies, PV systems, wind energy conversio ystems, storage systems and other renewable energy engineering applications. Design of the standard switching powe upply topologies such as the rectifiers, inverters, buck, boost, buck-boost, and Cuk switch mode converters. PWM lgorithms.

**Co-requisite:** REE 301

**REE 302 - Power Systems Analysis (3-3-0)**

Basic principles, Per-unit system, Power generation, Transmission and subtransmission, Distribution, Loads, Power facto correction, Balanced three-phase power, Generator and transformer models, line model, Power flow analysis, Powe dispatch problem, Transient stability, Dynamic stability, Symmetrical components and unbalanced faults, Load frequency control, Automatic generation control, Reactive power and generation control, Power system stabilizer (PSS) design.

Prerequisite: EE 205 **Co-requisite:** REE 3021

**REE 3021 - Power Systems Analysis Lab (1-0-3)**

Per-unit system conversion, Parameters of a transmission lines, Formation of Y-bus using singular transformation metho with and without mutual coupling, Power angle curve for synchronous machine, Formation of Jacobian matrix, Load flow tudies for a given power system using software package, Fault studies for a given power system using software package Optimal generator scheduling for thermal power plants using software Package, Critical clearing time, Design of PSS egulators using pole placement method.

**Co-requisite:** REE 302

**REE 303 – Measurement and Instrumentation (3-3-0)**

ntroduction to instrumentation and control of renewable energy systems, Principles of measurements; Stati haracteristics, accuracy, precision, repeatability, reproducibility, resolution, sensitivity, linearity, drift, span, range lynamic characteristics, transfer function, zero order instruments, first order instruments, step and ramp response of firs rder instruments, frequency response of first order instruments, second order instruments, step ramp response of secon rder instruments, dead time; Elements, errors types of errors, cross errors, systematic errors, random errors; Basi lectronics and display instruments; Transducers, sensors, and actuators; Measuring instruments/devices for temperature ressure, velocity, speed, flow, torque and solar flux, current, voltage and power factor; Industrial instrumentation Environmental pollution monitoring devices, Metrological stations.

**Prerequisite:** EE 205 and REE 203 **Co-requisite:** REE 3031

**REE 3031 – Measurement and Instrumentation Lab (1-0-3)**

ntroduction to laboratory instrumentation. Computerized data acquisition. Statistical analysis of data. Time series dat nd spectral analysis. Transducers for measurement of solid, fluid and dynamical quantities. Design of experiments. Basi nstrumentation and measurements in conducting the experiments for electrical and mechanical measurements Developing experimental system and experimental strategy.

**Co-requisite:** REE 303

**REE 304 - Solar PV (3-3-0)**

PV including the solar irradiation and the sunlight properties, semiconductors physics, PN junctions, PV principle o operation, PV materials, PV design, PV efficiency, limitations of PV cells, PV panel design aspects, techniques for testing PV systems and components, illustrations of solar PV systems, PV integration with electric grids, 3-hours in Lab including basics and characterization, measuring the effects of temperature, dust and light shading on the performance o the solar PV systems.

**Prerequisite:** REE 201, REE 301 **Co-requisite:** REE 3041

**REE 3041 - Solar PV Lab (1-0-3)**

This course covers the various aspects of solar photovoltaic systems including measurement of solar irradiance, sola photovoltaic modules, recent MPPT techniques, latest literature of converter design, energy storage for PV applications balance of systems, grid integration of PV systems, PV system protection, economics of grid connected PV system and system yield performance using PV system.

**Co-requisite:** REE 304

**REE 305 - Wind Energy Technology (3-3-0)**

Wind Energy Systems including wind energy and wind power design and principles, operation of wind energy systems economic analysis of wind energy system, site selection and limitations, wind conditions data monitoring and analysis calculations of electrical power capacity from windmills, integration of windmills electricity with electrical network.

**Prerequisite:** ME 311, REE 302 **Co-requisite:** REE 3051

**REE 3051 - Wind Energy Technology Lab (1-0-3)**

Lab consists of 3 hours of practical applications about aerodynamics, dynamic behavior, electro-technical interrelation and loads on the wind turbine and related generator measurements and calculations. Students asked to perform measurements and data analysis concerning the power curve on a laboratory small wind turbine. Written report at the end of the semester is provided and evaluated by the Lab instructor.

**Co-requisite:** REE 305

**REE 306 – Heat and Mass Transfer (3-3-0)**

Heat and Mass Transfer including an introductory treatment of the governing laws for heat and mass transfer, covering topics of steady state and transient conduction, fundamentals and engineering treatment of convection heat transfer, heat transfer with phase change (boiling/condensation), radiation heat transfer and heat exchangers, fundamentals of mass transfer, differential equations of mass transfer, steady state and unsteady-state molecular diffusion, convective mas

transfer, interface mass transfer, mass transfer theories, mass transfer equipment, Absorption and humidification operations, both analytical and numerical solution methods are presented.

**Prerequisite:** ME 311 **Co-requisite:** REE 307

**REE 307 – Heat and Fluid Laboratory (1-0-3)**

Heat and Fluid Laboratory course covers the experimental applications related to both fluid mechanics and heat transfe courses. The main focus will be in the basic experiments related to heat transfer and fluid mechanics. The performed Test will concentrate on the topics related to renewable energy applications such as heat exchangers, losses in pipe flow pumps and turbines performance.

**Co-requisite:** REE 306

**REE 350 - Summer Practical Training (0-0-0)**

Summer Training including 8 working weeks in summer of real practical field training to increase students skills and offering a real career opportunities for both students in the field of sustainable and renewable energy engineering and industries, students are required to submit a technical report to the training supervisor and should fullfill the requirement of presentation and discussions by academic SEE committee.

**Prerequisite:** ENGL 214 and a completion of 97 CRT

**REE 401 - Solar Thermal Energy (3-3-0)**

Solar Thermal Energy including characteristics of solar radiation and solar collectors, collector performance, long-term operation behaviour, solar thermal system modelling, thermal storage process, concentrators and solar power systems using PCM and nano- fluids to enhance solar thermal performance, 3D computer aided design and simulation.

**Prerequisite:** REE 304, REE 306

**REE 402 - Energy Efficiency (3-3-0)**

Energy Efficiency including analysis of energy systems efficiency, material targets core areas of efficiency in space heating and cooling design, detail design analysis of combustion engines and space heating and cooling processes computer aided simulation of energy consumption and energy efficiency.

**Prerequisite:** REE 303, REE 305

**REE 403 - Economics of Energy Applications (3-3-0)**

Economics of Energy Systems including a fundamentals of the engineering economics then discussed the economics o energy statistics, demand for sustainable and conventional energy, supply of electricity produced by both sustainable and

conventional energy techniques, exploration, production, transportation, processing and marketing o sustainable and renewable energy, energy tariff challenges, introduction to energy- economics of th nvironment.

**Prerequisite:** MATH 335

**REE 404 – Energy generation and control equipment (3-3-0)**

Basic principle of electricity generation. Development of generator design. Power transformers. Various motors used i power stations. Three phase induction generators, Doubly-fed induction generator (DFIG) and synchronous generators Wind energy conversion system components. Wind turbine generators including asynchronous induction generators power electronics, filters, transformers. Photovoltaic energy conversion system components. Maximum power poin tracking (MPPT). Storage. Connection to the electric grid and maintenance. Synchronization. Single phase and thre phase AC voltage regulators. Control systems. Phase controlled line commuted converters. Filters, Inductor filter an Capacitor filter. AC commutators machines. Load regulation.

**Prerequisite:** REE 301, REE 403

**REE 405 - Energy Conversion and Storage Applications (3-3-0)**

Energy Conversion and Storage Applications including examination of the principles and energy storage characteristics o electric energy storage techniques including batteries, electric-double layer capacitors and pseudo-capacitors, therma energy storage techniques including PCM energy storage, and mechanical energy storage techniques including compressed air, flywheels, hydroelectric storage.

**Prerequisite:** REE 303, REE 305 **Co-requisite:** REE 4051

**REE 4051 - Energy Conversion and Storage Applications Lab (1-0-3)**

This laboratory course compliments the lecture course REE 405. It examines the fundamental physics and chemistry o elected energy conversion and energy storage devices and their use and interconnects strategies in electric powe pplications. This laboratory course provides hands-on experiences with the topics of 405.

**Co-requisite:** REE 405

**REE 440 - Senior Design Project I (1-1-0)**

Senior Design Project I course including an integration of various selective components of the renewable energy engineering curriculum. A comprehensive discussion of topics related to the senior design project issues is devoted by ecture, such as a project topic selection related to real field, format, writing and organization of the progress reports an inal comprehensive report, presentation, teamwork, engineering experience and knowledge should be devoted in al project activities. Students divided into groups at the end of the semester, each group should provide a project topi

proposal, presentation and final report. The project should be a comprehensive evaluation and/or cas study providing analysis of a real REE issue.

**Prerequisite:** REE 350

**REE 441 - Senior Design Project II (2-0-6)**

Senior Design Project II course including an integration of a various selective components related to REE curriculum Students should apply the basic knowledge related to their project topic such as physics, mathematics, writing skills, 3D CAD, materials sciences and all engineering sciences studied in the entire REE program. A complete and comprehensiv project based on the first stage of senior design project I experience should be fulfilled taking into considerations a rea field issues related to coop summer training and/or industrial field of the renewable energy engineering. Student shoul provide a complete designed project including a presentation and progress reports and final report taking int consideration reliability, ethics, social impact, safety and economics of the proposed project. The topic of the projec should cover a real issue related to REE providing suitable and applicable solutions.

**Prerequisite:** REE 440

**REE 411 – Network Engineering and Management (3-3-0)**

Network Engineering and Management including technologies for integrating renewable energy sources (RES) to th grid-modelling, analysing power network-data acquisition, control and associated software in the context of powe electronic converters-sensors, data acquisition systems and control equipment.

**Prerequisite:** REE 302, REE 403

**REE 412 - Electronic Devices (3-3-0)**

Advanced topics of Electrical and Electronic materials and devices including an advanced electromagnetism an nductance, AC power circuit, circuits, resonant circuits, circuit theorems, Thevenin's, superposition, amplifiers, op-amp heory, boolean logic and logic gates, combination logic.

**Prerequisite:** REE 301

**REE 413 - Advanced Solar Cells (3-3-0)**

Advanced Solar Cells and Systems including novel solar cells technologies, in detailed solar cells modules operatio principles an physics, measurement techniques and performance analysis of the solar cells. Including also the systems o andem solar cells, concentrator (CPV and HCPV) and hybrid solar PV (3-generations).

**Prerequisite:** REE 304

**REE 414 - PV Design and Manufacturing (3-3-0)**

PV Design and Manufacturing including, solar cells operations, different trends in commercial cel echnology, manufacturing processes, performance and product reliability depending on different solar cells parameter nd processing, silicon-based and third generation solar cells complete production processes, heterojunction solar cells uitability of materials, manufacturing technology and application.

**Prerequisite:** REE 304

**REE 415 - PV for Buildings (3-3-0)**

PV for Buildings course including PV systems in the buildings, integration of PV modules into the building. efficien buildings, building directions and its effect on and solar accessibility, building energy simulation software. PV i buildings and related challenges, Advanced topics related to efficient and smart buildings with PV systems.

**Prerequisite:** REE 304

**REE 416 - Passive Solar Buildings (3-3-0)**

Passive solar buildings course including the solar energy and passively heating and/or cooling of the buildings, sola adiations, zero building energy efficient design, passive solar heating, thermal mass, and passive cooling.

**Prerequisite:** REE 401, REE 402

**REE 417 - Wind Turbines: Design and operation (3-3-0)**

Wind Turbines: Design and operation including complications of production of electricity from wind power, win urbines locations and atmospheric science, analysis of experimental data, design and control analysis of wind turbin components, wind turbines sizing and citing analysis, adaptation of wind turbines with smart grids.

**Prerequisite:** REE 305

**REE 418 - Advanced Fluid Mechanics (3-3-0)**

Advanced Fluid Mechanics including control volume analysis, dimensional analysis and similitude, compressible flow low in ducts, fluid flow in pipelines, effects of viscous flow and heat transfer, waves and shocks, viscous fluid flow ydrodynamic lubrication and boundary layers, elasto-hydro dynamics theory and Reynolds equation.

**Prerequisite:** ME 311

**REE 419 - Wind Turbines and Related Equipment (3-3-0)**

Wind Turbine and related equipment including, design of Wind Turbines components includes wind turbines structure and frame, generator, and atmospheric science, analysis of experimental data, design nd control analysis of wind turbine components, wind turbines sizing and citing analysis, adaptation of wind turbines vith smart grids.

**Prerequisite:** REE 305

**REE 420 – Engineering of Biomass and Energy Systems (3-3-0)**

Biomass Energy Systems including biomass characterization techniques and range of biomass energy sources (forestry vastes and crops), biochemical and thermochemical conversion processes (direct combustion, biomass co-firing gasification, pyrolysis, anaerobic digestion, fermentation, landfill gas and cogeneration), chemical reactors and basi process design, biofuels from biomass (biodiesel, syngas, biogas).

**Prerequisite:** REE 402

**REE 421 – Hydrogen and Fuel (3-3-0)**

Hydrogen and Fuel Cells including thermodynamics of fuel cells, chemical reaction engineering, electrochemical ngineering, studding various types of major fuel cells including polymer electrolyte membrane fuel cell (PEMFC), direct nethanol fuel cell (DMFC), alkaline fuel cell (AFC), Urea Fuel Cells (UFC), molten carbonate fuel cell (MCFC), solid xide fuel cell (SOFC), metal air fuel cell (MAFC), and microbial fuel cell (MFC), electrodes and membrane materials.

**Prerequisite:** REE 306

**REE 422 - Hydroelectric Power Engineering (3-3-0)**

Hydroelectric Power Engineering including advanced topics on hydro-power production, hydrology, power, head, flow ate, turbines hydrodynamics; Francis, Kaplan, Pelton, cross-flow. System components; generators, governors, penstocks pillways, valves, gates, trash racks. Large-scale and. Pumped storage.

**Prerequisite:** REE 402

**REE 423 - Geothermal Energy Engineering (3-3-0)**

Geothermal Energy Engineering including an introduction and exploration of heat mapping of geothermal, characteristics of the geothermal reservoir, analysis of temperature and heat transfer in a borehole (dry steam, flash steam and binary cycle power plants), test analysis of the geothermal well for electricity generation, heat pumps of the ground source, heating and cooling, economical assessment of geothermal projects.

**Prerequisite:** REE 306

**REE 424 – Electromagnetic Field Analysis (3-3-0)**

Electromagnetic Field Analysis course including an introduction to electromagnetic fields, electrica potential, magnetic materials, magnetic inductance, time varying fields and Maxwell's equations, plan vave propagation, reflection and refraction, fiberoptics and transmission lines.

**Prerequisite:** REE 301

**REE 425 - Electric Power Distribution (3-3-0)**

Electric power distribution system course including planning, design and operations, load characterisation and distributio ransformers, design of local transmission lines, design considerations of the primary and secondary feeders, voltag egulation for distribution system, protection, reliability and smart grid performance.

**Prerequisite:** REE 402

**REE 426 - Applied Control Engineering (3-3-0)**

Applied Control Engineering course including analysis of a control systems, computer- based controller for continuou nd discrete-time industrial process, parametric model identification, digital control design, z-transformation, digitizing nalog controllers, PID and PLC controllers, and computer-based simulations.

**Prerequisite:** REE 302

**REE 427 – Optoelectronics Devices (3-3-0)**

Optoelectronics course including the principles, interaction of light with semiconductor materials in a p-n junction ncluding absorption phenomena, electroluminescence, and stimulated emission, direct and indirect compoun emiconductors, basic devices, photodiodes, LEDs, semiconductor optical amplifiers, laser diodes, array detectors CMOS, CCD, LEDs arrays, solar cells, imaging with array detectors and LED displays.

**Prerequisite:** REE 304

**REE 428 - Microcontroller and Embedded Systems (3-3-0)**

Microcontroller and Embedded Systems course including an introduction to microcontrollers and interfacing, operation pplications, organization, analysis of specific processors, software and hardware interface systems, different embedde ystems.

**Prerequisite:** REE 302

**REE 429 - Special Topics in Solar Energy (3-3-0)**

This course covers emerging and advanced topics in the field of solar energy. The contents will vary depending on th opic.

**Prerequisite:** REE 304, REE 401

**REE 430 - Special Topics in Wind Energy (3-3-0)**

This course covers emerging and advanced topics in the field of wind energy. The contents will vary depending on th topic.

**Prerequisite:** REE 305, REE 402

**REE 431 - Special Topics in Bio-energy (3-3-0)**

This course covers emerging and advanced topics in the field of bio-energy. The contents will vary depending on th topic.

**Prerequisite:** REE 306, REE 402

**REE 432 - Special Topics in Energy Systems (3-3-0)**

This course covers emerging and advanced topics in the field of energy systems. The contents will vary depending on th topic.

**Prerequisite:** REE 302, REE 402

# Program key performance indicator (KPI's)

| Code | Key Performance Indicators | Description |
|---|---|---|
| **KPI-P-01** | Percentage of achieved indicators of the program operational plan objectives **(i8)** | Percentage of performance indicators of the operational plan objectives of the program that achieved the targeted annual level to the total number of indicators targeted for these objectives in the same year |
| **KPI-P-02** | The awareness and support of the teaching staff and administrators of the mission of the program/institution **(i2)** | Percentage of faculty and program staff who are aware of the program / institution's mission using a questionnaire / interview to the total number of faculty and staff. |
| **KPI-P-03** | Students' Evaluation of quality of learning experience in the program **(i10)** | Average of overall rating of final year students for the quality of learning experience in the program on a five-point scale in an annual survey |
| **KPI-P-04** | Students' evaluation of the quality of the courses **(i6)** | Average students overall rating for the quality of courses on a five-point scale in an annual survey |
| **KPI-P-05** | Completion rate **(i12)** | Proportion of undergraduate students who completed the program in minimum time in each cohort |
| **KPI-P-06** | First-year students retention rate **(i1)** | Percentage of first-year undergraduate students who continue at the program the next year to the total number of first-year students in the same year |
| **KPI-P-07** | Students' performance in the professional and/or national examinations | Percentage of students or graduates who were successful in the professional and / or national examinations, or their score average and median (if any) |
| **KPI-P-08** | Graduates' employability and enrolment in postgraduate programs **(i14,19)** | Percentage of graduates from the program who within a year of graduation were:<br>a. employed<br>b. enrolled in postgraduate programs during the first year of their graduation to the total number of graduates in the same year |
| **KPI-P-09** | Average number of students in the class | Average number of students per class (in each teaching session/activity: lecture, small group, tutorial, laboratory or clinical session) |

| Code | Key Performance Indicators | Description |
|---|---|---|
| **KPI-P-10** | Employers' evaluation of the program graduates proficiency **(i26)** | Average of overall rating of employers for the proficiency of the program graduates on a five-point scale in an annual survey |
| **KPI-P-11** | Student evaluation of the Value and Quality of Field Activities **(i15)** | Percentage of students' satisfaction with the presence and quality of field activities during the semester and the academic year at the program / college / university. |
| **KPI-P-12** | Students' satisfaction with the offered services **(i18,28)** | Average of students' satisfaction rate with the various services offered by the program (restaurants, transportation, sports facilities, academic advising, ...) on a five-point scale in an annual survey |
| **KPI-P-13** | Ratio of students to teaching staff **(i9)** | Ratio of the total number of students to the total number of full-time and full-time equivalent teaching staff in the program |
| **KPI-P-14** | Percentage of teaching staff distribution | Percentage of teaching staff distribution based on:<br>a. Gender<br>b. Branches<br>c. Academic Ranking |
| **KPI-P-15** | Proportion of teaching staff leaving the program **(i37)** | Proportion of teaching staff leaving the program annually for reasons other than age retirement to the total number of teaching staff. |
| **KPI-P-16** | Percentage of publications of faculty members **(i36)** | Percentage of full-time faculty members who published at least one research during the year to total faculty members in the program |
| **KPI-P-17** | Rate of published research per faculty member **(i42)** | The average number of refereed and/or published research per each faculty member during the year (total number of refereed and/or published research to the total number of full-time or equivalent faculty members during the year) |
| **KPI-P-18** | Citations rate in refereed journals per faculty member **(i44)** | The average number of citations in refereed journals from published research per faculty member in the program (total number of citations in refereed journals from published research for full-time or equivalent faculty members to the total research published) |

| Code | Key Performance Indicators | Description |
|---|---|---|
| **KPI-P-19** | Relevance of the qualifications and experience of faculty members to the courses they teach **(i17)** | Percentage of faculty members with qualifications and experience of the courses they are studying compared to the total number of courses offered during the academic year. |
| **KPI-P-20** | The percentage of full-time teaching staff members and the others of administrative staff that participate in community services activities **(i49)** | Number of full-time faculty, other staff and administrators engaged in a community service activity during the academic year compared to the total number of faculty, other staff and administrators |
| **KPI-P-21** | Satisfaction of beneficiaries with the learning resources **(i13,27,33)** | Average of beneficiaries' satisfaction rate with the adequacy and diversity of learning resources (references, journals, databases… etc.) on a five-point scale in an annual survey. |

# Facilities (Classrooms – Laboratories - Specialized equipment - ….etc)

## A. Offices, Classrooms and Laboratories

College of Engineering is located in a purpose-built modern building (Building # B14) in the main campus o University of Ha'il. The college was shifted to the current location in the Fall of 2018. The building is equippe with modern Building Management System (BMS) for environment control. The Department of Electrica Engineering is located towards the northern side of the building in the ground, first and second floor. The nev building provides much more space for offices, classrooms, laboratories, and facilities than those, which wer available in the old building.

### A.1 Offices

n majority of cases, faculty members have their own offices, and in general one faculty member has his ow office. The office has adequate furniture and is equipped with wired/wireless internet connection and in a fe occasions has a desktop computer, printer machine to print out documents. The average office size is adequat o receive student visitors to discuss education and advising related matters. Whenever there arises a need, ther s a seminar room with a round table to hold departmental meetings, thesis defenses and other activities. Th ollowing Table 7- 1, lists the EE department count of the ground, first and second floor with all of its rooms.

Table 7- 1, Count of room facilities on three floors.

| Floor | Room | Number of rooms |
|---|---|---|
| **Ground Floor** | Departmental Labs | 5 |
| **Ground Floor** | Computer Labs | 1 |
| **Ground Floor** | Toilets | 2 |
| **First Floor** | Departmental Labs | 4 |
| **First Floor** | Classrooms | 6 |
| **First Floor** | Offices | 3 |
| **First Floor** | Toilets | 2 |
| **Second Floor** | Offices | 36 |
| **Second Floor** | Department's Chairman Office | 1 |

| | | |
|---|---|---|
| **Second Floor** | Break Faculty Members | 1 |
| **Second Floor** | Sessions | 2 |
| **Second Floor** | Terrace | 2 |
| **Second Floor** | Toilets | 2 |

## A.2 Classrooms

All classrooms are equipped with white boards, data show with a separate white screen. No stationary PCs are available in classrooms, students and faculty bring in their own laptops if they desire to use the data show to present their materials. Classrooms of the BSc Electrical Engineering program are located on the ground and the first floors.

These rooms vary in size and some of them are shared among different programs subject to availability. Details of the ground, first and second floors is shown in the table below with classrooms highlighted in Table 7- 2.

Table 7- 2, Classroom Locations & Capacity

| Floor | Room Number | Classroom capacity |
|---|---|---|
| **First Floor** | F-184 | 45 |
| | F-186 | 30 |
| | F-188 | 30 |
| | F-190 | 45 |
| | F-195 | 35 |
| | F-196 | 35 |

## A.3 Laboratory Facilities

From the Program Educational Objectives: Graduates will model, analyze, design, and experimentally evaluate components or systems that achieve desired technical specifications subject to the reality of economic constraints.

Instructional laboratories feature modern equipment and computer-aided design tools that are more than adequate for most undergraduate courses. Nevertheless, many students take advantage of state-of-the-art research facilities to support their project work.

Labs are used by both faculty and students for course work as well as to conduct research. It is worth noting that some physical rooms are shared among different labs. Table 7- 3 shows different Labs and their locations as well as sizes. Senior students can use these labs for their projects.

**Electrical Circuits Lab**: This lab helps students to apply basic measurements of electrica circuit, voltage, current and components such as resistance, capacitance and inductance. Experimenta verification of basic electrical laws and theories such as series and parallel connections.

**Electrical Circuits and Digital Logic Lab**: This lab facilitates students to utilize fundamentals electrical circui and digital logic circuits using lab equipment. It includes modern work benches, digital and analog millimeters unction generators and digital oscilloscopes etc. Experimental verification of basic electrical laws and theorie such as Ohm, KV, KCL, NVM, MCM, superposition, Norton, Thevenin's and maximum power transfer.

**Electronics and Digital logic circuit design Lab**: This lab serves the core courses such as EE 200 (Digita ogic circuit design). It familiarizes the student with logic gates and medium scale integration (MSI) circuits Within this lab, the student tests the validity of the logic concepts. Furthermore, they can analyze ‹design ‹build and test basic combinational and sequential logic circuits. Also, this lab serves the core courses EE 203 "Electronics I" and EE 303 "Electronics II". In this lab the students learns the basic operations of electroni components such as diodes, BJT and MOSFET. In addition, the operation and applications of single nultistage ‹feedback and operational amplifier circuits are demonstrated. Furthermore ‹the students are give experience of operation and application of active filters and oscillators.

**Electric Energy Machine Lab**: This lab helps student to apply fundamental Electric Energy machines design such as balanced three phase circuits, magnetic circuit, single phase transformers, DC generators, DC motors Three-Phase synchronous generators, Three-Phase synchronous motors, Three-Phase induction motor with Slip Ring rotor, Three-Phase squirrel cage induction motor and related work benches.

**Electrical Engineering Design and Simulation Lab:** In this lab students perform software and hardwar experiments in EE390-Digital Systems Engineering. The laboratory has ten PCs with TASM installed, ten Flight-86 embedded training kits and ten training kits for microcontroller 8051. Experiments include ntroduction to Debug and Turbo Debugger, Addressing modes and data transfer instructions, Arithmeti nstructions, Shift and rotate instructions, Using BIOS Services and DOS functions Part 1: Text-base Graphics, Using BIOS Services and DOS functions Part 2: Pixel-based Graphics, Introduction to Flight8 Microprocessor Trainer and Application Board, Flight86 Application I – Traffic Lights, Flight86 Applicatio I – Motor Control and Introduction to the 8051 Microcontroller.

**Digital Systems and Communications Lab:** Students perform hardware and software experiments in relatio o EE370-Communications Engineering-I. The laboratory has ten workstations equipped with PCs oscilloscopes ‹and function generators. Hardware experiments are performed using analog and digita communications trainers. Experiments include Amplitude and Angle modulation/demodulation, sampling an quantization, pulse code modulation/demodulation ‹and channel effects. Software simulations are carried out Two spectrum analyzers with bandwidths up to 1.2 GHz are also available for observing the spectra o baseband/band pass signals.

**Control Engineering Lab:** The lab constitutes the practice part of control engineering course. It is a review o modeling, simulation, and implementation of a physical dynamical system by a linear time invariant ordinary differential equation. Compensators are designed to guarantee transient and steady state specifications.

**Computer Lab:** This computer lab is a modern, spacious facility equipped with the lates echnology. It features a variety of computers, as well as a wide range of software applications. The lab also ha high-speed internet connection and access to printers and scanners. The room is well-lit and comfortable, witl rgonomic chairs for students to use while working. There are also whiteboards for group collaboration an rainstorming sessions. The lab is open to all students and faculty members, providing an ideal environment fo earning, research, and creativity. It serves course such as ICS 103 and courses that require programmin oftware tools. 17 in number computers are available equipped with the relevant software packages.

**Power Electronics Lab:** This lab is a dedicated to the study and development of power electronics. It i quipped with the latest technology and equipment to enable students to gain hands-on experience in the field o ower electronics. The lab provides students with an opportunity to explore the fundamentals of powe lectronics, including topics such as electrical machines, power converters, motor drives, and control systems tudents can also gain practical experience in designing and building their own circuits and systems. The lal lso provides access to various software packages for simulation and analysis of power electronic systems.

**Renewable Energy Lab:** This is a state-of-the-art facility dedicated to researching and developing new sola nergy technologies. The lab features a variety of cutting-edge equipment, including photovoltaic cells, sola hermal systems, and advanced solar tracking systems. Researchers in the lab are able to conduct experiment n a variety of topics related to solar energy, such as energy storage, efficiency improvements, and cos eduction. The lab also provides educational opportunities for students interested in learning more abou enewable energy sources.

aboratory facilities for Department of Industrial Engineering are located on the first floor of the buildin elow the faculty offices (Room numbers F – 078, F – 081, F – 084, F – 088 and F – 091) and a computer lal oused in Room F – 213. All labs are available to the students and faculty during the regular college hours However, laboratory facilities can also be used outside hours with the permission of the Department Chairman.

Table 7- 3 Laboratories size, capacity and utility.

| No | Name of Lab | Location | Purpose of the Lab | Course for Lab | Students /session |
|---|---|---|---|---|---|
| **1.** | Electrical Circuits | F-200 | Analysis and design of basic electric circuits | EE201, EE202 | 15 |
| **2.** | Electronics, Digital Logic Design | F-189 | Testing of logic circuits, Testing basic operation of electronic components | EE200, EE203, EE303 | 15 |
| **3** | Electrical Engineering Design Simulation Lab | F-192 | Performing software and hardware experiments in EE390. | EE 204, EE390 | 15 |
| **4** | Computer Lab | G-278 | It serves the IT course such as ICS 103 and courses that require programming software tools. | ICS 103, ICS 252 | 17 |
| **5** | Electric Circuits and Digital Logic Lab | G-273 | Analysis and design of fundamental electric circuits and logic circuits | EE201, EE202 | 15 |
| **6** | Electric Energy Machines | G-263 | Testing and characterizing different magnetic circuits and electric machines | EE 206, EE306, EE460 | 15 |
| **7** | Power Electronics Lab | G-266 | Testing and analyzing a variety of power electronics components and related circuits. | EE 206, EE306, EE460 | 15 |
| **8** | Digital Systems and Communications Lab | F-185 | Testing communication systems and measurements of room acoustics. | EE370 | 15 |
| **9** | Control Engineering Lab | G-269 | Modelling and simulation and implementation of physical dynamical systems | EE 380 | 15 |
| **10** | Renewable Energy Lab | G-261 | Modelling and implementation of solar and renewable energy resources | REE 201, REE3041, REE3051 REE3011 | 15 |

afety purposes, all labs have the following equipment installed:

1- **Health and safety guidelines**

All the labs are installed with a large sized flex bearing health and safety guidelines. At the beginning of each semester students are advised to read and understand the health and safety guidelines. Moreover, these guidelines are made permanent part of laboratory manuals for each course of the program. All the working benches are fitted with emergency cutoff switches.

**2- Fire Extinguishers**

All the laboratories fitted with water sprinklers. Most of the ground floor laboratories are equipped with dry riser facility. Moreover, all the laboratories are equipped with appropriate fire extinguishers.

**3- First aid kit and medical facility**

EE department has been fitted with first aid kits including general corridors and the labs. Selective faculty members have been trained for first aid in case of an emergency.

University has its own Medical Centre that is accessible to all faculty members and students. The Medical Centre provides all basic facilities such as, lab examination, X-Ray, medicines etc. Apart from General Practitioner, the Medical Centre also has specialists to cater for necessary advice. In a situation where the treatment is not within the scope of the Medical Centre, the faculty members and students may be referred to the Government Hospitals.

## 3. Computing Resources

A computer lab with 17 workstations is housed in Room G-278. The computer lab is equipped with all necessary software applications required by the students such as Microsoft Office suite. The lab also has licensed versions of MATLAB software for simulation and LABVIEW software. The lab is also equipped with smart multimedia projector and white board.

Access to computer labs are timetabled according to classes schedule at the beginning of each term, free time slots are left for students to come in and work on their own projects.

Computer labs are strictly used for educational purposes, no administrative and/or managerial tasks are allowed to be performed in these labs. Internet access is free of charge for students via a WiFi network that covers the whole campus and the dormitories.

The faculty members and students also have access to Blackboard System for uploading of lectures and other course material. Blackboard system has been an important tool for imparting online lectures especially during COVID – 19 situation.

## C. Guidance

Each lab is displayed with health and safety description flex. During each lab session, the instructor remains present in the lab to help students for carry out experiments. The faculty members answer any questions which students may ask regarding current running experiment. The faculty members collect and grade reports and do documentation to prepare students' results and comments on each experiment. A lab engineer is always present to provide students with equipment and/or tools they may need.

Instructor and engineer make sure of proper use of equipment and that safety rules are being complied with during lab sessions. IT professionals are also ready to help the students who use the labs, in case of any technical issues that may be faced by them.

## D. Maintenance and Upgrading of Facilities

Efforts are constantly being made to ensure proper maintenance of all lab equipment as well as upgradation to provide a conducive learning environment for the students. And also to ensure that each equipment is serviceable and safe to use.

### D.1 Maintenance of Facilities

All lab equipment is routinely checked by the instructor before the start of the session to ensure that it is serviceable and safe to use. In case of any malfunction of an equipment the OEM or the local vendor may be called to carry out necessary repairs.

The maintenance of the building is carried out by the University Maintenance Department.
A team of cleaners is available the week days. The team is responsible for dusting and cleaning the offices corridors, laboratories, toilets and the window glasses.

### D.2 Upgradation of Facilities

A full-time laboratory manager, maintains laboratory equipment and supplies. Each lab is supplied by a log book. Any faulty equipment is reported by faculty members in the log book with date, name and serial number of the equipment. Once the equipment is fixed the engineer completes the log book by dating and signing the form.

## E. Library Services

The central library of UoH is maintained by the Deanship of Library Affairs and its services are available to all the faculty members and students. The central library has wide range of books and journals related to Electrical Engineering. In addition to main University library, College of Engineering has a small library of its own inside the college of engineering building.

Library material in main University Library is shelved in open stacks using the Dewey Decimal Classification Scheme. The Library collection is accessible to all faculty members and students during the weekday work hours. Professional librarians are available during working hours in order to provide any assistance as needed by library users.
All faculty members and students also have access to Saudi Digital Library (SDL) where it provides access to all the major databases such as, IEEE Xplore, ACM Digital Library, Science Direct, Springer, Taylor & Francis Wiley, Oxford etc. and numerous more.

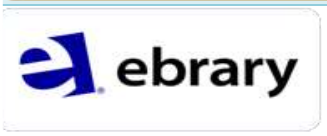
All library digital services are accessible through personal account of the faculty members as well as the students. All essential books required by the program are available in the library.

The faculty members and the students have access to the world's major providers of scientific, technical, and medical information data bases and online versions of many journals including those depicted in the following Table 7- 4.

Table 7- 4. Database Menu

| | |
|---|---|
| SDL المكتبة الرقمية السعودية Saudi Digital Library | **Saudi Digital Library** |
| ProQuest | ProQuest Central |
| ISI Web of KNOWLEDGE | Web of Science® - ISI Thomson Reuters |
| IEEE Xplore DIGITAL LIBRARY | IEEE/IEE |
| AMERICAN MATHEMATICAL SOCIETY MathSciNet | Math Science |
| WILEY | Wiley |
| SciVerse | Science Direct |
| SpringerLink | Springer |
| Emerald Research you can use | Emerald |

University of Hail

| | |
|---|---|
|  | British Medical Journals BMJ |
|  | IGI Global |
|  | Economist Historical Archive |
|  | eBrary |
|  | Jaypee |
|  | AAAS/Science |
|  | CAB Reviews - CABI |
|  | Emerald |
|  | Computing - ProQuest |
|  | OECD |
|  | American Society of Civil Engineers - جمعية الأمريكية للمهندسين المدنيين |

University of Hail

| | |
|---|---|
|  | Safari |
|  | Nature Publisher Group |
|  | Oxford Journals - Oxford University |
|  | Nutrition and Food Science - CABI |
|  | AIP - Scitation |
|  | MyiLibrary |
|  | قاعدة رسائل دار المنظومة |
|  | الجامع الكبير Al Jamea |
|  | AskZad |
|  | مكتبة نون(Nooon Books) |
|  | Edu Search |
|  | Eco Link |

| | |
|---|---|
| University of Hail islamic info | قاعدة العلوم الإسلامية والقانونية<br>Islamic Info |
| AraBase | اللغة العربية والأدب والعلوم الإنسانية_<br>Arab Base |
| Wolters Kluwer Health \| OvidSP | Ovid |
| ACCESS Medicine | Access Medicine |
| RSC Publishing | Royal Society of Chemistry -RSC- جمعية الملكية للكيمياء |
| GALE CENGAGE Learning | Gale Databases |
| Taylor & Francis Taylor & Francis Group | Taylor & Francis |
| UpToDate ONLINE | UpToDate |
| SAGE journals | SAGE |
| OXFORD | OXFORD |
| CAMBRIDGE JOURNALS | Cambridge |
| nature | Nature |

## F. Overall Comments on Facilities

All laboratory and library facilities are well suited to serve their purpose. These facilities are provided to safely accomplish the program educational objectives and provide a conducive learning environment. Excellen classrooms with high speed internet connections, laboratories and associated equipment are available to foste faculty-student interaction and to create a climate that encourages professional development and professiona activities. Computing and information infrastructures are in place to support the instructional and scholarly activities of the faculty as well as the students.

The University Office performs annual safety audits of each building. The audits include offices, classrooms laboratories, storage and shipping areas, and building utilities (electricity, water, sewer, heat/ac, elevators, fire etc.). Each program must maintain records of maintenance and calibration of equipment owned by and used by the program. This includes office equipment (copiers, fax machines, scanners, and printers) and laboratory equipment.

## Graduates employment opportunities

Electrical engineering has wide applications in manufacturing, service, commercial, and governmental sectors. Rapid Electronic development in the Kingdom of Saudi Arabia definitely requires an increasing number of competent and well-trained electrical engineers.

Typical industries and organizations, which employ mechanical engineers include:

- Electrical/Electronic industries
- Electrical power generation and distribution
- Automation and Control
- Telecommunications
- Defense
- Oil & Gas
- Food processing industries
- Health systems management
- Trading, logistics and transportation industries
- Banking and service organizations
- Training, research and development institution

# EQUIPMENT

## LIST OF EQUIPMENT AVAILABLE IN DIFFERENT LABORATORIES

### 1. Electrical Energy Machines Lab

| ELECTRIC ENERGY MACHINES LAB-Inventory | | | |
|---|---|---|---|
| **S. No** | **Description** | **Model #** | **Number of Units** |
| 1 | Multimeter Peak Tech | 3315 | 19 |
| 2 | Watt meters | CA405 | 9 |
| 3 | Motor Protection Switch | 732-83 | 6 |
| 4 | Three pole ON/OFF Switch | 731-42 | 10 |
| 5 | Multi Fuction Measurement Instrument | 727-230 | 18 |
| 6 | Sychronizing Indicator | 731-62 | 8 |
| 7 | Double Frequency Meter | 727-27 | 4 |
| 8 | Synchronoscope | 727-28 | 5 |
| 9 | Field Regulator Generator | 732-66 | 5 |
| 10 | Field Regulator Motor | 732-65 | 8 |
| 11 | Three Phase Transformer | 733-90 | 6 |
| 12 | Single Phase Transformer | 733-97 | 5 |
| 13 | Inductor Load | 732-42 | 8 |
| 14 | Resistive Load | 733-10 | 7 |
| 15 | Capacitive Load | 733-11 | 8 |
| 17 | Rotor Starter | 732-99 | 7 |
| 18 | Star Delta Switch | 731-47 | 5 |
| 19 | Star Delta Reversing Switch | 731-48 | 2 |
| 23 | Frequency Meter | | 4 |
| 24 | Volt Meter | | 2 |
| 27 | Starter | 732-64 | 1 |
| 33 | Transformer | 726-80 | 1 |
| 34 | Reversing Switch | 731-49 | 2 |
| 36 | Transformer | 45-90 | 1 |
| 37 | Multi Function Meter | | 2 |
| 38 | Field Regulator Motor | | 2 |
| 39 | Contact unit | | 4 |

| | | | |
|---|---|---|---|
| 40 | Tacho Generator | | 3 |
| 41 | Blocking Gear | | 6 |
| 42 | Three Phase transformer | | 3 |
| 43 | Single Phase transformer | | 2 |
| 44 | Resistive load | | 2 |
| 45 | Starter | | 1 |
| 46 | Switch three phase pole | | 1 |
| 47 | AC power Supply | | 2 |
| 48 | LD Didactic GNBH | | 2 |
| 49 | capacitive load | | 2 |
| 50 | LD Didactic GNBH | | 2 |
| 51 | Inductive Load | | 1 |
| 52 | DC Multifinction machine | | 18 |
| 53 | Sychronous machines | | 5 |
| 54 | Bifilar wound machine | | 3 |
| 55 | Reluctance motor | | 6 |
| 56 | Square cage motor | | 7 |
| 57 | Dc shunt wound machine | | 3 |
| 58 | Repulsion motor | | 6 |
| 59 | Multi Function Machine | | 7 |

## 2. Power Electronics Lab

| POWER ELECTRONICS LAB-Inventory | | | |
|---|---|---|---|
| **S. No** | **Description** | **Model #** | **Number of Units** |
| 1 | Diode/thyristor branch pair | 73508 | 11 |
| 2 | Thyristor 12A/1000V | 73503 | 10 |
| 3 | Triac | 73504 | 12 |
| 4 | Diode 11A/1000V | 73502 | 2 |
| 5 | Schuko socket | 729061 | 11 |
| 6 | Phase control noise filter 3x4.5A | 735190 | 6 |
| 7 | Gate trigger switch | 73516 | 1 |
| 8 | Switching logic | 73515 | 1 |
| 9 | Selenium rectifier 25V/10A | 73501 | 3 |

| | | | |
|---|---|---|---|
| 10 | Switch TPEE POL | 73142 | 1 |
| 11 | Industrial frequency converter 300v | 735312 | 3 |
| 12 | Transformer SMP | 735105 | 5 |
| 13 | Final control element 115-230V | 73422 | 3 |
| 14 | Voltage divider 20:1 | 73420 | 3 |
| 15 | IGBT 1000V/10A | 735346 | 12 |
| 16 | MOSFET 500V/10A | 735342 | 5 |
| 17 | Gain and offset adjust | 73419 | 3 |
| 18 | Bulb socket E14 | 72909 | 4 |
| 19 | PID Controller | 734061 | 6 |
| 20 | Sensor cassy | 524010 | 2 |
| 21 | Machine test system 0.3 | 731989USB01 | 3 |
| 22 | Pulse group control unit | 73514 | 5 |
| 23 | Reference variable generator | 73402 | 4 |
| 24 | DC power supply +_15V/3A | 72686 | 3 |
| 25 | Control unit PWM PFM | 735341 | 6 |
| 26 | Control unit 1.0 | 73255 | 1 |
| 27 | Multifunction measuring instrument | 727230USB | 3 |
| 28 | Load power electronic | 73509 | 4 |
| 29 | Temperature controlled system 45V | 73511 | 6 |
| 30 | Isolation amplifier four channels | 735261 | 4 |
| 31 | Control unit six pulse digital | 735135 | 4 |
| 32 | Trigger point limiter | 73520 | 5 |
| 33 | Absolute value circuit | 73423 | 3 |
| 34 | Transformer 54/90 3N | 72680 | 4 |
| 35 | Fuse three fold superfast acting | 73518 | 5 |
| 36 | Gate trigger switch | 73516 | 2 |
| 7 | Switching logic | 73515 | |
| 38 | Function generator 200 kHz | 726961 | 6 |
| 39 | Socket | 729061 | 7 |
| 40 | Run up control unit | 73517 | 3 |
| 41 | Control transformer AC | 73524 | 3 |
| 42 | Adaptive PI controller | 734065 | 2 |
| 43 | Oscilloscope HAMEG | | 3 |
| 44 | 3 Phase transformer 6/10 +23/0 | 521291 | 4 |

| | | | |
|---|---|---|---|
| 45 | Servomotor | 731989-02 | 3 |
| 46 | Rheostat | | 3 |
| 47 | Shunt wound machine | 66286 | 4 |
| 48 | Squirrel cage motor | 66643 | 3 |
| 49 | Tacho generator | 73101 | 3 |
| 50 | Multimeter Peaktech | 3315 | 13 |

## 3. Control Engineering Lab

| Control Engineering Lab Inventory | | | |
|---|---|---|---|
| **S. No** | **Description** | **Serial #** | **Number of Units** |
| 1 | Apple Computers | A550601046-57 | 11 |
| 2 | Lab work benches with power installed | | 11 |
| 3 | Simulated control system module | W632712103 | 10 |
| 4 | Transfer element module | W726107117 | 9 |
| 5 | Test Function Generator module | | 10 |
| 6 | Measurement Indicator module | | 10 |
| 7 | AC/DC Stabilizer module | W633310205 | 8 |
| 8 | DC Generator with Tacho Generator mod | w634307004 | 10 |
| 9 | Power Amplifier module | W630515447 | 11 |
| 10 | PID Controller module | W719907097 | 9 |
| 11 | DC Power Supply +-15V module | W706106001 | 4 |
| 12 | Sensor Cassy 2 module | W1009426 | 11 |
| 13 | Function Module module | W633310215 | 9 |
| 14 | Torque Synchro Module | W633808173 | 17 |
| 15 | Servo Set Point Potentiometer Module | W633310283 | 9 |
| 16 | Differential Pressure Transducer Module | WR00003074 | 1 |
| 17 | Liquid Controller System Module | WA00016379 | 1 |
| 18 | Temperature Control system Module | | 1 |
| 19 | Motor Generator Set Module | | 1 |
| 20 | On Load Switch Module | | 1 |
| 21 | Laser Printer | CNCK831065 | 1 |
| 22 | Laser Printer | | 1 |

| | | | |
|---|---|---|---|
| 23 | Multimedia Projector Fitted to Ceiling | | 1 |
| 24 | Digital Multimeters | | 2 |
| 25 | Projector Screen Fitted | | 1 |
| 26 | White Board Fitted | | 1 |
| 27 | Office Table | | 1 |
| 28 | Textile Revolving Chairs | | 17 |
| 29 | Textile Revolving Chairs | | 4 |
| 30 | Cupboard Standard | | 1 |
| 31 | Cupboard Glass Doors | | 1 |
| 32 | Chest of Drawers | | 1 |
| 33 | Chest of Drawers | | 2 |

## 4. Electric Circuits and Digital Logic Lab

| Electric Circuits and Digital Logic Lab Inventory | | | |
|---|---|---|---|
| **S. No** | **Description** | **Model #** | **Number of Units** |
| 1 | Computer HP LE1901 | Desk Top | 13 |
| 2 | Digital Oscilloscope Peak Tech | 1215 | 10 |
| 3 | Function Generators Peak Tech | 4030 | 9 |
| 4 | DC Dual Power Supply | 6010D | 10 |
| 5 | Digital Multimeters Peak Tech | 3315 | 20 |
| 6 | 3 Phase Xtra low voltage Transformer | 52129 | 2 |
| 7 | Experiment Trnasformer | 725332G | 12 |
| 8 | Watt Meter | 531831 | 10 |
| 9 | Resistance Substitution Box | 236A | 3 |
| 10 | Capacitance Substitution Box | 237 | 3 |
| 11 | Lab Inductance Box | 3270 | 23 |
| 12 | Proto Board Digital Lab | IDL800 | 3 |
| 13 | Proto Board | PB503 | 3 |
| 14 | Proto Board MCP | M21-500 | 1 |
| 15 | Analogue Multimeters | 531-120 | 10 |
| 16 | Stop Watches Casio | HS-3 | 8 |
| 17 | Work Benches Power Fitted | | 10 |
| 18 | Work Tables | | 6 |
| 19 | White Board Fitted | | 1 |

## 5. Computer Laboratory

| Computer Lab | | | |
|---|---|---|---|
| **S.No.** | **Description** | **Model** | **Number of Units** |
| 1. | HP Desk Top PCs | All in one Business PC | 25 |

## 6. Electric Circuits Laboratory

| Electric Circuits Lab Inventory | | | |
|---|---|---|---|
| **S. No.** | **Description** | **Model #** | **Number of Units** |
| 1 | Oscilloscopes PINTEK | PS355 | 12 |
| 2 | Function Generators | 1016 | 10 |
| 3 | Dual Power Supplies Peak Tech | 6010D | 9 |
| 4 | Apple computers+keyboards+mice | IMAC | 6 |
| 5 | Work Stations with breadboards and electrical fittings. | | 12 |
| 6 | Multimeters Peak Tech | 3315USB | 11 |
| 7 | Smart Board | SB68V | 1 |
| 8 | White Board | | 1 |
| 9 | Sitting Stools Textile Look | Textile | 7 |
| 10 | Fire Extinguisher Powder 6Kgs | Red | 1 |

## 7. Computer Lab (Digital System Engineering)

| S No | Description | No of Units |
|---|---|---|
| **1** | Computers HP Pro one | 9 |
| **2.** | Peak tech Oscilloscope | 5 |
| **3.** | Peak tech Function Generators | 5 |

| | | |
|---|---|---|
| **4.** | Peak tech DMM Desk Top | 5 |
| **5.** | Peak tech DMM 3315 | 5 |
| **6.** | Communication Transmission line Labvolt | 4 |
| **7.** | Flight Development Board | 13 |
| **8.** | Flight 86 Trainer | 29 |

## 8. Electronics and Digital Logic Laboratory

| Electronics Lab Inventory | | | |
|---|---|---|---|
| **S. No.** | **Description** | **Model #** | **Number of Units** |
| 1 | Computers | Desk Top | 10 |
| 2 | Oscilloscope Peak Tech Digital | 1170 | 7 |
| 3 | Oscilloscope Instek | GOS6103 | 1 |
| 4 | Oscilloscope HAMEG | HM507 | 4 |
| 5 | Function Generator Peak Tech | 1016 | 13 |
| 6 | Dual Power Supply Instek | GPC3030DQ | 8 |
| 7 | Work Benches | Fitted | 24 |

## 9. Digital System and Communication Laboratory

| S No. | Description | No of Units |
|---|---|---|
| **1** | Computers HP Pro One 400 | 11 |
| **2.** | Work Bench | 24 |
| **3.** | Emona Telecom Trainer | 8 |
| **4.** | Peak Tech Oscilloscope 1170 | 8 |
| **5** | Spectrum Analyser | 2 |

| | | |
|---|---|---|
| **6.** | Peak Tech Function Generator | 10 |
| **7.** | NI Embedded Controller 8135 | 1 |
| **8.** | NI Elvis II+ | 1 |
| **9.** | NI USRP 2920 | 2 |