


# الجامعـــة الإسلاميـــة للتكنولوجيا

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**

ORGANISATION OF ISLAMIC COOPERATION (OIC)

# COURSE STRUCTURE
# AND
# COURSE CONTENTS

Department

of

**Electrical and Electronic Engineering (EEE)**

August 2025

# Preface

The Department of Electrical and Electronic Engineering at IUT prides itself on its commitment to providing top-tier undergraduate and post-graduate education and fostering groundbreaking research. Our aim remains steadfast: to nurture the finest engineers, educators, and professionals capable of making significant contributions on both national and international stages.

In line with our dedication to staying abreast of industry advancements and state-of-the-art technologies, we are committed to continually updating our course curricula, expanding laboratory facilities, and enhancing teaching and research materials. Despite constraints in resources, we persistently strive to refine and introduce courses that ensure that our students remain competitive globally. This year, we are proud to introduce several enhancements to our syllabus and course offerings. Building upon feedback from our esteemed alumni and collaborating with renowned faculties abroad, we have redesigned our curriculum to align more closely with international standards.

Notably, students now have the opportunity to specialize in one of three clusters of elective courses: Communication, Power, and Electronics and Signals. This specialization, alongside a robust foundation in core courses, equips our graduates with the versatility and expertise demanded by today's dynamic job market and academia. Furthermore, our laboratory facilities have been revamped to offer a blend of design-oriented classes with a strong emphasis on practical applications and simulation. We have invested in state-of-the-art equipment to ensure that our students

receive hands-on training that reflects real-world scenarios. Within this catalog, you will find comprehensive information about our faculty, their academic backgrounds, and research interests. Additionally, details regarding the various laboratories housed within our department are provided, showcasing our commitment to fostering an environment conducive to innovative research and learning. As we navigate through the academic year, I encourage all students and stakeholders to stay connected with their advisors and the department office for any updates or changes to course offerings or university regulations. Together, let us continue to uphold the legacy of excellence that defines the Department of Electrical and Electronic Engineering at IUT.

Prof. Dr. Syed Iftekhar Ali
Head, Department of Electrical and
Electronic Engineering
Islamic University of Technology (IUT)

Dhaka
August 2025

# CONTENTS

## 4. Detailed Course Information

## Message from the Vice-Chancellor

With utmost reverence to the Almighty, I express my gratitude for the honor bestowed upon me to serve as the Vice Chancellor of the esteemed Islamic University of Technology (IUT). As we embark on this academic journey together, I am deeply honored to guide an institution committed to knowledge, critical thinking, and holistic development.

Our primary goal is to create an environment that is favorable to learning. The Islamic University of Technology (IUT) embodies the idea that a university is more than just a place to study; it serves as a locus for the cultivation of intellectual refinement and growth. It is a place where minds come together to foster wisdom. We strive to create an environment where learning flourishes, where minds converge, and where the pursuit of knowledge is enriched by diverse cultures and backgrounds. Within our vibrant community, students are encouraged to engage in rigorous intellectual discourse, pursue their passions, and embrace lifelong learning.

This handbook stands as a testament to our unwavering commitment to excellence in education. It encapsulates our collective efforts to nurture the next generation of leaders, instilling in them the values and skills necessary for success in an ever-evolving world. From our meticulously designed curricula to our innovative programs and facilities, every aspect of this handbook reflects our dedication to empowering our students and enriching their academic experience.

I extend my heartfelt gratitude to all who have contributed to the development and dissemination of this handbook. Together, we are

shaping the future of education and inspiring positive change in our communities and beyond.

Prof. Dr. Mohammad Rafiqul Islam
Vice Chancellor,
Islamic University of Technology (IUT)

# Chapter 1

# General Information: Islamic University of Technology

## 1.1 Origin

Islamic University of Technology at Dhaka, Bangladesh commonly known as IUT is a subsidiary organ of the Organization of the Islamic Cooperation (OIC), representing fifty-seven member countries from Asia, Africa, Europe and South America.

It was initially established as the Islamic Centre for Technical and Vocational Training and Research, ICTVTR in pursuance of the Resolution No. 5/9-E of the Ninth Islamic Conference of Foreign Ministers (ICFM) held in Dakar, Senegal in 1978. The foundation stone of ICTVTR was laid on 27 March 1981 by His Excellency Late Ziaur Rahman, the President of Bangladesh in the presence of His Excellency Late Yasir Arafat, President of Palestine and Late Dr. Habib Chatty, the then Secretary General of the OIC on the 30-acre land donated by the Government of the People's Republic of Bangladesh to the OIC.

ICTVTR was renamed as the Islamic Institute of Technology (IIT), by the Twenty-second ICFM held in Casablanca, Kingdom of Morocco in 1994. It is mandated to help develop human resources in the Member Countries of the OIC in the fields of engineering and technology as well as technical education.

The process of renaming Islamic Institute of Technology (IIT) as Islamic University of Technology (IUT) began with a discussion in the 25th meeting of the Governing Board of IIT held in Dhaka, Bangladesh on 20 – 23 November 2000. In course of deliberation, the Honorable Members of the Governing Board felt the necessity of renaming the Institute and decided unanimously the following:

"5.9.13 The Governing Board opined that considering the academic programs being conducted in the fields of engineering, technology and technical education, and the level it has reached, IIT might be considered as a typical educational Institution of a Technological University, and in order to facilitate its interactions with other Universities of renown, to enable its graduates to pursue their higher studies elsewhere and to attract meritorious students from the Member States of OIC, it is proposed and recommended that the Institute may be renamed as "Islamic University of Technology" after fulfilling appropriate procedural requirements."

The recommendation of the Governing Board set in motion the issue of renaming and necessitated the raising of the matter in different hierarchies of authorities of the Institute. After getting the required clearance from the Governing Board, the above proposal was placed before the 24th Session of the Islamic Commission for Economic, Cultural and Social Affairs (ICECSA) held in Jeddah, Kingdom of Saudi Arabia on 10 – 13 February 2001, which also acted as the General Assembly of the Institute and was approved unanimously vide recommendation No. 48/24-E (Clause – 5) on activities of the Islamic Institute of Technology (IIT), Dhaka which reads as follows:

"5. Approves the proposal to rename the Institute as 'Islamic University of Technology (IUT)' as recommended by the Governing Board, without any financial implications".

The Honorable Secretary General of the Organization of the Islamic Cooperation (OIC) in his report on Science and Technology as a follow-up of above recommendation, reflected in the report of ICECSA, submitted to the 28th Session of the Islamic Conference of Foreign Ministers (ICFM) held in Bamako, Republic of Mali on 25 – 27 June 2001 highlighted the issue of renaming which reads as follows:

"The Islamic Institute of Technology (IIT), Dhaka, Bangladesh was established by Resolution No. 5/9-E of the 9th ICFM with the name of "Islamic Centre for Technical and Vocational Training and Research (ICTVTR)". The Institute was renamed by Resolution No. 27/22-E of the 22nd ICFM as **Islamic Institute of Technology (IIT)**. The Institute provides a professional training leading to engineering degrees in

various technical sectors. Name of the Institute is proposed to be changed into **Islamic University of Technology (IUT)**.

As the institute constitutes a privileged instrument of inter-Islamic cooperation in the domain of specialized human resources, it should be supported financially and morally, in its strive to attain state of the art academic standards."

Following the recommendation of the ICECSA and report of the Secretary General and on the recommendation of the Committee for Economic and Social Affairs, the following remarkable decision was adopted on 27 June 2001 in the final Plenary of the 28th Session of ICFM vide Resolution No. 48/28-E on activities of Islamic Institute of Technology (IIT), Dhaka:

"Approves the proposal to rename the Institute as 'Islamic University of Technology (IUT)' as recommended by the Governing Board, without any financial implication."

The decision of the 28th Session of the ICFM was made public through Final Communiqué, relevant extract of which is as follows:

"124. The Conference commended the activities of the Islamic Institute of Technology in Dhaka, decided that the Institute should become a university without financial implications, with the title "The Islamic University of Technology", and encouraged it to continue its efforts in developing the human resources of Member States in the area of science and technology."

The renaming of IIT as IUT is an important milestone in the annals of this unique educational institution, only of its kind under the umbrella of the OIC which has been emerging as the most visible demonstration of the Islamic Solidarity and Joint Islamic Action under the Makkah – Al – Mukarramah Declaration.

IUT is basically an educational and research institution offering a wide range of undergraduate and postgraduate academic programs conducted in the fields of engineering, computer science & information technology and teacher training. It also offers knowledge and skill updating and upgrading short and special courses as needed by the Member States.

International and regional seminars and workshops are also arranged regularly by IUT to provide forums and to keep abreast of the latest technological developments. It also undertakes technological and industrial research projects, promotes technical cooperation, exchanges technical know-how and disseminates basic information of development of human resources as co-focal point under UN-OIC collaboration among the Member States of the OIC. IUT ensures coordination between its objectives with other national and regional institutions of the Islamic countries as well as with international institutions. It also undertakes advisory and consultancy services for Government, International Bodies, Foundations, and allied Organizations.

# 1.2 Location

The University is located at Board Bazar, Gazipur, about 30 km north of Dhaka (Latitude=23˚43'N, Longitude=90˚25'E), the capital of Bangladesh. The capital is served by an international airport with a widely developed airlines network with the rest of the world and by satellite telecommunication.

# 1.3 Vision and Mission

## 1.3.1 Vision

To be a leading University of Science, Engineering and Technology in the World.

## 1.3.2 Mission

1. Providing education & training of international standard for the youths of the Ummah.
2. Undertaking quality research leading to innovation.

3. Launching cutting-edge disciplines matching the requirements of the member states.
4. Internationalizing through increasing overseas students, staff, and external collaboration.

## 1.4 Administration

### Chancellor

Secretary General of OIC

### Vice-Chancellor

### Pro-vice Chancellor

### Administrative Officers

Registrar
Comptroller
Librarian
Chief of Human resource and Cabinet office
Internal Auditor
Chief of Planning & Development
Chief Medical Officer
Sr. Sub-Divisional Engineer
Head, Office of Students' Welfare
Head, Office of Accreditation and Quality Assurance
Head, International Affairs and External Communication
Head, Planning, Procurement and Development (PPD) Office
Executive Engineer, General Services and Engineering Office
The Chief Security and Safety Officer

## Deans of Academic Faculties

Dean, Faculty of Engineering and Technology
Dean, Faculty of Science and Technical Education

## Heads of Academic Departments

Head, Department of Mechanical and Production Engineering (MPE)
Head, Department of Electrical and Electronic Engineering (EEE)
Head, Department of Technical and Vocational Education (TVE)
Head, Department of Computer Science and Engineering (CSE)
Head, Department of Civil and Environmental Engineering (CEE)
Head, Department of Business and Technology Management (BTM)
Head, Department of Natural Sciences (NSc)

## Provost of Residential Halls

Provost, Halls of Residence (Male)
Provost, Halls of Residence (Female)

## Administrative Departments & Offices

Planning, Procurement and Development Office
Institute of Energy and Environment (IEE)
Directorate of Students Welfare Office of Provost
Information and Communication Technology (ICT) Centre
Department of Research, Extension, Advisory Services and Publications (REASP)
Registrar's Office
Human Resource and Cabinet Office
Finance and Accounts Office
Library
Office of Students' Welfare
University Medical Center

Office of Accreditation and Quality Assurance (AQA)
International Affairs and External Communication (IAEC) Office
General Services and Engineering Office
Campus Security and Safety Office
Continuing Education and E-Learning Centre (CEEC)
Campus Security and Safety Office

## 1.5 Objectives and Function

The Islamic University of Technology is basically an educational and research institution. The main objective of the University is to help generally in human resources development in member states of the OIC, particularly in different fields of engineering, technology and technical education.

In fulfillment of its objectives, the University undertakes, among others, the following necessary and appropriate functions:

- Provide instruction in engineering, technology, and technical and vocational education and in such branches of learning connected with the above fields as per requirement of the Member States and as approved the Conference, and in particular, train instructors, technicians in technologies needed in the Member States and to upgrade the midlevel and lower-level manpower to international standards.
- Conduct, promote and guide research in engineering, in industrial and technological fields and in technical and vocational education to the benefits of the Member States of the OIC.
- Hold examination and grant and confer certificates, degrees, diplomas, and other academic distinctions on persons who have pursued courses of study provided by the University and have passed the examinations of the University under such conditions as may be prescribed by the academic rules and regulations of the University.

- May confer other academic distinctions on persons of high eminence of the Member States with the approval of the general assembly on the recommendation of the Board.
- Promote technical cooperation, exchange technical know-how and disseminate basic information in the field of human resource development through short and special courses, seminars, workshops, and publications.
- Ensure coordination between the objective of the University with other national and regional institutions of the Islamic Countries as well as with international institutions.
- Undertake advisory and consultancy services for government, International Bodies and foundations or allied organizations.
- Participate in the meetings of commissions and committees established by the Conference with appropriate background and technical papers.
- Cooperate and collaborate with the General Secretariat, and with other subsidiary and affiliated organs of the conference.
- Any other relevant functions as may be decided from time to time.

## 1.6 Structure

The structure of the University comprises the Joint General Assembly, the Governing Board, Syndicate, and the Vice Chancellor. The internal setup and working conditions of the University are governed by its Internal Rules and Regulations (IRR) as approved by the Islamic Conference of Foreign Ministers (ICFM) as well as by the provisions of the Personnel and Financial

Regulations of the Organisation of Islamic Cooperation (OIC). The Vice Chancellor of the University is the chief executive in charge of the overall management of the University and takes measures necessary for realizing the objectives of the University. The Member States cooperate in every possible manner to assist the University in pursuing its objectives. The budget of the

University is financed by mandatory contributions of the Government of the Member States in proportion to their contribution to the budget of the General Secretariat of the OIC.

# 1.7 Authoritative Bodies

## 1.7.1 Joint General Assembly

The Islamic Commission for Economic, Cultural, and Social Affairs consisting of all Member States of the OIC acts as a Joint General Assembly of the Subsidiary Organs including IUT. The Joint General Assembly acting as General Assembly of the University:

- Determines the general policy of the University and provides general guidance to it.
- Examines the activity programme of the University and submits its recommendations to the Islamic Conference of Foreign Ministers (ICFM).
- Examines and approves the Internal Rules and Regulations governing the internal activities of the University.
- Elects the members of the Governing Board for a specific period.
- Examines the whole budget which is prepared on a programme basis before its submission to the Permanent Finance Committee (PFC).
- Considers and submits for the approval of the ICFM the final accounts of the University after having been audited by the Finance Control Organ (FCO).

## 1.7.2 Governing Board

The Governing Board is composed of:

- Nine members including a member of the Host Country to be elected by the Joint General Assembly from amongst experienced and competent candidates in the field of activities of the University

proposed by the Member States, with due regard to the principle of equitable geographical distribution to the extent possible. Current members are from People's Republic of Bangladesh, Kingdom of Saudi Arabia, Republic of Kazakhstan, Republic of Chad, Islamic Republic of Pakistan, Republic of Iraq, State of Kuwait, Republic of Guinea Bissau, and Republic of Senegal.

- The Secretary General of the OIC or his representative and the Vice Chancellor of IUT are ex-officio members.
- The Governing Board formulates programme policies and exercises technical supervision over the activities of the University. It also focuses on consideration of the programme of action and the report on the activities of the University and submits its recommendations to the Joint General Assembly.
- Examines the programme budget and final accounts of the University before their submission to the Joint General Assembly.
- Consults the General Secretariat about the measures to be taken by the University to promote its objectives.
- Frames the Internal Rules and Regulations of the University before its submission to the Joint General Assembly for approval.
- Approves the curricula of training and research programmes on the recommendation of the Academic Council of the University.
- Confers and grants degrees, diplomas, and certificates as per approved academic regulations of the University.

Current Governing Board of IUT is given below:

| **Governing Board (2024)** | |
|---|---|
| H.E. Prof. Saleh I. Alqasoumi<br>Professor of Pharmacognosy<br>College of Pharmacy<br>Department of Pharmacognosy<br>King Saud University<br>Kingdom of Saudi Arabia | Chairman |

| | |
|---|---|
| Representative of the Government of the Republic of Kazakhstan | Member |
| Representative of the Government of the People's Republic of Bangladesh | Member |
| Representative of the Government of the Republic of Chad | Member |
| Representative of the Government of the Islamic Republic of Pakistan | Member |
| Representative of the Government of the Republic of Iraq | Member |
| Representative of the Government of the State of Kuwait | Member |
| Representative of the Government of the Republic of Guinea | Member |
| Representative of the Government of the Republic of Senegal | Member |
| Representative of H.E. the Secretary General of the OIC & Chancellor of IUT | Member (Ex-officio) |
| Vice-Chancellor, IUT | Member (Ex-officio) |
| Foreign Secretary or Representative, Ministry of Foreign Affairs, Government of the People's Republic of Bangladesh | Member (Ex-officio) |

### 1.7.3 Syndicate

The Syndicate of the Governing Board is empowered to deal, between meetings of the Governing Board, with any matter that may be referred to it by the Vice Chancellor or that may be delegated by the Governing Board. All interim actions of the Syndicate are reported to the Governing Board. The Syndicate of the Governing Board consists of the following members:

- Vice-Chancellor of IUT, Chairman
- Four Heads of Diplomatic Missions of the Member States in Bangladesh, nominated by the Governing Board: Islamic Republic of Iran, State of Qatar, Kingdom of Morocco, and Malaysia.
- Representative of the contact Ministry of the host country not below the rank of Joint Secretary.
- The Vice Chancellor of BUET or his Representative not below the rank of Professor.
- Two Heads of teaching Departments of IUT nominated by the Vice-Chancellor.
- One senior Professor, nominated by the Vice-Chancellor.
- One senior Professor, nominated by the Academic Council.
- Registrar, IUT –Member-Secretary.

## 1.7.4 Academic Council

The Academic Council consists of the following members:

- The Vice Chancellor of IUT, Chairman.
- Heads of the Departments, Members.
- Professors, Members.
- Representatives from five Embassies / High Commissions of the Member States in Dhaka, Bangladesh nominated by the Governing Board: The High Commission of Brunei Darussalam, The Embassy of Arab Republic of Egypt, The Embassy of Libya, The High Commission of Islamic Republic of Pakistan, and The High Commission of Malaysia to Bangladesh.
- The Vice-Chancellor, Dhaka University of Engineering & Technology, Gazipur, Member.
- A Chairman of Public Sector Industrial Corporation, to be nominated by the Government of the People's Republic of Bangladesh, Member.

- One Professor of the Bangladesh University of Engineering and Technology, to be nominated by the Vice-Chancellor of the University, Member.
- The Director General of Technical Education, Government of the People's Republic of Bangladesh, Member.
- The Director General, Bureau of Manpower, Employment and Training, Government of the People's Republic of Bangladesh, Member.

Subject to other provisions, the Academic Council:

- Advises the Governing Board on all academic matters.
- Makes Regulations for the proper conduct of teaching, training, and examinations, and for promoting academic life in the University and for the award of Fellowships, Scholarships, Medals, and Prizes.
- Proposes to the Governing Board for the constitution of Departments and Departmental Committees of the University.
- Lays down conditions under which the students/trainees may be given admission to the various courses of studies and the examinations held by the University.
- Prescribes, subject to the approval of the Governing Board and upon the recommendations of the Syllabus Committee, the courses of studies, the Syllabuses, and the outlines of texts for all the examinations.
- Recognizes the examinations of other Institutes or Institutions, Boards, and Universities as equivalent to the corresponding examinations of the University.
- The Academic Council, within the provisions of these regulations, appoints the Admission Committee, the Syllabus Committees, and the Examination Committee for Trainees / Students' admission, formulation of Syllabuses, and conducting examinations respectively.

Current Academic Council of IUT is given below:

| **Academic Council (2024)** | |
|---|---|
| Vice-Chancellor, IUT | Chairman |
| Representative of the High Commission of Brunei Darussalam in Dhaka | Elected Member |
| Representative of the Embassy of Egypt in Dhaka | Elected Member |
| Representative of the Embassy of Libya in Dhaka | Elected Member |
| Representative of the High Commission of Malaysia in Dhaka | Elected Member |
| Representative of the High Commission of the Islamic Republic of Pakistan in Dhaka | Elected Member |
| Vice-Chancellor, DUET, Gazipur, Bangladesh | Ex-officio Member |
| Secretary, Ministry of Education, Government of Bangladesh | Ex-officio Member |
| Director General, Directorate of Technical Education, Government of Bangladesh | Ex-officio Member |
| Chairman, Bangladesh Steel Engineering Corporation, Kawran Bazar, Dhaka | Nominated Ex-officio Member |
| Dean, Faculty of Mechanical Engineering, BUET, Dhaka. | Nominated Ex-officio Member |
| Pro Vice-Chancellor, IUT (Acting) | Internal Member |
| Dean, Faculty of Engineering and Technology, IUT | Internal Member |
| Dean, Faculty of Science and Technical Education, IUT | Internal Member |

| | |
|---|---|
| Head, MPE Department, IUT | Internal Member |
| Head, EEE Department, IUT | Internal Member |
| Head, TVE Department, IUT | Internal Member |
| Head, CSE Department, IUT | Internal Member |
| Head, CEE Department, IUT | Internal Member |
| Head, BTM Department, IUT | Internal Member |
| Head, NSc Department, IUT | Internal Member |
| Professors, EEE Department, IUT | Internal Members |
| Professors, MPE Department, IUT | Internal Members |
| Professors, CEE Department, IUT | Internal Members |
| Professors, CSE Department, IUT | Internal Members |
| Professors, TVE Department, IUT | Internal Members |
| Registrar, IUT | Member Secretary |

## 1.7.5 Statutory Committees

Besides, among others, there are the following Statutory Committees to ensure proper management of programs and activities in the relevant and related fields.

### Finance Committee

Finance Committee consists of the following:

| **Finance Committee** | |
|---|---|
| Vice-Chancellor, IUT | Chairman |
| Representative of the Govt. of People's Republic of Bangladesh | Member |
| Representative of the Embassy of the Islamic Republic of Afghanistan in Bangladesh | Member |

| | |
|---|---|
| Representative of the Embassy of the UAE in Bangladesh | Member |
| Representative of the Embassy of the Republic of Turkey in Bangladesh | Member |

## Selection Board

Selection Board consists of the following:

| **Selection Board (Associate Professor and Professor)** | |
|---|---|
| Vice-Chancellor | Chairman |
| Pro-Vice-Chancellor | Member |
| Dean of the Faculties | Member |
| Head of the relevant Department | Member |
| Two representatives of the Diplomatic Mission of the OIC member states in Bangladesh nominated by the Board | Member |
| One representative nominated by the Host Country | Member |
| Two members within the University nominated by the Academic Council | Member |
| One external member in the relevant field selected by the Vice-Chancellor | Member |
| One member from the senior regular faculty in the relevant field within the University selected by the Vice-Chancellor | Member |
| Chief of Establishment | Secretary |
| **Selection Board (Lecturer and Assistant Professor)** | |
| Pro-Vice-Chancellor | Chairman |
| Dean of the relevant Faculty | Member |

| | |
|---|---|
| Head of the relevant Department | Member |
| Two representatives of the Diplomatic Mission of the OIC member states in Bangladesh nominated by the Board | Member |
| One representative nominated by the Host Country | Member |
| Two members within the University nominated by the Academic Council | Member |
| One external member in the relevant field selected by the Vice-Chancellor | Member |
| One member from the senior regular faculty in the relevant field within the University selected by the Vice-Chancellor | Member |
| Chief of Establishment | Secretary |
| **Selection Board (Registrar, Chief of Human Resource and Cabinet Office, Comptroller and University Librarian)** | |
| Vice-Chancellor | Chairman |
| Pro-Vice-Chancellor | Member |
| Head of the relevant office/department/institute | Member |
| Two representatives of the Diplomatic Mission of the OIC member states in Bangladesh nominated by the Board | Member |
| One representative nominated by the Host Country | Member |
| Two members within the University nominated by the Syndicate | Member |
| One external member in the relevant field selected by the Vice-Chancellor | Member |
| Chief of Establishment | Secretary |

| Selection Board (All the remaining posts) | |
|---|---|
| Pro-Vice-Chancellor | Chairman |
| Head of the relevant office/department/institute | Member |
| One member within the University nominated by the Syndicate | Member |
| One external member in the relevant field selected by the Vice-Chancellor | Member |
| Chief of Establishment | Member - Secretary |

**Other Statutory Committees:**

- Research Committee (CASR)
- Dean's Committee
- Departmental Committee
- Planning and Development Committee
- Student's Welfare Committee
- Student Disciplinary Committee
- Syllabus Committee
- Faculty Committee
- Administrative Advisory Committee

# Chapter 2

# Academic Rules and Regulation

## 2.1 Academic Calendar

IUT follows the Semester System for the purpose of classroom teaching and examinations. An academic year consists of two semesters, each of sixteen weeks of instruction. They are winter semester and summer semester. There is also a short semester in between summer semester of the last academic year and winter semester of the upcoming academic year to facilitate the industrial training for IUT students of all departments and arrangement of short courses by all departments on different need basis professional topics.

## 2.2 Medium of Instructions

The official languages of the University are Arabic, English and French. Medium of instruction and examinations at present is English. English Language Programmes are arranged for Arabic and French-speaking students when needed. All students are required to learn one of the three languages as second language. However, all non-Arabic speaking students are required to learn Arabic as spoken language.

## 2.3 Admission

Each academic year, the Islamic University of Technology (IUT) announces it's offering of programs in Doctor of Philosophy, Master of Science, Master of Engineering, Bachelor of Science, and Diploma under various academic departments. Nominations of eligible candidates for admission to different programs of study are invited from the relevant Ministries or Authorities of the Member States by the end of September. Nominations for the programs are to be sent to IUT in order of merit on

the basis of tests prescribed by the University and conducted by the Nominating Authority and Focal Points of the Member States of the OIC.

Each nomination should be accompanied with Application of the nominee in the prescribed form duly filled in and signed, available in the office of the Nominating Authority and Focal Points, along with attested copies of Academic Certificates and Mark Sheets, reports from an authorized Medical Board or Medical Practitioner on eyesight, hearing and general fitness for prolonged mental and physical exertion, blood and urine, chest X-ray and contagious and communicable diseases. Candidates having contagious and communicable diseases e.g. tuberculosis, venereal diseases, AIDS, HIV positive, hepatitis B, etc. are not eligible for admission.

Final selection of students for admission from amongst the nominated candidates of all the Member States will be made by IUT on the basis of merit, geographical distribution and option given by the candidates. If, however, the number of eligible candidates for a particular program/specialization is not sufficient in a particular academic year, it will not be offered. The selected candidates are required to take admission by reporting to the Registrar on or before the date of beginning of the academic year as specified by the Registrar.

# 2.4 Admission Requirement

IUT offers programs of various durations. The entrance requirements for different programs of study for which enrolment is sought are detailed below.

## 2.4.1 Undergraduate Programmes

4-Year Bachelor of Science programmes in Mechanical and Production Engineering (MPE), Electrical and Electronic Engineering (EEE), Computer Science and Engineering (CSE), and Civil and Environmental Engineering (CEE) require Higher / Upper Secondary School Certificate

in Science from a Board / University or its equivalent. The candidates are required to have good grades in Mathematics, Physics, Chemistry and English.

### 2.4.2 Postgraduate Programmes

For admission to Ph.D. program, a candidate must have obtained M.Sc. Engg./ M. Engg./ M.Sc. degree in the relevant branch or equivalent degree from any recognized institution, having a minimum CGPA of 3 out of 5 or 2.5 out of 4 in the relevant Programme. For admission to the courses leading to the award of the Degree of M.Sc. Engg./M. Engg./M.Sc. in any branch, a candidate must have obtained B.Sc. Engg./ 4-year B.Sc. Degree in the relevant branch or equivalent from any recognized institution, having a minimum CGPA of 3.0 out of 5 or 2.5 out of 4 in the relevant program and good performances in other examinations.

## 2.5 Course Registration Procedure and Requirements

Every student in IUT has an account in Student Information System (SIS) implemented by IUT KPI Quality Assurance unit. At the beginning of each semester, each student has to register his required courses for that semester in SIS consulting with his advisor. Details procedure of course registration process is given in "Student Guide".

## 2.6 Student Advisory System

All Advisors do the job of advising of his assigned students as per the guidelines given below:

1. An Advisor will maintain contact with his advisee at regular intervals throughout the academic year. For this purpose, the

Advisor may call meetings with the students once or twice each month.

2. The Advisor will advise and guide the student in all matters in order to solve academic problems faced by the students during his stay at IUT and may discuss personal problems which may affect academic pursuit.
3. Discussion with the students may include the important points of the "Students Guide" so that the students follow the instructions given in the Guidebook meticulously.
4. Each student should also be reminded about the requirement of the minimum percentage of attendance in relation to his current percentage of attendance both in theory and lab classes. Information about submission of lab reports and home assignments in time should also be discussed.
5. They should also discuss the existing situation regarding attending the class tests and quiz examination.
6. They may also be advised to take good preparation before regular examinations, class tests and quizzes, so that they may avoid the Referred Examination and Automation system, i.e. cancellation of admission in case of two consecutive failures.
7. The students coming from outside Bangladesh should be reminded of their own responsibility for getting their visa extended well before the expiry date in order to avoid heavy fine for each day of delay. The Protocol Officer will render all possible help in this respect.

# 2.7 Grading Systems

## 2.7.1 Postgraduate Programmes in Engineering

The minimum duration of the M.Sc. Engg., M.Sc. and M. Engg. programmes shall normally be three semesters, each consisting of 16 weeks. A candidate for the Masters Degree must complete all requirements for the Degree within a maximum period of five calendar

years from the date of his admission. Academic progress shall be measured in terms of credit hours earned by a student. One credit hour subject shall require one hour of lecture per week for one semester, while one credit hour for thesis/project/ /sessional/special studies should normally require two hours of work per week for one semester. The number of credit hours for each subject is specified in the syllabus of the respective Department. The number of subjects to be offered per semester will be decided by Postgraduate Committee (PGC) but a student cannot register for more than 12 credit hours per semester. For the Degree of M.Sc. Engg./ M.Sc., a student must earn a minimum total of 36 credit hours, including a Thesis for which a total of 18 credit hours shall be assigned. For the Degree of M. Engg., a student must earn a minimum total of 36 credit hours including a Project for which a total of 6 credit hours shall be assigned.

The course curriculum and subject of study of the different departments shall be as recommended by the respective PGC, checked by the Committee for Advanced Studies and Research (CASR) and approved by the Academic Council. The Departmental Post Graduate Committee (PGC) may review the curriculum from time to time and recommend any changes as may be considered necessary and get it finally approved by the Academic Council. For any particular semester the courses to be offered will be decided by the PGC.

The grading system is as follows:

| **Marks obtained (in percentage)** | **Letter Grade** | **Grade Point** |
|---|---|---|
| 80 & Above | A+ | 4.00 |
| 75 to <80 | A | 3.75 |
| 70 to <75 | A- | 3.50 |
| 65 to <70 | B+ | 3.25 |
| 60 to <65 | B | 3.00 |
| 55 to <60 | B- | 2.75 |
| 50 to <55 | C+ | 2.50 |
| 45 to <50 | C | 2.00 |

| | | |
|---|---|---|
| Less than 45 | F | 0.00 |
| | I | Incomplete |
| | W | Withdrawn |
| | S | Satisfactory |
| | U | Unsatisfactory |

The minimum average **GPA** for pass will be 2.5. Courses in which the student gets **F** shall not be counted towards credit requirements and for the calculation of Grade Point Average (GPA). Grade **I** is given only when a student is unable to sit for the examination of a course at the end of semester because of circumstances beyond his control. **W** grade will be given to a student who withdraws in writing from a course four weeks before the completion of the semester. **S** & **U** grades will be given in case of thesis only.

Detailed rules and regulations governing Ph.D. and Masters Programmes are available in a separate publication named "Rules and Regulations for Postgraduate Programmes".

## 2.7.2 Undergraduate Programmes in Engineering and all Programmes of Technical Education

For sixteen weeks' teaching period per semester, each period of teaching per week in a theory subject or theoretical part of a subject constitutes one "unit" or 1.00 Credit Hour and carries 100 marks. Three periods per week in a sessional subject or sessional part of a subject or tutorial part of a subject constitutes 1.50 Credit Hour and carries 150 marks. Two periods per week in a sessional subject or tutorial part of a subject constitute 1.00 Credit Hour and carries 100 marks.

Examination in a theory course / theoretical part of a course consists of the following four parts:

| | |
|---|---|
| 1. Class attendance | 10% of total marks |
| 2. Class test / Quiz | 15 % of total marks |
| 3. Mid-semester Examination | 25% of total marks |
| 4. Semester-final Examination | 50% of total marks |

For class attendance, the marks are distributed as follows:

| **Attendance** | **Marks** |
|---|---|
| 95% and above | 10% |
| 90% - <95% | 8% |
| 85% - <90% | 6% |
| 80% - <85% | 4% |
| 75% - <80% | 2% |
| Below 75% | 0% |

Four quizzes are held and distributed evenly over the semester. The best three quiz results are considered. Mid Semester Examination is usually held around the middle of the semester on the portion of the syllabuses covered by then. Semester Final Examination covers the entire syllabus.

Final grade in theoretical / theoretical part of a course shall be on the basis of the total aggregate of marks secured by the student in attendance, quizzes, mid-semester examination and semester final examination. A student missing any quiz or the mid-semester or the semester final examinations shall be considered to have got zero in that quiz or the examination of the course.

The tutorial part of a course shall be assessed continuously throughout the semester in the form of quizzes, homework and library assignments. Marks so obtained shall be added with that of corresponding theoretical or sessional course.

The sessional or sessional part of a course shall be assessed continuously throughout the semester. In addition a final examination may be conducted.

Final grades in all courses are recorded in letter grades on the basis of aggregate marks. For any course a student must secure 40% or above of the total aggregate marks to pass the course.

As per decision and approval of the 51st Academic council the grading system is as follows:

| Marks obtained (in percentage) | Letter Grade | Grade Point |
|---|---|---|
| 80 & Above | A+ | 4.00 |
| 75 to <80 | A | 3.75 |
| 70 to <75 | A- | 3.50 |
| 65 to <70 | B+ | 3.25 |
| 60 to <65 | B | 3.00 |
| 55 to <60 | B- | 2.75 |
| 50 to <55 | C+ | 2.50 |
| 45 to <50 | C | 2.25 |
| 40 to <45 | D | 2.00 |
| Less than 40 | F | 0.00 |

Total grade points secured divided by the total Credit Hours taken shall be Grade Point Average (GPA). A student is declared to have passed the semester examinations when he passes in all the courses of the semester having minimum GPA of 2.00 for all undergraduate programmes.

A student failing in not more than two theoretical courses may be allowed to sit for Referred Examination on the course or courses to be held normally within two weeks from the commencement of the next semester. The Referred Examinations will cover the entire syllabus of the course(s).

A student who passes the Referred Examinations shall be declared to have passed the relevant Semester Examination. **The grading for a subject will be according to the grading system mentioned above with a maximum of B grade.** If he fails in the Referred Examinations, he may sit for backlog exam as per rule.

Results of examinations of the successful candidates and of those eligible for referred examinations are announced by the Registrar after it has been considered by the Examination Committee and endorsed by the Vice Chancellor. A student is eligible for award of Certificate, Diploma, Higher Diploma, Bachelor Degree, and Master Degree for which he was admitted when he passes the prescribed subjects of all the semesters and successfully completes approved industrial attachment, special assignments, practical training and remedial courses as the case may be. The details are given in the publication on Academic Rules as approved by the Academic Council.

The awards are classified as -

- First Class with Honours
- First Class,
- Second Class.

However, no class is awarded in the case of Master of Technical Education. A student securing Cumulative Grade Point Average (CGPA) of 3.75 and above is placed in the First Class with Honours. Those securing CGPA of 3.00 and above are placed in the First Class. Other successful candidates are placed in the Second Class.

**IUT Gold Medal** is awarded Department-wise to the students who get highest CGPA at the end of the programme but not less than 3.80 out of 4.00 among different programmes of each Department (having duration of 2 years or more). **OIC Gold Medal** is awarded to a student who secures at least CGPA of 3.90 out of 4.00 at the end of the programme and tops the list of all successful students of all the programmes of all the Departments. However, only OIC Gold Medal will be awarded to the student who becomes eligible for both the medals.

## 2.8 Student Feedback System

At the end of each semester, student has to give his feedback on the courses he has taken in that semester in Student Information System (SIS). Details procedure of student feedback is given in “Student’s Guide”.

# Chapter 3

# Department of Electrical and Electronic Engineering

## 3.1 Introduction

The Department of Electrical and Electronic Engineering (EEE) is the largest department of the Islamic University of Technology (IUT) with an annual intake of 180 undergraduate students. Offering both undergraduate and graduate programs, the department has established itself in a leading position in engineering education in Bangladesh. It offers students a unique hands-on experience in state-of-the-art laboratories and instruction from well-qualified and dedicated faculty.

The EEE department always ensures close interaction between students and faculty to extract the best out of the students. It also maintains continuous interactions with industry leaders in areas such as electronics, telecommunication, integrated circuits, power electronics, and power system which give an added impetus to the students to acquire strong theoretical foundation and exceptional practical experience.

The EEE department is making major contributions toward the achievement of the cherished goal of IUT in developing human resources of the Member States of Organisation of Islamic Cooperation (OIC), especially in the fields of Engineering, Science and Technology. Different programs are offered by the department to prepare the students to place themselves in the highly competitive world of modern technology.

The Department of Electrical and Electronic Engineering has a vibrant research-oriented culture. The department has undertaken research in various areas of Electrical and Electronic Engineering. These focused areas include power electronics, energy, high power misystemse and

communication systems and networks, biomedical engineering, control systems, intelligent systems, robotics, and VLSI circuit design.

Special training programs are also designed and offered on short-term basis as per the request from Member States of OIC. Seminars and Workshops on national and international levels are organized by the department to disseminate information on current progress in Technology and Technical know-how among the personnel of the OIC Member States who are involved in the promotion, development, and application of Electrical and Electronic Engineering.

## 3.2 Vision and Mission of the Department

### 3.2.1 Vision

To become a global leader in producing competent engineers, innovators, researchers, and entrepreneurs in the diverse areas of electrical and electronic engineering for the benefit of society.

### 3.2.2 Mission

- To instill diverse cutting-edge knowledge, competency, and positive professional attitudes to its graduates to cope with the challenges of the upcoming revolution in electrical and electronic engineering industries.
- To impart knowledge and professional skills in a motivational way while keeping abreast of the latest developments in the electrical and electronic engineering area.
- To carry out state-of-the-art research with a strong foundation and good design skills in electrical and electronic engineering.
- To play leading roles in promoting the Muslim Ummah's competitiveness for integration into the global economy and serve the OIC member states in particular and the entire world in general.

## 3.3 List of Faculty and Staff Members with Field of Expertise

### Present Faculty

| Faculty | Field of Expertise |
|---|---|
| **Head of the Department** | |
| Prof. Dr. Syed Iftekhar Ali<br>Ph.D. (BUET), M.Sc. Engg. (BUET), MASc. (University of Waterloo, Canada), B.Sc. Engg. (BUET) | Semiconductor device modeling, Material characterization, Low-power TCAM circuits |
| **Professors** | |
| Prof. Dr. Mohammad Rakibul Islam<br>Ph.D. (Kyung Hee), M.Sc. Engg. (BUET), MBA (IBA), B.Sc. Engg. (BUET) | Wireless Communication, Optics, Photonics, Plasmonics and Machine learning applications. |
| Prof. Dr. Khondokar Habibul Kabir<br>Ph.D. (Osaka, Japan), M.Sc. Engg. (Osaka, Japan), B.Sc. Engg. (IUT) | Intelligent Internet of Things (IoT), Intelligent Energy Networking (EN), Intelligent Grid, ML, AI and Bio-Inspired Game theory in IoT, Blockchain in EN, Underwater Internet of Things (U-IoT) |

| | |
|---|---|
| Prof. Dr. Mr. Golam Sarowar<br>Ph.D. (IUT),M.Sc. Engg. (BUET),<br>B.Sc. Engg (IUT) | Power Electronics, Control System, Machine Learning |
| Prof. Dr. Mohammad Tawhid Kawser<br>Ph.D. (IUT), M.Sc. Engg. (Virginia Tech), B.Sc. Engg. (BUET) | 4G/5G Cellular Communication, NB-IoT, V2X, Non-Terrestrial Networks (NTN) |
| Prof. Dr. Mr. Ashik Ahmed<br>Ph.D. (IUT), M.Sc. Engg. (KFUPM),<br>B.Sc. Engg.(IUT) | Power System Stability, Engineering Optimization, Nonlinear Control, Green Energy. |
| Prof. Dr. Rakibul Hasan Sagor<br>Ph.D. (IUT), M.Sc. Engg. (KFUPM),<br>B.Sc. Engg.(IUT) | Photonics, Plasmonics, High Power Microwave |
| Dr. Mr. Nafiz Imtiaz Bin Hamid<br>Ph.D. (IUT), M.Sc. Engg. (IUT),<br>B.Sc. Engg. (IUT) | Wireless Communications, Next Generation Cellular Networks, THz Transmission, Biomedical Signal Analysis |

**Assistant Professor**

| | |
|---|---|
| Mr. Muhammad<br>M.Sc. Engg. (IUT), B.Sc. Engg. (IUT) | Optimization in Renewable Energy |
| Mr. Quazi Nafees UI Islam<br>M.Sc. Engg. (IUT), B.Sc. Engg. (IUT) | Engineering Optimization, Microgrid |
| Dr. Mohammad Masum Billah<br>PhD (Kyung hee University, Korea), M. Sc. Engg. (Inha University, Korea), B. Sc. Engg. (BUITMS, Pakistan) | Semiconductor devices, VLSI Design, MOSFET and Transistors Technologies, Sensor circuits, Ferroelectric DRAM |
| Mr. Fardeen Hasib Mozumder<br>M.Sc. Engg. (Texas A&M University), B.Sc. Engg. (IUT) | Computer Architecture, Digital System Design, Machine Learning |

**Lecturer**

| | |
|---|---|
| Mr. Asif Newaz<br>MSc in CSE (EWU), BSc in EEE (IUT) | AI, Machine Learning, Computer Vision, Biomedical Engineering, Signal Processing |

| | |
|---|---|
| Mr. Nadim Ahmed<br>MSc in EEE (IUT), BSc in EEE (IUT) | Deep Learning, Computer Vision, Embedded Systems |
| Mr. Sheikh Montasir Mahbub<br>MSc in EEE (IUT), BSc in EEE (IUT) | Photonics, Plasmonics, Nonlinear Optics |
| Mr. Ashraful Islam Mridha<br>MSc in EEE (IUT) (Ongoing), BSc in EEE (IUT) | Machine Learning, Computer Vision, Reinforcement Learning, Electric Vehicle |
| Mr. Md. Samiur Rahman<br>M.Sc. in EEE (IUT), BSc in EEE (IUT) | Optimization algorithm, Engineering Optimization, Wireless Communication, Cellular Communication, 3G/LTE/5G |
| Mr. Md. Arefin Rabbi Emon<br>M.Sc. in EEE (IUT) (Ongoing), BSc in EEE (IUT) | Machine Learning & Robotics, Software development |
| Mr. Hasan Jamil Apon<br>M.Sc. in EEE (IUT), BSc in EEE (IUT) | Engineering Optimization, Power System Stability, Microgrids, Electric Vehicles. |

| | |
|---|---|
| Mr. Mohd. Abu Bakar Siddique<br>B.Sc. in EEE (IUT) | Plasmonics, Artificial Intelligence. |
| Mr. Sheikh Munim Hussain<br>M.Sc. in EEE (BUET) (Ongoing),<br>BSc in EEE (BUET) | Photonics, Plasmonics |
| Ms. Wasifa Rahman Rashmi<br>M.Sc. in EEE (IUT) (Ongoing),<br>BSc in EEE (IUT) | Plasmonics, PCF design for sensing application |

**Junior Lecturer**

| | |
|---|---|
| Mr. Abdullah Taharat<br>BSc in EEE (IUT) | Nanophotonics, Plasmonics, Machine Learning |
| Ms. Anika Rahman Habiba<br>MSc in EEE (IUT) (Ongoing),<br>BSc in EEE (IUT) | Plasmonics, Alternative Plasmonic Materials |
| Mr. Mohammad Abrar Kabir<br>MSc in EEE (IUT) (Ongoing),<br>BSc in EEE (IUT) | Plasmonics |
| Mr. Aseer Imad Keats<br>MSc in EEE (IUT) (Ongoing),<br>BSc in EEE (IUT) | Photonics, Plasmonics, Optics, Bio-sensors, Alternative Plasmonic Materials |

| | |
|---|---|
| Mr. Liman Shams<br>MSc in EEE (IUT) (Ongoing),<br>BSc in EEE (IUT) | Cellular Communication, Electronics |
| Ms. Sumaiya Bashar<br>MSc in EEE (IUT) (Ongoing),<br>BSc in EEE (KUET) | 6G Wireless Communication System |
| Mr. Mohammad Aman Ullah<br>MSc in EEE (IUT) (Ongoing),<br>BSc in EEE (IUT) | Deep Learning, Computer Vision |
| Mr. Salman Hossain<br>MSc in EEE (IUT) (Ongoing),<br>BSc in EEE (IUT) | Power System, Optimization, Machine Learning and Deep Learning Solutions for Renewable Energy |
| Mr. Ahmed Jawad Rashid<br>MSc in EEE (IUT) (Ongoing),<br>BSc in EEE (IUT) | Computer Vision, Cellular Communication |

## Faculty on Leave

### Assistant Professor

Mr. Md. Thesun Al-Amin

Mr. Safayat Bin Hakim

Mr. Fahim Faisal

Mr. Md. Mehedi Hassan Galib

Mr. Md. Nazrul Islam Siddique
Mr. Mirza Fuad Adnan
Mr. Shabir Ahmed
Mr. Md. Omar Faruque
Mr. Mirza Muntasir Nishat
Mr. Rabiul Al Mahmud
Mr. Md. Arif Hossain
Mr. Saad Mohammad Abdullah
Mr. Md. Farhad Hassan
Dr. Fahim Abid

**Lecturer**

Mr. Md. Faiyaz Kabir
Mr. Rashadul Hasan Badhon
Mr. Nchouwat Ndumgouo Ibrahim Moubarak
Mr. Md. Saiful Islam Sumon
Mr. Hayder Jahan Parash
Mr. AMK Muntasir Shamim
Mr. Sabiq Muhtadi
Ms. Sanjida Ali
Mr. Md. Sayed Hasan Rifat
Mr. Ahmad Shafiullah
Mr. Mahbubur Rahman
Mr. A. K. M. Rakib
Mr. Shadman Shahriar Sharar
Ms. Maisha Farjana Etu

## Part Time Faculty

Dr. Md. Arifur Rahman
Professor, Dept. of EEE, DUET

Dr. S. M. Mahfuz Alam
Assoc. Prof., Dept. of EEE, DUET

Dr. Umme Fawzia Rahim
Asst. Prof., Dept. of CSE, DUET

Dr. Ahmed Al Mansur
Assoc. Prof., Dept. of EEE, Green University of Bangladesh

Dr. Md. Obayedullah
Professor, Math Dept., BUET (Retd.)

Dr. Aminul I. Talukder
Professor, Dept. of Physics, DU

Dr. Zulfiqar Hasan Khan
Assoc. Prof., Physics Dept., DU

Dr. Md. Azizar Rahman
Assoc. Prof., Physics Dept., BUET

Dr. A. K. M. Akhter Hossain
Professor, Physics Dept., BUET

Dr. Mohammed Abdul Basith
Professor, Physics Dept., BUET

Dr. Muhammad Ruhul Amin

Assoc. Prof, Dept. of Physics, DU

Dr. Mohammad Khurshed Alam
Assoc. Prof., Physics Dept., BUET

Dr. Md. Abdul Maleque
Professor, Math Dept., BUET (Retd.)

Dr. Muhammad Samir Ullah
Assoc. Prof., Physics Dept., BUET

Dr. Mohammad Shahid Ullah
Dept. of Art and Science, AUST

Dr. Nour Md. Mofiz Uddin Khan
Dept. of Chem., DUET

Dr. Md. Rafikul Islam
Lecturer, Dept. of Chemistry, DUET

Mr. Tasin Intisar
Lecturer, Dept. of EEE, AUST

**Staff Members**

Mr. Masudur Rahman Sarker
Sub Divisional Engineer

Mr. Engr. Muhammad Anowar Kabir
Sub Divisional Engineer

Mr. Md. Golam Mostafa
Assistant Engineer

Mr. Md. Rasel Mia
Assistant Engineer

Mr. Md. Mozammel Hossain
Assistant Engineer

Mr. Ashadul Haque
Assistant Engineer

Mr. Md. Mamun Mian
Assistant Engineer

Mr. Md Ehsanul Islam
Senior Operator

Mr. Md. Rashik Molla
Lab Attendant

Mr. Faisal Ahmed
Senior Assistant Secretary

## 3.4 Study Programmes

### 3.4.1 Undergraduate Programmes

The programs are:

- Bachelor of Science in Electrical and Electronic Engineering

The B.Sc. Engineering program in Electrical and Electronic Engineering comprises of four years of study consisting of eight consecutive semesters of sixteen weeks duration each.

The course curricula contain engineering science of high level as well as components for hands-on-experience to produce engineers of international standard having relevance to the development needs of the Member States. The course curricula are under constant scrutiny and review and continuously updated to meet the current needs and requirements. The levels and contents are always kept at international standard. The laboratory facilities are also upgraded from time to time to incorporate new ideas and technologies.

### 3.4.2 Postgraduate Programs

The programs are:

- Doctor of Philosophy in Electrical and Electronic Engineering
- Master of Science in Electrical and Electronic Engineering
- Master of Electrical and Electronic Engineering

The Department offers two research degrees, Doctor of Philosophy (Ph.D.) and Master of Science (M.Sc.) in Electrical and Electronic Engineering. These higher degrees are awarded on the basis of prescribed coursework and independent but supervised research in a topic, culminating in the submission of a thesis. For the M.Sc. degree, the period of candidature is normally 3 semesters requiring 18 credit hours of course work and 18 credit hours of research. Completion of the Ph.D. degree requires 54 credit hours and normally takes 6 semesters.

Master of Engineering in Electrical and Electronic Engineering is structured around coursework and requires 30 credit hours of course work and 6 credit hours of research/projects. The period of candidature for this program is normally 3 semesters.

## 3.5 Labs and Facilities under Electrical and Electronic Department

With a view to enabling the students to have hands on experience and to properly understand the applicability of theories taught in the classrooms, the following laboratories and workshops have been established:

- Electrical Machine Lab.
- Power Systems Lab.
- Electrical Utilization Lab.
- Electrical Workshop
- Switchgear and Protection Lab.
- Microprocessor and Micro-controller Systems Lab.
- Control System Lab.
- Digital Electronics Lab.
- Measurements and Instrumentation Lab.
- Electronics Lab.
- Electronic Workshop
- Industrial Electronics Lab.
- Microwave & Radio Engineering Lab
- Telecommunication Lab.
- Signal Processing Lab.
- VLSI Circuits Lab.
- Medical Electronics Lab.
- Physics Lab.

# Chapter 4

# Detailed Course Information

## 4.1 Course Structure for Undergraduate Programme

### 4.1.1 Course Credit Distribution Table

| Category | Description | Theory Credit | % (Theory credit) | Lab Credit | Total Credit |
|---|---|---|---|---|---|
| A | Arts, Humanities and Social Science | 22 | 15.71% | 2.00 | 24 |
| B | General Science and Mathematics | 21 | 15.00% | 2.25 | 23.25 |
| C | Engineering Compulsory | 73 | 52.14% | 34.75 | 107.75 |
| D | Elective Courses for Specialization Groups | 12 | 8.57% | 1.50 | 13.50 |
| E | Pseudo-compulsory Courses | 12 | 8.57% | 3.00 | 15.00 |
| **Total** | | **140** | **100%** | **43.5** | **183.50** |

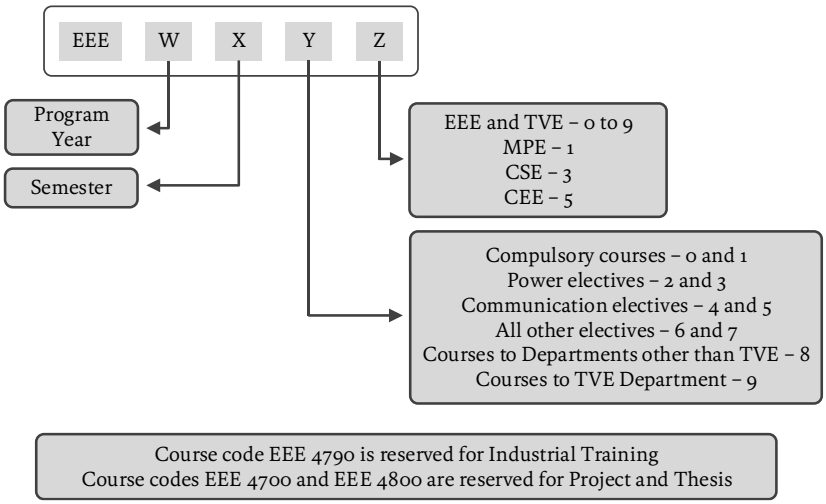
### 4.1.2 Course Designation and Numbering System

All departmental courses (course number starting with EEE) are numbered according to EEE departmental internal policy. According to that policy, each course contains four digits WXYZ in a course code EEE

WXYZ. The first digit W indicates program year. For a 4-year program such as B.Sc. Engineering, the first digit is 4, e.g., course code is EEE 4XYZ. The second digit X represents semester (1 to 8). For example, a course in third semester of a four year program will be EEE 43YZ. Third and fourth digits YZ represent type of course as follows:

| **3rd and 4th digit (YZ)** | **Meaning** | **3rd digit (Y)** |
|---|---|---|
| 01 to 19 | Compulsory courses | 0 or 1 |
| 20 to 39 | Power electives | 2 or 3 |
| 40 to 59 | Communication electives | 4 or 5 |
| 60 to 79 | All other electives | 6 or 7 |
| 80 to 99 | Courses offered to other departments and industrial training (90) | 8 or 9 (9 for TVE, 8 for other) |

Odd fourth digit Z represents theory course and even fourth digit Z represents sessional course. Fourth digit Z for EEE theory courses to other departments is 1 for MPE, 3 for CSE, 5 for CEE. The numbering policy can be summarized in the following figure:



## 4.1.3 Category-wise Course Structure

### A. Arts, Humanities and Social Science

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| Hum 4122/ Hum 4124 | Arabic I/ English I | Practical | 2 | 1.00 |
| Hum 4125 | Islamic Philosophy, History and Culture | Theory | 3 | 3.00 |
| Hum 4222/ Hum 4224 | Arabic II/ English II | Practical | 2 | 1.00 |
| Hum 4225 | Professional Ethics and Legal Issues | Theory | 3 | 3.00 |
| Hum 4421 | Science, Technology and Islam | Theory | 2 | 2.00 |
| IPE 4591 | Engineering Management | Theory | 3 | 3.00 |
| IPE 4791 | Engineering Economics | Theory | 2 | 2.00 |
| BTM 4821 | Business Communication Skill | Theory | 3 | 3.00 |
| Hum 4823 | Sociology and Financial Accounting | Theory | 3 | 3.00 |
| Hum 4825 | Technology, Environment and Society | Theory | 3 | 3.00 |
| **Contact Hours: 26 Credit Hours: 24.00** | | | | |

### B. General Science and Mathematics

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| Math 4121 | Mathematics I (Calculus and Geometry) | Theory | 3 | 3.00 |

| | | | | |
|---|---|---|---|---|
| Math 4123 | Mathematics II (Matrices and Differential Equations) | Theory | 3 | 3.00 |
| Math 4221 | Mathematics III (Complex Variable, Vector Analysis and Statistics) | Theory | 3 | 3.00 |
| Math 4321 | Mathematics IV (Transform Techniques and Linear Algebra) | Theory | 3 | 3.00 |
| Phy 4121 | Engineering Physics I | Theory | 3 | 3.00 |
| Phy 4122 | Engineering Physics I Lab. | Practical | 3/2 | 0.75 |
| Phy 4221 | Engineering Physics II | Theory | 3 | 3.00 |
| Phy 4222 | Engineering Physics II Lab. | Practical | 3/2 | 0.75 |
| Chem 4121 | Engineering Chemistry | Theory | 3 | 3.00 |
| Chem 4122 | Engineering Chemistry Lab. | Practical | 3/2 | 0.75 |
| **Contact Hours: 25.5 Credit Hours: 23.25** | | | | |

## C. Engineering Compulsory

### Group 1: Electrical Engineering General

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| EEE 4101 | Electrical Circuit I | Theory | 3 | 3.00 |
| EEE 4102 | Electrical Circuit I Lab. | Practical | 3 | 1.50 |
| EEE 4201 | Electrical Circuit II | Theory | 3 | 3.00 |
| EEE 4202 | Electrical Circuit II Lab. | Practical | 3 | 1.50 |
| EEE 4416 | Simulation Lab. | Practical | 2 | 1.00 |
| EEE 4790 | Industrial Training | | | 1.00 |
| EEE 4700 | Project and Thesis | Practical | 6 | 3.00 |
| EEE 4800 | Project and Thesis | Practical | 6 | 3.00 |
| **Contact Hours: 26 Credit Hours: 17.00** | | | | |

**Group 2: Power Systems**

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| EEE 4418 | Electrical Services Design | Practical | 2 | 1.00 |
| EEE 4301 | Electrical Power Transmission and Distribution | Theory | 3 | 3.00 |
| EEE 4302 | Electrical Power Transmission and Distribution Lab. | Practical | 3/2 | 0.75 |
| EEE 4305 | Energy Conversion I | Theory | 3 | 3.00 |
| EEE 4306 | Energy Conversion I Lab. | Practical | 3/2 | 0.75 |
| EEE 4401 | Power System I | Theory | 3 | 3.00 |
| EEE 4402 | Power System I Lab. | Practical | 3/2 | 0.75 |
| EEE 4405 | Energy Conversion II | Theory | 3 | 3.00 |
| EEE 4406 | Energy Conversion II Lab. | Practical | 3/2 | 0.75 |
| EEE 4801 | Power Generation | Theory | 3 | 3.00 |
| **Contact Hours: 23 Credit Hours: 19.00** | | | | |

**Group 3: Communication**

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| EEE 4403 | Communication Engineering I | Theory | 3 | 3.00 |
| EEE 4404 | Communication Engineering I Lab. | Practical | 3/2 | 0.75 |
| EEE 4501 | Electromagnetic Fields and Waves | Theory | 3 | 3.00 |
| EEE 4703 | Communication Engineering II | Theory | 3 | 3.00 |
| EEE 4704 | Communication Engineering II Lab. | Practical | 3/2 | 0.75 |
| **Contact Hours: 12 Credit Hours: 10.50** | | | | |

**Group 4: Electronics and Signals**

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| EEE 4203 | Electronics I | Theory | 3 | 3.00 |
| EEE 4204 | Electronics I lab. | Practical | 3 | 1.50 |
| EEE 4303 | Electronics II | Theory | 3 | 3.00 |
| EEE 4304 | Electronics II Lab. | Practical | 3 | 1.50 |
| EEE 4307 | Digital Electronics | Theory | 3 | 3.00 |
| EEE 4308 | Digital Electronics lab. | Practical | 3 | 1.50 |
| EEE 4407 | Random Signals and Processes | Theory | 3 | 3.00 |
| EEE 4408 | Random Signals and Processes Lab. | Practical | 3/2 | 0.75 |
| EEE 4409 | Semiconductor Physics | Theory | 3 | 3.00 |
| EEE 4503 | Power Electronics | Theory | 3 | 3.00 |
| EEE 4504 | Power Electronics lab. | Practical | 3 | 1.50 |
| EEE 4601 | Signals and Systems | Theory | 3 | 3.00 |
| EEE 4602 | Signals and Systems Lab. | Practical | 3/2 | 0.75 |
| EEE 4701 | Digital Signal Processing I | Theory | 3 | 3.00 |
| EEE 4702 | Digital Signal Processing I Lab. | Practical | 3/2 | 0.75 |
| **Contact Hours: 40.50 Credit Hours: 32.25** | | | | |

**Group 5: Interdisciplinary**

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| EEE 4505 | Computational Methods in Engineering | Theory | 3 | 3.00 |

| | | | | |
|---|---|---|---|---|
| EEE 4506 | Computational Methods in Engineering Lab. | Practical | 3 | 1.50 |
| EEE 4518 | Electrical and Electronic Workshop | Practical | 2 | 1.00 |
| EEE 4603 | Measurement and Instrumentation | Theory | 3 | 3.00 |
| EEE 4604 | Measurement and Instrumentation Lab. | Practical | 3/2 | 0.75 |
| EEE 4605 | Control System Engineering I | Theory | 3 | 3.00 |
| EEE 4606 | Control System Engineering I Lab. | Practical | 3/2 | 0.75 |
| EEE 4607 | Research Methodology | Theory | 2 | 2.00 |
| EEE 4616 | Microprocessor and Assembly Language Programming Lab. | Practical | 3 | 1.50 |
| EEE 4705 | Microcontroller Based System Design | Theory | 3 | 3.00 |
| EEE 4706 | Microcontroller Based System Design Lab. | Practical | 3/2 | 0.75 |
| **Contact Hours: 26.50 Credit Hours: 20.25** | | | | |

**Group 6: Inter-departmental**

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| MCE 4192 | Mechanical Engineering Drawing | Practical | 3/2 | 0.75 |
| MCE 4391 | Basic Mechanical Engineering | Theory | 3 | 3.00 |
| MCE 4392 | Basic Mechanical Engineering Lab. | Practical | 3/2 | 0.75 |
| CSE 4271 | Computer Programming | Theory | 2 | 2.00 |
| CSE 4272 | Computer Programming Lab. | Practical | 3 | 1.50 |
| CEE 4106 | Civil Engineering Drawing | Practical | 3/2 | 0.75 |
| **Contact Hours: 12.5 Credit Hours: 8.75** | | | | |

## D. Elective Courses for Specialization Groups

| Power Systems Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4535 | Renewable Energy System | Theory | 3 | 3.00 |
| EEE 4635 | Power System Operation and Control | Theory | 3 | 3.00 |
| EEE 4721 | Power System Protection | Theory | 3 | 3.00 |
| EEE 4722 | Power System Protection Lab. | Practical | 3/2 | 0.75 |
| EEE 4723 | Switchgear and Control Equipment I | Theory | 3 | 3.00 |
| EEE 4723 | Switchgear and Control Equipment I Lab. | Practical | 3/2 | 0.75 |
| EEE 4825 | Utilization of Electrical Energy | Theory | 3 | 3.00 |
| EEE 4826 | Utilization of Electrical Energy Lab. | Practical | 3/2 | 0.75 |
| EEE 4823 | Computer Methods in Electric Power System | Theory | 3 | 3.00 |
| EEE 4824 | Computer Methods in Electric Power System Lab. | Practical | 3/2 | 0.75 |
| EEE 4827 | Switchgear and Control Equipment II | Theory | 3 | 3.00 |
| EEE 4828 | Switchgear and Control Equipment II Lab. | Practical | 3/2 | 0.75 |
| EEE 4821 | Advanced Power System Protection | Theory | 3 | 3.00 |
| EEE 4822 | Advanced Power System Protection Lab. | Practical | 3/2 | 0.75 |

| Communication Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4551 | Data Communication and Networking I | Theory | 3 | 3.00 |
| EEE 4651 | Data Communication and Networking II | Theory | 3 | 3.00 |
| EEE 4653 | Advanced Communication Techniques | Theory | 3 | 3.00 |
| EEE 4741 | Microwave Engineering | Theory | 3 | 3.00 |
| EEE 4742 | Microwave Engineering Lab. | Practical | 3/2 | 0.75 |
| EEE 4853 | Cellular Communication | Theory | 3 | 3.00 |
| EEE 4854 | Cellular Communication Lab. | Practical | 3/2 | 0.75 |
| EEE 4841 | Optical Communication | Theory | 3 | 3.00 |
| EEE 4842 | Optical Communication Lab. | Practical | 3/2 | 0.75 |

| Electronics and Signals Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4571 | Compound Semiconductor and Heterojunction Device | Theory | 3 | 3.00 |
| EEE 4579 | Engineering Materials | Theory | 3 | 3.00 |
| EEE 4671 | Optoelectronics | Theory | 3 | 3.00 |
| EEE 4673 | Photonics and Plasmonics | Theory | 3 | 3.00 |
| EEE 4763 | Medical Electronics | Theory | 3 | 3.00 |
| EEE 4764 | Medical Electronics Lab. | Practical | 3/2 | 0.75 |
| EEE 4865 | Digital Filter Design | Theory | 3 | 3.00 |
| EEE 4866 | Digital Filter Design Lab. | Practical | 3/2 | 0.75 |
| EEE 4877 | Analog Integrated Electronics | Theory | 3 | 3.00 |
| EEE 4878 | Analog Integrated Electronics Lab. | Practical | 3/2 | 0.75 |

## E. Pseudo-compulsory Courses

| Communication Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4541 | Wireless Communication | Theory | 3 | 3.00 |
| EEE 4542 | Wireless Communication Lab. | Practical | 3/2 | 0.75 |

| Power Systems Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4631 | Power System II | Theory | 3 | 3.00 |
| EEE 4632 | Power System II Lab. | Practical | 3/2 | 0.75 |

| Interdisciplinary Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4709 | Artificial Intelligence and Machine Learning | Theory | 3 | 3.00 |
| EEE 4710 | Artificial Intelligence and Machine Learning Lab. | Practical | 3/2 | 0.75 |
| EEE 4775 | Robotics and Automation | Theory | 3 | 3.00 |
| EEE 4776 | Robotics and Automation Lab. | Practical | 3/2 | 0.75 |
| CSE 4781 | Object Oriented Programming | Theory | 3 | 3.00 |
| CSE 4782 | Object Oriented Programming Lab. | Practical | 3/2 | 0.75 |
| EEE 4773 | Digital Image Processing | Theory | 3 | 3.00 |
| EEE 4774 | Digital Image Processing Lab. | Practical | 3/2 | 0.75 |

| Electronics and Signals Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4861 | VLSI Design | Theory | 3 | 3.00 |
| EEE 4862 | VLSI Design Lab | Practical | 3/2 | 0.75 |

## 4.1.4 Semester-wise Course Structure

### First Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| Hum 4122/ Hum 4124 | Arabic I/ English I | Practical | 2 | 1.00 |
| Hum 4125 | Islamic Philosophy, History and Culture | Theory | 3 | 3.00 |
| Math 4121 | Mathematics I (Calculus and Geometry) | Theory | 3 | 3.00 |
| Math 4123 | Mathematics II (Matrices and Differential Equations) | Theory | 3 | 3.00 |
| Phy 4121 | Engineering Physics I | Theory | 3 | 3.00 |
| Phy 4122 | Engineering Physics I Lab. | Practical | 3/2 | 0.75 |
| Chem 4121 | Engineering Chemistry | Theory | 3 | 3.00 |
| Chem 4122 | Engineering Chemistry Lab. | Practical | 3/2 | 0.75 |
| EEE 4101 | Electrical Circuit I | Theory | 3 | 3.00 |
| EEE 4102 | Electrical Circuit I Lab. | Practical | 3 | 1.50 |
| MCE 4192 | Mechanical Engineering Drawing | Practical | 3/2 | 0.75 |
| CEE 4106 | Civil Engineering Drawing | Practical | 3/2 | 0.75 |
| **Contact Hours: 29 Credit Hours: 23.50** | | | | |

## Second Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| Hum 4222/ Hum 4224 | Arabic II/ English II | Practical | 2 | 1.00 |
| Hum 4225 | Professional Ethics and Legal Issues | Theory | 3 | 3.00 |
| Math 4221 | Mathematics III (Complex Variable, Vector Analysis and Statistics) | Theory | 3 | 3.00 |
| Phy 4221 | Engineering Physics II | Theory | 3 | 3.00 |
| Phy 4222 | Engineering Physics II Lab. | Practical | 3/2 | 0.75 |
| EEE 4201 | Electrical Circuit II | Theory | 3 | 3.00 |
| EEE 4202 | Electrical Circuit II Lab. | Practical | 3 | 1.50 |
| EEE 4203 | Electronics I | Theory | 3 | 3.00 |
| EEE 4204 | Electronics I Lab. | Practical | 3 | 1.50 |
| CSE 4271 | Computer Programming | Theory | 2 | 2.00 |
| CSE 4272 | Computer Programming Lab. | Practical | 3 | 1.50 |
| **Contact Hours: 29.5 Credit Hours: 23.25** | | | | |

## Third Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| Math 4321 | Mathematics IV (Transform Techniques and Linear Algebra) | Theory | 3 | 3.00 |
| EEE 4301 | Electrical Power Transmission and Distribution | Theory | 3 | 3.00 |
| EEE 4302 | Electrical Power Transmission and Distribution Lab. | Practical | 3/2 | 0.75 |
| EEE 4303 | Electronics II | Theory | 3 | 3.00 |
| EEE 4304 | Electronics II Lab. | Practical | 3 | 1.50 |
| EEE 4305 | Energy Conversion I | Theory | 3 | 3.00 |
| EEE 4306 | Energy Conversion I Lab. | Practical | 3/2 | 0.75 |
| EEE 4307 | Digital Electronics | Theory | 3 | 3.00 |
| EEE 4308 | Digital Electronics Lab. | Practical | 3 | 1.50 |
| MCE 4391 | Basic Mechanical Engineering | Theory | 3 | 3.00 |
| MCE 4392 | Basic Mechanical Engineering Lab. | Practical | 3/2 | 0.75 |
| **Contact Hours: 28.5 Credit Hours: 23.25** | | | | |

## Fourth Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| Hum 4421 | Science, Technology and Islam | Theory | 2 | 2.00 |
| EEE 4401 | Power System I | Theory | 3 | 3.00 |
| EEE 4402 | Power System I Lab. | Practical | 3/2 | 0.75 |
| EEE 4403 | Communication Engineering I | Theory | 3 | 3.00 |
| EEE 4404 | Communication Engineering I Lab. | Practical | 3/2 | 0.75 |
| EEE 4405 | Energy Conversion II | Theory | 3 | 3.00 |
| EEE 4406 | Energy Conversion II Lab. | Practical | 3/2 | 0.75 |
| EEE 4407 | Random Signals and Processes | Theory | 3 | 3.00 |
| EEE 4408 | Random Signals and Processes Lab. | Practical | 3/2 | 0.75 |
| EEE 4409 | Semiconductor Physics | Theory | 3 | 3.00 |
| EEE 4416 | Simulation Lab. | Practical | 2 | 1.00 |
| EEE 4418 | Electrical Services Design | Practical | 2 | 1.00 |
| **Contact Hours: 27 Credit Hours: 22.00** | | | | |

## Fifth Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| IPE 4591 | Engineering Management | Theory | 3 | 3.00 |
| EEE 4505 | Computational Methods in Engineering | Theory | 3 | 3.00 |
| EEE 4506 | Computational Methods in Engineering Lab. | Practical | 3 | 1.50 |
| EEE 4501 | Electromagnetic Fields and Waves | Theory | 3 | 3.00 |
| EEE 4503 | Power Electronics | Theory | 3 | 3.00 |
| EEE 4504 | Power Electronics Lab. | Practical | 3 | 1.50 |
| EEE 4518 | Electrical and Electronic Workshop | Practical | 2 | 1.00 |
| | Elective Course from Specialization Groups * | | 3 | 3.00 |
| | Pseudo-compulsory Course ** | | 3 - 3/2 | 3.75 |
| **Contact Hours: 27.50 Credit Hours: 22.75** | | | | |

* Each student will be offered a course available under the specialization group assigned to him/her. Available courses are outlined in section 4.1.5 (A) under the title "Elective Courses for Specialization Groups".

** One course will be offered as a pseudo-compulsory course which will be mandatory for all students. Available courses are outlined in section 4.1.5 (B) under the title "Pseudo-compulsory Courses".

## Sixth Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| EEE 4601 | Signals and Systems | Theory | 3 | 3.00 |
| EEE 4602 | Signals and Systems Lab. | Practical | 3/2 | 0.75 |
| EEE 4603 | Measurement and Instrumentation | Theory | 3 | 3.00 |
| EEE 4604 | Measurement and Instrumentation Lab. | Practical | 3/2 | 0.75 |
| EEE 4605 | Control System Engineering I | Theory | 3 | 3.00 |
| EEE 4606 | Control System Engineering I Lab. | Practical | 3/2 | 0.75 |
| EEE 4607 | Research Methodology | Theory | 2 | 2.00 |
| EEE 4616 | Microprocessor and Assembly Language Programming Lab. | Practical | 3 | 1.50 |
| | Elective Course from Specialization Groups * | | 3 | 3.00 |
| | Pseudo-compulsory Course ** | | 3 - 3/2 | 3.75 |
| **Contact Hours: 26.00 Credit Hours: 21.50** | | | | |

* Each student will be offered a course available under the specialization group assigned to him/her. Available courses are outlined in section 4.1.5 (A) under the title "Elective Courses for Specialization Groups".

** One course will be offered as a pseudo-compulsory course which will be mandatory for all students. Available courses are outlined in section 4.1.5 (B) under the title "Pseudo-compulsory Courses".

## Seventh Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| IPE 4791 | Engineering Economics | Theory | 2 | 2.00 |
| EEE 4700 | Project and Thesis | Practical | 6 | 3.00 |
| EEE 4701 | Digital Signal Processing I | Theory | 3 | 3.00 |
| EEE 4702 | Digital Signal Processing I Lab. | Practical | 3/2 | 0.75 |
| EEE 4703 | Communication Engineering II | Theory | 3 | 3.00 |
| EEE 4704 | Communication Engineering II Lab. | Practical | 3/2 | 0.75 |
| EEE 4705 | Microcontroller Based System Design | Theory | 3 | 3.00 |
| EEE 4706 | Microcontroller Based System Design Lab. | Practical | 3/2 | 0.75 |
| EEE 4790 | Industrial Training * | | | 1.00 |
| | Elective Course from Specialization Groups ** | | 3 - 3/2 | 3.75 |
| | Pseudo-compulsory Course *** | | 3 - 3/2 | 3.75 |
| **Contact Hours: 30.50 Credit Hours: 24.75** | | | | |

***** Industrial training programme will be organized by IUT during the session break in between 6$^{th}$ and 7$^{th}$ semester and it is compulsory for all the students of B.Sc. Engg. (EEE). Duration of the training programme will be about four weeks.

** Each student will be offered a course available under the specialization group assigned to him/her. Available courses are outlined in section 4.1.5 (A) under the title “Elective Courses for Specialization Groups”.

*** One course will be offered as a pseudo-compulsory course which will be mandatory for all students. Available courses are outlined in section 4.1.5 (B) under the title “Pseudo-compulsory Courses”.

## Eighth Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| BTM 4821 | Business Communication Skill | Theory | 3 | 3.00 |
| Hum 4823 | Sociology and Financial Accounting | Theory | 3 | 3.00 |
| Hum 4825 | Technology, Environment and Society | Theory | 3 | 3.00 |
| EEE 4800 | Project and Thesis | Practical | 6 | 3.00 |
| EEE 4801 | Power Generation | Theory | 3 | 3.00 |
| | Elective Course from Specialization Groups * | | 3 - 3/2 | 3.75 |
| | Pseudo-compulsory Course ** | | 3 - 3/2 | 3.75 |
| **Contact Hours: 27.00 Credit Hours: 22.50** | | | | |

* Each student will be offered a course available under the specialization group assigned to him/her. Available courses are outlined in section 4.1.5 (A) under the title “Elective Courses for Specialization Groups”.

** One course will be offered as a pseudo-compulsory course which will be mandatory for all students. Available courses are outlined in section 4.1.5 (B) under the title “Pseudo-compulsory Courses”.

## 4.1.5 Semester-wise Elective Course Structure

The students will be permanently divided into three groups of specialization in 3rd year and 4th year. The three groups are – **Communication**, **Power Systems**, and **Electronics & Signals**. Each student will be assigned to a specialization group and will be offered courses available under that group each semester.

In each semester of 3rd year and 4th year –

i) One course will be offered as a **specialization specific elective course**, where three courses from the three different fields will be offered to the corresponding groups of specialization.

ii) Another course will be offered as **pseudo-compulsory course** (this course will be mandatory for all students).

## A. Elective Courses for Specialization Groups

### Fifth Semester

| Power Systems Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4535 | Renewable Energy System | Theory | 3 | 3.00 |

| Communication Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4551 | Data Communication and Networking I | Theory | 3 | 3.00 |

| Electronics and Signals Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4571 | Compound Semiconductor and Heterojunction Device | Theory | 3 | 3.00 |
| EEE 4579 | Engineering Materials | Theory | 3 | 3.00 |

## Sixth Semester

| Power Systems Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4635 | Power System Operation and Control | Theory | 3 | 3.00 |

| Communication Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4651 | Data Communication and Networking II | Theory | 3 | 3.00 |
| EEE 4653 | Advanced Communication Techniques | Theory | 3 | 3.00 |

| Electronics and Signals Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4671 | Optoelectronics | Theory | 3 | 3.00 |
| EEE 4673 | Photonics and Plasmonics | Theory | 3 | 3.00 |

## Seventh Semester

| Power Systems Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4721 | Power System Protection | Theory | 3 | 3.00 |
| EEE 4722 | Power System Protection Lab. | Practical | 3/2 | 0.75 |
| EEE 4723 | Switchgear and Control Equipment I | Theory | 3 | 3.00 |
| EEE 4724 | Switchgear and Control Equipment I Lab. | Practical | 3/2 | 0.75 |

| Communication Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4741 | Microwave Engineering | Theory | 3 | 3.00 |
| EEE 4742 | Microwave Engineering Lab. | Practical | 3/2 | 0.75 |

| Electronics and Signals Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4763 | Medical Electronics | Theory | 3 | 3.00 |
| EEE 4764 | Medical Electronics Lab. | Practical | 3/2 | 0.75 |

## Eighth Semester

| Power Systems Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4825 | Utilization of Electrical Energy | Theory | 3 | 3.00 |
| EEE 4826 | Utilization of Electrical Energy Lab. | Practical | 3/2 | 0.75 |
| EEE 4823 | Computer Methods in Electric Power System | Theory | 3 | 3.00 |
| EEE 4824 | Computer Methods in Electric Power System Lab. | Practical | 3/2 | 0.75 |
| EEE 4827 | Switchgear and Control Equipment II | Theory | 3 | 3.00 |
| EEE 4828 | Switchgear and Control Equipment II Lab. | Practical | 3/2 | 0.75 |
| EEE 4821 | Advanced Power System Protection | Theory | 3 | 3.00 |
| EEE 4822 | Advanced Power System Protection Lab. | Practical | 3/2 | 0.75 |

| Communication Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4853 | Cellular Communication | Theory | 3 | 3.00 |
| EEE 4854 | Cellular Communication Lab | Practical | 3/2 | 0.75 |
| EEE 4841 | Optical Communication | Theory | 3 | 3.00 |
| EEE 4842 | Optical Communication Lab | Practical | 3/2 | 0.75 |

| Electronics and Signals Group | | | | |
|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **Contact Hours** | **Credit Hours** |
| EEE 4865 | Digital Filter Design | Theory | 3 | 3.00 |
| EEE 4866 | Digital Filter Design Lab. | Practical | 3/2 | 0.75 |
| EEE 4877 | Analog Integrated Electronics | Theory | 3 | 3.00 |
| EEE 4878 | Analog Integrated Electronics Lab. | Practical | 3/2 | 0.75 |

## B. Pseudo-compulsory Courses

### Fifth Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| EEE 4541 | Wireless Communication | Theory | 3 | 3.00 |
| EEE 4542 | Wireless Communication Lab | Practical | 3/2 | 0.75 |

### Sixth Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| EEE 4631 | Power System II | Theory | 3 | 3.00 |
| EEE 4632 | Power System II Lab | Practical | 3/2 | 0.75 |

## Seventh Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| EEE 4709 | Artificial Intelligence and Machine Learning | Theory | 3 | 3.00 |
| EEE 4710 | Artificial Intelligence and Machine Learning Lab | Practical | 3/2 | 0.75 |
| EEE 4775 | Robotics and Automation | Theory | 3 | 3.00 |
| EEE 4776 | Robotics and Automation Lab | Practical | 3/2 | 0.75 |
| CSE 4781 | Object Oriented Programming | Theory | 3 | 3.00 |
| CSE 4782 | Object Oriented Programming Lab | Practical | 3/2 | 0.75 |
| EEE 4773 | Digital Image Processing | Theory | 3 | 3.00 |
| EEE 4774 | Digital Image Processing Lab | Practical | 3/2 | 0.75 |

## Eighth Semester

| Course Code | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| EEE 4861 | VLSI Design | Theory | 3 | 3.00 |
| EEE 4862 | VLSI Design Lab | Practical | 3/2 | 0.75 |

## 4.2 Course Structure for Post-Graduate Programme

| Course Number | Course Title | Type of Course | Contact Hours | Credit Hours |
|---|---|---|---|---|
| EEE 6000 | Thesis | | | 18.00 |
| EEE 6002 | Project | | | 6.00 |
| EEE 6105 | Advanced Engineering Analysis | Theory | 3 | 3.00 |
| EEE 6200 | Selected Topics in Electrical and Electronic Engineering | Theory | 3 | 3.00 |
| EEE 6229 | VLSI Design | Theory | 3 | 3.00 |
| EEE 6231 | Advanced Analog IC Design | Theory | 3 | 3.00 |
| EEE 6233 | Advanced Analog Electronics | Theory | 3 | 3.00 |
| EEE 6235 | Advanced Solid-State Devices | Theory | 3 | 3.00 |
| EEE 6237 | IC Processing and Fabrication Technology | Theory | 3 | 3.00 |
| EEE 6301 | Power System Reliability | Theory | 3 | 3.00 |
| EEE 6303 | Power System Planning | Theory | 3 | 3.00 |
| EEE 6305 | Transients in Power System | Theory | 3 | 3.00 |
| EEE 6307 | Power System Modeling | Theory | 3 | 3.00 |
| EEE 6309 | Computer Methods in Power System Analysis | Theory | 3 | 3.00 |
| EEE 6311 | Power System Optimization | Theory | 3 | 3.00 |

| | | | | |
|---|---|---|---|---|
| EEE 6313 | Power System Dynamics and Stability | Theory | 3 | 3.00 |
| EEE 6315 | Solar and Wind Energy Systems | Theory | 3 | 3.00 |
| EEE 6317 | Solar Cell Technology | Theory | 3 | 3.00 |
| EEE 6401 | Optical Fiber Communication | Theory | 3 | 3.00 |
| EEE 6403 | Wireless Communication | Theory | 3 | 3.00 |
| EEE 6405 | Advanced Digital Signal Processing | Theory | 3 | 3.00 |
| EEE 6407 | Digital Communication | Theory | 3 | 3.00 |
| EEE 6409 | Information Theory | Theory | 3 | 3.00 |
| EEE 6411 | Wireless Ad Hoc and Sensor Networks | Theory | 3 | 3.00 |
| EEE 6413 | Engineering Optimization | Theory | 3 | 3.00 |
| EEE 6501 | Switching Theory | Theory | 3 | 3.00 |
| EEE 6503 | Advanced Computer Architecture | Theory | 3 | 3.00 |
| EEE 6505 | Analysis and Design of Digital Integrated Circuits | Theory | 3 | 3.00 |
| EEE 6507 | CISC Microprocessor System Design | Theory | 3 | 3.00 |
| EEE 6509 | Cloud Computing Technologies for Smart Grids | Theory | 3 | 3.00 |
| EEE 6511 | Advanced Internet of Things (IoT) | Theory | 3 | 3.00 |
| EEE 6601 | Antennas and Propagation | Theory | 3 | 3.00 |
| EEE 6603 | Microwave Devices and Circuits | Theory | 3 | 3.00 |

| | | | | |
|---|---|---|---|---|
| EEE 6605 | Semiconductor Lasers | Theory | 3 | 3.00 |
| EEE 6607 | Computational Electromagnetics | Theory | 3 | 3.00 |
| EEE 6701 | Nonlinear Control System | Theory | 3 | 3.00 |
| EEE 6703 | Modern Control | Theory | 3 | 3.00 |
| EEE 6705 | Digital Control System | Theory | 3 | 3.00 |
| EEE 6801 | Power Electronics | Theory | 3 | 3.00 |

# 4.3 Course Syllabus

## 4.3.1 Contents of Undergraduate Courses

### 4.3.1.1 Courses Offered by EEE Department to EEE Students

#### First Semester

**Hum 4122 Arabic I** **Credit 1.00**

Reading Comprehension; Letters and Pronunciation; Construction of words; Use of letters (Shamsi & Kamari) in words; Use of determiners and pronouns; Use of interrogatives; Use of nominal and verbal sentences Use of adverbs; Use of tenses; Use of Feminine & Masculine Genders; Use of Numerical; Conjunctive Adverbs; Conversation and dialogues in real life. Improvement of communication skill using audio-visual aid.

**Hum 4124 English I** **Credit 1.00**

Listening & Speaking: Situational dialogues; Use of dialogues in conversations; Reading out, talks; Listening to prescribed cassettes; Watching documentaries. Reading: Reading comprehension; Reading for pleasure; Reading for understanding; Reading with strategies. Writing & Grammar: Word classes, sentence types; Number, person, gender; Tenses and sequences of tenses; Nouns and determiners; Operators; If-clauses; Paragraphs & letters; Text analysis. Vocabulary: In lists; Contextualized; In talks; In exercises.

**Hum 4125 Islamic Philosophy, History and Culture** **Credit 3.00**

Islamic Philosophy: Islam as Din; Sources of Islamic Code of Life; Social, Economic and Political system of Islam; Islamic; Ethics: Human values in Islam, Dignity of Man, Women & Islam Family Ties, Moral values, Decency and Decorum, Brotherhood, Friendship and Amity in human society,

Truthfulness, Honesty, Sincerity, Righteousness, Piety and Religiousness; Social vices; Role of Islam in eradicating social evils; Islam and Environment; Islam and the world peace.

Life and works of the Prophet Muhammad (SM). Caliphate of the pious caliphs. Islamic Culture & Islamic festivals; Islamic Arts and Crafts; Importance of acquiring knowledge of Science and Technology in the light of the Holy Quran and the Sunnah; Relation between Science & Technology and Islam; Scientific indications in the Holy Quran, Impact of Science, Technology and Religion on Society and Social Development. Contributions of Islamic Civilization and Scientific achievement on the development of modern Science and Technology.

**Math 4121 Mathematics I (Calculus and Geometry) Credit 3.00**

Differential calculus: Limit, continuity, and differentiability of functions. Successive differentiation. Leibnitz theorem. Taylor and Maclaurin theorem, expansion of functions in series. Indeterminate forms. Partial differentiation, tangent, normal, curvature, asymptotes, envelopes, curve tracing. Determination of maximum and minimum of functions with applications.

Integral Calculus: Integration by the method of substitution. Integration by parts. Integration by successive reduction. Standard integrals. Definite integrals, its properties and use in summing series. Determination of area under a plane curve and area of a region enclosed by two curves in Cartesian and polar co-ordinates. Trapezoidal and Simpson's rules. Arc length of a curve in Cartesian and polar co-ordinates. Volumes and surface areas of solids of revolution.

Two-dimensional co-ordinate geometry: Change of axes. Transformation of co-ordinates. Simplifications of equation of curves.

**Math 4123 Mathematics II (Matrices and Differential Equations) Credit 3.00**

Matrices: Definition of matrices. Algebra of matrices. Transpose of a matrix. Determinants. Inverse of a matrix, rank of matrix, elementary transformations. Factorization. Introduction to system of linear equations. Gaussian elimination. Quadratic forms. Matrix polynomials. Eigenvalues and Eigenvectors.

Ordinary differential equations: Definition, solution of first order differential equation, variable separable form, reducibility, exact differential equation, integrating factor. Solution of second order differential equations with constant co-efficient and their applications. Factorization of the operator, solution of simultaneous differential equation of first and second order with applications in electrical engineering problems. Solution of linear differential equations with variable Coefficients, series solution of differential equations.
Partial differential equations: First and second order partial differential equation, Boundary value problems. Laplace equation and Poisson equation and their solution in rectangular and cylindrical co-ordinates. Eigen value and boundary value problems in electrical and electronic Engineering.

**Phy 4121 Engineering Physics I Credit 3.00**

Atomic structure. Thompsons, Rutherford and Bhor's atomic model. Atomic arrangement in solids. Different types of bonds in solids- metallic, Vander Walls and ionic bond.

Electronic structure of materials: Free electron the theory, Metallic conduction. Energy bands, Brillouin zones, Temperature dependence of metallic conductivity. Semiconductors: Band theory, intrinsic and extrinsic semiconductors, Fermi levels, mobility and electrical conductivity, carrier diffusion and life time, P-N junction, biasing conditions, V-I characteristics, effects of temperature on diode characteristics. Magnetic materials: Properties, Dia-, Para- and Ferro-magnetism, Hysteresis loop, B-H curve, Energy losses in magnetic

materials and their measurements. Soft and hard magnetic materials, ferrities.

Optics: Interference. Young's double slit experiment, fringe width, determination of wavelength of light and thickness of a transparent sheet. Interference due to reflection. Newton's ring. Determination of refractive index of a liquid. Fresnel and Fraunhoffer diffraction through single slit. Intensity of diffracted beam. Polarization: Polarized and Non-polarized light. Light polarization by reflection. Double refraction, Malus law, Intensity of polarized light.

Photoelectricity: Laws of photoemission and Einstein's equation. Photoelectric cell and its use. Introduction to superconductivity and its application.

### Phy 4122 Engineering Physics I Lab. Credit 0.75

Experiments based on Phy 4121.

### Chem 4121 Engineering Chemistry Credit 3.00

Atomic structure, Quantum numbers, Electronic configuration, Periodic table. Properties and uses of noble gases. Different types of chemical bonds and their properties. Molecular structures of compounds. Selective organic reactions.

Different types of solution and their compositions. Phase rule, phase diagram of monocomponent system. Liquid crystals. Properties of dilute solutions. Thermo chemistry; chemical kinetics, catalysis, chemical equilibriums. Ionization of water and pH concept. Electrical properties of solution.

Electrolysis and electroplating. Electroplating and its importance. Electrochemistry; Mechanism of electrolytic conduction. Transport number, Kohl – Rausch's law. Different types of cells, cell emf. Single electrode potentials, secondary cells or Accumulators, Lead accumulator and alkaline accumulator. Nernst Equation. Electrochemical cell; Redox number; electrode potential.

**Chem 4122 Engineering Chemistry Lab. Credit 0.75**

Experiments based on Chem 4121.

**EEE 4101 Electrical Circuit I Credit 3.00**

Basic concepts: Charge and current, voltage, power and energy, passive sign conventions. Circuit Elements: electrical power sources, ideal and practical sources, dependent and independent sources. DC analysis of resistive circuits: series, parallel and series-parallel circuits and Delta-Wye transformation: Kirchhoff's voltage and current laws, potential and current division rules with their applications and Tellegen's theorem. Network Analysis Methods: Branch current analysis, Nodal analysis and Mesh analysis, Supernode and Supermesh concepts. Network Theorem: Linearity and Superposition theorem, Source transformation, Thevenin's theorem, Norton's theorem and Maximum power transfer theorem.

Energy storage elements: Inductors (L) and Capacitors (C), steady state behavior of inductors and capacitors for DC sources, energy stored in inductors and capacitors. Different arrangements of inductors and capacitors.

Introduction to AC circuit analysis: AC waveform, average value, root mean squared value/ effective values, form factor, peak factor, phase relation and phasor concept. Steady state AC analysis: Effect of AC on R, L and C and their combinations; phase relation between voltage and current associated with R, L and C; impedance and admittance concepts, analysis of series, parallel and series -parallel and Delta-Wye circuits:, AC power and power factor, phasor diagram.

Magnetic circuit and concepts: Magnetic flux density (B) and field intensity (H), permeability, reluctance, B-H curve and hysteresis, self-inductance and mutual inductance. Analysis of series, parallel and series-parallel magnetic circuits. Eddy current and core loss in a magnetic circuit.

**EEE 4102 Electrical Circuit I Lab. Credit 1.50**

Hardware experiments and simulations based on EEE 4101.

## Second Semester

**Hum 4222 Arabic II Credit 1.00**

Reading comprehension, general exercise and revision of lessons; Nouns; singular, plural and various modifications; Use of verbs and pronouns, new words, different parts of speech.

**Hum 4224 English II Credit 1.00**

Listening & Speaking: Listening to dialogues, watching movies or documentaries; Conversations, Picture description, storytelling, etc.; Conversational traits. Reading: Reading for comprehension; Intensive reading; Time reading; Strategy-based reading; Reading comprehension exercises. Writing & Grammar: Conditionals, sentence change; Passivation, Reported speech; Modality, Prepositions; Adverbs, adjectives; Embedded and super-ordinate clauses, operators; Letters and paragraphs; Writing letters, e-Mails, reports, stories on familiar and unfamiliar subjects. Miscellaneous: Vocabulary development; Contextualized vocabulary items; Word-games; Culture in language; Tenses and usage.

**Hum 4225 Professional Ethics and Legal Issues Credit 3.00**

Professional Ethics: Introduction to Engineering ethics and professionalism; Moral Reasoning and Codes of Ethics; Moral Frameworks for Engineering Ethics; Ethical Problem-Solving Techniques; Engineering as Social Experimentation; Risk, Safety, and Accidents; Engineer's Responsibilities and Rights; Honesty and Research Integrity; Computer Ethics;

Environmental Ethics; Global Issues; Cautious Optimism and Moral Leadership.

Ethical aspects that an engineer must follow while working in electrical or electronic industries e.g., electrical cables, chip design, IoT solutions, etc.

Legal Issues: Introduction to Legal Issues for engineering, business and industrial law, Law of contract, elements of valid contract, parties competent to contract, Sale of goods and higher purchase. Industrial law in Bangladesh, factories act, industrial relation ordinance. Workman compensation. All the issues are compared with the context of Islamic point of view.

Fundamental and standard norms and practices that need to be followed in electrical and electronic engineering companies.

**Math 4221 Mathematics III (Complex Variable, Vector Analysis and Statistics) Credit 3.00**

Complex Variable: Introduction to complex variable. Complex differentiation and integration. Calculus of residues. Contour integration and conformal mapping.

Vector analysis: Tripe products, their geometric interpretation and application. Differentiation and integration of vectors Line, surface, and volume integrals. Gradient, divergence, curl, and their physical significance. Green's theorem, Stoke's theorem. Divergence theorem and their applications.

Statistics and elementary quality control: Correlation. Regression, Elementary probability theory. Binomial, Poission and Normal distribution. Tests of hypothesis. Application of elementary quality control to practical problems.

**Phy 4221 Engineering Physics II Credit 3.00**

Structure of matter: Classification of Solids; Crystalline and non-crystalline solids; unit cell, Crystal systems, Crystal structures, Atomic radius and crystal packing and packing density. Crystal directions, Planes

and Planar spacing and cell edge. Bragg's law. Deflects in Solids: Frankel and Schottky deflects; Diffusion in solids.

Modern Physics: Special theory of relativity, Galilean relativity, Lorentz transformation equations, relativistic length, time and mass. Mass energy relation. Photo-electric effect. Compton scattering. Radioactivity. Radioactive decay law. Half-lifes, mean life. Introduction to Nuclear fission and fusion. Nuclear power plant.

Thermal electricity: Thermocouple, Seebeck effect, Peltier and Thompson effect, Thermo-emf.

Wave and oscillation: Simple harmonic motion, damped simple harmonic oscillations, forced oscillations, resonance vibrations of membranes and columns. Combination and composition of simple harmonic motions, Lissajous' figures. Transverse and longitudinal nature of waves, travelling and standing waves, intensity of wave, energy calculation of progressive and stationary waves, phase velocity, group velocity. Sound waves: velocity of longitudinal wave in a gaseous medium. Doppler effect. Architectural acoustics: Sabine's formula, requisites of a good auditorium.

**Phy 4222 Engineering Physics II Lab. Credit 0.75**

Experiments based on Phy 4221.

**EEE 4201 Electrical Circuit II Credit 3.00**

Review of single-phase steady state AC circuit analysis: Introduction to phasor method in AC circuit analysis. Nodal analysis, Mesh Analysis of AC circuits. Network theorems applied to AC circuit analysis. Series and parallel resonances. AC power calculation: Instantaneous power and average power, reactive power, power factor and power triangle.

Polyphase circuits: Voltage and current relations and power in balanced and unbalanced 3-phase circuits, 3-phase power measurement. Coupled circuits: Magnetically coupled circuits, mutual inductance, co-efficient of coupling, dot convention, energy in coupled circuits. Transient analysis of simple first and second order R-L-C circuits without and with sources.

Two-Port Networks: Impedance, Admittance, Hybrid and Transmission parameters of two port network, interconnections of two-port networks. Image impedance and characteristic impedance of tee (T) and pi ($\pi$) sections. Matching networks.

Passive Filters: Frequency response. Fundamental filter equation and filter classification. Design specifications of low-pass, high-pass and band-pass filters. Conventional filters with constant-k and m-derived half and full sections. Introduction to modern filter design.

**EEE 4202 Electrical Circuit II Lab. Credit 1.50**

Hardware and software-based experiments based on EEE 4201.

**EEE 4203 Electronics I Credit 3.00**

Introduction to semiconductors: P-N junction as a circuit element: Intrinsic and extrinsic semiconductors, operational principle of p-n junction diode, contact potential, current-voltage characteristics of a diode, simplified large and small signal models, iteration and graphical analysis, dynamic resistance, and capacitance. Diode circuits: Half wave and full wave rectifiers, rectifiers with filter capacitor, characteristics of a Zener diode, Zener shunt regulator, clamping and clipping circuits.

Bipolar Junction Transistor (BJT) as a circuit element: current components, BJT characteristics and regions of operation, BJT as an amplifier, biasing the BJT for discrete circuits, small signal equivalent circuit models, BJT as a switch. Single stage mid-band frequency BJT amplifier circuits: Voltage and current gain, input and output impedance of a common base, common emitter and common collector amplifier circuits.

Introduction to Junction Field-Effect-Transistor (JFET). Metal Oxide Semiconductor Field Effect Transistor (MOSFET) as circuit element: structure and physical operation of an enhancement MOSFET, threshold voltage, Body effect, current-voltage characteristics of an enhancement MOSFET, biasing discrete and integrated MOS amplifier

circuits, single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter.

**EEE 4204 Electronics I Lab. Credit 1.50**

Hardware and software-based experiments on EEE 4203.

## Third Semester

**Math 4321 Mathematics IV (Transform Techniques and Linear Algebra) Credit 3.00**

Fourier Series: Fourier series expansion, evaluation of Fourier co-efficients, full range and half range series. Odd and even functions, harmonic analysis.

Laplace Transforms: Definition, elementary transformation and properties. Solution of differential and integro-differential equations using Laplace transformation and simple applications to circuit problems.

Linear Algebra: Euclidean n-space. Linear transformation from $\Re^n$ to $\Re^m$. Properties of linear transformation from $\Re^n$ to $\Re^m$. Real vector spaces and subspaces. Basis and dimension. Rank and nullity. Inner product spaces. Gram-Schmidt process and QR-decomposition. Diagonalization. Linear transformations. Kernel and Range. Application of linear algebra to electric networks.

**EEE 4301 Electrical Power Transmission and Distribution Credit 3.00**

General system layout, Low voltage D.C. distribution system, A.C. distribution system, radial and ring systems, distributor aspects, sag calculations, poles and towers insulators, calculation of inductance and capacitance. Current and voltage relations on a transmission line, short lines, Medium-length lines, Long lines; cables, manufacture, laying and

jointing of cables, insulation resistance and capacitance. Protection of transmission and distribution systems. Types of bus systems and their layout, Flexible AC transmission system (FACTS). High Voltage DC transmission system. Introduction to Smart Grid.

**EEE 4302 Electrical Power Transmission and Distribution Lab. Credit 0.75**

Experiments based on EEE 4301.

**EEE 4303 Electronics II Credit 3.00**

Frequency response of amplifiers: Poles, zeros and Bode plots, amplifier transfer function, techniques of determining 3dB frequencies of amplifier circuits, frequency response of single-stage and cascade amplifiers, frequency response of differential amplifiers.

Operational amplifiers (Op-Amp): Properties of ideal Op-Amps, non-inverting and inverting amplifiers, inverting integrators, differentiator, weighted summer and other applications of Op-Amp circuits, effects of finite open loop gain and bandwidth on circuit performance, logic signal operation of Op-Amp, DC imperfections. General purpose Op-Amp: DC analysis, small-signal analysis of different stages, gain and frequency response of 741 Op-Amp. Op-Amp Design: design of a differential amplifier for a given specification, design of gain stages and output stages, compensation.

Negative feedback: properties, basic topologies, feedback amplifiers with different topologies, stability, frequency compensation. Active filters: Different types of filters and specifications, transfer functions, realization of first and second order low, high and bandpass filters using Op-Amps.
Signal generators: Basic principle of sinusoidal oscillation, Op-Amp RC oscillators, LC and crystal oscillators. Power Amplifiers: Classification of output stages, class A, B and AB output stages.

**EEE 4304 Electronics II Lab. Credit 1.50**

Hardware and software-based experiments on EEE 4303.

**EEE 4305 Energy Conversion I Credit 3.00**

Review of electromagnetic induction. Basic principle of a Generator and a motor. Concept of torque angle. Power flow diagram for an elementary generator and motor.

D.C. Machines: Main constructional features, Function of brush and commutator. Armature winding systems: lap and wave windings. Different types of excitation. Armature reaction and methods of neutralizing armature-reaction. Losses and efficiency of D.C. machines. Determination of efficiency by practical methods.

D.C. Motors: Torque equation, back e.m.f., factors determining speed, characteristic Curves. D.C. motor starters, speed control. Application of D.C. motors.

Transformers, basic principle, construction, cooling methods, use of conservator and breather. Turns-ratio, EMF equation. Phasor diagram and equivalent circuit of a transformer on no-load and on-load. Voltage regulation, losses and efficiency. Transformer - tests. Auto-transformer and Instrument Transformers: (C.T. and P.T.), Parallel operation of transformers. Three-phase transformers. Gas Insulated Transformer (GIT), Cast Resin Transformer. Introduction to the design of single phase transformer

**EEE 4306 Energy Conversion I Lab. Credit 0.75**

Experiments based on EEE 4305.

**EEE 4307 Digital Electronics Credit 3.00**

Number system and Codes: General way of representing numbers, decimal, binary, octal and hexadecimal number systems and their representation, conversion of number from one system to another.

Compliment in number system. Different Codes: BCD, Alphanumeric, Gray, Excess-3, ASCII and error detection codes.

Digital Logic: Boolean algebra, De-Morgan's Theorem logic gates and their truth tables. Canonical form of logic expression.

Simplification of logic expression: Algebraic method, K-Map and Quine-McClauskey method. Realization by using NAND/NOR gates.

Classification of logic systems: Combinational logic system. Combinational logic design using MSI and LSI. Adders, subtractors, Code Converters. Magnitude Comparator Encoder, Decoder, Multiplexer, De-multiplexer, ROM, RAM, Programmable logic Array (PLA), D/A and A/D converters with applications. Different types of digital storage media.

Implementation of basic static logic gates in CMOS and BiCMOS: DC characteristics, noise margin and power dissipation. Power optimization of basic gates and combinational logic circuits.

Sequential logic system: Flip-Flops, clocked RS, JK, Master Slave JK, D-type, T-type, Flip-Flops, Flip-Flop Design. Sequential logic Registers: Different types of Registers and their applications. Counters and their simplified design.

### EEE 4308 Digital Electronics Lab. Credit 1.50

Hardware and simulation based Experiments using Hardware Description Language (HDL) based on EEE 4307.

## Fourth Semester

### Hum 4421 Science, Technology and Islam Credit 2.00

Definition: Science and Technology; Relation between science and technology; Development of science and technology till date; Islam, concept, origin and examples of main religions & their tenets; Comparative study among Islam, Christianity, Judaism, Hinduism and

Buddhism; Relation between science and technology and Islam; Science and technology in different religions; Creation of the universe, Scientific approach the Big Bang Theory of primordial Ball; Approach through different religions, Islamic-Kun-Faya-Kun Concept; Scientific indications in the Holy Quran; Impact of science, technology and religion on society and social development; Contributions of Islamic civilization; Contributions of Western Civilization; Islam and the West.

**EEE 4407 Random Signals and Processes Credit 3.00**

Experiments, Models, and Probabilities: Set Theory, Applying Set Theory to Probability, Conditional Probability, Independence, Sequential Experiments and Tree Diagrams, Discrete Random Variables: Probability Mass Function, Families of Discrete Random Variables, Cumulative Distribution Function (CDF), Averages, Functions of a Random Variable, Expected Value of a Derived Random Variable, Variance and Standard Deviation, Conditional Probability Mass Function. Continuous Random Variables: The Cumulative Distribution Function, Probability Density Function, Expected Values, Families of Continuous Random Variables, Gaussian Random Variables, Delta Functions, Mixed Random Variables, Probability Models of Derived Random Variables, Conditioning a Continuous Random Variable. Pairs of Random Variables: Joint Cumulative Distribution Function, Joint Probability Mass Function, Marginal PMF, Joint Probability Density Function, Marginal PDF, Functions of Two Random Variables, Expected Values, Conditioning by an Event, Conditioning by a Random Variable, Independent Random Variables, Bivariate Gaussian Random Variables. Random Vectors: Probability Models of N Random Variables, Vector Notation, Marginal Probability Functions, Independence of Random Variables and Random Vectors, Functions of Random Vectors, Expected Value Vector and Correlation Matrix, Gaussian Random Vectors. Sums of Random Variables: Expected Values of Sums, PDF of the Sum of Two Random Variables, Moment Generating Functions, MGF of the Sum of Independent Random Variables, Random Sums of Independent Random Variables, Central Limit Theorem, Applications of the Central Limit Theorem, The Chernoff Bound. Parameter Estimation Using the Sample Mean: Sample Mean: Expected Value and Variance, Deviation of a

Random Variable from the Expected Value, Point Estimates of Model Parameters, Confidence Intervals, Hypothesis Testing: Significance Testing, Binary Hypothesis Testing, Multiple Hypothesis Test. Estimation of a Random Variable: Optimum Estimation Given Another Random Variable, Linear Estimation of X given Y, MAP and ML Estimation, Linear Estimation of Random Variables from Random Vectors. Stochastic Processes: Types of Stochastic Processes, Random Variables from Random Processes, Independent, Identically Distributed Random Sequences, The Poisson Process, The Brownian Motion Process, Expected Value and Correlation, Stationary Processes, Wide Sense Stationary Stochastic Processes, Gaussian Processes, Markov Chains.

### EEE 4408 Random Signals and Processes Lab. Credit 0.75

Experiments based on EEE 4407.

### EEE 4409 Semiconductor Physics Credit 3.00

Energy bands in semiconductor, Carrier statistics and Fermi level, carrier concentrations at equilibrium, temperature dependence of carrier concentrations, conductivity and mobility, effects of temperature and doping on mobility, high field effect, Hall effect, invariance of Fermi level. Carrier lifetime, direct and indirect recombination, quasi-Fermi level, photoconductive devices, Drift and diffusion of carriers, continuity and diffusion equations.

PN junction contact potential, equilibrium Fermi level, space charge, forward and reverse bias, carrier injection, minority and majority carrier currents, avalanche and zener breakdown, time variation of stored charge, reverse recovery transient and capacitance. Metal-semiconductor junctions: Schottky barriers, rectifying and ohmic contacts.

Bipolar Junction Transistor: Basic principle of pnp and npn transistors, emitter efficiency, base transport factor and current gain, diffusion equation in the base, terminal currents, coupled-diode model and charge control analysis.

MOSFET: capacitance, energy band diagrams and flat band voltage, threshold voltage analysis and control, static C-V characteristics, MOSFET operation, I-V relationship and body effect.

Optoelectronic devices: Photo diodes. Light Emitting Diodes: Visible and infrared LED, principle, material. Semiconductor Laser.

### EEE 4401 Power System I Credit 3.00

Representation of power systems, single line diagrams, impedance and reactance diagrams, per-unit system of calculations. Reactance of synchronous generators and its equivalent circuits, Symmetrical fault calculations, limitation of short circuit current using reactors.

Symmetrical components, positive, negative and zero sequence network of generators, transformers and lines, Unsymmetrical fault calculations.

Power and reactive power flow calculations of simple systems, load flow studies of large systems, control of voltage, power and reactive power.

### EEE 4402 Power System I Lab. Credit 0.75

Experiments based on EEE 4401.

### EEE 4403 Communication Engineering I Credit 3.00

Overview of communication systems: Basic blocks in a communication system, Basic principles, fundamental elements, system limitations, message source, bandwidth requirements, transmission media types, and transmission capacity. Noise: Source, characteristics of various types of noise and signal to noise ratio.

Modulation: Base-band communication and concept of modulation and demodulation; Amplitude Modulation (AM): Double side band(DSB), single side band (SSB), vestigial side band (VSB), quadrature amplitude modulation (QAM); spectral analysis, generation and detection of each type; Angle modulation: Instantaneous frequency, Frequency modulation (FM) and Phase modulation (PM), spectral analysis, demodulation of FM and PM. Pulse modulation: Sampling, quantizing and encoding; pulse

amplitude modulation (PAM); pulse width modulation (PWM); pulse position modulation (PPM) ; pulse code modulation (PCM); line coding; differential pulse code modulation; delta modulation. Digital modulation: Amplitude-shift keying- principle, ON-OFF keying; phase-shift keying (PSK), M-PSK, OQPSK, DPSK; frequency-shift keying (FSK), MSK, GMSK, M-QAM; Multiplexing: Time-division multiplexing (TDM) - principle, receiver synchronization, frame synchronization, TDM of multiple bit rate systems; frequency-division multiplexing (FDM) - principle, de-multiplexing.

Introduction to multiple access techniques: TDMA, FDMA, CDMA, OFDMA.

### EEE 4404 Communication Engineering I Lab. Credit 0.75

Experiments based on EEE 4403.

### EEE 4405 Energy Conversion II Credit 3.00

Alternators: Basic Principle, construction, EMF equation, synchronous reactance, voltage regulation and parallel operation.

Synchronous motors: Basic principle, Starting methods, effect of excitation on armature current, V - curves.

Three-phase induction motor: Theory of rotating magnetic field. Construction of induction motor, rotor types. Speed and slip, starting torque, speed control, performance characteristic and equivalent circuit.

Single-phase induction motor: Basic principle, cross-field theory, double revolving field theory. Different methods of starting a single-phase induction motor. Amplidyne and other special motors.

### EEE 4406 Energy Conversion II Lab. Credit 0.75

Experiments based on EEE 4405.

**EEE 4416 Simulation Lab. Credit 1.00**

Introduction to simulation tool environment, built-in functions and toolboxes, basic math operations, element by element operations, variables and assignment statement, conditionals, iteration and loops, arrays and vectors, matrix operations, logical operations, numerical methods analysis (Integration, 1st order ODEs, exponential growth etc.) using the simulation tool, implementation of electrical network theorems.

Plotting, histograms, plotting several graphs in one window, inserting labels, legends and titles, 3D and parametric plotting, GUI, introduction to graphical block diagramming tool for modelling and analyzing multi-domain dynamic systems.

**EEE 4418 Electrical Services Design Credit 1.00**

Wiring system design, drafting, and estimation. Design for illumination and lighting. Electrical installations system design: substation, BBT and protection, air-conditioning, heating and lifts.

Design for intercom, public address systems, telephone system and LAN. Design of security systems including CCTV, fire alarm, smoke detector, burglar alarm, and sprinkler system. Prepaid Energy Meter, Smart Metering System.

Societal, health, legal, and cultural considerations of electrical service design. Electrical service design projects that consider public health and safety related, cultural, sociological, and environmental consequences of the project.

## Fifth Semester

**EEE 4505 Computational Methods in Engineering Credit 3.00**

Mathematical modeling and Engineering Problem solving. Basic concepts of errors in numerical computation: Approximation and round-

off errors, truncation errors and the Taylor series, error propagation. Roots of non-linear algebraic and transcendental equations: Bracketing method -bisection method and false-position method; Open method - Fixed point iteration, the Newton-Raphson method, the Secant method, Brent's method, finding multiple roots, systems of non-linear equations. Roots of polynomials: Muller's method and Baristow's Method. Numerical solution of algebraic equations: Gauss elimination method, LU decomposition and matrix inversion and Gauss Seidel method. Curve fitting: Least Square Regression, Interpolation and Fourier approximation. Numerical integration and differentiation. Numerical solution of ordinary differential equations: Euler's method and Runge-Kutta Methods. Numerical solution of partial differential equations: Finite difference (FD) methods, numerical stability, implicit FD method. Introduction to numerical optimization. Application of the numerical techniques in solving Electrical and Electronic Engineering problems.

**EEE 4506 Computational Methods in Engineering Lab. Credit 1.50**

Experiments based on EEE 4505.

**EEE 4501 Electromagnetic Fields and Waves Credit 3.00**

Electrostatics: Coulomb's law, force, electric field intensity, electrical flux density. Gauss theorem with application, electrostatic potential, boundary conditions, method of images. Laplace's and Poisson's equations, energy of an electrostatic system, conductors and dielectrics.

Magnetostatics: Concept of magnetic field. Ampere's law, Biot-Savert law vector magnetic potential, energy of magnetostatics system, mechanical forces and torques in electric and magnetic fields. Graphical field mapping with applications, solution to Laplace's equations. Rectangular, cylindrical and spherical harmonics with applications. Maxwell's equations, their derivations, continuity of charges, concept of displacement current. Boundary conditions for time- varying systems. Potential used with varying charges and currents. Retarded potential, Maxwell's equations in different coordinate systems.

Relationship between circuit theory and field theory: Circuit concepts and the derivation from the field equations. High frequency circuit concepts, circuit radiation resistance, Skin effect and circuit impedance, Concepts of good and perfect conductors and dielectrics. Current distribution in various types of conductors, depth of penetration, internal impedance, power loss, calculation of inductance and capacitance.

Propagation and reflection of electromagnetic waves in unbounded media; Plane wave propagation polarization, power flow and Poyinting's theorem. Transmission line analogy, reflection from conducting and conduction dielectric boundary; Display lines ion in dielectric, liquids and solids, plane wave propagation through the ionosphere, introduction to radiation.

### EEE 4505 Power Electronics Credit 3.00

Power semiconductor devices: structure and characteristics; snubber circuits, switching loss. Controlled rectifiers: full/half-controlled converters, dual converters, and sequence control. AC regulator circuits, reactive power compensators. DC-DC converters, switching dc power supplies. Inverters: square wave and PWM types, filters, inverters for induction heating and UPS.

### EEE 4506 Power Electronics Lab. Credit 1.50

Experiments based on EEE 4505.

### EEE 4518 Electrical and Electronic Workshop Credit 1.00

The purpose of this course is to allow students to do new and challenging experiments in emerging areas of Electrical Engineering. Students will complete hardware projects from various areas of electrical engineering. The project will focus on digital electronics, communications, machines, drives and power systems, machine learning, and electromagnetics taking into account its public health and safety related, cultural, sociological, and environmental implications.

## 5th Semester Elective Courses from Specialization Groups

### Power Systems Group

**EEE 4535 Renewable Energy System Credit 3.00**

Importance of renewable energy sources. Statistics regarding solar radiation and wind speed. Insulation; geographical distribution, atmospheric factors, measurements. Solar cell; principle of operation, spectral response, factors affecting conversion efficiency, I-V characteristics, maximum power output. PV modules and arrays: stationary and tracking. PV systems: stand alone, battery storage, inverter interfaces with grid. Wind turbine generators: Types, operational characteristics, cut-in and cut-out speed, control, grid interfacings, AC-DC-AC link.

### Communication Group

**EEE 4551 Data Communication and Networking I Credit 3.00**

Overview of networking and the internet; core and access networks, data transfer: throughput, latency and round-trip time; physical media, circuit-switched and packet-switched networks, OSI model, WAN, MAN, LAN, PAN; Ethernet: physical layer connections, MAC ID, frame format, transmission and reception with CSMA/CD; Network Layer Protocols: IP – packet format, fragmentation and reassembly, global addressing scheme, Subnetting and Classless Addressing, Classless Interdomain Routing (CIDR), Address Translation (ARP), Host Configuration: DHCP, Error Reporting: ICMP; IPv6–packet format, auto-configuration and advanced routing capabilities, mobility support; Mobile IP – routing, route optimization; Virtual circuit technologies: Asynchronous Transfer Mode (ATM); virtual networks and tunnels, Virtual Private Networks (VPNs); bridges, switches and routers, forwarding table and routing table, spanning tree algorithm, Distance-vector routing: Routing Information Protocol (RIP); Link-state routing: Open Shortest Path First Protocol

(OSPF); Area Border Router (ABR), multicast addresses, Multicast Routing: DVMRP, PIM and MSDP; Multiprotocol Label Switching (MPLS), ARPANET, NSFNET backbone, Autonomous System (AS), Inter-domain Routing: iBGP and eBGP. Transport Layer Protocols: User Datagram Protocol (UDP), Transmission Control Protocol (TCP) – segment format, three-way handshake, state-transition diagram, sliding window, reliable and ordered delivery, protecting against wraparound, keeping the pipe full, silly window syndrome, Nagle's algorithm, adaptive retransmission, TCP extensions, Stream Control Transmission Protocol (SCTP); Transport for Real-Time Applications (RTP) – requirements, packet format, control protocol, RTCP; GPRS Tunneling Protocol (GTP); Name Resolution: domain hierarchy, Domain Name Server (DNS); Simulation of Ethernet and TCP/IP.

## Electronics and Signals Group

### EEE 4571 Compound Semiconductor and Heterojunction Device — Credit 3.00

Compound semiconductor: Zinc-blend crystal structures, growth techniques, alloys, band gap, density of carriers in intrinsic and doped compound semiconductors. Hetero-Junctions: Band alignment, band offset, Anderson's rule, single and double sided hetero-junctions, quantum wells and quantization effects, lattice mismatch and strain and common hetero-structure material systems.
Hetero-Junction diode: Band banding, carrier transport and I-V characteristics. Hetero-junction field effect transistor: Structure and principle, band structure, carrier transport and I-V characteristics. Hetero-structure bipolar transistor (HBT): Structure and operating principle, quasi-static analysis, extended Gummel-Poon model, Ebers-Moll model, secondary effects and band diagram of a graded alloy base HBT.

### EEE 4579 Engineering Materials — Credit 3.00

Classical theory of electrical and thermal conduction: Scattering, mobility

and resistivity, temperature dependence of metal resistivity, Mathiessen' rule, thermal conductivity.

Introduction to quantum mechanics: Wave nature of electrons, Schrodinger's equation, one-dimensional quantum problems- infinite quantum well, potential step and potential barrier; Heisenberg's uncertainty principle, tunneling and quantum box.

Modern theory of metals: Determination of Fermi energy and average energy of electrons, classical and quantum mechanical calculation of specific heat.

Dielectric properties of materials: Dielectric constant, dipole moment, polarization mechanisms, internal field, Clausius-Mosotti equation, spontaneous polarization, frequency dependence of dielectric constant, dielectric loss and piezoelectricity.

Magnetic properties of materials: Magnetic moment, magnetization and relative permittivity, different types of magnetic materials, origin of ferromagnetism and magnetic domains, soft and hard magnetic materials, ferrites.

Introduction to superconductivity: Zero resistance and Meissner effect, Type I and Type II superconductors and critical current density.

## 5th Semester Pseudo-compulsory Courses

### EEE 4541 Wireless Communication Credit 3.00

Electromagnetic wave concepts: EM wave types, plane wave, wave impedance, power flow, polarization.
Radio wave propagation: properties to support NLOS communication, advantages of low frequency communication, radio frequency spectrum regulation, ITU bands, ISM and UNII bands, ground wave, space wave and sky wave, path loss and shadowing, penetration, rain attenuation.
Introduction to Antenna radiation: basic antenna types, radiation pattern, gain, directivity, beamwidth, near and far field, antenna matching.
Diffraction: Knife-edge diffraction geometry, Fresnel zones.

Scattering: Rayleigh criterion, radar cross section model.
Propagation model: Free space model, two-ray model, log-distance path loss model, log-normal shadowing, Okumura-Hata model, Erceg model, COST 231-Walfish-Ikegami model, ITU model.
Indoor propagation model: attenuation factor model, partition losses.
Fading: large- and small-scale fading, multipath channel characteristics, power delay profile, channel sounding, delay spread, coherence bandwidth, Doppler spread, coherence time, flat and frequency selective fading, slow and fast fading.
Statistical channel models: Time-varying channel impulse response, Rayleigh and Rician fading, tapped delay line model, level crossing rate and average fade duration.
Space diversity and polarization diversity, interleaving, adaptive modulation, and coding, interference-limited vs. noise-limited scenarios, near-far problem, hidden and exposed node problem.
Spread spectrum: FHSS, DSSS, THSS. Chipping, spreading, and correlating
MIMO Systems: Narrowband multiple antenna system model, transmit precoding and receiver shaping, parallel decomposition of channel.

### EEE 4542 Wireless Communication Lab. Credit 0.75

Experiments based on EEE 4541.

## Sixth Semester

### EEE 4601 Signals and Systems Credit 3.00

Signals and Systems: Classifications of signals and systems. Basic operations on signals. Commonly encountered elementary signals. Continuous-time (CT) and discrete-time (DT) systems. Basic system properties.

Linear Time-Invariant (LTI) Systems: The CTLTI systems –impulse response, zero input response and zero state response and convolution

integral. The DTLTI systems –representation of DT signals in terms of impulses, impulse response and convolution sum.

Fourier Series Representation of Periodic Signals: CT and DT periodic signals, properties of continuous and discrete-time Fourier series, Fourier series and LTI systems.

Continuous-Time Fourier Transform: Properties, convolution and multiplication properties. Application of Fourier transform to LTI system analysis. Sampling and aliasing.

Laplace Transform: Region of convergence, inverse Laplace transform, properties, analysis of LTI systems using Laplace transform.

**EEE 4602 Signals and Systems Lab. Credit 0.75**

Experiments based on EEE 4601.

**EEE 4603 Measurement and Instrumentation Credit 3.00**

Philosophy of sensors, transducer and instruments for signal to measure. Time measurement techniques : period, phase, time constant measurements.

Frequency measurement techniques : Frequency, ratio and product, high and low frequency measurements; Measurements and measurement systems, Errors in measurement and their statistical analysis, Dynamic characteristics of instruments, Sensing elements and transducers for measurement of motion, force, pressure, flow, temperature, light, vacuum, etc.

Different types of transducers and their principle of operations and interfacing; Electronic Timers; 555 & OP-AMP and its applications. Measurement of resistance, inductance, and capacitance-A.C and D.C bridge methods. Magnetic Measurements, Optoelectronic Measurement, Cathode Ray Oscilloscope (CRO), Instruments for Generation and Analysis of Waveform, Signal Analyzers, High Frequency Measurements.

Electronic instrumentation: Instrumentation and isolation amplifiers. Analog switches, S/H circuits, Data converters, V/F, F/V, A/D, D/A

conversion. Data acquisition system. Noise in Electronic systems, design of low noise circuits, Programmable instruments, and digital interfacing: serial, parallel. GPIB.

Industrial instrumentation: Introduction to Instrumentation systems. Static and dynamic characteristics of instruments. Non-destructive testing using Ultrasonic and eddy current.

Signal Conditioning and acquisition: Signal conditioning, signal transmission methods; Data loggers, PC based data acquisition systems, Interfacing and bus standards, programmable logic controllers and their industrial applications.

### EEE 4604 Measurement and Instrumentation Lab. Credit 0.75

Experiments based on EEE 4603.

### EEE 4605 Control System Engineering I Credit 3.00

Basic concepts: Notion of feedback, open- and closed-loop systems. Modeling and representations of control systems: Ordinary differential equations, Transfer functions, Block diagrams, Signal flow graphs, Performance and stability: Time-domain analysis, Second-order systems, Characteristic-equation and roots, Routh-Hurwitz criteria, Frequency domain techniques: Root-locus methods, Frequency responses, Bode-plots, Gain-margin and phase-margin, Nyquist plots, M and N circles; Nichols chart. Compensator design: Proportional, PI and PID controllers, Lead-lag compensators. State-space concepts: introduction, representation, transformation.

### EEE 4606 Control System Engineering I Lab. Credit 0.75

Hardware experiments & simulations based on EEE 4605.

### EEE 4607 Research Methodology Credit 2.00

Research process: definition of research, objective, and motivation of conducting research, significance of research, main components of research process, research approaches, qualitative and quantitative research, research ethics.
Research problem: research problem identification, developing research questions, conducting literature review.
Research design and methods: developing research design, data collection, sampling, designing of experiments, repeatability, reproducibility, and reliability; statistical analysis, hypothesis testing; research tools.
Scientific writing: types of scientific report, structure and components of conference and journal articles and theses, presentation of research outcome; ethics and scientific conduct, ethics in life science studies, plagiarism, copyright, intellectual property rights.

**EEE 4616 Microprocessor and Assembly Language Programming Lab. Credit 1.50**

Introduction to microprocessors. Intel 8086 microprocessor: Architecture, addressing modes, instruction sets, assembly language programming, system design and interrupt. Interfacing: programmable peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access, keyboard and display interface.

## 6th Semester Elective Courses from Specialization Groups

## Power Systems Group

**EEE 4635 Power System Operation and Control Credit 3.00**

Principles of power system operation: SCADA, convention and competitive environment. Unit commitment, static security analysis.

State estimation, optimal power flow, automatic generation control and dynamic security analysis.

## Communication Group

**EEE 4651 Data Communication and Networking II** **Credit 3.00**

Introduction to Wireless Networks, Wireless Links and Network Characteristics.
Different Wireless Networks: Based on Network Architecture – Infrastructure-based networks, Infrastructure-less networks, Based on Communication Coverage Area- WWANs, WMANs, WLANs, WPANs; Wireless Access Points.
IEEE 802.11: Architecture and standards, physical layer specifications, versions, network types, MAC protocol.
Ad Hoc Network: Wireless Ad Hoc Networks, Mobile Ad Hoc Networks (MANETs), Self-organized networks, Routing in Ad Hoc networks.
IEEE 802.15: Bluetooth and its specifications; IEEE 802.16: WiMAX and its specifications.
Wireless Sensor Networks (WSN): WSN specification, roles of nodes: source, sink, actuator, sensing and communication range, energy consumption, clustering of sensors: regularly placed sensors, Heterogeneous WSNs, mobile sensors; application of sensor networks for smart environments; MANET vs. WSN; self-organization and localization in sensor networks; Wireless Mesh Network (WMN); Introduction to Delay-Tolerant Networking (DTN).

**EEE 4653 Advanced Communication Techniques** **Credit 3.00**

Multicarrier Techniques for 4G Systems, characteristics of Multipath Fading Channels, Rayleigh and Ricean Fading Channels, frequency Selective and Frequency Nonselective Fading Channels, OFDM Characteristics, Radio Channel Model, Theoretical Bit Error Rate Analysis, Applications of OFDM, Combination of OFDM and CDMA. Channel Model, DS-CDMA System, Bit Error Rate Analysis, MC-CDMA

System, Bit Error Rate Analysis, Design of MC-CDMA System, OFDM Adaptive Array Antennas.

Introduction to Optical Wireless Communication Systems (Li-Fi), Coded modulation techniques for optical wireless channels, Wireless optical CDMA communication systems, Multiple-input multiple-output (MIMO) techniques for indoor optical wireless communications, Free-space optical communications, Visible-light communications. Fibre-to-the Home (FTTH), radio over fibre (RoF), optical-wireless integration, high-capacity photonic switching networks.

Introduction of wireless sensor network, node architecture, communication interface, basic architecture framework, MAC layer, localization, Energy Efficient Information Processing, Routing, Fault Tolerant Algorithms Protocols, Quality of Service.

Overview of WiMAX, Technical Foundations of WiMAX, WiMAX Network Architecture, Link-Level Performance of WiMAX, System-Level Performance of WiMAX.

Introduction to Ultra-Wideband network, UWB Features, UWB Antennas, Antenna Requirements, Ultra-Wide Band Wireless Channels, impulse Response Modeling of UWB Wireless Channels, Path Loss, The IEEE UWB Channel Model, Frequency Modeling of UWB Channels, UWB Multiple Access Modulation, Pseudorandom Time Hopping, UWB Channel Capacity.

Voice over IP Technology, IP Signaling Protocols, VoIP Applications and Services.

Introduction to ZigBee, ZigBee Architecture, ZigBee Stack, ZigBee Applications.

Basic Software Defined Radio Architecture, Software Radio Applications, Hybrid Radio Architecture, Baseband Analog Circuits for Software Defined Radio, Software-Defined Radio Receivers for Deep Space Applications.

Introduction to Cognitive Radio Networking, Cognitive Radio Networking Preliminaries, Software Defined Radio as a Platform for Cognitive Radio, Routing Schemes, Delay.

Basics of Radio Frequency Identification RFID Systems, RuBee networks, RFID middleware, Antenna Design for Ultrawideband RFID Systems, open-source RFID-standard for wireless sensor network (DASH7).

Evolution of near field communication (NFC), NFC operating modes and essentials, Ubiquitous computing and NFC, General architecture of NFC. Introduction to Indoor location services, Basic Positioning Techniques Building Modeling, Position Refinement, Trajectory Computing, Event Detection for Indoor location-based service (LBS)
Introduction to Ipv6 over Low power Wireless Personal Area Networks (6LoWPAN), Application Protocols, Mobility and Routing.

## Electronics and Signals Group

### EEE 4671 Optoelectronics Credit 3.00

Optical properties in semiconductors: Direct and indirect band-gap materials, radiative and non-radiative recombination, optical absorption, photo-generated excess carriers, minority carrier lifetime, luminescence and quantum efficiency in radiation.

Properties of light: Particle and wave nature of light, polarization, interference, diffraction, and blackbody radiation.

Light emitting diode (LED): Principles, materials for visible and infrared LED, internal and external efficiency, loss mechanism, structure and coupling to optical fibers.

Stimulated emission and light amplification: Spontaneous and stimulated emission, Einstein relations, population inversion, absorption of radiation, optical feedback, and threshold conditions.

Semiconductor Lasers: Population inversion in degenerate semiconductors, laser cavity, operating wavelength, threshold current density, power output, hetero-junction lasers, optical and electrical confinement. Introduction to quantum well lasers.

Photo-detectors: Photoconductors, junction photo-detectors, PIN detectors, avalanche photodiodes and phototransistors.

Solar cells: Solar energy and spectrum, silicon and Schottkey solar cells.

Modulation of light: Phase and amplitude modulation, electro-optic effect, acousto-optic effect, and magneto-optic devices.

Introduction to integrated optics.

**EEE 4673 Photonics and Plasmonics Credit 3.00**

Introduction to photonics, plasmonics, overview of the current research in academia and industry.
Electromagnetic theory of light; electromagnetic properties of material; constitutive relationships and material parameters; electromagnetic waves in dielectric media.
Polarization of light; reflection and refraction; fresnel equations; absorption, dispersion, and scattering of electromagnetic waves.
Optical properties of metals; surface plasmon polaritons (spp) on planar interfaces; spp modes for shape resonances, gratings, and light scattering from rough surfaces; applications of spps: surface enhanced raman spectroscopy (sers), sensing, subwavelength properties in light-guiding, spasers, and plasmonic circuitry, plasmonic subwavelength enhanced transmission of light etc.
Plasmonic nanoparticles; localized plasmon resonances; chain of plasmonic nanoparticles; Applications of localized plasmon resonances: sers, sensing, optical nanoantennas and plasmonic waveguides, biomedical applications, tunable plasmonic devices.
Metamaterials concept; negative-permittivity and negative-permeability metamaterials; double-negative materials.
Perfect absorbers; super lens, hyperbolic metamaterials and application in high-resolution imaging: hyper lens; tunable photonic metamaterial-based devices.
Introduction to metasurfaces; frequency selective surfaces; guided mode resonances (gmr); examples of metasurfaces and gmr based devices; perfect control over transmission and reflection using metasurfaces.

## 6th Semester Pseudo-compulsory Courses

**EEE 4631 Power System II** **Credit 3.00**

The stability problem of power system. Distinction between steady state and transient stability. The swing equation and its solution. Solution of networks for stability studies. Transient stability limits criteria. Two machine and multi-machine problems. Stability under different types of faults. Typical stability studies and methods of improving stability. The influence of swinging and out-of step operation upon protective relays. Rapid reclosing for improving stability.

**EEE 4632 Power System II Lab.** **Credit 0.75**

Experiments based on EEE 4631.

## Seventh Semester

**EEE 4700 Project and Thesis** **Credit 3.00**

The students are required to undertake a major in the field of Electrical and Electronic Engineering. The objective is to provide an opportunity to the students to develop initiative, creative ability, confidence and engineering judgment. The results of the work should be submitted in the form of a report which include appropriate drawings, charts, tables, references etc.

**EEE 4701 Digital Signal Processing I** **Credit 3.00**

Introduction to digital signal processing (DSP): Discrete-time signals and systems, autocorrelation, cross correlation, impulse response, finite impulse response (FIR) and infinite impulse response (IIR) of discrete-time systems, difference equation, convolution, transient and steady state response.

Discrete transformations: Discrete Fourier series, discrete-time Fourier series, discrete Fourier transform (DFT) and properties, circular convolution, fast Fourier transform (FFT), inverse fast Fourier transform,

z-transformation – properties, transfer function, poles and zeros and inverse z-transform.
Digital Filters: FIR filters- linear phase filters, specifications, design using window, optimal and frequency sampling methods; IIR filters- specifications, design using impulse invariant, comb-filter, introduction to multi-rate filtering. Wavelet transform and its application.

### EEE 4702 Digital Signal Processing I Lab. Credit 0.75

Experiments based on EEE 4701.

### EEE 4703 Communication Engineering II Credit 3.00

Signals and Spectra: Classification of Signals, spectral density, autocorrelation, bandwidth of digital data, Formatting and baseband modulation: Formatting textual and analog data, Baseband transmission, PCM Waveform Types, Correlative coding, Baseband demodulation/detection: Error Performance Degradation, Detection of binary signals in Gaussian noise, Inter symbol Interference, Equalization. Bandpass modulation and demodulation: Digital bandpass modulation techniques, Phase shift keying, Detection of signals in Gaussian noise, Coherent detection, Noncoherent detection, Error performance for binary systems, M-ary signaling and performance, Symbol error performance,

Communications link analysis: Link margin. Channel coding: Waveform coding, Types of error control, Structured sequence, parity check codes, Linear block codes, Error detecting and correcting capability, Well known block codes: Humming Codes, Extended Golay Codes, BCH Codes. Convolutional codes: Encoding, Convolution encoder representation, 110iterbi decoding. Introduction to cellular telephony, satellite, and optical communication.

### EEE 4704 Communication Engineering II Lab. Credit 1.50

Experiments based on EEE 4703.

**EEE 4705 Microcontroller Based System Design** **Credit 3.00**

Introduction to the general structure of microcontrollers. Discussions on architectures, instruction sets, memory hierarchies, pipelining, and RISC principles. Specific details of Intel8051/Atmega32/PIC18. Interfacing Peripherals: Keyboard, display, ADC, Programmable parallel port 8255, External memory, Motors, RTC etc.

**EEE 4706 Microcontroller Based System Design Lab.** **Credit 0.75**

Experiments based on EEE 4705.

**EEE 4790 Industrial Training** **Credit 1.00**

Industrial training programme will be organized by IUT during the session break in between 6$^{th}$ and 7$^{th}$ semesters and it is compulsory for all the students of B.Sc. Engg. (EEE). Duration of the training programme will be about four weeks.

## 7$^{th}$ Semester Elective Courses from Specialization Groups

## Power Systems Group

**EEE 4721 Power System Protection** **Credit 3.00**

Purpose of power system protection. Criteria for detecting faults: over current, differential current, difference of phase angles, over and under voltages, power direction, symmetrical components of current and voltages, impedance, frequency and temperature. Instrument transformers: CT and PT. Electromechanical, electronic and digital Relays: basic modules, over current, I.D.M.T. characteristic, differential, distance and directional. Trip circuits. Unit protection schemes: Generator, transformer, motor, bus bar, transmission and distribution

lines. Miniature circuit breakers and fuses. Circuit breakers: Principle of arc extinction, selection criteria and ratings of circuit breakers, types - air, oil, SF6 and vacuum.

**EEE 4722 Power System Protection Lab. Credit 0.75**

Experiments based on EEE 4721.

**EEE 4723 Switchgear and Control Equipment I Credit 3.00**

Fundamentals of fault clearing, current interruption in A.C. circuit breakers, recovery voltage and prestriking voltage transients, switching of capacitor banks and unloaded lines, rated characteristics of circuit breakers arc extinction, arc interruption, arc extinction in different types of circuit breakers, arc-extinction devices, operating mechanism, control apparatus. Air break circuit breakers, bulk oil circuit breakers, minimum oil circuit breakers, Sulphur Hexafluoride (SF-6) circuit breakers, air blast circuit breakers, vacuum circuit breakers and their comparative study Control panels, basic control circuit devices. Alternator switchgear and control panels, automatic voltage control equipment. Apparatus for automatic voltage control equipment. Apparatus for automatic synchronization control. Transformer tap changing control equipment. Automatic reclosing control of circuit breakers and oil circuit reclosers (OCRS). Gas Insulated Switchgear (GIS).

**EEE 4724 Switchgear and Control Equipment I Lab. Credit 0.75**

Experiments based on EEE 4723.

## Communication Group

### EEE 4741 Microwave Engineering Credit 3.00

Transmission Lines: Voltage and current in ideal lines, Reflection, transmission, standing wave, impedance transformation, Smith chart, impedance matching, quarter-wave matching, single and double stub matching; Scattering parameters (S-parameters), Waveguides: General formulation for guided waves, parallel plate waveguides, rectangular waveguides, circular waveguides, different modes of propagation, power flow and losses in waveguides; Microstrip and Stripline: their structures and their characteristics impedances. Resonant Cavities: Simple rectangular resonant cavities, energy storage, losses and Q of the resonators, modes in rectangular resonators. Microwave Devices: Directional coupler, attenuator, phase shifter, circulator, isolator, etc. Microwave amplifiers and oscillators: Gain and stability, Stability circles, Single-stage transistor amplifier design, Design for maximum gain and specified gain, Low-Noise Amplifier (LNA) design.

### EEE 4742 Microwave Engineering Lab. Credit 0.75

Experiments based on EEE 4741.

## Electronics and Signals Group

### EEE 4763 Medical Electronics Credit 3.00

Scope of Medical Electronics, Introductory concepts on basic body functions; Membrane potential – Nerve Action potential, Nerve Conduction Velocity (NCV), electrical RC equivalent circuit of nerve fiber.

Bioelectrical signal measurement, signal size and frequency content of different bio-electrical signals: Electromyogram (EMG), Electrocardiograph (ECG), Electroencephalogram (EEG), Evoked nerve, muscle and brain potentials. Noise and interference, and their elimination. Bioelectrical amplifier design, analysis for gain, input and output impedance, Common Mode Rejection Ratio, Patient safety,

Microshock and electrical Isolation; Measurement of sensory and motor NCV through evoked action potentials, Electrical Nerve Stimulation, Design of a nerve stimulator. Transducers: Electrode as transducer, electrical activity at electrode-body interface, electrode equivalent circuit, electrode impedance.

Heart conduction block and artificial pacemaker, Heart fibrillation and Defibrillator; Temperature, flow and velocity sensors as needed in Thermometry, and blood flow measurement; Blood Pressure measurement and monitoring, Blood Cell counters; Pulse beat monitor, Electronic Stethoscope, Focused Impedance Measurement, application ideas.

Ultrasound scanning techniques: A, B and M scans and applications, Use of LASER in medicine; Radioactivity and Radiotherapy; Hearing test, Correction of hearing; Basic concepts on Infrared heating, radio-frequency heating, Ultrasound heating, Bio-telemetry, Telemedicine; Basics of Clinical X-ray equipment, Fluoroscopy, Digital X-ray, CT scanner; Basics of Gamma Camera, SPECT, MRI and PET.

**EEE 4764 Medical Electronics Lab. Credit 0.75**

Experiments based on EEE 4763.

## 7th Semester Pseudo-compulsory Courses

**EEE 4709 Artificial Intelligence and Machine Learning Credit 3.00**

Introduction to AI: narrow AI, general AI.
Searching: state-space search, heuristic search, adversarial search. constraint satisfaction.
Knowledge representation: propositional logic, inference.
Probability: bayesian network, markov models.
Learning: introduction to machine learning. Paradigms of learning: supervised, unsupervised, and reinforcement learning.

Problem formulations: classification and regression. The notion of training, validation, and testing; generalization and overfitting, performance metrics, hypothesis testing.
ML algorithms: decision tree learning, instance-based learning, bayesian learning, support vector machines, linear regression, logistic regression, ensemble learning.
Artificial neural networks: gradient descent, mlp, backpropagation.
Unsupervised learning: clustering. PCA and dimensionality reduction.
Deep learning: convolutional neural networks (CNN), recurrent neural networks (RNN).
Application of AI: computer vision (CV), natural language processing (NLP), recommender systems, generative adversarial networks (GAN).

**EEE 4710 Artificial Intelligence and Machine Learning Lab. Credit 0.75**

Experiments based on EEE 4709.

**EEE 4775 Robotics and Automation Credit 3.00**

Introduction to robotics: overview, history, types, applications, components
Robot kinematics and dynamics: degrees of freedom, motion planning, forward and inverse kinematics, control of manipulators.
Sensors and actuators: types, applications, interface, understanding sensor data.
Computer Vision and Image Processing: Fundamentals of Image Processing, Image Analysis Techniques, computer vision, Object Detection and Recognition.
Introduction to automation: overview, history, types, applications, components.
Industrial automation: programmable logic controllers (PLCs), supervisory control and data acquisition (SCADA), distributed control system (DCS), human-machine interface (HMI).
Robotics and automation programming: introduction to robot operating system (ROS), robot simulation, automation software.

Emerging trends in robotics and automation: ai and machine learning, internet of things (IOT), robotic process automation (RPA), industry 4.0, smart factories.

### EEE 4776 Robotics and Automation Lab Credit 0.75

Experiments based on EEE 4775.

### EEE 4773 Digital Image Processing Credit 3.00

Introduction and Digital Image Fundamentals, Digital image Representation, Image Enhancement in the Spatial Domain, Image Enhancement in the Frequency Domain, Image Restoration, Image Compression, Image Segmentation, Object Recognition.

### EEE 4774 Digital Image Processing Lab. Credit 0.75

Experiments based on EEE 4773**.**

## Eighth Semester

### Hum 4823 Sociology and Financial Accounting Credit 3.00

**Sociology:** Concepts of family and society (Islamic and non-Islamic): Growth of family and society; functions of family and society, obligation of family and social life. State and Nation: Elements of state and their characteristics; functions of the State, definition of the Nation, elements of the Nation and their characteristics; Relationship between Nation and State:-Islamic concept and Western concept. Government: different forms and types of Government. Citizenship: Rights and obligations. International Blocks and organizations: OIC, UNO, Commonwealth of Nation etc. Resources of Muslim world. Possible Socio-economics and cultural integration of Muslim Countries.

**Financial Accounting:** Accounting its origin and development, Definition of accounting and bookkeeping, used and users of financial information, transactions, assets, liabilities, and the accounting cycle. Journal, Ledger, Cashbook, Tribal balance, Income statement, Retained earnings, statement and balance sheet. Interpretation of financial statements, use of accounting information in project evaluation and other decision-making.

### Hum 4825 Technology, Environment and Society — Credit 3.00

Definition of terminology – technology, environment, society and development; Inter-dependence of technology, environment, society and development; Growth of technologies and its contribution to human development; Current state of technology and its future use as an instrument of change in twenty first century; Impact of technology upon the environment, impact of the environment upon human changes in the global climates; Environment friendly technology, Technology and development; Renewable energy and environments. Technology and environmental hazards, its remedies. Major hazards of industry. The improvement of working conditions in the industry.

Analysis of problems to calculate the net emissions or generations of harmful elements by a medium or large manufacturing company.

Calculating the cost and number of solar panel installations to offset the emissions or generations of harmful elements by a particular industry or process, for example, CO2 emissions from a vehicle manufacturing plant or CO2 emissions from the vehicles of a city.

Societal impacts of investment in renewable energy plants, e.g. nuclear power plant, solar power plant, etc.

### EEE 4800 Project and Thesis — Credit 3.00

The students are required to undertake a major project in the field of Electrical and Electronic Engineering. The objective is to provide an opportunity to the students to develop initiative, creative ability, confidence and engineering judgment. The results of the work should be

submitted in form of a report which should include appropriate drawings, charts, tables, references etc.

### EEE 4801 Power Generation Credit 3.00

Basis: power force, energy, work, electricity, units; energy system, power system; energy conversions.
Energy Sources: types, forms, natural, man-made, global energy and electricity use trend, source conservation.
Power Loads: types, demand factor, diversity factor, load curves, ideal load curve, peak load, base load, load factor, capacity factor, utilization factor, and load forecasting etc.
Electricity Generation: steam turbine, gas turbine, combined cycle, diesel, hydro and nuclear power plants; solar and wind bulk electricity.
Issues: environmental pollution, climate change, safety and legal requirements.
Plant Performance: efficiency, performance curves, heat rate, incremental heat rate, plant component performance, plant scheduling, captive generation, industrial cogeneration.
Plant economics and management criteria, electricity tariff, site selection etc.
Interconnected Power System: types, key issues, capacity savings, and power sharing among generating units.

## 8th Semester Elective Courses from Specialization Groups

## Power Systems Group

### EEE 4825 Utilization of Electrical Energy Credit 3.00

Economics of Electrical Energy Utilization: Economics of Electric power supply, general rule for charging the energy, Economical cross section of a conductor, ratings of a motor, temperature rise in a motor, power factor improvement, methods of reducing power factor occurrence, most economical power factor, economic choice of equipment.

Electric Heating: Salient features of electric heating, resistance heating, induction heating, electric arc heating, dielectric heating, methods of generating high frequency power

Illumination: Laws of illumination, classification of light sources, incandescent lamps, sodium vapor lamps, mercury vapor lamps, fluorescent lamps, design of illumination systems, indoor lighting schemes, outdoor lighting schemes, flood lighting, street lighting and energy saving lamps

Electrolytic Process: Principle of electro deposition, laws of electrolysis, applications of electrolysis.

Electric Drives and Traction, Electricity in Automobile, Refrigeration and Air-conditioning

### EEE 4826 Utilization of Electrical Energy Lab. Credit 0.75

Experiments based on EEE 4825.

### EEE 4823 Computer Methods in Electric Power Systems Credit 3.00

Review of Matrix algebra. Incidence and network matrices: Introduction, Formation of bus admittance matrix – by method of inspection, by method of singular transformation, Formation of Bus Impedance Matrix by step-by-step building algorithm (with mutual coupling elements). Sparse matrix techniques

Three phase networks: Three phase balanced and unbalanced network elements, Algorithm for formation of three phase bus impedance matrix.

Load Flow Study: Special purpose load flow, fast decoupled load flow, dc power flow, backward and forward sweep

Short Circuit Studies, Sequence circuits. Short Circuit Current and Voltage calculations for SLG, DLG, L-L and Three phase Faults.

Transient stability studies: Modified Euler's method, Runge-Kutta method, Milne's predictor corrector method. Representation of power system for transient stability studies – load representation, network performance equations. Solution techniques with flow charts.

Optimal power flow

**EEE 4824 Computer Methods in Electric Power Systems Lab.** **Credit 0.75**

Experiments based on EEE 4823.

**EEE 4827 Switchgear and Control Equipment II** **Credit 3.00**

Circuit breaker testing, type tests, routine tests, short circuit testing of circuit breakers, short circuit testing plants, insulation requirement and high voltage testing of circuit breakers, H.R.C. fuses and their applications, indoor switchgear, metal clad switchgear, low voltage control gear, contractors, low voltage circuit breakers, molded case circuit breakers, isolators and earthing switches. Schemes of electrical layout and bus bar designs in different types of stations and sub-stations. Control of power by reactance, automatic supervisory control equipment. Automatic Control Equipment for stand by supply.

**EEE 4828 Switchgear and Control Equipment II Lab.** **Credit 0.75**

Experiments based on EEE 4827.

**EEE 4821 Advanced Power System Protection** **Credit 3.00**

Non-directional and directional time graded system or feeder protection, Over current and earth fault protection of lines, Distance protection, Pilot wire protection, Carrier current protection, and Different types of surge protection, diverters, and their selection. Performance of transmission lines with respect to lightning phenomena and stroke currents.
Different types of neutral and equipment grounding of power systems and selection. Earth resistance and their measurements.
Methods of analyzing generalizing and visualizing protective relay response: Superimposing Relay and System characteristics on R-X Diagram.

Power Swings and Loss of Synchronism, Effect on Distance Relays of Power Swing and Loss of Synchronism; Response of polyphase and single-phase Directional Relays under different System conditions.
Application of Protective Relays for Bus Zone protection. Introduction to SCADA system.

**EEE 4822 Advanced Power System Protection Lab. Credit 0.75**

Experiments based on EEE 4821.

## Communication Group

**EEE 4853 Cellular Communication Credit 3.00**

Evolution of cellular technologies, operating bands, radio access protocols for UMTS, HSPA and LTE, network architecture, protocol stack, RRC states.
Registration areas: PLMN, LA, RA, URA, TA, area update.
UE and network identities: IMSI, TMSI, GUTI, IMEI, RNTI, UE categories, ECGI, GUMMEI, PCI.
CDMA, OFDMA, SC-FDMA, spreading, OVSF codes, scrambling, radio frame, resource block, frequency reuse, sectoring, cell splitting, impact of cell size and cluster size, FFR, PFR and SFR, antenna at cell site, co-channel and adjacent channel interference, Radio Network Planning (RNP) objectives and techniques.
Heterogeneous network: macro, pico and femto cells, relay nodes, CSG.
Carrier aggregation, self-optimizing network (SON), load balancing, link budget calculations, logical, transport and physical channels. Radio bearer, QoS requirements, reference signals, MIB and SIB messages, PDU formats of MAC, RLC and PDCP sublayers, TM, UM and AM operations, ciphering and integrity protection, header compression, resource scheduling and allocation, link adaptation, synchronization, random access, paging, Hybrid ARQ (HARQ), Discontinuous reception (DRX), buffer status reporting, power control, actions after powering up UE, service request, bearer setup,

Voice Service: IMS, VoLGA, CSFB, MO and MT call setup and release, Short Message Service (SMS)
Cell reselection, Hard and Soft Handover: intra-frequency, inter-frequency and inter-RAT, measurement and reporting, handover preparation and command.
Overcoming dropped calls and packet loss, Multimedia Broadcast Multicast Service (MBMS), Device-to-Device (D2D), Public Warning System (PWS)
UE positioning: OTDOA, A-GNSS, E-CID

**EEE 4854 Cellular Communication Lab. Credit 0.75**

Experiments based on EEE 4853.

**EEE 4841 Optical Communication Credit 3.00**

Introduction to Optical Communication: Fiber optics – a review of the state of the art, Evolution of Lightwave Systems, Basic Concepts, Optical Communication Systems, Lightwave System Components.
Review of elementary optics, Elementary Theory of Propagation through Optical Fibers. Reflection, Refraction, Dispersion and Attenuation of Signals Propagation through Fiber Cables. Propagation characteristics of different kinds of fibers: Step-Index Fibers, Graded-Index Fibers. Wave Propagation, Maxwell's Equations, Fiber Modes: Single and Multi-mode Fiber. Dispersion in Single-Mode Fibers: Group-Velocity Dispersion, Material Dispersion, Waveguide Dispersion, Higher-Order Dispersion, Polarization-Mode Dispersion. Fiber Losses: Attenuation Coefficient, Material Absorption, Rayleigh Scattering, Waveguide Imperfections
Nonlinear Optical Effects (Four Wave Mixing, Cross-phase Modulation) & Fiber Manufacturing.
Optical Transmitter: Basic Concepts: Radiative and Non-radiative Recombination, Emission and Absorption Rates. Light-Emitting Diodes, LED structures, Power–Current Characteristics. Laser in the Field of Optical Communication: Optical Gain, Feedback and Laser Threshold, Laser Structures, Laser Characteristics. Transmitter Design.
Optical detectors/ receivers: Basic Concepts. Detector Responsivity, Rise Time and Bandwidth. Common Photodetectors. Receiver Design:

Receiver Noise, Sensitivity and sensitivity degradation, Receiver performance
Optical Amplifiers: Basic Concepts, Amplifier Applications, Raman Amplifiers and Erbium-Doped Fiber Amplifiers
Local data distribution, data transmission and telemetry: System Architectures
Point-to-Point Links, Distribution Networks and Local-Area Networks. Design Guidelines: Loss and Dispersion Limited Lightwave Systems, Power Budget, Sources of Power Penalty. Unguided and guided Optical Communication System & Economy of Optical Fiber System in Telecommunications.
Next generation fibers: Photonic crystal fibers, Nano-fiber tips & antennas, Higher-order modes, Air core fibers. Advanced Infrared propagation: radiant intensity, emitter beam pattern, detector sensitivity, link distance.

### EEE 4842 Optical Communication Lab. Credit 0.75

Experiments based on EEE 4841.

## Electronics and Signals Group

### EEE 4865 Digital Filter Design Credit 3.00

Basic concepts of digital filtering, Types of digital filters. FIR filter design methods: Z-transform, Transform function of discrete-time systems, Effect of the poles and zeros of the transfer function, FIR filter realization, Window functions, Finite word-length effects. IIR filter design: IIR filter realization, Reference analog prototype filter, Analog prototype filter to analog filter transformation, Low-pass filter, High-pass filter, Band-pass filter, Band-stop filter, Bilinear transformation. Filter design using VHDL and Implementing on FPGA.

### EEE 4866 Digital Filter Design Lab. Credit 0.75

Experiments based on EEE 4869.

### EEE 4877 Analog Integrated Electronics Credit 3.00

Review of FET amplifiers: Passive and active loads and frequency limitation. Current mirror: Basic, cascade and active current mirror.
Differential Amplifier: Introduction, large and small signal analysis, common mode analysis and differential amplifier with active load.
Noise: Introduction to noise, types, representation in circuits, noise in single stage and differential amplifiers and bandwidth.
Band-gap references: Supply voltage independent biasing, temperature independent biasing, proportional to absolute temperature current generation and constant transconductance biasing.
Switch capacitor circuits: Sampling switches, switched capacitor circuits including unity gain buffer, amplifier and integrator.
Phase Locked Loop (PLL): Introduction, basic PLL and charge pumped PLL.

### EEE 4878 Analog Integrated Electronics Lab. Credit 0.75

Experiments based on EEE 4877.

## 8th Semester Pseudo-compulsory Courses

### EEE 4861 VLSI Design Credit 3.00

VLSI technology: Terminology and trends, MOS transistor characteristics, NMOS and CMOS inverters, dc and transient characteristics. Pass transistors and Pass gates. CMOS layouts and design rules, Complex CMOS gates, Resistance and Capacitance estimation and modeling Signal propagation delay, Noise margins and power consumption.

CMOS building blocks: adders, counters, parity generators, shift registers, multipliers, barrel shifters. Data paths, memory structures, PLAs and FPGAs. Speeding up technologies, BiCMOS circuits, GaAs technology.

### EEE 4862 VLSI Design Lab. Credit 0.75

Experiments based on EEE 4861.

### 4.3.1.2 Courses Offered by Other Departments to EEE Students

## Courses Offered by MPE Department

### MCE 4192 Mechanical Engineering Drawing Credit 0.75

Introduction to Engineering Drawings, Drawing instruments and their uses. Alphabet of lines and uses of Alphabet of lines, scales of drawing and dimensioning. Drawing geometrical figures including exercising of tangents. Orthographic views, arrangements of views in first angle and third angle. Exercising on orthographic views of straight and taper surfaced simple block. Isometric and oblique drawing of simple block. Full sectioning. Practice on lettering and numerals, lettering exercising on a composition.

### MCE 4391 Basic Mechanical Engineering Credit 3.00

Study of fuels; Thermodynamic system, state, process and cycle. First and Second Laws of thermodynamics; Steam generating units with accessories and mountings; Study of steam generators and steam turbines.
Introduction to internal combustion engines and their cycles; Study of SI engines, CI engines and gas turbines with their accessories.
Refrigeration and air conditioning: their applications; Study of different refrigeration methods; Refrigerants; Refrigeration equipment: compressors, condensers, evaporators, expansion devices, other control and safety devices; Psychrometrics; Study of air conditioning systems with their accessories.
Types of fluid machinery; Study of impulse and reaction turbines: Pelton wheel and Kaplan turbine; Study of centrifugal and axial flow machines: pumps, fans, blowers and compressors; Study of reciprocating pumps.

### MCE 4392 Basic Mechanical Engineering Lab. Credit 0.75

Experiments based on MCE 4391.

### IPE 4591 Engineering Management Credit 3.00

Basic management theory and practice, division of management structure into elemental functions, management functions and their inter-relationships, industrial organisation and organisational objectives, communications and job instructions, management of human resources, team work, leadership and human relationship, personnel system, performance appraisal and incentive scheme, manpower planning-forecasting labour demand, planning, scheduling and organising work, industrial relations-general framework, procedures for settlement of disputes, current development; industrial accident prevention, plant layout, working environment and material handling, work study, inventory control, basic costing and budgetary control.

### IPE 4791 Engineering Economics Credit 2.00

Introduction to engineering economic decision, cash flow analysis and basic concepts of discounting, cost of capital, required ROR equivalence. Business mathematics: Investment appraisal criteria for economic decisions, present worth, internal rate of return, social consideration in investment, benefit-cost ratio Decisions involving depreciation and inflation, taxes, sensitivity analysis.

## Courses Offered by CSE Department

### CSE 4271 Computer Programming Credit 2.00

Introduction, Programming Concepts, Algorithm and Logic, Constants, Variables, Keywords and Data Types, Operators and expressions, Managing Input and Output Operations, Decision Making and Branching, Decision Making and Looping, Arrays, Multi-dimensional Arrays, Strings, User defined functions, Recursion, Structures and Unions, File Management in C, Pointers, Dynamic Memory Allocation and Linked List, The Preprocessor and some advanced topics, Advanced data types and operators.

### CSE 4272 Computer Programming Lab. Credit 1.50

Experiments based on CSE 4271.

### CSE 4781 Object Oriented Programming Credit 3.00

Concept of classes and objects, data and module encapsulation; polymorphism, inheritance, sub-typing, Advanced I/O, virtual function; object-oriented design; generic classes, static and dynamic binding, generic classes; exception handling, Namespace and standard template library.

Examples of languages for handling visual information; Examples of languages for handling visual interactions; visualization of data and information about data; visualization of programs and execution, visual interface design systems.

### CSE 4782 Object Oriented Programming Lab. Credit 0.75

Experiments based on CSE 4781

## Courses Offered by CEE Department

### CEE 4106 Civil Engineering Drawing Credit 0.75

Introduction- lettering, numbering and heading; instrument and their use; sectional views and isometric views of solid geometrical figures. Plan, elevation and section of multistoried building; building services drawings; detailed drawing of lattice towers.

## Courses Offered by BTM Department

### BTM 4821 Business Communication Skill Credit 3.00

The project cycle, project proposal and evaluation, contractual provisions, specification writing techniques.
Written communication: report writing, memoranda, letters, instructions, notice, personal filing systems etc.
Oral communication: listening skills, informal and formal meetings, power point, transparency based oral presentation, audio-visual communications. Introduction to e-commerce.

### 4.3.1.3 Reserved Pool of Elective Courses

The following courses have been excluded from the syllabus during introduction of specialization. However, any course from this pool may be reintroduced in the future if required.

## Power System Group

**High Voltage Engineering** **Credit 3.00**

High voltage DC: Rectifier circuits, voltage multipliers, Van-de-Graaf and electrostatic generators. High voltage AC: Cascaded transformers and Tesla coils. Impulse voltage: Shapes, mathematical analysis, codes and standards, single and multi-stage impulse generators, tripping and control of impulse generators. Breakdown in gas, liquid and solid dielectric materials. Corona.
High voltage measurements and testing. Over-voltage phenomenon and insulation coordination. Lightning and switching surges, basic insulation level, surge diverters and arresters.

**Electrical Installations** **Credit 3.00**

General requirement of installation, Symbols and Codes, electrical installation for residential, commercial and industrial buildings-preparation of Drawings for Electrical Installation: Consideration and selection of Conductors and Cables.

Installation of Electrical Machines, transformers and substations: Electrical Installation Protection, protection against lightning surges, over voltages and short circuits, selection of different types, cut-outs and circuit breakers.

**Electrical Installations Lab.** **Credit 0.75**

Experiments based on Electrical Installations.

**Nuclear Power Engineering** **Credit 3.00**

Comparison analysis of conventional and non-conventional power plants; Non-conventional sources of power generation; solar and wind power, power from ocean, thermal, wave and tidal sources; Introduction to nuclear reactors and power plants; heat generation and removal; Types of nuclear reactors, reactor coolants, Thermodynamic cycles for nuclear power stations, Shielding, Introduction to reactor reliability and safety analysis, Radioactive waste disposal; Economics of nuclear power; Introduction to nuclear fuel cycles.

**Power Plant Engineering and Economy** **Credit 3.00**

Introduction to thermal, hydro and nuclear power stations. Nuclear reactor, reactor construction and control. Power reactors. Central station Reactors. Nuclear hazards.

Variable load problems, plotting and analysis of load curves, chronological load curves and load duration curve. Energy load curve and its use. Load factor, capacity factor, demand factor, utilization factor, diversity factor etc. and their impact over the cost analysis of power generation and utilization. Load forecasting, selection of units and plant location.

Load shearing: Base load and peak load plants. Use of chronological load curves to distribute loads among units.

Power plant Economics: Economic operation of power plants. Input output curve, heat rate curve, and incremental rate curve. Use of incremental rate curve for optimum load scheduling. Transmission line loss, determination of loss co-efficient. Economic conductor selection, Kevin's law. Graphical method for location of distribution systems. Tariff and tariff design. Bus system. Importance of power control. Current limiting reactors. Different types of bus system layout. Forces on bus system in case of short circuit.

**Smart Grid** **Credit 3.00**

Fundamental Elements of Design, analysis, and development of Smart Grid.

Introduction to the basic concepts of power systems along with the inherent elements of computational intelligence, communication technology and decision support system

The automation and computational techniques for guarantying adaptability and capability of handling new systems and components. The interoperability of different renewable energy sources to ensure minimum changes in the existing legacy system. Standards and requirements for designing new devices, systems, and products for the Smart Grid.

Power flow analysis and optimization scheme for the generation, transmission, distribution, demand response, and reconfiguration for the Smart Grid.

## Advanced Electrical Machines Credit 3.00

Special Machines: Interpretation of generalized machines from field concepts. Linear induction motor, stepper motor and control circuits, universal magnet motors, hysteresis motor, synchronous reluctance, and switched reluctance motor, amplidynes and metadynes, synchros and control transformers, repulsion motor, permanent magnet DC motor, brushless DC motor, brushless synchronous machines.

DC and AC motor control: Semiconductor static power converters, fundamentals of DC and AC motor control by using semiconductor static power converters.

Electrical machine design: Design principles, single and three phase transformer design, design of single and three phase induction motors, application of computers in modern design of electrical machines.

## HVDC Power Transmission Credit 3.00

DC power transmission technology, HVDC converters system control, faults and protection, smoothing reactors, reactive power control, multi-terminal DC system, analysis of AC/DC dynamic simulation converters and DC systems.

## Communication Group

### Information and Coding Theory Credit 3.00

Information Theory: Entropy and mutual information for discrete ensembles; Asymptotic equipartition property; Markov chains; Shannon's noiseless coding theorem; Encoding of discrete sources. Data Compression, Discrete memoryless channels; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Deferential entropy; Calculation of channel capacity for Gaussian channels; Rate distortion function. Coding Theory: Linear Codes, distance bounds, generator and parity check matrices, error-syndrome table; a brief overview of rings and ideals; Cyclic codes, generator and parity check polynomials, Finite fields, applications of finite fields to cyclic codes; BCH codes and Reed-Soloman Codes; An overview of convolutional codes. Maximum likelihood decoding; Introduction to iterative codes and its sub-optimal decoding algorithms.

### Satellite and Radar System Credit 3.00

Satellite Orbits and Launching: Kepler's laws, Geostationary and non-geostationary orbits, Orbit perturbations; Radio Wave Propagation: Signal impairment: rain attenuation, atmospheric losses, ionospheric effects, Polarization, Antenna radiation patterns, Antenna arrays; Space Segment: Power supply, Attitude control, Station keeping, Thermal control, Transponders; Earth Segment: Receive-only TV antennas, Transmit-receive earth stations; Space Link: Link power budget equations, Intermodulation, Inter-satellite links, VSATS, GPS.

Radar Basics: Radar equation, minimum detectable signal, radar cross-section, pulse repetition frequency, range ambiguities. Introduction to MTI and Pulse radar. Introduction to Tracking radars. Radar clutter. Different types of radar display. Overview of radar antennas.

## Electronics and Signals Group

### Illumination Engineering — Credit 3.00

Basic Illumination, The visible spectrum, Terms used in illumination, solid angle, illuminous flux, Luminous intensity, reduction factor, illumination, luminance, reflection ratio, specific output, specific consumption, laws of illumination, Inverse square law, Lambert's cosine law, illuminations calculations, Polar curves of light distribution, Roussean's figure. Design of lighting schemes and layouts, Photometry, light generation, Incandescent lamps, fluorescent lamps, Lighting circuits, Economics of lighting systems.

### Analog Filter Design — Credit 3.00

Filter preliminaries: Terminology; Magnitude and Phase responses; Classification (LPF, HPF, BPF, APF etc.,)

Approximation Theory: Butterworth, Chebychev, Elliptic and Bessel Filters; Frequency Transformation.

Sensitivity: Basic concepts; Application to filters – Q sensitivity, wp sensitivity. Elements of passive network synthesis: Properties and synthesis of LC, RC driving point and transfer functions; Singly- and Doubly-terminated ladder networks.

Basics of Active Filter Synthesis: RC-OPAMP circuits, Biquad circuits based on negative feedback and positive feedback topologies; Active networks based on passive ladder structures; Effects of real OPAMPS on active filters.

Introduction to Switched-Capacitor Filters: The MOS switch; Simulation of resistors using Switched –Capacitor circuits.

### Analog Filter Design Lab. — Credit 0.75

Experiments based on Analog Filter Design.

### Embedded System Design — Credit 3.00

Embedded processing – Evolution, Issues and challenges.

System and processor architecture: Von Neumann, Harvard and their variants; Memory architecture and devices; input-output devices and mechanisms; Instruction set and addressing Modes; interfacing of memory and peripheral devices – Functional and timing issues; Application specific logic design using Field programmable devices and ASICs; analog to digital and digital to analog converters; Bus I/O and networking considerations; Bus and wireless protocols.

Embedded system software: Constraints and performance targets; real-time operating systems: introduction, Scheduling in real-time operating systems.

Memory and I/O management: Device Drivers.

Embedded software development: Flow, environments and tools, system specification and modeling, programming paradigms, system verification.

Performance analysis and optimizations: Speed, power and area optimization; testing of embedded systems system design examples using microcontrollers, PLC and FPGA.

**Embedded System Design Lab.** **Credit 0.75**

Experiments based on Embedded System Design.

**Bio Instrumentation** **Credit 3.00**

Human body: Cells and physiological systems. Bioelectricity: genesis and characteristics.

Measurement of bio-signals: Ethical issues, transducers, amplifiers and filters.

Electrocardiogram: electrocardiography, phono cardiograph, vector cardiograph, analysis and interpretation of cardiac signals, cardiac pacemakers and defibrillator. Blood pressure: systolic, diastolic mean pressure, electronic manometer, detector circuits and practical problems in pressure monitoring. Blood flow measurement: Plethymography and electromagnetic flow meter.

Measurement and interpretation: electroencephalogram, cerebral angiograph and cronical X-ray. Brain scans. Electromayogram (EMG). Tomograph: Positron emission tomography and computer tomography. Magnetic resonance imaging. Ultrasonogram. Patient monitoring system and medical telemetry. Effect of electromagnetic fields on human body.

**Bio Instrumentation Lab.** **Credit 0.75**

Experiments based on Bio Instrumentation.

**Digital Signal Processing II** **Credit 3.00**

Linear Prediction and Optimum Linear Filters: Innovations representation of a stationary random process, Forward and backward linear prediction, Solution of the normal equations, Properties of linear prediction-error filter, Autoregressive (AR) lattice and autoregressive moving average (ARMA) lattice-ladder filters.

Adaptive signal processing: FIR adaptive filters, steepest descent adaptive filter, LMS algorithm, convergence of LMS algorithms, Application: noise cancellation, channel equalization, adaptive recursive filters, recursive least squares.

Multirate signal processing: up-sampler and down-sampler, filters in sampling rate alternation systems; multi-stage design of decimator and interpolator, polyphase decomposition; arbitrary sampling rate converter, Lagrange interpolation, digital filter banks, uniform DFT filter banks, Nyquist filters, quadrature-mirror filter banks, perfect reconstruction two-channel FIR filter banks, multi-level filter banks.

Perfect reconstruction filter banks: Power symmetric, alias-free multi-channel and tree structured filter banks.

Wavelet transforms: Fourier Transform: Its power and limitations, Short time fourier transform, The gabor transform, Discrete time fourier transform and filter banks, Continuous wavelet transform, and Wavelet transform in ideal case.

### Digital Signal Processing II Lab. Credit 0.75

Experiments based on Digital Signal Processing II.

### Biomedical Signal Processing Credit 3.00

Introduction to Biomedical Signals: Origin of biosignals and their characteristics. Survey of major modalities for Biosignal processing: X-ray, EEG, fMRI, ECG, Ultrasound, CT, MRI, PET, and SPECT. Noise and artefacts in biosignals.

Methods and techniques for analyzing biosignals: Introduction to linear systems: Fourier Transform, Radon Transform, Short term Fourier Transform, Advanced Time frequency Analysis (Wavelet Transform). Filtering, enhancement, restoration and registration of biomedical signals/images. Edge detection and segmentation of biomedical signals/images. Feature extraction of biosignals using popular clustering and classification techniques.

### Biomedical Signal Processing Lab. Credit 0.75

Experiments based on Biomedical Signal Processing.

## Interdisciplinary Group

### Microprocessor System Design Credit 3.00

Review of 8086 family of microprocessors. Instructions and data access methods in a 32-bit microprocessor; Representation of operands and operators; Instruction formats; Designing Arithmetic Logic Unit; Processor design: single bus, multi-bus architecture; Control Unit Design: hardwired, micro-programmed and pipeline; VLSI implementation of a microprocessor or part of a microprocessor design.

Microprocessor development systems: Controller for PLC; graphics processor, pen drive & external hard disk controller; arithmetic processor (Intel 8087), FFT and array processor.

**Microprocessor System Design Lab.** **Credit 0.75**

Experiments based on Microprocessor System Design.

**Control System Engineering II** **Credit 3.00**

Modeling of physical systems-Linearization and its consequences, Concepts of state and State-space. Derivation of state models from transfer functions and ordinary differential equations. Solution of state equations- Controllability and Observability. Classification of synthesis method of sensitivity and error analysis and stability. Design via state space, Performance measures like ISE, ITAE; Quadratic indices

State equations of digital systems with sample and hold, state equation of digital systems, digital simulation and approximation. Solution of discrete state equations: by z-transform, state equation and transfer function, state diagrams, state plane analysis. Stability of digital control systems. Digital simulation and digital redesign. Time domain analysis. Frequency domain analysis. Optimal linear digital regulator design. Digital state observer. Microprocessor control. Introduction to neural network and fuzzy control, adaptive control, $H_\alpha$ Control, nonlinear control.

**Control System Engineering II Lab.** **Credit 0.75**

Hardware experiments & simulations based on Control System Engineering II**.**

**Data Structures and Algorithms** **Credit 3.00**

Elementary data objects, Elementary data structures, arrays, lists, stacks, queues, link list, pointers, graphs, trees. Memory management. Sorting and searching, hash techniques.

Techniques for analysis of algorithms, Methods for the design of efficient algorithms: divide and conquer, greedy method, back tracking, branch and bound, Basic search and traversal techniques, lower bound theory, concept of NP-hard and NP-complete problems.

**Data Structures and Algorithms Lab.** **Credit 0.75**

Experiments based on Data Structures and Algorithms.

**Discrete Mathematics** **Credit 3.00**

Set theory, Elementary number theory, Graph theory, Paths and trees, Generating functions, Algebraic structures, Semigraph, Permutation groups, Binary relations, functions, Mathematical logic, Propositional calculus and predicate calculus.

**Operating System and System Programming** **Credit 3.00**

Introduction to O.S., evaluation of Operating Systems. Memory management: memory addressing, paging & storage multiplexing, virtual memory, Processing memory: process state, concurrent processing, synchronization, process scheduling, Deadlocks & its handling, protection system. Performance evaluation. Basic concepts of system programming, assembler, compiler, loader, technical design of assembler and compiler.

**Operating System and System Programming Lab.** **Credit 0.75**

Experiments based on Operating System and System Programming.

**Database Management and Information System** **Credit 3.00**

Concepts and methods in database system. File organization and retrieval. Data manipulation. Query formulation and language. Data base models. Data description languages, database integrity and security. Data dictionary/directory systems, database administration. Data base design. Survey of some existing database management systems.

Development of computerized information systems in support of the key decision-making responsibilities of management. Some applications

using COBOL program. An introduction to the role of information and system theory in managerial design making. The effectiveness and critical analysis in meeting the needs of management.

**Database Management and Information System Lab.** **Credit 0.75**

Experiments based on Database Management and Information System.

**System Analysis and Design** **Credit 3.00**

System concepts. System and System analysis, system planning, approach to systems development, user involvement, feasibility assessment. System investigations: objectives, methods, recording. Logic System Design, Physical Design of computer and manual sub-system, project management and documentation.

Software Project Management: life cycle, specification design, documentation, maintenance and control. Nature and sources of software tools. Program system organization, analysis of program performance, testing and verification methods, editing formatting, Microprocessing co-ordination of multiple programs.

**System Analysis and Design Lab.** **Credit 0.75**

Experiments based on System Analysis and Design.

**Software Development** **Credit 3.00**

Students will work in groups or individually to produce high quality software including new I/O drives and similar projects involving operating system modules in different languages. Students will write structural programs and use proper documentation.

**Software Development Lab** **Credit 0.75**

Experiments based on Software Development.

## 4.3.2 Contents of Postgraduate Courses

**EEE 6000 Thesis** **Credit 18.00**

**EEE 6002 Project** **Credit 6.00**

**EEE 6105 Advanced Engineering Analysis** **Credit 3.00**

Wavelet transform, chaos and bifurcation theorems, Walsh function, Greens function, finite element techniques, Fuzzy logic, Genetic algorithms, and Stochastic process.

**EEE 6200 Selected Topics in Electrical and Electronic Engineering** **Credit 3.00**

**EEE 6229 VLSI Design** **Credit 3.00**

Design of microelectronic circuits such as registers, CMOS subsystem, adder and related functions, multipliers, programmable logic arrays (PLAs) via large scale integrated circuitry with emphasis on high-level structured design methods for VLSI systems.

**EEE 6231 Advanced Analog IC Design** **Credit 3.00**

Data converter fundamentals, Analog to digital converter (ADC) building blocks, ADC architectures, Digital to analog converter (DAC) architectures, The successive approximation register (SAR) ADC, Operational amplifier (op-amp) in data converters, Resistor R-2R DAC, Op-amp design, SC circuits, Op-amp design for switch capacitor (SC) circuits, Effects of offsets, Continuous-time design, Common mode feedback (CMFB), Design using SC CMFB, The design of fully-differential op-amp, Stability, Offset storage, Dynamic analog circuit design, Sample and hold (S/H), Bottom plate sampling, Low noise design, MOSFET noise modeling, Noise performance of amplifiers, Mirrors, Op-amp noise modeling and feedback, Op-amp noise modeling with simulation, Averaging noise, Shot and flicker noise, Signal to noise ratio (SNR), Noise

factor (NF), Optimum source resistance, Input-referred noise, Thermal noise, kT/C noise, Power spectral density (PSD), Noise effective bandwidth (NEB), Noise measurements.

**EEE 6233 Advanced Analog Electronics Credit 3.00**

Feedback amplifier principles, linear wide-band low-noise feedback amplifier design, voltage and current regulators, switching regulators.

**EEE 6235 Advanced Solid State Devices Credit 3.00**

Semiconductor theory, development of mathematical analysis and systematic modeling of solid-state devices, characteristics and properties of solid-state devices, p-n junction, bipolar and unipolar transistors, noise models of active devices.

**EEE 6237 IC Processing and Fabrication Technology Credit 3.00**

Integrated circuit processing, solid state diffusion, diffusion technology, nonideal effects in diffusion, ion implantation, thermal oxidation, oxide for diffusion, masking, film deposition, photolithography and etching, device isolation, contacts and metallization; Si bipolar and MOSFET technologies, advanced bipolar processes, BiCMOS.

**EEE 6301 Power System Reliability Credit 3.00**

Review of basic probability theory, Basic reliability concepts. Markovian model of generation unit, Development of load models, Probabilistic simulation of generating systems, Reliability indices: Recursive, segmentation and cummulant method to obtain loss of load probability (LOLP), Modeling for forecast uncertainty, Reliability evaluation: energy limited units, interconnected systems, composite transmission and generating system, and substation and switching stations.

**EEE 6303 Power System Planning Credit 3.00**

Basic objectives of power system planning, Generation expansion planning process, Electrical demand forecasting: current demand forecasting approaches. Generation planning: economic analysis, expected energy generation, expected fuel cost, Booth-Baleriux, cummulant and segmentation methods, Probabilistic simulation of hydro and energy limited units, Expected energy production cost of interconnected systems, Economic aspects of interconnection, Different aspects of load management, WASP, Joint ownership of generation.

**EEE 6305 Transients in Power System Credit 3.00**

Transients in simple electric and magnetically linked circuits, impacts of switching on rotating machinery. Parallel operation of interconnected networks, Interaction of Governors in power systems. Overvoltage during power system faults. Systems voltage recovery characteristics. Effect of arc restriking on recovery voltage. Switching surges and overvoltage arrester requirements. Overvoltage caused by sudden loss of load and by open conductor.

**EEE 6307 Power System Modeling Credit 3.00**

Overview of the applications of power electronics at utility and demand sides, sources of harmonics: utility devices and consumer loads. Various models for nonlinear and dynamic loads. High voltage direct current (HVDC) transmission system modeling. AC-DC load flow studies. Modeling of flexible AC transmission systems (FACTS): conventional thyristor controlled reactors and phase shifters, voltage source inverter (VSI) based static condenser (STATCON) and unified power flow controller (UPFC). Transient stability and sub-synchronous resonance (SSR) studies incorporating magnetic energy storage (SMES) models. Modeling of utility interfaced with photovoltaic and wind energy sources. Power quality, cyclic and noncyclic voltage flicker, total harmonic distortion (THD) analysis, remedial measures and harmonic load flow studies.

**EEE 6309 Computer Methods in Power System Analysis Credit 3.00**

General review of network theory, matrix analysis and computer modeling. Incidence matrices, primitive networks and formation of impedance and admittance networks matrices. Algorithms for formation of network matrices. Three-phase networks: symmetrical components and sequence impedances, balanced and unbalanced faults. Faults impedance and admittance matrices. Short circuit studies using ZBUS and ZLCOP, open circuit fault studies. Load flow studies, power flow equations. Gauss-Seidel, Newton-Raphson, decoupled and fast decoupled methods of load flow analysis. Three phase load flow.

**EEE 6311 Power System Optimization Credit 3.00**

Economic load dispatch in thermal and hydro-thermal system; reactive power optimization; optimal power flow. Linear programming and non-linear programming techniques to optimal power flow problems. Security constrained optimization. Unit commitment and maintenance scheduling, Interchange evaluation, Minimum emission dispatch.

**EEE 6313 Power System Dynamics and Stability Credit 3.00**

Review of Swing equation.
Nonlinear Dynamic Modeling of Salient-pole Synchronous machine, Model order reduction for Synchronous machine dynamic model, Time-domain based simulation.
Modeling of Synchronous machine connected to infinite bus (SMIB), Dynamic response of SMIB system based on time domain simulation, Development of the linearized dynamic model of SMIB System. Stability analysis based on frequency domain response.
Dynamic modeling of Generator Excitation system, Development of Heffron-Phillips Model, Power System Stabilizer Design.
Dynamic modeling of Hydro Turbine System, Speed Governor Model.
Dynamic modeling of three phase Induction Machine.

**EEE 6315 Solar and Wind Energy Systems Credit 3.00**

Importance of Photovoltaics (PV) energy, Energy from the sun, Solar Cell, and Sunlight. Insolation: geographical distribution, solar radiation, Air Mass, and measurements. Solar Cell: Structure, principle of operation, spectral response, I-V characteristics, factors affecting conversion efficiency, losses, and measurements, Applications, Solar cell materials, devices, and efficiency, current solar cell technology. PV systems: Stand-alone and grid-connected systems, Different connection topologies, Single-stage and multi-stage PV systems, PV inverter technologies, Maximum Power Point Tracking (MPPT) techniques, Grid-tied PV inverter: demands and standards, PV sizing, solar home system, solar concentrating system: ideal concentrators, stationary and periodically adjusted concentrators, tracking concentrators, concentrator cell design. Wind turbine generators: types, operational characteristics, cut-in and cut-out speed control, grid interfacings, AC-DC-AC link, wind resource assessment.

**EEE 6317 Solar Cell Technology Credit 3.00**

Solar cell basics, sunlight, semiconductor material for solar photovoltaic, electron-hole pair generation, recombination, and the basic equation of device physics, carrier injections in photovoltaic p-n junction, dark characteristic, illuminated characteristic, solar cell output parameters, solar cell efficiency limits, losses, and measurement, illuminated characteristics of solar cells, dark characteristics of solar cells. Standard silicon solar cell technology: Sand to metallurgical-grade silicon, metallurgical grade silicon to semiconductor-grade silicon, semiconductor-grade polysilicon to single-crystal wafers, single-crystal wafers to solar cells, solar cells to solar cell modules, module construction, cell operating temperature, module durability, module circuit design. Thin film solar cell technology: amorphous-Si solar cell technology, CdTe solar cell technology, CIGS solar cell technology, CZTS solar cell technology.

**EEE 6401 Optical Fiber Communication Credit 3.00**

Introduction to advantages and future prospects of optical fiber communication. Optical fiber-mode theory, fiber types and characteristics. Light sources: light emitting diode and laser diode. Detectors: PIN and avalanche photodetectors. Receiver analysis: direct detection and coherent detection, noises and limitations. Transmission limitations: chromatic dispersion, nonlinear refraction, scattering, four wave mixing, laser phase noises. Optical amplifier: laser and fiber amplifiers. Multichannel optical system: frequency division and wavelength division multiplexed systems. Optical devices and components for communication.

**EEE 6403 Wireless Communication Credit 3.00**

Introduction to cellular concepts, frequency reuse, cochannel interference, handoff. Radio propagation in and around buildings. Friis equation, multipath, narrow-band and wideband channels, small scale and large-scale statistics, space and time signal variation. Receiver sensitivity, sources of noise. Performance statistics: coverage, margin, digital modulation, adjacent channel interference, and digital error rates. Wide band channels, maximum transmission rates. Multi-server queuing and traffic, Erlang formulas.

**EEE 6405 Advanced Digital Signal Processing Credit 3.00**

Review of discrete-time signals and systems, applications of Z-transform, discrete Fourier transform (DFT) and fast Fourier transform (FFT) to frequency analysis of signals and systems. Design of digital filters. Multirate digital signal processing. Linear prediction and optimum linear filters. Power spectrum estimation.

**EEE 6407 Digital Communication Credit 3.00**

Elements of a digital communication system and information theory. Modulation and demodulation for the additive Gaussian noise channel. Efficient signaling with coded waveforms. Digital signaling over a channel with intersymbol interference and additive Gaussian noise-

characterization of Band-Limited Channels. Digital signaling over fading multipath channels. Spread spectrum signals for digital communications.

**EEE 6409 Information Theory Credit 3.00**

Information-theoretic quantities: Entropy, mutual information and divergence. Asymptotic equipartition property (AEP), Data compression. Channel capacity, Strong coding theorem (random coding exponent). Network information theory: Multiple access channels and broadcast channels. Advanced topics: Fading channels, MIMO channels and wideband channels.

**EEE 6411 Wireless Ad Hoc and Sensor Networks Credit 3.00**

Background on Networking: Computer Networks, Overview of Wireless Networking, Ad Hoc Network, Wireless Sensor
Networks; Wireless Ad Hoc Networks: Topology-Based Routing Protocols, Position-Based Routing, Broadcasting, Multicasting and Geocasting, Wireless Local Area Networks (WLANs), Wireless Private Area Networks (WPANs), TCP over Ad Hoc Networks, Distributed Power Control and Rate Adaptation for Wireless Ad Hoc Network; Wireless Sensor Networks: Sensing and Communication Range, Energy Consumption, Clustering of Sensors; Sensors for Smart Environments; Data Retrieval in Sensor Networks; Integrating Mobile Ad Hoc Networks (MANETs), Wireless Local Area Networks (WLANs) and Cellular Networks; Self-Organization and Localization in Wireless Ad Hoc and Sensor Networks; Optimized Energy and Delay-Based Routing in Wireless Ad hoc and Sensor Networks; NFC (Near Field Communication); Delay Tolerant Networks (DTN): Architecture, Model, Bundle Layer, Challenges and Applications.

**EEE 6413 Engineering Optimization Credit 3.00**

Overview of Engineering Optimization: Methods of Proof and required Notation; Vector Spaces and Matrices; Transformations; Concepts from

Geometry; Elements of Calculus; Classical Optimization Techniques; Linear Programming: Simplex Method,
Advanced Topics; Nonlinear Programming: One-Dimensional Minimization, Search Methods, Newton Method; Unconstrained Optimization Techniques; Constrained Optimization Techniques;
Integer Programming; Modern Methods of Optimization: Game Theory, Bio-inspired optimization Technique, Ant Colony Optimization, Evolutionary Game Theory; Practical Aspects of Optimization: Engineering Case Studies.

**EEE 6501 Switching Theory Credit 3.00**

Digital systems design; introduction to switching algebras, overview of integrated circuit technologies, analysis and synthesis of combinational circuits, special properties of selected switching functions, sequential circuits, fundamental mode analysis, pulse mode analysis, and sequential credit synthesis.

**EEE 6503 Advanced Computer Architecture Credit 3.00**

Introduction to the problems involved in designing and analyzing current machine architectures. Performance and cost analysis, pipeline processing, vector machines and numerical applications, hierarchical memory design, and multiprocessor architectures.

**EEE 6505 Analysis and Design of Digital Integrated Circuits Credit 3.00**

MOS and bipolar device models and second order effects. Circuit Device and circuit level optimization of digital building blocks. design styles and arithmetic structures. Estimation and minimization of energy consumption. Interconnected models and parasitics; driver design; timing issues: clock skew, self-timed circuits. Memory architectures; circuits: sense amplifiers and devices. Testing of integrated circuits.

**EEE 6507 CISC Microprocessor System Design** **Credit 3.00**

Overview of advanced architecture CICS microprocessors and their associated support components with emphasis on incorporating these devices into both general purpose and embedded board level designs for multi-microprocessor systems utilizing open architecture system buses. 32-bit CISC microprocessors, memory management, floating point support, advanced peripherals, PLD- based "glue logic" design, performance evaluation, IEEE standard open architecture system buses, and various pertinent interface and networking standards.

**EEE 6509 Cloud Computing Technologies for Smart Grids** **Credit 3.00**

Introduction to Smart Grids : Concept and Benefits of Smart Grids; Cloud Computing Fundamentals : Basics of Cloud Computing Technologies; Smart Grid Architecture and Implementation : Architecture Overview, Practical Implementation of Cloud Computing in Smart Grids; Blockchain Technology for Energy Sharing and Secure Transactions : Use of Blockchain in Energy Sharing, Ensuring Secure Transactions in Smart Grids; Integration of Renewable Energy Sources : Role of Cloud Computing in Integrating Renewable Energy; Data Security and Privacy in Smart Grids : Security and Privacy Concerns, Cloud Computing Solutions for Security Challenges; Smart Grid of the Future : Future Developments and Advancements, Role of Cloud Computing in Future Smart Grids.

**EEE 6511 Advanced Internet of Things (IoT)** **Credit 3.00**

Introduction to IoT and Cyber Physical Systems (CPS): Definition, principles, and integration with CPS; IoT Devices: Infrastructure and Programming principles for IoT devices; Wireless Network Design and Optimization for IoT: Principles of designing and optimizing wireless networks for IoT; Fog Computing for IoT Devices : Understanding and implementing fog computing architectures; Edge-Cloud IoT Platforms:

Integration and optimization of edge-cloud architectures; AI and Machine Learning for IoT: Applications and integration of AI and deep/machine learning in IoT systems; Security and Privacy Preserving Mechanisms : Techniques for ensuring the security and privacy of IoT data; Recently Published Algorithms, Systems, and Applications in IoT : Survey of advancements in IoT research; Key Opportunities and Challenges in IoT Research : Exploration of opportunities and challenges in the evolving IoT landscape.

**EEE 6601 Antennas and Propagation Credit 3.00**

Antenna theory; application of Maxwell's equations to determine electromagnetic fields of antennas; radiation, directional arrays, impedance characteristics, aperture antennas; application of reaction concept and variational principles in antennas and propagation.

**EEE 6603 Microwave Devices and Circuits Credit 3.00**

Introduction to high frequency systems and circuits; fundamentals of microwave integrated circuits; microwave two-terminal and three-terminal solid-state devices; waveguide and microstrip solid-state circuits.

**EEE 6605 Semiconductor Lasers Credit 3.00**

III-V compound semiconductor materials, spontaneous and stimulated emission in lasers; optical wave guiding equation solutions, quantum noise and spectral linewidth properties of lasers; principle and structure of photodiodes; III-V compound material technology.

**EEE 6607 Computational Electromagnetics Credit 3.00**

Review of techniques and applications in computational electromagnetics. Finite-Difference Time-Domain solution of Maxwell's equations: boundary conditions, numerical stability, numerical dispersion, near-to-far field transformation. Introduction to Finite-

Elements Technique: basis and weighting functions, Galerkin's method, nodal and edge elements, variational formulation, applications. Introduction to the Method of Moments: integral formulation of electrostatics, Green's function, point matching and Galerkin's method, treatment of open regions.

**EEE 6701 Nonlinear Control System Credit 3.00**

Techniques available to analyze and synthesize nonlinear and discontinuous control systems. Modern stability theory, time-varying systems, DF, DIDF, Lyapunov theory, adaptive control, identification and design principles using these concepts; examples of electronic and electromechanical systems.

**EEE 6703 Modern Control Credit 3.00**

Vector norms; induced operator norms; Lp stability; the small grain theorem; performance/robustness trade-offs; L1 and Hoo optimal P control as operator norm minimization; $H_2$ optimal control.

**EEE 6705 Digital Control System Credit 3.00**

Introduction to digital control: Overview discrete-time systems, Modeling of digital control system; Sampling and reconstruction. Open-loop discrete-time systems, Closed-loop systems, Time response characteristics and Stability of digital control system.
Digital control system design: Different types of digital compensators design, Transfer function approach to controller design; Pole placement controllers: State space approach to controller design and state estimation.

**EEE 6801 Power Electronics Credit 3.00**

Principles and characteristics of power semiconductor devices; classification of static power converters and their applications, ac phase controller; pulse width modulation; switch mode DC to DC converters, resonant converters; Fourier analysis of static converter waveforms.

## 4.3.3 Contents of EEE Courses Offered to Other Departments

### 4.3.3.1 Under-Graduate Programmes

### EEE Courses Offered to MPE Department

**EEE 4281 Electrical Circuits and Machines Credit 3.00**

Ohm's and Kirchhoff's laws, Delta-Wye transformation. Network analysis, Thevenin's and Norton's theorems. Magnetic field rules and intensity, Biot-Savart law, energy of magnetic field. Theory of ferromagnetism, B.H. curves, hysteresis loss, eddy currents, total core loss. Forces upon a current-carrying conductor and charged particle moving in a magnetic field. Electric motor. Electromagnetic induction, Lenz's law, BLV rule, elementary A.C. generator. Instantaneous current and power, R, L, C, RL and RLC branches. Average values, different factors, real and reactive power. Use of vector algebra, impedance in polar and Cartesian forms. Impedance in series, parallel branches, series-parallel circuits. Sinusoidal single-phase circuit analysis. Balanced polyphase circuits: three-phase, four wire system of generated emfs, three-phase, three-wire systems, balanced wye loads, balanced delta loads, power in balanced systems, power factor.

**EEE 4282 Electrical Circuits and Machines Lab. Credit 0.75**

Experiments based on EEE 4281

**EEE 4381 Electronics and Digitization Techniques Credit 3.00**

Semiconductor, Diode, BJT, MOSFET, their structures, characteristics, equivalent and biasing circuits, and principle of operations. Operational Amplifier, Differential modes of operation, CMRR, inverting, non-inverting and summing amplifiers, integrator, differentiator, concept of active filters. Power Electronics: Silicon controlled rectifier, (SCR), half-

wave and full-wave rectifications, filtering, regulation with Zener diode and linear regulators, Switch-mode power supplies. Barkhausen criterion, sinusoidal and non-sinusoidal oscillators, applications, and typical circuits. Digital electronics, Boolean algebra and signed number representation schemes in binary, implementation of Boolean functions using various logic gates, concept of combinatorial and sequential circuits, registers and counters from functional viewpoint, concept of programmable processors and microcontrollers. Introduction to ADC and DAC.

### EEE 4382 Electronics and Digitization Techniques Lab. Credit 0.75

Experiments based on EEE 4381

## EEE Courses Offered to CSE Department

### EEE 4383 Electronic Devices and Circuits Credit 3.00

Semiconductors, Junction Diode and characteristics, Bipolar transistor characteristics, Small signal low frequency h parameter model, Hybrid pie model. Amplifiers, Darlington pairs, introduction to oscillators, differential amplifiers, operational amplifiers, linear application of Op-Amp, gain, input and output impedance, offset null adjustments, frequency response and noise.
Introduction to JFET, MOSFET, PMOS, NMOS and CMOS: biasing and application in switching circuits. SCR, TRIAC, DIAC, PJT, CRT: characteristics and applications. Introduction to rectifiers, active filters, regulated power supply, stabilizer and UPS.

### EEE 4384 Electronic Devices and Circuits Lab. Credit 0.75

Experiments based on EEE 4383.

**EEE 4483 Digital Electronics & Pulse Techniques** **Credit 3.00**

Diode logic gates, Transistor switches, Transistor gates, MOS gates, Logic Families: TTL, ECL, IIL and CMOS logic with operation details, Propagation delay, Product and noise immunity, Open collector and high impedance gates,

Electronic circuits for flip-flops, Counters and register, Memory systems, PLAs, A/D and D/A converters with applications, S/H circuits, LED, LCD and optically coupled oscillators, Non-linear applications of Op-Amps, Analog switches.

Linear wave shaping: Diode wave shaping techniques, Clipping and Clamping circuits, Comparator circuits, Switching circuits, Pulse transformers, Pulse transmission, Pulse generation, Monostable, bistable and astable Multivibrators, Schmitt trigger, Blocking oscillators and time-base circuit, Timing circuits, Simple voltage sweeps, Linear current sweeps.

**EEE 4484 Digital Electronics & Pulse Techniques Lab.** **Credit 0.75**

Experiments based on EEE 4483

## Other Courses Offered to CSE Department (Bachelor of Science in CSE)

**Phy 4241 Physics II** **Credit 3.00**

Electrical Units and Standards. Electrical Networks, circuit solutions series, series-parallel networks, loop and Nodal methods. Delta-wye Transformation, Circuit Theorems: Superposition theorem, Thevenin's and Norton's Theorem. Concept of Dual Networks.

Basic principle of generation of Alternating and Direct Current, Introduction to phasor algebra as applied to A.C. circuit analysis. Solution of A.C. circuits: Series, Parallel and Series-Parallel circuit, R.L.C circuits

series and parallel resonance. Applications of Networks theorems to A.C. circuits.

The magnetic intensity, flux/density, magnetic effects of Electric current, Magnetic circuit concepts, BH curves, characteristics of magnetic materials, magnetic force and its utilization, Hysteresis and eddy current losses, magnetic circuit with A.C. and D.C. excitation.

**Phy 4242 Physics II Lab** **Credit 0.75**

Experiments based on Phy 4241.

## Other Courses Offered to CSE Department (Bachelor of Science in SWE)

**Phy 4143 Physics II** **Credit 3.00**

Electrical Units and Standards. Electrical Networks, circuit solutions series, series-parallel networks, loop, and Nodal methods. Delta-wye Transformation, Circuit Theorems: Superposition theorem, Thevenin's and Norton's Theorem. Concept of Dual Networks.

Basic principle of generation of Alternating and Direct Current, Introduction to phasor algebra as applied to A.C. circuit analysis. Solution of A.C. circuits: Series, Parallel and Series-Parallel circuit, R.L.C circuits series and parallel resonance. Applications of Networks theorems to A.C. circuits.

The magnetic intensity, flux/density, magnetic effects of Electric current, Magnetic circuit concepts, BH curves, characteristics of magnetic materials, magnetic force and its utilization, Hysteresis and eddy current losses, magnetic circuit with A.C. and D.C. excitation.

**Phy 4144 Physics II Lab** **Credit 0.75**

Experiments based on Phy 4241.

## EEE Courses Offered to CEE Department

### EEE 4385 Electrical and Electronic Technology — Credit 3.00

Electrical Units and standards, Electrical networks and circuit solution techniques, Delta-wye- Transformation, Circuit Theorems. Basic principle of generation of Alternating and Direct Current. Introduction to Phasor Algebra as applied to AC circuit analysis. Solution of AC circuits: RLC circuits- series and parallel Resonances, AC power analysis.

Ampere's circuital law, B–H curve, solution of magnetic circuits, hysteresis and eddy current losses, an application of magnetic force, Introduction to magnetic circuits.

Three phase AC Circuits: Three phase EMF generation, delta and Y – connections, line and phase quantities, solution of three phase circuits, balanced supply voltage and balanced load, phasor diagram, measurement of power in three phase circuits.

DC Machines: Specification and Characteristics of DC generators and motors.

Transformers: Introduction to Transformer, Auto Transformer, CT & PT and their characteristics, Specification, and Ratings.

Induction Motor: Classification, Specification, Torque-speed and its characteristics.

Introduction to Synchronous Machines and fractional Horsepower motor.

Introduction to Electronic Switch devices, Rectifier, Amplifier, Oscillator and SMPS.

Introduction from Gate to Microcontroller and its applications.

Electric wiring for residential and commercial loads. Basic idea of Grounding and earthling of electric installation.

### EEE 4386 Electrical and Electronic Technology Lab. — Credit 0.75

Experiments based on EEE 4385.

## EEE Courses Offered to BTM Department

### EEE 4361 Electrical and Electronic Technology — Credit 3.00

Electrical Units and standards, Electrical networks and circuit solution techniques, Delta-wye- Transformation, Circuit Theorems. Basic principle of generation of Alternating and Direct Current. Introduction to Phasor Algebra as applied to AC circuit analysis. Solution of AC circuits: RLC circuits- series and parallel Resonances, AC power analysis.

Ampere's circuital law, B–H curve, solution of magnetic circuits, hysteresis and eddy current losses, an application of magnetic force, Introduction to magnetic circuits.

Three phase AC Circuits: Three phase EMF generation, delta and Y – connections, line and phase quantities, solution of three phase circuits, balanced supply voltage and balanced load, phasor diagram, measurement of power in three phase circuits.

DC Machines: Specification and Characteristics of DC generators and motors.

Transformers: Introduction to Transformer, Auto Transformer, CT & PT and their characteristics, Specification, and Ratings.

Induction Motor: Classification, Specification, Torque-speed and its characteristics.

Introduction to Synchronous Machines and fractional Horsepower motor.

Introduction to Electronic Switch devices, Rectifier, Amplifier, Oscillator and SMPS.

Introduction from Gate to Microcontroller and its applications.

Electric wiring for residential and commercial loads. Basic idea of Grounding and earthling of electric installation.

### EEE 4362 Electrical and Electronic Technology Lab. — Credit 0.75

Experiments based on EEE 4361.

## EEE Courses Offered to TVE Department

## Diploma in Technical Education (DTE)

### EEE 4395 Energy Conversion I Credit 3.00

Review of electromagnetic induction. Basic principle of a Generator and a motor. Concept of torque angle. Power flow diagram for an elementary generator and motor.

D.C. Machines: Main constructional features, Function of brush and commutator. Armature winding systems: lap and wave windings. Different types of excitations. Armature reaction and methods of neutralizing armature-reaction. Losses and efficiency of D.C. machines. Determination of efficiency by practical methods.

D.C. Motors: Torque equation, back e.m.f., factors determining speed, characteristic Curves. D.C. motor starters, speed control. Application of D.C. motors.

Transformers, basic principle, construction, cooling methods, use of conservator and breather. Turns-ratio, EMF equation. Phasor diagram and equivalent circuit of a transformer on no-load and on-load. Voltage regulation, losses, and efficiency. Transformer - tests. Auto-transformer and Instrument Transformers: (C.T. and P.T.), Parallel operation of transformers. Three-phase transformers. Gas Insulated Transformer (GIT), Cast Resin Transformer. Introduction to the design of single-phase transformer

### EEE 4396 Energy Conversion I Lab. Credit 0.75

Experiments based on EEE 4395.

### EEE 4391 Electrical Power Transmission and Distribution Credit 3.00

General system layout, Low voltage D.C. distribution system, A.C. distribution system, radial and ring systems, distributor aspects, sag calculations, poles and towers insulators, calculation of inductance and

capacitance. Current and voltage relations on a transmission line, short lines, Medium-length lines, Long lines; cables, manufacture, laying and jointing of cables, insulation resistance and capacitance. Protection of transmission and distribution systems. Types of bus systems and their layout, Flexible AC transmission system (FACTS). High Voltage DC transmission system. Introduction to Smart Grid.

**EEE 4392 Electrical Power Transmission and Distribution Lab. Credit 0.75**

Experiments based on EEE 4391.

**EEE 4397 Digital Electronics Credit 3.00**

Number system and Codes: General way of representing numbers, decimal, binary, octal and hexadecimal number systems and their representation, conversion of number from one system to another. Compliment in number system. Different Codes: BCD, Alphanumeric, Gray, Excess-3, ASCII and error detection codes.

Digital Logic: Boolean algebra, De-Morgan's Theorem logic gates and their truth tables. Canonical form of logic expression.

Simplification of logic expression: Algebraic method, K-Map and Quine-McClauskey method. Realization by using NAND/NOR gates.

Classification of logic systems: Combinational logic system. Combinational logic design using MSI and LSI. Adders, subtractors, Code Converters. Magnitude Comparator Encoder, Decoder, Multiplexer, De-multiplexer, ROM, RAM, Programmable logic Array (PLA), D/A and A/D converters with applications. Different types of digital storage media.

Implementation of basic static logic gates in CMOS and BiCMOS: DC characteristics, noise margin and power dissipation. Power optimization of basic gates and combinational logic circuits.

Sequential logic system: Flip-Flops, clocked RS, JK, Master Slave JK, D-type, T-type, Flip-Flops, Flip-Flop Design. Sequential logic Registers:

Different types of Registers and their applications. Counters and their simplified design.

**EEE 4398 Digital Electronics Lab. Credit 1.50**

Hardware and simulation-based Experiments using Hardware Description Language (HDL) based on EEE 4397.

**EEE 4497 Electronics I Credit 3.00**

Introduction to semiconductors: P-N junction as a circuit element: Intrinsic and extrinsic semiconductors, operational principle of p-n junction diode, contact potential, current-voltage characteristics of a diode, simplified large and small signal models, iteration and graphical analysis, dynamic resistance and capacitance. Diode circuits: Half wave and full wave rectifiers, rectifiers with filter capacitor, characteristics of a Zener diode, Zener shunt regulator, clamping and clipping circuits.

Bipolar Junction Transistor (BJT) as a circuit element: current components, BJT characteristics and regions of operation, BJT as an amplifier, biasing the BJT for discrete circuits, small signal equivalent circuit models, BJT as a switch. Single stage mid-band frequency BJT amplifier circuits: Voltage and current gain, input and output impedance of a common base, common emitter and common collector amplifier circuits.

Introduction to Junction Field-Effect-Transistor (JFET). Metal Oxide Semiconductor Field Effect Transistor (MOSFET) as circuit element: structure and physical operation of an enhancement MOSFET, threshold voltage, Body effect, current-voltage characteristics of an enhancement MOSFET, biasing discrete and integrated MOS amplifier circuits, single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter.

**EEE 4498 Electronics I Lab. Credit 1.50**

Hardware and software-based experiments on EEE 4497.

**EEE 4495 Energy Conversion II Credit 3.00**

Alternators: Basic Principle, construction, EMF equation, synchronous reactance, voltage regulation and parallel operation.

Synchronous motors: Basic principle, Starting methods, effect of excitation on armature current, V - curves.

Three-phase induction motor: Theory of rotating magnetic field. Construction of induction motor, rotor types. Speed and slip, starting torque, speed control, performance characteristic and equivalent circuit.

Single-phase induction motor: Basic principle, cross-field theory, double revolving field theory. Different methods of starting a single-phase induction motor. Amplidyne and other special motors.

**EEE 4496 Energy Conversion II Lab. Credit 0.75**

Experiments based on EEE 4495.

**EEE 4493 Measurement and Instrumentation Credit 3.00**

Philosophy of sensors, transducer, and instruments for signal to measure. Time measurement techniques : period, phase, time constant measurements.

Frequency measurement techniques : Frequency, ratio and product, high and low frequency measurements; Measurements and measurement systems, Errors in measurement and their statistical analysis, Dynamic characteristics of instruments, Sensing elements and transducers for measurement of motion, force, pressure, flow, temperature, light, vacuum, etc.

Different types of transducers and their principle of operations and interfacing; Electronic Timers; 555 & OP-AMP and its applications. Measurement of resistance, inductance, and capacitance-A.C and D.C bridge methods. Magnetic Measurements, Optoelectronic Measurement,

Cathode Ray Oscilloscope (CRO), Instruments for Generation and Analysis of Waveform, Signal Analyzers, High Frequency Measurements.

Electronic instrumentation: Instrumentation and isolation amplifiers. Analog switches, S/H circuits, Data converters, V/F, F/V, A/D, D/A conversion. Data acquisition system. Noise in Electronic systems, design of low noise circuits, Programmable instruments, and digital interfacing: serial, parallel. GPIB.

Industrial instrumentation: Introduction to Instrumentation systems. Static and dynamic characteristics of instruments. Non-destructive testing using Ultrasonic and eddy current.

Signal Conditioning and acquisition: Signal conditioning, signal transmission methods; Data loggers, PC based data acquisition systems, Interfacing and bus standards, programmable logic controllers and their industrial applications.

**EEE 4494 Measurement and Instrumentation Lab. Credit 0.75**

Experiments based on EEE 4493.

**EEE 4491 Power System I Credit 3.00**

Representation of power systems, single line diagrams, impedance and reactance diagrams, per-unit system of calculations. Reactance of synchronous generators and their equivalent circuits, Symmetrical fault calculations, limitation of short circuit current using reactors.

Symmetrical components, positive, negative and zero sequence network of generators, transformers and lines, Unsymmetrical fault calculations.

Power and reactive power flow calculations of simple systems, load flow studies of large systems, control of voltage, power, and reactive power.

**EEE 4492 Power System I Lab. Credit 0.75**

Experiments based on EEE 4491.

**EEE 4591 Power Electronics Credit 3.00**

Power semiconductor devices: structure and characteristics; snubber circuits, switching loss. Controlled rectifiers: full/half-controlled converters, dual converters, and sequence control. AC regulator circuits, reactive power compensators. DC-DC converters, switching dc power supplies. Inverters: square wave and PWM types, filters, inverters for induction heating and UPS.

**EEE 4592 Power Electronics Lab. Credit 1.50**

Experiments based on EEE 4591.

**EEE 4599 Renewable Energy System Credit 3.00**

Importance of renewable energy sources. Statistics regarding solar radiation and wind speed. Insulation; geographical distribution, atmospheric factors, measurements. Solar cell; principle of operation, spectral response, factors affecting conversion efficiency, I-V characteristics, maximum power output. PV modules and arrays: stationary and tracking. PV systems: stand alone, battery storage, inverter interfaces with grid. Wind turbine generators: Types, operational characteristics, cut-in and cut-out speed, control, grid interfacings, AC-DC-AC link.

**EEE 4595 Switchgear and Control Equipment I Credit 3.00**

Fundamentals of fault clearing, current interruption in A.C. circuit breakers, recovery voltage and prestriking voltage transients, switching of capacitor banks and unloaded lines, rated characteristics of circuit breakers arc extinction, arc interruption, arc extinction in different types of circuit breakers, arc-extinction devices, operating mechanism, control apparatus. Air break circuit breakers, bulk oil circuit breakers, minimum oil circuit breakers, Sulphur Hexafluoride (SF-6) circuit breakers, air blast circuit breakers, vacuum circuit breakers and their comparative study

Control panels, basic control circuit devices. Alternator switchgear and control panels, automatic voltage control equipment. Apparatus for automatic voltage control equipment. Apparatus for automatic synchronization control. Transformer tap changing control equipment. Automatic reclosing control of circuit breakers and oil circuit reclosers (OCRS). Gas Insulated Switchgear (GIS).

**EEE 4596 Switchgear and Control Equipment I Lab. Credit 0.75**

Experiments based on EEE 4595.

**EEE 4597 Telecommunication Principles Credit 3.00**

Introduction to communication systems: Fundamental elements, various signals and tones, different types of telephone instruments, different types of transmission media, bandwidth requirements, signal to noise ratio and rate of communication.

Information theory: Measure of information, error free communication over a noisy channel, channel capacity

Noise: External noise, internal noise, noise calculations and noise figure.

Modulation and demodulation: Baseband and carrier transmission. Amplitude modulation: SSB, DSB, VSB. Angle modulation: bandwidth of angle modulated wave, demodulation of AM and angle modulated waves.

Sampling and PCM: Sampling theorem, signal reconstruction, aliasing, quantization, PCM, DPCM, Companding.

Principles of digital data transmission: Simple digital communication system, line coding, pulse shaping, scrambling.

Multiplexing: FDM, FDM hierarchy. TDM, digital hierarchy (T1 carrier system)

Traffic analysis: Network traffic load and parameters, GOS, blocking parameters.

## EEE 4598 Telecommunication Principles Lab. Credit 0.75

Experiments based on EEE 4597.

## EEE 4593 Wireless Communication Credit 3.00

Electromagnetic wave concepts: EM wave types, plane wave, wave impedance, power flow, polarization.
Radio wave propagation: properties to support NLOS communication, advantages of low frequency communication, radio frequency spectrum regulation, ITU bands, ISM and UNII bands, ground wave, space wave and sky wave, path loss and shadowing, penetration, rain attenuation.
Introduction to Antenna radiation: basic antenna types, radiation pattern, gain, directivity, beamwidth, near and far field, antenna matching.
Diffraction: Knife-edge diffraction geometry, Fresnel zones.
Scattering: Rayleigh criterion, radar cross section model.
Propagation model: Free space model, two-ray model, log-distance path loss model, log-normal shadowing, Okumura-Hata model, Erceg model, COST 231-Walfish-Ikegami model, ITU model.
Indoor propagation model: attenuation factor model, partition losses.
Fading: large- and small-scale fading, multipath channel characteristics, power delay profile, channel sounding, delay spread, coherence bandwidth, Doppler spread, coherence time, flat and frequency selective fading, slow and fast fading.
Statistical channel models: Time-varying channel impulse response, Rayleigh and Rician fading, tapped delay line model, level crossing rate and average fade duration.
Space diversity and polarization diversity, interleaving, adaptive modulation, and coding, interference-limited vs. noise-limited scenarios, near-far problem, hidden and exposed node problem.
Spread spectrum: FHSS, DSSS, THSS. Chipping, spreading, and correlating
MIMO Systems: Narrowband multiple antenna system model, transmit precoding and receiver shaping, parallel decomposition of channel.

**EEE 4594 Wireless Communication Lab. Credit 0.75**

Experiments based on EEE 4593.

**EEE 4687 Power System I Credit 3.00**

Representation of power systems, single line diagrams, impedance, and reactance diagrams, per-unit system of calculations. Reactance of synchronous generators and their equivalent circuits, Symmetrical fault calculations, limitation of short circuit current using reactors.

Symmetrical components, positive, negative and zero sequence network of generators, transformers and lines, Unsymmetrical fault calculations.

Power and reactive power flow calculations of simple systems, load flow studies of large systems, control of voltage, power, and reactive power.

**EEE 4688 Power System I Lab. Credit 0.75**

Experiments based on EEE 4687.

**EEE 4691 Control System Engineering I Credit 3.00**

Basic concepts: Notion of feedback, open- and closed-loop systems. Modeling and representations of control systems: Ordinary differential equations, Transfer functions, Block diagrams, Signal flow graphs, Performance and stability: Time-domain analysis, Second-order systems, Characteristic-equation and roots, Routh-Hurwitz criteria, Frequency domain techniques: Root-locus methods, Frequency responses, Bode-plots, Gain-margin and phase-margin, Nyquist plots, M and N circles; Nichols chart. Compensator design: Proportional, PI and PID controllers, Lead-lag compensators. State-space concepts: introduction, representation, transformation.

**EEE 4692 Control System Engineering I Lab. Credit 0.75**

Hardware experiments & simulations based on EEE 4691.

## EEE 4693 Measurement and Instrumentation Credit 3.00

Philosophy of sensors, transducer, and instruments for signal to measure. Time measurement techniques : period, phase, time constant measurements.

Frequency measurement techniques : Frequency, ratio and product, high and low frequency measurements; Measurements and measurement systems, Errors in measurement and their statistical analysis, Dynamic characteristics of instruments, Sensing elements and transducers for measurement of motion, force, pressure, flow, temperature, light, vacuum, etc.

Different types of transducers and their principle of operations and interfacing; Electronic Timers; 555 & OP-AMP and its applications. Measurement of resistance, inductance, and capacitance-A.C and D.C bridge methods. Magnetic Measurements, Optoelectronic Measurement, Cathode Ray Oscilloscope (CRO), Instruments for Generation and Analysis of Waveform, Signal Analyzers, High Frequency Measurements.

Electronic instrumentation: Instrumentation and isolation amplifiers. Analog switches, S/H circuits, Data converters, V/F, F/V, A/D, D/A conversion. Data acquisition system. Noise in Electronic systems, design of low noise circuits, Programmable instruments, and digital interfacing: serial, parallel. GPIB.

Industrial instrumentation: Introduction to Instrumentation systems. Static and dynamic characteristics of instruments. Non-destructive testing using Ultrasonic and eddy current.

Signal Conditioning and acquisition: Signal conditioning, signal transmission methods; Data loggers, PC based data acquisition systems, Interfacing and bus standards, programmable logic controllers and their industrial applications.

## EEE 4694 Measurement and Instrumentation Credit 0.75 Lab.

Experiments based on EEE 4693.

**EEE 4695 Switchgear and Control Equipment II** **Credit 3.00**

Circuit breaker testing, type tests, routine tests, short circuit testing of circuit breakers, short circuit testing plants, insulation requirement and high voltage testing of circuit breakers, H.R.C. fuses and their applications, indoor switchgear, metal clad switchgear, low voltage control gear, contractors, low voltage circuit breakers, molded case circuit breakers, isolators and earthing switches. Schemes of electrical layout and bus bar designs in different types of stations and sub-stations. Control of power by reactance, automatic supervisory control equipment. Automatic Control Equipment for stand by supply.

**EEE 4696 Switchgear and Control Equipment II Lab.** **Credit 0.75**

Experiments based on EEE 4695.

**EEE 4699 Power System Operation and Control** **Credit 3.00**

Principles of power system operation: SCADA, convention and competitive environment. Unit commitment, static security analysis. State estimation, optimal power flow, automatic generation control and dynamic security analysis.

**EEE 4697 Signals and Systems** **Credit 3.00**

Signals and Systems: Classifications of signals and systems. Basic operations on signals. Commonly encountered elementary signals. Continuous-time (CT) and discrete-time (DT) systems. Basic system properties.

Linear Time-Invariant (LTI) Systems: The CTLTI systems –impulse response, zero input response and zero state response and convolution integral. The DTLTI systems –representation of DT signals in terms of impulses, impulse response, and convolution sum.

Fourier Series Representation of Periodic Signals: CT and DT periodic signals, properties of continuous and discrete-time Fourier series, Fourier series and LTI systems.

Continuous-Time Fourier Transform: Properties, convolution, and multiplication properties. Application of Fourier transform to LTI system analysis. Sampling and aliasing.

Laplace Transform: Region of convergence, inverse Laplace transform, properties, analysis of LTI systems using Laplace transform.

**EEE 4698 Signals and Systems Lab. Credit 0.75**

Experiments based on EEE 4697.

**EEE 4700 Project & Thesis Credit 3.00**

The students are required to undertake a project in the related field of Electrical and Electronic Engineering. The results of the work should be submitted in the form of a report.

**EEE 4791 Microwave Engineering Credit 3.00**

Transmission Lines: Voltage and current in ideal lines, Reflection, transmission, standing wave, impedance transformation, Smith chart, impedance matching, quarter-wave matching, single and double stub matching; Scattering parameters (S-parameters), Waveguides: General formulation for guided waves, parallel plate waveguides, rectangular waveguides, circular waveguides, different modes of propagation, power flow and losses in waveguides; Microstrip and Stripline: their structures and their characteristics impedances. Resonant Cavities: Simple rectangular resonant cavities, energy storage, losses and Q of the resonators, modes in rectangular resonators. Microwave Devices: Directional coupler, attenuator, phase shifter, circulator, isolator, etc. Microwave amplifiers and oscillators: Gain and stability, Stability circles, Single-stage transistor amplifier design, Design for maximum gain and specified gain, Low-Noise Amplifier (LNA) design.

**EEE 4792 Microwave Engineering Lab. Credit 0.75**

Experiments based on EEE 4791.

**EEE 4793 Advanced Electronics I Credit 3.00**

Excess carriers in semiconductors, carrier lifetime, diffusion of carriers. Optical process in semiconductors: Radiative and non-radiative recombination, optical absorption, luminescence. Light Emitting Diodes: Visible and infrared LED, principle, material, construction. Photodetectors: photoconductor, junction photodiode, p-I-n photodiode, avalanche photodiode, phototransistor: Solar cell; Silicon solar cell, thin film solar cell, heterostructural solar cell, IC fabrication technology: Monolithic and hybrid circuits, device elements, charge transfer devices, LSI, VLSI, and ULSI techniques.

**EEE 4794 Advanced Electronics I Lab. Credit 0.75**

Experiments based on EEE 4793.

**EEE 4795 Microcontroller Based System Design Credit 3.00**

Introduction to the general structure of microcontrollers. Discussions on architectures, instruction sets, memory hierarchies, pipelining, and RISC principles. Specific details of Intel8051/Atmega32/PIC18. Interfacing Peripherals: Keyboard, display, ADC, Programmable parallel port 8255, External memory, Motors, RTC etc.

**EEE 4796 Microcontroller Based System Design Lab. Credit 0.75**

Experiments based on EEE 4795.

**EEE 4800 Project &Thesis Credit 3.00**

The students are required to undertake a project in the related field of Electrical and Electronic Engineering. The results of the work should be submitted in the form of a report.

### EEE 4895 Power Generation Credit 3.00

Basis: power force, energy, work, electricity, units; energy system, power system; energy conversions.
Energy Sources: types, forms, natural, man-made, global energy and electricity use trend, source conservation.
Power Loads: types, demand factor, diversity factor, load curves, ideal load curve, peak load, base load, load factor, capacity factor, utilization factor, and load forecasting etc.
Electricity Generation: steam turbine, gas turbine, combined cycle, diesel, hydro and nuclear power plants; solar and wind bulk electricity.
Issues: environmental pollution, climate change, safety and legal requirements.
Plant Performance: efficiency, performance curves, heat rate, incremental heat rate, plant component performance, plant scheduling, captive generation, industrial cogeneration.
Plant economics and management criteria, electricity tariff, site selection etc.
Interconnected Power System: types, key issues, capacity savings, and power sharing among generating units.

### EEE 4899 Power System II Credit 3.00

The stability problem of power system. Distinction between steady state and transient stability. The swing equation and its solution. Solution of networks for stability studies. Transient stability limits criteria. Two machine and multi-machine problems. Stability under different types of faults. Typical stability studies and methods of improving stability. The influence of swinging and out-of step operation upon protective relays. Rapid reclosing for improving stability.

### EEE 4893 Advanced Electronics II Credit 3.00

Metal-semiconductor junctions: Schottky and ohmic contacts. Semiconductor heterojunctions: structure, band alignment. Negative conductance microwave devices: Transit time devices, Gunn effect and related devices. Spontaneous and stimulated emission, Einstein relationship, threshold conditions, pumping methods. Semiconductor Laser: population inversion, confinement, turn-on delay, emission power, materials Biomedical electronics: active and rest potentials, electrocardiograph (ECG), pacemaker.

**EEE 4894 Advanced Electronics II Lab. Credit 0.75**

Experiments based on EEE 4893.

## 4.3.3.2 Post-Graduate Programmes

## EEE courses offered to TVE Department

## Master of Science in Technical Education (M.Sc.TE)

### EEE 6191 Analysis and Synthesis of Circuits Credit 3.00

Introductory network concepts. Definitions and symbols. Sign convention. Terminals and ports. Network functions. Complex frequency, driving point and transfer functions. Representation by poles and zeros. Properties of network function. Properties of Immittance function; Positive real function. Hurwitz Polynomials, Natural frequencies of network; Parts of a network function. (Magnitude and phase plots, Bode and Nyquist diagrams). Minimum phase transfer function. Calculation of a network function from prescribed real part. Imaginary part. Magnitude or phases. Synthesis of two element; Kind-one port LC, RC and RL one port network.

Two port networks. Classification and characterization of two ports. Two port parameters and natural frequencies. Interconnections of two ports. Common two port configuration. Scattering parameters. One end parameters; Iterative and Image Parameters. Filters; Type of filters. Frequency and impedance scaling. Image parameter. Filters; Design frequency transformation. Butterworth and Schebychev response. Insertion loss. Methods of net-work analysis. Block diagrams. Signals flow graphs, State variable techniques. Lattice networks. Bartletts bisection theorem. Synthesis of Lattice network. Unbalancing of Lattice networks transmission characteristic. Signal distortions. Relationship between bandwidth and rise time, and between delay time and net-functions.

### EEE 6193 Electric and Magnetic Properties of Materials Credit 3.00

Atoms and aggregates of atoms; Crystals, waves in crystals; Schro-dinger wave equation, Quantum statics; Conductivity theory; Collision theory and conductivity of metals; Conductors; Carrier transport theory, P.N. Junction photocells; Solar cells; Tunneling principles, Dielectric; polar

and non-polar dielectrics; Langevin function, Clausius- Mossotti Equation, Ferro-electricity.

Magnetic properties of materials; Magnetic moment; Domain wall motion and coercive force in crystals; Polycrystalline and permanent magnetic materials; Magnetic resonance; Testing of magnetic materials; Super conductivity. Quantum electronics.

### EEE 6195 Modern Control Theory Credit 3.00

General Introduction; State space concept: System design by State – Transition method concept of controllability and observability. Optimal control- variational calculus method; Principle of maximum and dynamic programming. Stochastic and adaptive control processor, Online computer control.

Vector norms; induced operator norms; Lp stability; the small grain theorem; performance/robustness trade-offs; L1 and Hoo optimal P control as operator norm minimization; H2 optimal control.

### EEE 6197 Applied EM Theory Credit 3.00

Generalized approached to field theory: Introduction to reaction concept; Wave propagation through isotropic, anisotropic and gyrotropic media. Scattering of EM waves.

Antenna theory; application of Maxwell's equations to determine electromagnetic fields of antennas; radiation, directional arrays, impedance characteristics, aperture antennas; application of reaction concept and variational principles in antennas and propagation.Advance topics in EM Theory.

### EEE 6199 Solid State Devices Credit 3.00

Solid State Diodes and Triodes: Visible and infrared LED, principle, material, construction. Photodetectors: photoconductor, junction photodiode, p-I-n photodiode, avalanche photodiode; Solid state microwave devices, Integrated electronic circuits: MOS transistor characteristics, NMOS and CMOS inverters.

### EEE 6291 High Voltage Engineering Credit 3.00

High voltage supplies: A.C.: Cascaded Transformers. Tesla Coils; D.C: Valve Rectifier Circuit, Cascaded Rectifiers. Electrostatic Generators:

Van-de-Graaff generators. Corona; Power loss calculations. Breakdown of solid, liquid and gaseous dielectrics. Insulation tests. Standard specification.

Impulse generators. Impulse wave shapes. Mathematical analysis and design consideration of impulse generators. Triggering of Impulse generators; Measurement of high voltages. Transmission Line design based on direct strokes, Insulation Coordination. Lightning arresters and protector tubes.

### EEE 6293 Power System Stability Credit 3.00

The stability problem of power system. Distinction between steady state and transient stability. The Swing equation and its solution. Solution of networks for stability studies. Transient stability limits criteria. Two machine and multimachine problems. Stability under different types of faults. Typical stability studies and methods of improving stability. The influence of swinging and out-of step operation upon protective relays. Rapid reclosing for improving stability.

### EEE 6297 Microwave Engineering Credit 3.00

H.F. Transmission lines; Smith chart: Impedance matching and applications. E.M. Wave propagation. Reflection and refraction. Wave guides: Parallel plane, rectangular, coaxial wave guides.

Transit time effects; Velocity modulation; Space charge wave; Microwave tubes; Klystron, Magnetron, Travelling Wave Tube Amplifier. Wave guide components. Cavity resonators. Antennas and radiation. Hertzian dipole. Long antenna analysis Radiation patterns, Rhombic and slot antenna. Antenna arrays. Introduction to antenna array design.

**EEE 6299 Microwave Theory and Techniques Credit 3.00**

Microwave oscillators and amplifiers: Principles of generation of millimeter and sub-millimeter waves; Detailed analysis of Klystrons, Magnetrons and TWT amplifiers and Backward Wave Oscillators (BWO). Harmonic generators, Gunn-effect devices. Microwave Circuits: Microwave network analysis and synthesis. Matrix representation and scattering matrix. Analysis of waveguide discontinuation obstacles, junctions and cavities and strip lines. Methods of microwave precision measurements.

**EEE 4692 Advanced Electronics Credit 3.00**

Designing Linear and nonlinear electronic circuits with operational amplifiers, Survey of available op-amps, Amplifications and limitations. Applications in Communication and instrumentation. Application of digital IC's in Communication circuits. Survey of logic families (TTL, ECL, CMOS, etc.) and their suitability for different applications. Design of Active filters, digital filters.

**EEE 6391 Engineering Analysis Credit 3.00**

Professional methods of dealing with problems in Electrical and Electronic Engineering. Mathematical and Physical principles applied to problems of diverse topics. Linear spaces, N-dimensional and infinite dimensional vector spaces. Spectral Theory of Linear operators and their applications, Green's function and function concept and solution of engineering problems, variational methods. Simulation and optimization techniques. Statistical methods with application in electrical and electronic engineering.

**EEE 6393 Energy Conversion Credit 3.00**

Energy Conversion Processes: General introduction, energy sources, renewal and non-renewal energy sources, principle of conservation of energy, energy balance equations; Total energy concept. Direct Electrical Energy Conversion: Introduction; Magneto-hydrodynamic (MHD); Fuel

Cell; Thermo-electric, Ferro-electric electrostatic and Piezoelectric energy conversions; characteristics including efficiency, power densities, terminal properties and limitations.

Solar energy, Bulk power generation; Photo – electric and photo – voltaic, Solar Cell, Construction, characteristics including efficiency, applications and limitations. Electromechanical energy conversion: General introduction of Electrical to Mechanical, Mechanical to Electrical, Electrical and Electrical convention; Bulk energy conversion devices; General formulations of equations; Coordinate transformation and terminal characteristics.

### EEE 6395 Advanced Machine Design Credit 3.00

General Treatment of Electrical Machine Design. Review of standard procedures in design of D.C. Machines, A.C. Machines, transformers and special machines, Optimization and synthesis of design procedures. Application of material balance and critical path principles in electrical design. Design economics and safety factors. Applications of computers in modern designs including the operation of the machine in non-linear ranges; Magnetic flux-plots and heat transfer process, etc. Mechanical Design of Electrical Machinery and relation between Mechanical and Electric Machine Design.

### EEE 6397 Statistical Theory of Communication Credit 3.00

Periodic and random signals. Stationary random processes.

Elements of probability theory. Statistical Characteristics of messages and noise, Autocorrelation: Cross-correlation and spectral analysis. Determination of correlation functions and separation of signals from noise.

Application of correlation techniques. Optimum filter, prodictor, etc. Synthesis of optimum linear systems.

**EEE 6399 Telephone Traffic Theory Credit 3.00**

Introduction, Electronic switching: Basic switching system, Evolution of modern switching systems. Stored program control (SPC), centralized SPC and distributed SPC. Basic time division switching, time slot inter change, time multiplexed time switch.
Types of switching systems; Nature of telecommunication traffic; Full availability; Limited availability and link system; Lost call cleared theory; Lost call held theory; Non-blocking networks; Characteristics of telecommunication network planning; Traffic measurement, Traffic prediction; Traffic simulation.

**EEE 6491 Generalized Machine Theory Credit 3.00**

Introduction to generalized machine theory. Kron's Primitive machine; Moving to fixed-axis transformation; Parke's transformation; Three-phase to d-q transformation; Variable co-efficient transformation, other transformation; Matrix and tensor analysis of machine, Three-phase synchronous and induction machine; Two-phase servo motors; Single-phase induction motor. Smooth-motor two phase double excited machine; Smooth-air gap two-phase synchronous machine. Two-phase induction machine. The n-m winding symmetrical machine; diagonalisation by a change of variable; Symmetrical three phase machine and special limiting cases.

**EEE 6493 Optimization of Power System Operation Credit 3.00**

General principles of optimization, its application to power system planning, design and operation. Probability analysis for bulk power security and outage data. Economic operation of power system-economic operation of thermal plants, combined thermal and hydro-electric plants. Theory of economic operation of inter connected areas. Development and application of transmission loss formulae for economic operation of power systems. Methods of optimum scheduling and dispatch of generation.

**EEE 6495 Computer Aided Power System Design** **Credit 3.00**

General review of network and matrix theories. Algorithms for formation of network matrices. Three- phase networks flux-linkage calculations, line parameter calculations, short-circuit calculations, load flow studies, system stability studies, prediction of reliability, over voltages and relay coordination.

**EEE 6497 Transients in Power Systems** **Credit 3.00**

Transients in simple electric and magnetically linked circuits; Fundamentals. Impacts of Switching on rotating machinery. Parallel operation of interconnected networks.
Distribution of Power impacts. Interaction of Governor's in power systems. Overvoltage during power system faults. Systems voltage recovery characteristic. Effect of arc restriking on recovery voltage. Switching surges and overvoltage arrester requirements. Over voltages caused by sudden loss of load and by open conductor.

**EEE 6499 Laser Theory and Optical Communication** **Credit 3.00**

Quantum Electronics applied to electronic energy level transitions. Classical radiation and absorption by electronics. Narrow band spectra of solids; III-V compound material technology. Spontaneous and stimulated emission in lasers; optical wave guiding equation solutions, quantum noise and spectral linewidth properties of lasers; Principles of Gaseous and solid-state Laser devices. Laser rate equations. Principle and structure of photodiodes, Theory of Fiber optics. Fiber types and characteristics. Light sources: light emitting diode and laser diode. Detectors: PIN and avalanche photodetectors. Receiver analysis: direct detection and coherent detection, noises and limitations. Transmission limitations: chromatic dispersion, nonlinear refraction, scattering, four wave mixing, laser phase noises. Optical amplifier: laser and fiber amplifiers. Multichannel optical system: frequency division and wavelength division multiplexed systems.

## Compulsory, Non-Credit

**EEE 6190 Special Studies** **Credit N/A**

The students are required to undertake a major project in the field of electrical and electronic engineering in their respective specialization. The objective is to provide an opportunity to the students to develop initiative, creative ability, confidence and engineering judgement. The results of the work should be submitted in the form of a report which should include approximate drawings, charts, tables, references etc.

**EEE 6290 Special Studies** **Credit N/A**

The students are required to undertake a major project in the field of electrical and electronic engineering in their respective specialization. The objective is to provide an opportunity to the students to develop initiative, creative ability, confidence and engineering judgement. The results of the work should be submitted in the form of a report which should include approximate drawings, charts, tables, references etc.