K.R. MANGALAM UNIVERSITY
THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING & TECHNOLOGY

Bachelor of Technology- Electrical and Electronics Engineering

B. Tech (EEE)

Programme Code: 03

2018-22

Approved in the 17th Meeting of Academic Council Held on 29 June 2018

Member Secretary
Academic Council
K.R. Mangalam University

Registrar
K.R. Mangalam University
Sohna Road, Gurugram, (Haryana)

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About K.R Mangalam University

The K.R. Mangalam Group has made a name for itself in the field of education. The K.R. Mangalam story goes back to the chain of schools that offered an alternative option of world-class education, pitching itself against the established elite schools, which had enjoyed a position of monopoly till then. Having blazed a new trail in school education, the focus of the group was aimed at higher education.

K.R. Mangalam University is the fastest-growing higher education institute in Gurugram, India. K. R. Mangalam University was established under the Haryana Private University Act 2006, received the approval of Haryana Legislature vide Amendment Act # 36 of 2013 and consent of the Hon'ble Governor of Haryana on 11th April 2013, which was published in the Gazette notification vide Leg. No.10/2013, dated 3rd May 2013.

Since its inception in 2013, the University has been striving to fulfil its prime objective of transforming young lives through ground-breaking pedagogy, global collaborations, and world-class infrastructure. Resources at K.R Mangalam University have been continuously upgraded to optimize opportunities for the students. Our students are groomed in a truly interdisciplinary environment where they grow up with integrative skills through interaction with students from engineering, social sciences, management and other study streams.

K.R Mangalam University is unique because of its:

1. Enduring legacy of providing education to high achievers who demonstrate leadership in diverse fields.
2. Protective and nurturing environment for teaching, research, creativity, scholarship, social and economic justice.

Objectives

i. To impart undergraduate, post graduate and doctoral education in identified areas of higher education.
ii. To undertake research programmes with industrial interface.
iii. To integrate its growth with the global needs and expectations of the major stake holders through teaching, research, exchange & collaborative programmes with foreign, Indian Universities/Institutions and MNCs.
iv. To act as a nodal center for transfer of technology to the industry.
v. To provide job oriented professional education to the Indian student community with particular focus on Haryana.

About School of Engineering & Technology (SOET)

School of Engineering and Technology (SOET), K.R. Mangalam University is dedicated to fostering innovation, excellence, and advancement in engineering and technology. Empowering the new generation of change-makers by imparting exceptional understanding and intellect to facilitate the creation of highly sophisticated futuristic solutions. Our well-qualified academicians, accomplished researchers and industry insiders are focused on imparting their extensive knowledge and expertise to students through various lectures, workshops, industrial visits, projects, and competitions throughout the year ensuring that students

receive a comprehensive education that blends theory with practical application.

These programs offered at SOET have the distinct objective of equipping the students with knowledge, skills and attitudes in engineering and technology, to make them capable of successfully meeting the present requirements and future challenges in the engineering profession. SOET brings together outstanding academics, industry professionals, and experienced researchers to deliver a unique hands-on and multi-disciplinary learning experience.
The curriculum of programmes has been designed to cater to the ever changing needs and demands of the industry. The curriculum is regularly updated. The school has best infrastructure including domain-specific labs. SOET aims to provide exposure to the principles and practices of Design / Developments and Projects in the area of engineering. SOET is offering Ph.D. programs also.

School Vision

To create, disseminate, and apply knowledge in science and technology to meet the higher education needs of India and the global society, To serve as an institutional model of excellence in scientific and technical education characterized by integration of teaching, research and innovation.

School Mission

M1: To create an environment where teaching and learning are prioritized, with all support activities being held accountable for their success.

M2: To strengthen the institution's position as the school of choice for students across the State & Nation.

M3: To promote creative, immersive, and lifelong learning skills while addressing societal concerns.

M4: To promote co- and extra-curricular activities for overall personality development of the students.

M5: To promote and undertake all-inclusive research and development activities.

M6: To instill in learners an entrepreneurial mindset and principles.

M7: Enhance industrial, institutional, national, and international partnerships for symbiotic relationships.

M8: To help students acquire and develop knowledge, skills and leadership qualities of the 21st Century and beyond.

Programs offered by the School

B.Tech in Electrical and Electronics Engineering (EEE)

This program enables students to understand the systems of Electrical Machines, Power, Power Electronics & Drives, Microprocessors & Microcontrollers, Digital & Analog Electronics and related areas, etc.

Program Duration: - 4 Years (8 Semesters)

Eligibility Criteria: - The student should have passed the 10+2 examination conducted by the Central Board of Secondary Education or equivalent examination from a recognized Board in Science with mathematics as one of the subjects and with an overall aggregate of 50% or more.

Career Options

B.Tech in Electrical and Electronics Engineering (EEE) opens up a wide range of career opportunities in various industries such as Power Generation and Distribution, Renewable Energy, Electronics and Telecommunication, Automation and Control Systems etc.

Class Timings

The classes will be held from Monday to Friday from 9.10 am to 4.10 pm.

Scheme of Studies and Syllabi

The syllabus of B.Tech in Electrical and Electronics Engineering (EEE) program offered by the school is given in the following pages.

It is arranged semester wise from 1st to 8th semesters. For each course, the first line contains; Course Code, Title and Credits (C) of the course. It is followed by detailed syllabi.

Four Year B. Tech (EEE) Programme at a Glance

Semester	1	2	3	4	5	6	7	8	Total
Courses	9	10	10	9	12	11	8	4	**73**
Credits	26	26	27	26	27	27	20	17	**196**

Scheme of Studies

SEMESTER I							
SNo		**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	SE	ETMA105	APPLIED MATHEMATICS-I	3	1	0	4
2	SE	ETPH109	ENGINEERING PHYSICS	3	1	0	4
3	SE	ETCH125	ENVIRONMENTAL STUDIES	3	0	0	3
4	SE	ETCS103	PROGRAMMING FOR PROBLEM SOLVING	3	1	0	4
5	SE	ETME101	BASICS OF MECHANICAL ENGINEERING	3	1	0	4
6	OE		OPEN ELECTIVE-I				4
7	SE	ETPH151	ENGINEERING PHYSICS LAB	0	0	2	1
8	SE	ETCS153	PROGRAMMING FOR PROBLEM SOLVING LAB	0	0	2	1

9	SE	ETME151	BASICS OF MECHANICAL ENGINEERING LAB	0	0	2	1
TOTAL				**15**	**4**	**6**	**26**

SEMESTER II							
SNo		**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	SE	ETMA104	APPLIED MATHEMATICS-II	3	1	0	4
2	SE	ETEC101	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	3	1	0	4
3	SE	ETCS112	OBJECT ORIENTED PROGRAMMING	3	1	0	4
4	SE	ETEL101	COMMUNICATION SKILLS	4	0	0	4
5	OE		OPEN ELECTIVE - II				4
6	SE	ETME155	ENGINEERING GRAPHICS LAB	0	0	3	1.5
7	SE	ETEC151	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB	0	0	2	1
8	SE	ETCS166	OBJECT ORIENTED PROGRAMMING LAB	0	0	2	1
9	SE	ETEL171	COMMUNICATION SKILLS LAB	0	0	2	1
10	SE	ETME157	WORKSHOP PRACTICE	0	0	3	1.5
TOTAL				**13**	**3**	**12**	**26**

SEMESTER III							
SNo		**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	SE	ETMA201	APPLIED MATHEMATICS-III	3	1	0	4
2	SE	ETDM301	DISASTER MANAGEMENT	3	0	0	3
3	CC	ETEC233	ANALOG ELECTRONICS	3	1	0	4
4	CC	ETEC207	CIRCUITS & SYSTEMS	3	1	0	4
5	CC	ETEC210	DIGITAL ELECTRONICS	3	1	0	4
6	CC	ETEE201	ELECTROMECHANICAL ENERGY CONVERSION	3	1	0	4
7	SE	ETEC263	ANALOG ELECTRONICS LAB	0	0	2	1
8	SE	ETEC253	CIRCUITS & SYSTEMS LAB	0	0	2	1
9	SE	ETEC256	DIGITAL ELECTRONICS LAB	0	0	2	1
10	SE	ETEE251	ELECTROMECHANICAL ENERGY CONVERSION LAB	0	0	2	1
TOTAL				**18**	**5**	**8**	**27**

SEMESTER IV							
SNo		**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	CC	ETEC202	SIGNALS & SYSTEMS	3	1	0	4
2	CC	ETEC216	ADVANCE ANALOG ELECTRONICS	3	1	0	4
3	CC	ETEE315	POWER SYSTEM-I	3	1	0	4
4	CC	ETEE206	ELECTRICAL MACHINES	3	1	0	4
5	CC	ETEC204	ELECTROMAGNETIC FIELDS THEORY	3	1	0	4
6	SE	ETMC226	FUNDAMENTALS OF MANAGEMENT	3	0	0	3
7	SE	ETEC264	ADVANCE ANALOG ELECTRONICS LAB	0	0	2	1
8	SE	ETEE256	ELECTRICAL MACHINES LAB	0	0	2	1
9	SE	ETEC252	MATLAB PROJECT LAB	0	0	2	1
TOTAL				**18**	**5**	**6**	**26**

SEMESTER V							
SNo		**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	CC	ETEC311	MICROPROCESSOR SYSTEMS	3	1	0	4
2	CC	ETEC308	CONTROL SYSTEM	3	1	0	4
3	CC	ETEC305	MEASUREMENT & INSTRUMENTATION	3	0	0	3
4	CC	ETEE304	INDUSTRIAL ELELCTRICAL SYSTEMS	3	0	0	3
5	CC	ETEC303	ANALOG & DIGITAL COMMUNICATION	3	1	0	4
6	CC	ETEE312	POWER SYSTEM-II	3	1	0	4
7	SE	ETEC359	ANALOG & DIGITAL COMMUNICATION LAB	0	0	2	1
8	SE	ETEC353	MICROPROCESSOR SYSTEMS LAB	0	0	2	1
9	SE	ETEC355	MEASUREMENT & INSTRUMENTATION LAB	0	0	2	1
10	SE	ETEC358	CONTROL SYSTEM LAB	0	0	2	1
11	SE	ETEE351	PRACTICAL TRAINING-I	0	0	2	1
TOTAL				**20**	**4**	**10**	**27**

SEMESTER VI							
SNo		**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	SE	ETMC421	ENTREPRENEURSHIP DEVELOPMENT	3	0	0	3
2	CC	ETEC314	DIGITAL SIGNAL PROCESSING	3	1	0	4
3	CC	ETEE403	SWITCHGEAR AND PROTECTION	3	1	0	4
4	CC	ETEE316	POWER ELECTRONICS	3	1	0	4
5	CC	ETEC312	IoT ARCHITECTURE AND PROTOCOLS	3	0	0	3
6	CC	ETEC401	EMBEDDED SYSTEMS	3	1	0	4
7	SE	ETEC360	DIGITAL SIGNAL PROCESSING LAB	0	0	2	1
8	SE	ETEC451	EMBEDDED SYSTEMS LAB	0	0	2	1
9	SE	ETEE364	POWER ELECTRONICS LAB	0	0	2	1
10	SE	ETEC356	ELECTRONICS PROJECT DESIGN LAB	0	0	2	1
11	SE	ETEE362	POWER SYSTEM LAB	0	0	2	1
TOTAL				**18**	**4**	**10**	**27**

SEMESTER VII							
SNo		**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	CC	ETEE401	RENEWABLE ENERGY SYSTEM	3	1	0	4
2	CC	ETEC405	ARTIFICIAL INTELLIGENCE	3	1	0	4
3	DE		DEPARTMENTAL ELECTIVE	3	0	0	3
	CC	ETEE404	ELECTRIC DRIVES	3	1	0	4
4	SE	ETEE452	POWER SYSTEMS SIMULATION LAB	0	0	2	1
5	SE	ETEE457	MINOR PROJECT	0	0	4	2
6	SE	ETEE463	PRACTICAL TRAINING-II	0	0	2	1
7	SE	ETEC455	ARTIFICIAL INTELLIGENCE LAB	0	0	2	1
TOTAL				**12**	**3**	**10**	**20**

SEMESTER VIII							
SNo		**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1	CC	ETEE422	SMART ELECTRIC GRID	3	1	0	4
2	CC	ETEE425	ELECTRIC & HYBRID VEHICLES	3	1	0	4

3	DE		DEPARTMENTAL ELECTIVE	3	0	0	3
4	SE	ETEE460	MAJOR PROJECT	0	0	12	6
TOTAL				**9**	**2**	**12**	**17**

DEPARTMENTAL ELECTIVE							
SNo		**COURSE CODE**	**COURSE TITLE**	**L**	**T**	**P**	**C**
1		ETEC412	BIO MEDICAL ELECTRONICS	3	0	0	3
2		ETEC402	ROBOTICS	3	0	0	3
3		ETEC410	SATELLITE COMMUNICATION	3	0	0	3
4		ETEC413	RADAR & SONAR ENGINEERING	3	0	0	3
5		ETEC414	INTRODUCTION TO NANO TECHNOLOGY	3	0	0	3
6		ETEC425	DATA COMMUNICATION NETWORKS	3	0	0	3
7		ETEC430	FUZZY LOGIC AND SYSTEMS	3	0	0	3
8		ETEE407	HVDC AND FLEXIBLE AC TRANSMISSION SYSTEMS	3	0	0	3
9		ETEE408	ELECTRIC TRACTION	3	0	0	3
10		ETEE410	SWITCHED MODE POWER CONVERTERS	3	0	0	3
11		ETEE413	DESIGN OF ELECTRICAL SYSTEMS	3	0	0	3
12		ETEE414	HIGH VOLTAGE ENEGINEERING	3	0	0	3
13		ETEE415	COMPUTER METHODS IN POWER SYSTEM	3	0	0	3
14		ETEE418	POWER QUALITY	3	0	0	3
15		ETEE421	POWER SYSTEM OPERATION AND CONTROL	3	0	0	3
16		ETEE423	PLC AND SCADA	3	0	0	3

Abbreviations
CC: Core Course
SE: Specialization Elective
OE: Open Elective

EMESTER I

		L	**T**	**P**	**C**

ETCS103	PROGRAMMING FOR PROBLEM SOLVING	3	1	0	4

UNIT I

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm:

Flowchart / Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code- Arithmetic expressions and precedence

UNIT II

Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops. Arrays: Arrays (1-D, 2-D), Character arrays and Strings

UNIT III

Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Function: Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference.

Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function, Quick sort or Merge sort.

UNIT IV

Structure**:** Structures, Defining structures and Array of Structures

Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Suggested Text Books

1. Byron Gottfried, Schaum‘s Outline of Programming with C, McGraw-Hill

2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

ETCH 125	ENVIRONMENTAL STUDIES	L	T	P	C
		3	0	0	3

Course Overview:

Everything that surrounds and affects living organisms is environment. Environment includes all those things on which we are directly or indirectly dependent for our survival, whether it is living or biotic components like animals, plants or non-living or abiotic components like soil, air and water etc. It belongs to all, influences all and is important to all.

Environmental Protection Act (1986) defined ―Environment as the sum total of water, air and land, their interrelationship among themselves and with the human beings, other living organisms and materials.‖ Environmental studies are important since it deals with the most mundane problems of life like hygienic living conditions, safe and clean drinking water, fresh air, healthy food and sustainable development.

The syllabus for Environmental Studies includes conventional classroom teaching as well as field work. In this course the teacher simply acts as a catalyst to infer what the student observes or discovers in his/her own environment. Involvement of students in project work is one of the most effective learning tools for environmental issues. This syllabus is beyond the scope of textbook teaching and also the realm of real learning by observing the surroundings. The content of this course provides an overview of introduction to environment, concept of an ecosystem, various renewable and non-renewable resources, how various biodiversity occur and different means to conserve these. This course also includes various types of pollution and environmental policies & practices related with environs. Finally, it also highlights the relationship of human population with environment. The course further integrates to project work such as visit to an area to document environmental assets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site-Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds, and study of simple ecosystems. These studies are as imperative as it forms a unique synergistic tool

for comprehensive learning process. This will help students to recognize and appreciate how the technological advancement at global level, exponential growth of human population and their unlimited demands has put the environment at stake and has contaminated the environment worldwide.

Objective and expected Outcome:

The main objective of the course is to create consciousness among the students with the idea about healthy and safe environment. This course is aimed to explain students that the rapid industrialization, crazy consumerism and over-exploitation of natural resources have resulted in degradation of earth at all levels. These changes need the discussion, concern and recognition at national and international level with respect to formulate protection acts and sustainable developments policies. It can be possible only if every citizen of the nation is environmentally educated and gets involved into this matter at the grass root level to mitigate pollution.

After studying the course, the learners will be able to comprehend and become responsive regarding environmental issues. They will acquire the techniques to protect our mother earth, as without a clean, healthy, aesthetically beautiful, safe and secure environment no specie can survive and sustain. This is the only inheritance which every genera of specie passes to their future generation.

UNIT I

Introduction of Environmental Studies: Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

Natural Resources: Renewable and Non-renewable Resources

Land resources: land use change; Land degradation, soil erosion and desertification.

Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.

Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).

Energy resources: Renewable and non- renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

UNIT II

Ecosystems: Definition and Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession.

Case studies of the following ecosystems:

a) Forest ecosystem

b) Grassland ecosystem

c) Desert ecosystem

d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biological Diversity: Levels of biological diversity; genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots ; India as a mega-biodiversity nation; Endangered and endemic species of India; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity; Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

UNIT III

Environmental Pollution: Types, causes, effects and controls; Air, water, soil and noise pollution. Nuclear hazards and human health risks; Solid waste management: Control measures of urban and industrial waste; Pollution case studies.

Environmental Policies and practices: Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture.

Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. International agreements: Montreal & Koyoto protocol and convention on biological diversity. Nature reserves, tribal population and rights, human wild life conflicts in Indian context.

UNIT IV

Human Communities and the Environment: Human population growth: Impacts on environment, human health and welfare; Resettlement and rehabilitation of project affected persons; case studies; Disaster management: floods, earthquake, cyclones and landslides; Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan; Environmental ethics: Role of Indian and other religions and cultures in environmental conservation; Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Field work:

Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, Delhi Ridge, etc.

TEXT BOOKS:

1. Erach Bharucha, Textbook of Environmental Studies, Universities Press (P) Ltd., Hyderabad, India.
2. Anubha Kaushik and C. P. Kaushik, Environmental Studies, New Age International Publishers (P) Ltd. New Delhi.

REFERENCE BOOKS:

1. A.K. De, Environmental Chemistry, New Age International Publishers (P) Ltd. New Delhi.
2. P. H. Raven, D. M. Hassenzahl & L. R. Berg, Environment, John Wiley & Sons, New Delhi.
3. J. S. Singh, S. P. Singh and S. R. Gupta, Ecology, Environmental Science and Conservation, S. Chand Publication, New Delhi.

ETMA105	APPLIED MATHEMATICS - I	L	T	P	C
		3	1	0	4

Course Overview:

This course shows the modelling process in the context of matrix, and differential calculus, from a number of areas such as, economics, electric circuits, mechanical systems, fluid flow, and physics. Analytic methods from the elementary theory of differential equations and calculus will be provided to allow for the analysis of the various models being investigated.

Topics to be covered include: Matrices and their types: Elementary transformation**,** Inverse of matrix by elementary operations, Rank, Linear and orthogonal transformations, Hermitian and skew - Hermitian forms, Solutions of simultaneous linear equations, Eigen values, Eigen vectors and its properties, Caley - Hamilton theorem (without proof), Diagonalization of a matrix.

Differential Calculus: Successive differentiation, Leibnitz theorem (without proof), Taylor‘s and Maclaurin‘s theorem and expansion of functions, Asymptotes (Cartesian and polar), Curve Tracing, Curvature, Radius of Curvature, Maxima and Minima.

Partial Differentiation: Partial differentiation, Euler's theorem on homogeneous functions, Composite functions, Jacobians, Taylor's theorem of two variables and its application to approximate errors, Maxima-Minima for two variables, Lagrange‘s method of undermined multipliers.

Multiple Integration: Beta and Gamma integrals, Differentiation under integral sign, Double and Triple integrals computation of surface areas and volumes, change of variables

in double and triple integrals.

Objectives and expected outcomes:

Upon successful completion, students will have the knowledge and skills to:

Explain the fundamental concepts of matrix and differential calculus and their role in modern applied mathematics and real-world contexts.

Demonstrate accurate and efficient use of techniques involved in solving partial differentiation.

Apply problem-solving using techniques in differential calculus in diverse situations in physics, engineering and other mathematical contexts.

Student will able to solve improper integrals and evaluate multiple integrals in various coordinate systems.

UNIT I

Matrices and its application: Elementary transformation**,** Inverse of matrix by elementary operations, **Rank**, Linear and orthogonal transformations, Hermitian and skew - Hermitian forms, Solutions of simultaneous linear equations, Eigen values, Eigen vectors and its properties, Caley - Hamilton theorem (without proof), Diagonalization of a matrix.

UNIT II

Application of Differential Calculus: Successive differentiation, Leibnitz theorem (without proof), Taylor‘s and Maclaurin‘s theorem and expansion of functions, Asymptotes (Cartesian and polar), Curve Tracing, Curvature, Radius of Curvature.

UNIT III

Calculus of several Variables: Partial differentiation, Euler's theorem on homogeneous functions, Composite functions, Jacobians, Taylor's theorem of two variables and its application to approximate errors, Maxima-Minima for two variables, Lagrange‘s method of undermined multipliers.

UNIT IV

Multiple Integration: Beta and Gamma integrals, Differentiation under integral sign, Double and Triple integrals computation of surface areas and volumes, change of variables in double and triple integrals

TEXT BOOKS:

1. Kresyzig, "Advanced Engineering Mathematics", John Wiley and Sons.
2. Jain and Iyengar, "Advanced Engineering Mathematics", Narosa Publication.

REFERENCES BOOKS:

1. B.S.Grewal, ―Higher Engineering Mathematics‖, Khanna Publishers.
2. H.K. Dass, ―Advanced Engineering Mathematics‖, S. Chand & Company.

ETME 101	BASICS OF MECHANICAL ENGINEERING	L	T	P	C
		3	1	0	4

Course Overview:

This is one of the core subjects that introduces the student to the study of various mechanical engineering concepts and prepares the student for further studies and better understanding of engineering subjects like Engineering Thermodynamics, strength of materials and theory of machines, etc.

Objectives and expected outcomes:

Course Objectives: The subject expects students to achieve the following objectives.

- To analyse, design and improve practical thermal and/or mechanical systems.
- To give students practice in applying their knowledge of mathematics, science, and engineering and to expand this knowledge into the vast area of mechanical engineering.
- To enhance students' ability to design by requiring the solution of open ended problems.
- To prepare the students for higher level courses such as courses in Mechanics of Solids, Thermodynamics, Manufacturing, etc.

Course Outcomes: Upon the completion of this course the students will be able to:

- Know the basics of machine tool and their material properties.
- Understand the basic concepts of thermodynamics and Refrigeration.
- Get the knowledge of application of hydraulic turbines and pumps in various fields.
- Know various Power Transmission Methods and Devices.
- Understand the concept of Stress & Strain which is useful in various streams of engineering.

UNIT I

Introduction to Machine Tools and Commonly used Machine Tools in a Workshop: Lathe, Shaper, Planer, Milling, Drilling, Slotter, Introduction to Metal Cutting.

Basic concept of thermodynamics: Introduction, States, Work, Heat, Temperature, Zeroth, 1st, 2^{nd} and 3^{rd} law of thermodynamics, Concept of internal energy, enthalpy and entropy. Problems Properties of Steam & Steam Generator Formation of steam at constant pressure,

Thermodynamic properties of Steam, Use of steam tables, Measurement of dryness fraction by throttling calorimeter.

UNIT II

Refrigeration & Air-conditioning: Introduction to refrigeration and air -conditioning, Rating of refrigeration machines, Coefficient of performance, Simple refrigeration vapor compression cycle, Psychrometric charts and its use, Human comforts.

Hydraulic Turbines & Pumps: Introduction, Classification, Construction details and working of Pelton, Francis and Kaplan turbines, Specific speed and selection of turbines, Classification of water pumps and their working.

UNIT III

Power Transmission Methods and Devices: Introduction to Power transmission, Belt, Rope, Chain and Gear drive, Types and functioning of clutches.
Stresses and Strains: Introduction, Concept & types of Stresses and strains, Poison‘s ratio, stresses and strains in simple and compound bars under axial, flexure & torsional loading, Stress- strain diagrams, Hooks law, Elastic constants & their relationships.

UNIT IV

Introduction to Manufacturing Systems: Fundamentals of Numerical Control (NC), Advantage of NC systems, Classifications of NC, Comparison of NC and CNC

Text Books:

1. Elements of Mechanical Engineering – R.K.Rajput Lakmi Pub., Delhi
2. Elements of Mechanical Engineering – D.S.Kumar, S.K. Kataria and Sons
3. Engineering Thermodynamics- P.K.Nag TMH, New Delhi
4. Refrigeration & Air-conditioning – Arora & Domkundwar, Dhanpat rai & co.pvt ltd
5. Workshop Technology Vol.I & II - Hazra & Chaudhary, Asian Book Comp., New Delhi.
6. Process and Materials of Manufacture -- Lindberg, R.A. Prentice Hall of India, New Delhi.
7. Principles of Manufacturing Materials and Processes - Campbell, J.S.- McGraw- Hill

Reference Books:

1. Strength of Materials – Popov, Pub. PHI, New Delhi.
2. Hydraulic Machines – Jagdish Lal, Pub. Metropolitan, Allahabad.
3. Strength of Materials - G.H. Ryder, Pub. ELBS.

OPEN ELECTIVE - I	C
	6

There are three open electives offered by other departments / schools in first semester. The department will permit student to opt one open elective based on choice of student and consent of the course advisor.

ETPH109	ENGINEERING PHYSICS	C
		4

Course Overview:

Oscillations play an important role in the macro- and micro-world. Oscillation cannot be just mechanical. So, for instance, one can consider the oscillations of an electric current in an oscillatory circuit or a magnetic field strength in a dynamo, etc. These can be described by an equation similar to the one that defines mechanical displacements from a position of equilibrium. In spite of this fact, mechanical oscillations are mostly analyzed, keeping in mind their applicability to other types of oscillation. Oscillations originating from any source propagate further in space. The propagating oscillations are referred to as waves. Different waves exist, such as mechanical, electromagnetic, and acoustic, depending on what physical value is propagated. Mechanical waves can propagate only in an elastic media. If particle vibrations are agitated in a region of an elastic medium (solid, liquid or gaseous), as a consequence of the interaction among particles, this disturbance is transmitted to surrounding particles, which in turn, distributes excitation further. In this manner, the wave appears.

The physics and mathematics of wave motion underlie many important phenomena. The water wave on the sea, the vibration of a violin string, and the quantum mechanical wave associated with an electron can all be described in a similar way. Light too, often displays properties that are wave-like. We will start the course looking at "ray" optics, but then pause for a general treatment of waves of all types. We will start this waves section by reviewing ideas of oscillations and simple harmonic motion, and go on to look at the physics of travelling and standing waves i.e wave motion. We will apply these ideas to various types of wave, and see how all-pervading this topic is in physics.

Optics is the study of light and its uses. Light has long captured the fascination of humankind like Why should light bend upon entering water? Why does light spread out after passing through a narrow gap? How does light travel to us from the sun, through the void of space? These sorts of questions have ensured that optics has a long and engaging history. So in this lecture course we will look at basic ideas of light propagation, interference and diffraction of light, Polarization, and some of the many uses to which light is put.

Objective and Expected Outcome:

The main objective of this subject is to aware the students about various phenomenon of oscillation, waves and optics. This course first deal with the simple harmonic motion, damped

and forced simple harmonic oscillator. It deals with the Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion. This course also deals with the propagation of light and geometric optics, wave optics and lasers.

After the completion of the course, Students will be able to understand the physics behind various phenomenon‘s in oscillation, waves and optics. Students can understand various phenomenon and the cause or origin of them. They also can understand the physics behind various optical phenomenon‘s and various natural phenomenon which is happening in their surroundings.

		L	T	P	C
ETPH109	**ENGINEERING PHYSICS**	**3**	**1**	**0**	**4**

UNIT-I:

Simple harmonic motion, damped and forced simple harmonic oscillator

Mechanical and electrical simple harmonic oscillators damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor.

UNIT-II:

Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion

Transverse wave on a string, The wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary. Longitudinal waves and the wave equation for them, acoustics waves and speed of sound, wave groups and group velocity.

UNIT-III:

The propagation of light and geometric optics

Laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster‘s angle, total internal reflection

Wave optics

Huygens‘ principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young‘s double slit experiment, Newton‘s rings, Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

UNIT-IV:

Lasers

Amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Suggested Reference Books

(i) Ian G. Main, Oscillations and waves in physics

(ii) H.J. Pain, The physics of vibrations and waves

(iii)E. Hecht, Optics

(iv) A. Ghatak, Optics

(v) O. Svelto, Principles of Lasers

ETPH109	ENGINEERING PHYSICS LAB	L	T	P	C
		0	0	2	1

Course Overview:

This course gives an experimental understanding of the different phenomena of oscillation, waves and optics which students have encountered in theory course. Without experimental understanding it is very difficult to realize the theoretical concepts. This course contains experiments of oscillation, waves and optics.

Objective and Expected Outcome:

The objective of this course is to make students more familiar with the concepts of various phenomenons of oscillation, waves and optics through hands on experience. After this course students can gain knowledge about how we can find the value of acceleration due to gravity, wave length of a give source of light, refractive index of material of a given prism and specific rotation by the concept of polarization of light.

LIST OF EXPERIMENTS

1) To determine the value of acceleration due to gravity using Bar pendulum.
2) To determine the value of acceleration due to gravity using Kater‘s pendulum.
3) To determine the wavelength of sodium light using Newton`s ring apparatus.
4) To determine the wavelength of prominent lines of mercury by plane diffraction grating.

5) To determine the refractive index of the material of the prism for the given colours (wavelengths) of mercury light with the help of spectrometer.
6) To determine the specific rotation of cane sugar solution with the help of half shade polarimeter.
7) To determine the wavelength of He-Ne LASER using transmission diffraction grating.

Suggested Reference Books

- C. L.Arora, B.Sc Practical Physics (S Chand and Co. Ltd., New Delhi).
- Harnam Singh, Hemne P S, B.Sc. Practical Physics (S. Chand & Co).
- Indu Prakash, Ramakrishna, A Text Book of Practical Physics (Kitab Mahal, New Delhi).

ETME 151	BASICS OF MECHANICAL ENGINEERING LAB	C
		1

Course Overview:

This is one of the core lab subjects that introduces the student to the study of various mechanical engineering concepts and prepares the student for further studies and better understanding of engineering subjects like Engineering Thermodynamics, strength of materials and theory of machines, etc. through practical exposure.

Objective and Expected Outcome:

Course Objectives:

1. To calculate the Mechanical Advantage, Velocity Ratio and Efficiency of Single Start & Double Start Worm & Worm Wheel, Differential Wheel & Axle.
2. To study simple screw jack and compound screw jack and determine their efficiency.
3. To verify the law of Moments using Parallel Force apparatus. (simply supported type)
4. To evaluate the co-efficient of friction between wood and various surface (like Leather, Wood, Aluminum) on an inclined plane.
5. To Study Two-Stroke & Four-Stroke Diesel Engines and Petrol Engines.
6. To Study the vapor compression Refrigeration System and Window Room Air Conditioner.
7. To study the constructional features and working of Pelton wheel Turbine, Francis Turbine and Kaplan Turbine, etc.

Course Outcomes: Upon the completion of this course the students will be able to:

1. Understand the Mechanical Advantage, Velocity Ratio and Efficiency of various systems.
2. Understand concepts of screw jack, friction, law of moments.
3. Understand the Two-Stroke & Four-Stroke Diesel Engines and Petrol Engines.
4. Get the knowledge of various Refrigeration and Air- Conditioning Systems.
5. Know about the working of various turbines and pumps.

ETME 151	BASICS OF MECHANICAL ENGINEERING LAB	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. To verify the law of Force Polygon
2. To verify the law of Moments using Parallel Force apparatus. (simply supported type)
3. To determine the co-efficient of friction between wood and various surface (like Leather, Wood, Aluminum) on an inclined plane.
4. To find the forces in the members of Jib Crane.
5. To determine the mechanical advantage, Velocity ratio and efficiency of a screw jack.
6. To determine the mechanical advantage, Velocity ratio and Mechanical efficiency of the Wheel and Axle
7. To verify the law of moments using Bell crank lever.
8. To calculate the Mechanical Advantage, Velocity Ratio and Efficiency of Single Start, Double Start and Triple Start Worm & Worm Wheel.
9. To Study Two-Stroke & Four-Stroke Diesel Engines.
10. To Study Two-Stroke & Four-Stroke Petrol Engines.
11. To Study the vapor compression Refrigeration System.

ETCS153	PROGRAMMING FOR PROBLEM SOLVING LAB	L	T	P	C
		0	0	2	1

Course Overview:

This course emphasizes solving problems using the language, and introduces standard

programming techniques like alternation, iteration and recursion. It will briefly glimpse the basics of software engineering practices like modularization, commenting, and naming conventions which help in collaborating and programming in teams. This course is enabled the students to formulate algorithms for arithmetic and logical problems, convert these algorithms to C language programs. It also aims on using arrays, pointers and structures to formulate algorithms and programs. In addition to that, apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Objectives and Expected Outcomes:

At the end of the course, the students should be able to:

- To understand the various steps in program development
- To learn the syntax and semantics of C programming language
- To use the structural programming approach in solving the problem.

LIST OF EXPERIMENTS

Lab1: Familiarization with programming environment

Lab 2: Simple computational problems using arithmetic expressions Lab 3: Problems involving if-then-else structures
Lab 4: Iterative problems e.g., sum of series Lab 5: 1D Array manipulation
Lab 6: Matrix problems, String operations Lab 7: Simple functions
Lab 8 and 9: Programming for solving Numerical methods problems Lab 10: Recursive functions
Lab 11: Pointers and structures Lab 12: File operations

SEMESTER - II

		L	T	P	C
ETCS112	**OBJECT ORIENTED PROGRAMMING**	**3**	**1**	**0**	**4**

Course Overview:

This course introduces the concepts of object-oriented programming to students with a background in the procedural paradigm. The course begins with a brief review of control structures and data types with emphasis on structured data types and array processing. It then moves on to introduce the object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of object-oriented design. Other topics include

an overview of programming language principles, simple analysis of algorithms, basic searching and sorting techniques, event-driven programming, memory management and an introduction to software engineering issues.

Objectives and Expected Outcomes:

At the end of the course, the students should be able to:

1. Explain the steps in creating an executable program for a computer, including the intermediate representations and their purpose.
2. Manipulate binary patterns and understand the use of binary to represent numbers.
3. Apply good programming style and understand the impact of style on developing and maintaining programs.
4. Effectively use a version control system and the Linux command line tools for incremental development.
5. Explain the benefits of object-oriented design and understand when it is an appropriate methodology to use.
6. Design object-oriented solutions for small systems involving multiple objects.
7. Identify the relative merits of different algorithmic designs.

UNIT I

Introduction: Introducing Object-Oriented Approach related to other paradigms (functional, data decomposition), Characteristics of Object-Oriented Languages.

Basic terms and ideas: Abstraction, Encapsulation, Information hiding, Inheritance, Polymorphism, Review of C, Difference between C and C++, Cin, Cout, new, delete operators.

UNIT II

Classes and Objects: Abstract data types, Object & classes, attributes, methods, C++ class declaration, State identity and behavior of an object, Constructors and destructors, instantiation of objects, Default parameter value, Copy Constructor, Static Class Data, Constant Classes, C++ garbage collection, dynamic memory allocation.

UNIT III

Inheritance and Polymorphism: Inheritance, Types of Inheritance, Class hierarchy, derivation

– public, private & protected, Agrégations, composition vs classification hiérarchies, Polymorphism, Type of Polymorphism – Compile time and runtime, Method polymorphism, Polymorphism by parameter, Operator overloading, Parametric polymorphism, Generic function
– template function, function name overloading, Overriding inheritance methods

UNIT IV

Files and Exception Handling: Persistent objects, Streams and files, Namespaces, Exception

handling, Generic Classes

Standard Template Library: Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterates, Other STL Elements, The Container Classes, General Theory of Operation, Vectors.

TEXT BOOKS:

1. A.R. Venugopal, Rajjkumar, T. Ravishanker ―Mastering C++‖, TMH

2. R. Lafore, ―Object Oriented Programming using C++‖, BPB Publications.

3. Schildt Herbert, ―C++ Programming‖, 2nd Edition, Wiley DreamTech.

REFERENCE BOOKS:

1. D. Parasons, ―Object Oriented Programming with C++‖, BPB Publication
2. Steven C. Lawlor, ―The Art of Programming Computer Science with C++‖, Vikas Publication
3. Yashwant Kanethkar, ―Object Oriented Programming using C++‖, BPB

ETEC101	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	L	T	P	C
		3	1	0	4

Course Overview:

The course is designed to gain the essential knowledge about electrical circuit elements, DC circuits, AC circuits, magnetism, transformers and electrical machines. The undergraduates are familiarized with the basics of installations required for the protection and wiring. The fundamentals of power converters are part of the course.

Learning objectives:

- To understand the circuit behavior on the DC supply
- To analyze the complex circuits using various theorems to resolve it to a simple circuit.
- To understand the circuit behavior on the AC supply
- Analysis of single-phase ac circuits consisting of combinations(series and parallel) elements
- Working and application of transformer

- To analyze the behavior of electrical machines for the losses, efficiency and other parameters.
- To gain basic insight of inverters and boost converters.
- To get acquainted with components of low voltage switchgear

Expected Outcome:

- To understand and analyze basic electric and magnetic circuits
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations

UNIT I

Circuit Analysis: Ohm's Law, KCL, KVL Mesh and Nodal Analysis, Circuit parameters, energy storage aspects, Superposition, Thevenin's, Norton's, Reciprocity, Maximum Power Transfer Theorem, Millman's Theorem, Star-Delta Transformation. Application of theorem to the Analysis of D.C. circuits.

UNIT II

A.C. Circuits: R-L, R-C, R-L-C circuits (series and parallel), Time Constant, Phasor representation, Response of R-L, R-C and R-L-C circuit to sinusoidal input Resonance-series and parallel R-L-C Circuits, Q-factor, Bandwidth.

Cathode Ray Oscilloscope: Basic CRO circuit (Block Diagram), Cathode ray tube (CRT) & its component

UNIT III

Semiconductor Physics: Basic concepts, Intrinsic and extrinsic semiconductors, diffusion and drift currents.

P-N junction diode : Ideal diode, P-N junction under open-circuit and closed-circuit, Diode Current Equation, Diode Resistance, Transition and Diffusion Capacitance, Effect of Temperature, Carrier Life Time, Continuity Equation.

Special Diodes: Zener Diode, Photodiode, Light Emitting Diodes, applications of Diodes.

UNIT IV

Digital Electronics: Boolean algebra, Truth tables of logic gates (AND, OR, NOT), NAND, NOR as universal gates

Bipolar junction transistor: Introduction to transistors: construction, transistor operations, BJT characteristics, load line, operating point, leakage currents.

Application of BJT: CB, CE configurations, Introduction to FETs and MOSFETs.

TEXT BOOKS:

1. D.P. Kothari & I J Nagrath , Basic Electrical Engineering , Tata McGraw Hill , New Delhi.

2. B L Thareja – A text book of Electrical Technology

3. Boylestad & Nashelsky, ―Electronic Devices & Circuits‖, Pearson Education, 10th Edition.

4. V. K. Mehta & Rohit Mehta, ―Principles of Electronics‖, S. Chand Publishers, 27th Edition.

REFERENCE BOOKS:

1. Electrical Engineering Fundamentals, V.Del Toro

2. Problems in Electrical Engineering – Parker Smith.S.

3. Sedra A S and Smith K C, ―Microelectronic Circuits‖ 4th Ed., New York, Oxford University Press, New York.

4. Tocci R J and Widmer N S, ―Digital Systems – Principles and Applications‖, 8th Ed., Pearson Education India, New Delhi.

5. A.K. Sawhney, ―A course in Electrical & Electronics Measurements & Instrumentation‖, Dhanpat Rai & Sons.

ETMA104	APPLIED MATHEMATICS - II	L	T	P	C
		3	1	0	4

Course Overview:

The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of engineering and technology. This course is an introduction to Laplace Transformation, vector calculus, ordinary differential equations and Partial Differential Equations.

Topics includes:

Laplace Transformation: Existence condition, Laplace transform of standard functions, Properties,

Inverse Laplace transform of functions, Convolution theorem, solving linear differential equations using Laplace transform. Heaviside unit step function, Impulse function, Periodic function and their transforms.

Vector Calculus: Scalar and vector point functions, Gradient, Divergence, Curl with their physical significance, Directional derivatives, Properties, Line integrals, Surface integrals and Volume integrals, Gauss theorem, Green's theorem and Stoke‘s theorem (without proof).

Ordinary Differential Equations: Exact differential equations of first order and first degree, Linear differential equations of higher order with constant coefficients, Variation of parameters, Solution of simultaneous linear differential equations, Solution of homogeneous differential equations - Cauchy and Legendre forms.

Partial Differential Equations and its applications: Formation of partial differential equations, Lagrange‘s linear equation, Charpit‘s method of non-linear partial differential equations,

Method of separation of variables, Solution of wave and heat conduction equations, Initial and boundary value problems.

Objectives and expected outcomes:

Upon successful completion, students will have the knowledge and skills to:

1. Concepts & properties of Laplace Transforms
2. Solving differential equations using Laplace transform techniques
3. Determine the solution of a PDE by variable separable method
4. Analyze real world scenarios to recognize when ordinary differential equations (ODEs) or systems of ODEs are appropriate, formulate problems about the scenarios, creatively model these scenarios (using technology, if appropriate) in order to solve the problems using multiple approaches, judge if the results are reasonable, and then interpret and clearly communicate the results.
5. Identify an ordinary differential equation and classify it by order or linearity
6. Determine whether or not a unique solution to a first-order initial-value problem exists

UNIT I

Laplace Transformation: Existence condition, Laplace transform of standard functions, Properties, Inverse Laplace transform of functions, Convolution theorem, solving linear differential equations using Laplace transform. Heaviside unit step function, Impulse function, Periodic function and their transforms.

UNIT II

Vector Calculus:

Scalar and vector point functions, Gradient, Divergence, Curl with their physical significance, Directional derivatives, Properties, Line integrals, Surface integrals and Volume integrals, Gauss theorem, Green's theorem and Stoke‘s theorem (without proof).

UNIT III

Ordinary Differential Equations: Exact differential equations of first order and first degree, Linear differential equations of higher order with constant coefficients, Variation of parameters, Solution of simultaneous linear differential equations, Solution of homogeneous differential equations - Cauchy and Legendre forms.

UNIT IV

Partial Differential Equations and its applications: Formation of partial differential equations, Lagrange‘s linear equation, Charpit‘s method of non-linear partial differential

equations, Method of separation of variables, Solution of wave and heat conduction equations, Initial and boundary value problems.

TEXT BOOKS:

1. Kresyzig, "Advanced Engineering Mathematics", John Wiley and Sons.
2. Jain and Iyengar, "Advanced Engineering Mathematics", Narosa Publication.

REFERENCES BOOKS:

1. B.S.Grewal, ― Higher Engineering Mathematics‖, Khanna Publishers.
2. H.K. Dass, ―Advanced Engineering Mathematics‖, S. Chand & Company.

ETEL101	COMMUNICATION SKILLS	L	T	P	C
		4	0	0	4

Course Overview:

The world is shrinking into a global village and therefore, communication skills in English have emerged as a major means of empowerment and human resource development. Many professionals fail to make an impact on the global market as they lack the required communicative competence. The course will augment comprehension skills, enhance vocabulary, and enable to acquire impressive writing skills, assist correspondence with others effectively, aid in understanding the non-verbal cues and enrich skills in spoken English through a variety of teaching techniques. The course will be instrumental in acquiring proficiency both in spoken and oral language.

Objectives and Expected Outcomes

The course will help the learners to focus on communication activities in functional and situational contexts as well as enhance the four language skills of reading, writing, listening and speaking through real-life and professional situations. It will build confidence among the students and encourage them to speak fluently. Through practical learning and delivery, the learners will be able to identify their areas of strengths and weaknesses and improvise their personality and soft skills. The learners will be able to strengthen and broaden their communication skills through various insightful ways.

This learning program with its practice-based learning tasks will facilitate the learners to enhance their communication skills in a modern and globalized context, enhance their linguistic and communicative competence and hone their interpersonal skills.

UNIT I

Introduction to Communication: Meaning, Forms & Types of Communication; Process of Communication; Principles of Effective Communication/7Cs, Barriers in Communication; Literature: A Bird Came Down the Walk by Emily Dickinson

UNIT II

Essentials of Grammar: Parts of Speech: Noun, Pronoun, Adjective, Verb, Adverb, Preposition, Conjunction, Interjection; Using tenses; Articles; Types of sentences; Reported Speech; Punctuation; Literature: Stopping by Woods on A Snowy Evening by Robert Frost

UNIT III

Building Vocabulary: Word Formation (by adding suffixes and prefixes); Common Errors; Words Often Confused; One word substitution, Homonyms and Homophones; Antonyms &Synonyms, Phrasal Verbs, Idioms & Proverbs (25 each); Commonly used foreign words(15 in number); Literature: The Gift of Magi by O'Henry

UNIT IV

Personality Development: Etiquette & Manners; Leadership; Inter & intra personal skills; Attitude, Self-esteem & Self-reliance; Public Speaking; Body Language: Posture, Gesture, Eye Contact, Facial Expressions; Presentation Skills/ Techniques; Literature: My Prayer to Thee by Rabindranath Tagore;

TEXT BOOK:

Kumar, Sanjay and Pushplata. Communication Skills. Oxford University Press.

REFERENCE BOOKS / SITES:

1. Tickoo, M.L, Subramanian A. E. and Subramaniam P.R. Intermediate Grammar, Usage and Composition. Orient Blackswan.

2. Mitra, Barun K. Personality Development and Soft Skills. Oxford University Press.

3. ―Best Poems‖, http://100.best-poems.net/. 20 July 2016.

4. ―Classic English Short Stories‖, http://www.eastoftheweb.com/short- stories/Collections/ClasEngl.shtml, 20 July 2016.

OPEN ELECTIVE - II	C
	6

There are three open electives offered by other departments / schools in second semester. The department will permit student to opt one open elective based on choice of student and consent of the course advisor.

ETEL 171	COMMUNICATION SKILLS LAB	L	T	P	C
		0	0	2	1

Communication Skills Lab Activity

Activity 1: Self- introduction: Informal introduction & formal introduction; A detailed write up on formal _Self Introduction‘; Formal Introduction of oneself in front of the group.

Activity 2: News Reading: Introduction to _online News papers‘; Browsing and selecting the preferred Newspaper; Browsing through the News Headlines; Selecting interested News items; Comprehending the content, writing down the essence and reading the News in front of the Group. Discuss 5 to 8 new words or terms, 4 to 5 important personalities of that day‘s news etc.

Activity 3: JAM: Introduction to _Just A Minute speech‘ and the _Extempore speech‘; Preparation of speech on given topic(different topic for each student); delivery of the speech; Feedback(on content, time management, body language etc. highlighting the positive aspects first.)

Activity 4: News Discussions: Selecting News of the day, Discussing among the group, prepare the news content and prepare the group opinion about the issue and present it in front of the class by the group involving each member; select 5 new words & new usages from the selected news item

Activity 5: Conversation ability: Characteristics of effective conversation; Listening to a few sample conversations; preparing conversation based on the given situation; enacting the situation through effective delivery of the script; feedback & suggestions for improvement.

Activity 6: Role Play: Characteristics of Role Play; assigning roles; developing the content to deliver; enacting the role with effective delivery; feedback & suggestions for improvement.

Activity 7: Public Speaking: Characteristics of effective Public speaking; possible barriers; watching demo online; topic assignment, information gathering & recording; delivery in front of the class; feedback & suggestions for improvement. . (Different topic for each student)

Activity 8: Group Discussion: Importance and characteristics; Dos & Don‘ts in GD; Demo display; assign topic for the group, Preparation & performance; feedback & suggestions for improvement.

Activity 9: Debate: Difference between Group Discussion & Debating; Watching demo of Debating; Topic for the group of 2 or 4; preparation and performance; feedback & suggestions for improvement.

Activity 10: .**Interview:** Importance & purpose of Job Interview; Interview etiquettes; Watch demo interview; Appear for formal mock interview; feedback & suggestions for improvement.

ETEC151	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB	L	T	P	C
		0	0	2	1

Course Overview:

The course is designed to gain the essential knowledge about electrical circuit elements, DC circuits, AC circuits, magnetism, transformers and electrical machines. The undergraduates are familiarized with the basics of installations required for the protection and wiring. The fundamentals of power converters are part of the course.

Learning objectives:

- To understand the circuit behavior on the DC supply
- To analyze the complex circuits using various theorems to resolve it to a simple circuit.
- To understand the circuit behavior on the AC supply
- Analysis of single-phase ac circuits consisting of combinations(series and parallel) elements
- Working and application of transformer
- To analyze the behavior of electrical machines for the losses, efficiency and other parameters.

Laboratory Outcomes:

The students are expected to

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.

LIST of EXPERIMENTS

1. To get familiar with the working knowledge of the following instruments:

a) Cathode ray oscilloscope (CRO)

b) Multimeter (Analog and Digital)

c) Function generator

d) Power supply

2. To measure phase difference between two waveforms using CRO

   To measure an unknown frequency from Lissajous figures using CRO

3. To Verify the Thevenin' s and Norton‘s theorem

4. To Verify the Superposition theorem

5. To measure voltage, current and power in an A.C. circuit by LCR impedance method

6. To study the frequency response curve in series and parallel R-L-C circuit

7. a) Plot the forward and reverse V-I characteristics of P-N junction diode

   b) Calculation of cut-in voltage

   c) Study of Zener diode in breakdown region

8. To plot and study the input and output characteristics of BJT in common-emitter configuration.

9. Verification of truth tables of logic gates (OR,AND, NOT, NAND, NOR).

10. To get familiar with the working and use of seven-segment display.

ETCS166	OBJECT ORIENTED PROGRAMMING LAB	L	T	P	C
		0	0	2	1

Course Overview:

This course will give the learner an insight into how everything can be considered an object and how simply we can write code to implement it. It helps us in making programming relatable to real world, as everything around us can be an object (having properties and functionality)

Object-oriented programming aims to implement real world entities like inheritance, hiding, polymorphism etc in programming. The main aim of OOP is to bind together the data and the functions that operate on them so that no other part of code can access this data except that function.

Objective and Expected Outcome:

Students, who have already studied Structural programming like C, would understand how Object-oriented programming would help them in coding in a simpler and better way. For instance, a user of the program should only know what the input is and what is the output, he should not be concerned about the process. The programmer implements the concept through abstraction and information hiding, which are important features of object-oriented programming. The course would help students achieve the following goals:

- Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
- Understand fundamentals of object-oriented programming including defining classes, invoking methods, using class libraries, etc.
- Be aware of the important topics and principles of software development.
- Develop the ability to write a computer program to solve specified problems.

LIST OF EXPERIENTS

Q1. Raising a number n to a power p is the same as multiplying n by itself p times. Write a function called power ( ) that takes a double value for n and an int value for p, and returns the result as double value. Use a default argument of 2 for p, so that if this argument is omitted, the number will be squared. Write a main ( ) function that gets values from the user to test this function.

Q2. A point on the two dimensional plane can be represented by two numbers: an X coordinate and a Y coordinate. For example, (4,5) represents a point 4 units to the right of the origin along the X axis and 5 units up the Y axis. The sum of two points can be defined as a new point whose X coordinate is the sum of the X coordinates of the points and whose Y coordinate is the sum of their Y coordinates.

Write a program that uses a structure called point to model a point. Define three points, and have the user input values to two of them. Than set the third point equal to the sum of the other two, and display the value of the new point. Interaction with the program might look like this:
Enter coordinates for P1: 3 4

Enter coordinates for P2: 5 7
Coordinates of P1 + P2 are :
8, 11
Q 3. Create the equivalent of a four function calculator. The program should request the user to enter a number, an operator, and another number. It should then carry out the specified arithmetical operation: adding, subtracting, multiplying, or dividing the two numbers. (It should use a switch statement to select the operation). Finally it should display the result. When it

finishes the calculation, the program should ask if the user wants to do another calculation. The response can be _Y‘ or _N‘. Some sample interaction with the program might look like this.

Enter first number, operator, second number:
10/ 3 Answer = 3.333333
Do another (Y/ N)? Y

Enter first number, operator, second number 12 +
100 Answer = 112
Do another (Y/ N) ? N

Q4. A phone number, such as (212) 767-8900, can be thought of as having three parts: the area code (212), the exchange (767) and the number (8900). Write a program that uses a structure to store these three parts of a phone number separately. Call the structure phone. Create two structure variables of type phone. Initialize one, and have the user input a number for the other one. Then display both numbers. The interchange might look like this:

Enter your area code, exchange, and number: 415 555
1212 My number is (212) 767-8900
Your number is (415) 555-1212

Q 5. Create two classes DM and DB which store the value of distances. DM stores distances in meters and centimeters and DB in feet and inches. Write a program that can read values for the class objects and add one object of DM with another object of DB.

Use a friend function to carry out the addition operation. The object that stores the results maybe a DM object or DB object, depending on the units in which the results are required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display.

Q 6. Create a class rational which represents a numerical value by two double values- NUMERATOR & DENOMINATOR. Include the following public member Functions:

• constructor with no arguments (default).

• constructor with two arguments.

• void reduce( ) that reduces the rational number by eliminating the highest common factor between the numerator and denominator.

• Overload + operator to add two rational number.

• Overload >> operator to enable input through cin.

• Overload << operator to enable output through cout.

Write a main ( ) to test all the functions in the class.

Q 7. Consider the following class definition class father {

protected : int
age; public;
father (int x) {age =
x;} virtual void iam
( )
{ cout < < —I AM THE FATHER, my age is : ‖<< age<< end1:}

};

Derive the two classes son and daughter from the above class and for each, define iam ( ) to write our similar but appropriate messages. You should also define suitable constructors for these classes.
Now, write a main ( ) that creates objects of the three classes and then calls iam ( ) for them. Declare pointer to father. Successively, assign addresses of objects of the two derived classes to this pointer and in each case, call iam ( ) through the pointer to demonstrate polymorphism in action.

Q 8. Write a program that creates a binary file by reading the data for the students from the terminal. The data of each student consist of roll no., name (a string of 30 or lesser no. of characters) and marks.

Q9. A hospital wants to create a database regarding its indoor patients. The information to store include

a) Name of the patient

b) Date of admission

c) Disease

d) Date of discharge

Create a structure to store the date (year, month and date as its members). Create a base class to store the above information. The member function should include functions to enter information and display a list of all the patients in the database. Create a derived class to store the age of the patients. List the information about all the to store the age of the patients. List the information about all the pediatric patients (less than twelve years in age).
Q 10. Make a class **Employee** with a name and salary. Make a class **Manager** inherit from **Employee**. Add an instance variable, named department, of type string. Supply a method to **toString** that prints the manager‘s name, department and salary. Make a class **Executive** inherit from **Manager**. Supply a method **to String** that prints the string **“Executive”** followed by the information stored in the **Manager** superclass object. Supply a test program that tests these classes and methods.

Q11. Imagine a tollbooth with a class called toll Booth. The two data items are a type

unsigned int to hold the total number of cars, and a type double to hold the total amount of money collected. A constructor initializes both these to 0. A member function called payingCar ( )

increments the car total and adds 0.50 to the cash total. Another function, called nopayCar ( ), increments the car total but adds nothing to the cash total. Finally, a member function called displays the two totals. Include a program to test this class. This program should allow the user to push one key to count a paying car, and another to count a nonpaying car. Pushing the ESC kay should cause the program to print out the total cars and total cash and then exit.

Q12. Write a function called reversit ( ) that reverses a string (an array of char). Use for loop that swaps the first and last characters, then the second and next to last characters and so on. The string should be passed to reversit ( ) as an argument. Write a program to exercise reversit ( ). The program should get a string from the user, call reversit ( ), and print out the result. Use an input method that allows embedded blanks. Test the program with Napoleon‘s famous phrase,
―Able was I ere I saw Elba)‖.

Q13. Create some objects of the string class, and put them in a Deque-some at the head of the Deque and some at the tail. Display the contents of the Deque using the forEach ( ) function and a user written display function. Then search the Deque for a particular string, using the first That ( ) function and display any strings that match. Finally remove all the items from the Deque using the getLeft ( ) function and display each item. Notice the order in which the items are displayed: Using getLeft ( ), those inserted on the left (head) of the Deque are removed in ―last in first out‖ order while those put on the right side are removed in ―first in first out‖ order. The opposite would be true if getRight ( ) were used.

Q 14. Create a base class called shape. Use this class to store two double type values that could be used to compute the area of figures. Derive two specific classes called triangle and rectangle from the base shape. Add to the base class, a member function get_data ( ) to initialize base class data Members and another member function display_area ( ) to compute and display the area of figures. Make display_area ( ) as a virtual function and redefine this function in the derived classes to suit their requirements.

Using these three classes, design a program that will accept dimensions of a triangle or a rectangle interactively and display the area.

Remember the two values given as input will be treated as lengths of two sides in the case of rectangles and as base and height in the case of triangles and used as follows:

Area of rectangle = x *
y Area of triangle = ½ *
x * y

ETME 158	ENGINEERING GRAPHICS LAB	L	T	P	C
		0	0	3	1.5

Course Overview:

This course covers the fundamentals of engineering graphics including the drawing of orthographic, isometric, and auxiliary projections. Other topics include scaling, sectioning,

dimensioning, and drawing documentation. This course uses the latest release of computer-aided design (CAD) software commonly used in industry to introduce students to CAD interface, structure, and commands.

Objective and Expected Outcome:

Course Objectives: The Basic aim of this subject is to: -

- Increase ability to communicate with people
- Learn to sketch and take field dimensions.
- Learn to take data and transform it into graphic drawings.
- Learn basic Auto Cad skills.
- Learn basic engineering drawing formats
- Prepare the student for future Engineering positions for designing

Course Outcomes: After learning the course the students should be able to: -

- To know and understand the conventions and the method of engineering drawing.
- Interpret engineering drawings using fundamental technical mathematics.
- Construct basic and intermediate geometry.
- To improve their visualization skills so that they can apply these skill in developing new products.
- To improve their technical communication skill in the form of communicative drawings.
- Comprehend the theory of projection

UNIT I

Introduction: Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning line conventions and free hand practicing, AUTO CAD, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes, Definitions of HP, VP, RPP & LPP, Creation of 2D/3D environment, Selection of drawing size and scale, Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints.

Orthographic Projections:

Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes.

UNIT II

Orthographic Projections of Plane Surfaces (First Angle Projection Only):

Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only.

UNIT III

Projections of Solids (First Angle Projection Only):

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions.

Sections and Development of Lateral Surfaces of Solids:

Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP.

UNIT IV

Isometric Projection (Using Isometric Scale Only)

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of tetrahedron, hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres.

TEXT BOOKS:

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, Charotar Publishing House, Gujarat
2. Computer Aided Engineering Drawing - S. Trymbaka Murthy, - I.K. International Publishing House Pvt. Ltd., New Delhi, revised edition.

REFERENCE BOOKS:

1. Engineering Graphics - K.R. Gopala Krishna, edition Subash Publishers Bangalore.
2. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, -Prentice-Hall of India Pvt. Ltd., New Delhi.

ETME 157	WORKSHOP PRACTICE	L	T	P	C
		0	0	3	1.5

Course Overview:

Manufacturing is fundamental to the development of any engineering product. This course is intended to expose engineering students to different types of manufacturing/ fabrication processes, dealing with different materials such as metals, ceramics, plastics, wood, glass etc.

While the actual practice of fabrication techniques is given more weightage, some lectures and video clips available on different methods of manufacturing are also included.

Objective and Expected Outcome:

Course Objective:

- Understanding different manufacturing techniques and their relative advantages / disadvantages with respect to different applications
- The selection of a suitable technique for meeting a specific fabrication need
- Acquire a minimum practical skill with respect to the different manufacturing methods and develop the confidence to design & fabricate small components for their project work and also to participate in various national and international technical competitions.

Course Outcomes:

- Introduction to different manufacturing methods in different fields of engineering
- Practical exposure to different fabrication techniques
- Creation of simple components using different materials
- Exposure to some of the advanced and latest manufacturing techniques being employed in the industry

UNIT I

Materials: Spectrography method for finding composition of materials.

Wood Working Shop: Making of various joints, Pattern making.

UNIT II

Foundry Shop: Bench molding with single piece pattern and two piece pattern. Floor moulding - Making of bend pipe mould etc. Machine moulding - Making of mould using Match-plate pattern. Core making- Making and baking of dry sand cores for placing in horizontal, vertical and hanging positions in the mould cavity

Fitting Shop: Learning use of fitting hand tools, marking tools, marking gauge. Exercises: Jobs made out of MS Flats, making saw - cut filling V-cut taper at the corners, circular cut, fitting square in square, triangle in square.

UNIT III

Welding Shop: Electric Arc Welding, Edge Preparations, Exercises making of various joints. Bead Formation in horizontal, Vertical and Overhead positions.

Gas Welding: Oxy-Acetylene welding and cutting of ferrous metals.

Soldering: Dip soldering.

Brazing: With Oxy-Acetylene

gas. **UNIT IV**

Sheet Metal Shop: Learning use of sheet-metal tools, Exercises: Making jobs out of GI sheet metal. Cylindrical, Conical and Prismatic shapes. Project Shop: Extrusion of soft metals, Plastic coating of copper wires, Plastic.

SEMESTER III

		L	T	P	C
ETMA 201	**APPLIED MATHEMATICS - III**	**3**	**1**	**0**	**4**

Course Overview:

The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of engineering and technology. The first part of this module extends the theory of Fourier series and Fourier integral transform.

The second part of the module covers a complex variable which includes complex variable, analytic function, Cauchy-Riemann equations, and Residue theorem with their application.

Fourier series and its applications: Euler‘s formulae, Dirichlet‘s conditions, Change of interval, Fourier expansion of even and odd functions, Fourier expansion of square wave,

Rectangular wave; Saw-toothed wave; Half & Full rectified wave functions, Harmonic analysis.

Fourier integrals and Transforms: Fourier integral theorem, Fourier sine integral, Fourier cosine integral, Fourier sine Transform, Fourier cosine transform, Fourier transform and its properties, Finite Fourier sine transform, Finite Fourier cosine transform, Fourier transforms of derivatives.

Functions of Complex Variables: Introduction to complex number, Limit, Continuity and Derivatives of complex functions, Analytic functions, Cauchy-Riemann equations, Harmonic functions, Conformal mapping, Standard mappings (linear, square, inverse and bilinear), Complex line integral, Cauchy's integral theorem, Cauchy's integral formula, Zeroes and Singularities, Taylor series, Laurent's series, Calculation of residues, Residue theorem, Application of residue theorem to solve real integrals.

Objectives and Expected outcomes:

Upon successful completion, students will have the knowledge and skills to:

- Obtain the Fourier series and Fourier transform for a given function
- Evaluate real integrals using residue theorem
- Express analytic functions in terms of Taylor's series and Laurent series.
- Calculate complex line integrals and some infinite real integrals using Cauchy's integral theorem or residue calculus;
- Express any periodic function in term of sines and cosines
- Analyze one dimensional wave and heat equation

UNIT I

Fourier series and its applications: Euler's formulae, Dirichlet's conditions, Change of interval, Fourier expansion of even and odd functions, Fourier expansion of square wave, Rectangular wave; Saw-toothed wave; half & full rectified wave functions, Harmonic analysis.

UNIT II

Fourier integrals and Transforms: Fourier integral theorem, Fourier sine integral, Fourier cosine integral, Fourier sine Transform, Fourier cosine transform, Fourier transform and its properties, Finite Fourier sine transform, Finite Fourier cosine transform, Fourier transforms of derivatives.

UNIT III

Complex Numbers and Functions of Complex Variables: De Moivre's theorem, Roots of complex numbers, Euler's theorem, Logarithmic Functions, Circular and Hyperbolic

Functions, Limit, Continuity and Derivatives of complex functions, Cauchy-Riemann equations, necessary and sufficient conditions for a function to be analytic, polar form of the Cauchy- Riemann equations. Harmonic functions, application to flow problems

UNIT IV

Complex Integration and Conformal mapping: Standard mappings (linear, square, inverse and bilinear), Complex line integral, Cauchy's integral theorem, Cauchy's integral formula, Zeroes and Singularities, Taylor series, Laurent's series, Calculation of residues, Residue theorem, Application of residue theorem to solve real integrals.

TEXT BOOKS:

1. Kresyzig, "Advanced Engineering Mathematics", John Wiley and Sons.
2. Jain and Iyengar, "Advanced Engineering Mathematics", Narosa Publication.

REFERENCES BOOKS:

1. B.S.Grewal, ― Higher Engineering Mathematics‖, Khanna Publishers.
2. H.K. Dass, ―Advanced Engineering Mathematics‖, S. Chand & Company.

		L	T	P	C
ETEC233	**ANALOG ELECTRONICS**	**3**	**1**	**0**	**4**

Course Overview:

The course is to provide knowledge of Analog Electronics to students of various engineering disciplines. The course module includes basic diodes, basic knowledge of transistors and its biasing techniques and stabilization.

Objectives and Expected outcomes:

Course Objective:

- To understand operation of semiconductor devices.
- To understand DC analysis and AC models of semiconductor devices.
- To apply concepts for the design of Regulators and Amplifiers
- To verify the theoretical concepts through laboratory and simulation experiments.

- To implement mini projects based on concept of electronics circuit concepts

Expected Outcome:

- Understand the current voltage characteristics of semiconductor devices.
- Analyze dc circuits and relate ac models of semiconductor devices with their physical Operation.
- Design and analyze of electronic circuits.
- Evaluate frequency response to understand behavior of Electronics circuits.

UNIT I

Semiconductor Diodes and Rectifiers: Types of semiconductors, energy band diagrams, ideal diode, DC & AC resistance, drift & diffusion currents, transition & diffusion capacitance, reverse recovery time, temperature effects.

Some Special Devices: P-N junction diode, zener diode, Light emitting diode, Tunnel Diode, Photodiodes.

Rectifiers: Half-Wave Diode Rectifiers, Full-Wave Rectifier, Clippers and clampers circuits

UNIT II

Bipolar junction transistor: Introduction, transistor operations & characteristics, CB, CE, CC configurations, comparisons of different configurations, load line concept, leakage currents, modes of operations, Eber-moll's model, transistor applications: as a Switch and Amplifier.

Bias stabilization: Need for stabilization, fixed Bias, emitter bias, self-bias, bias stability with respect to variations in $I_{co,}$ V_{BE} &β, Stabilization factors.

UNIT III

Small signal amplifiers: Hybrid model for transistor at low frequencies, RC coupled amplifiers, frequency response, gain & impedance.

UNIT IV

Field Effect Transistor: Introduction to JFET, MOSFET, FET Biasing, FET characteristics.

1. **Text Books:** Boylestad & Nashelsky, ―Electronic Devices & Circuit Theory‖ PHI – VI Edition.

Reference Books:

1. Sedra & Smith, ―Micro Electronic Circuits‖ Oxford University Press.

2. Salivahanan, Suresh Kumar, Vallavaraj, ―Electronic devices and circuits‖ TMH.
3. J. Millman and Halkias, ―Integrated Electronics‖ TMH.

ETEC210	DIGITAL ELECTRONICS	L	T	P	C
		3	1	0	4

Course Overview:
Lectures and labs on digital logic, PALs, flip-flops, timing, counters, synchronization, and finite- state machines prepare students for the design and implementation of a final project of their choice, e.g., games, music, digital filters, wireless communications, graphics, etc. Extensive use of Verilog for describing and implementing digital logic designs. Students engage in extensive written and oral communication exercises.

Objectives and Expected outcomes:

Course Objective:

1. Explain the elements of digital system abstractions such as digital representations of information, digital logic, Boolean algebra, state elements and finite state machine (FSMs).
2. Design simple digital systems based on these digital abstractions, using the "digital paradigm" including discrete sampled information.
3. Use the "tools of the trade": basic instruments, devices and design tools.
4. Work in a design team that can propose, design, successfully implement and report on a digital systems project.
5. Communicate the purpose and results of a design project in written and oral presentations.

COURSE OUTCOME:

1. Create the appropriate truth table from a description of a combinational logic function.
2. Create a gate-level implementation of a combinational logic function described by a truth table using and/or/not gates, multiplexers or ROMs, and analyze its timing behavior.
3. Create a state transition diagram from a description of a sequential logic function and then convert the diagram into an implementation of a finite-state machine with the appropriate combinational and sequential components.
4. Describe the operation and timing constraints for latches and registers.
5. Draw a circuit diagram for a sequential logic circuit and analyze its timing properties (input setup and hold times, minimum clock period, output propagation delays).

6. Evaluate combinational and sequential logic designs using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power
7. Properly incorporate synchronous and asynchronous memories into a circuit design.
8. Discuss how to interface digital circuits with analog components (ADC, DAC, sensors, etc.).

UNIT – I

Number Systems and Codes: Review of number systems, BCD codes and arithmetic, Gray code, self-complimenting codes, Error detection and correction.

Digital Circuits: Switching algebra & simplification of Boolean expressions, De Morgan_s Theorem, Implementation of Boolean expressions (using logic gates)

UNIT – II

Combinational Logic Design: Combinational circuit designing, Minimization Techniques of Boolean functions such as Karnaugh map and Quine-Mc Cluskey methods, Arithmetic circuits, code convertors, multiplexers, demultiplexers, encoders, decoders & comparators. Parity generators and checkers.

Introduction to Sequential Logic: Need for sequential circuits, Binary cell, Latches and different types of Flip-Flop and their Conversions.

UNIT – III

Synchronous Sequential Circuit : Fundamentals of Synchronous sequential circuits, Analysis of Synchronous Sequential circuits, Design of Synchronous and Asynchronous Counters, Shift registers & Ring counters, Timing issues in synchronous circuits.

Asynchronous Sequential Circuits: Fundamentals of Asynchronous Sequential circuits. Analysis and design of Asynchronous Sequential circuits. Pulse mode and Fundamental-mode Circuits. Cycles, Races and Hazards in asynchronous circuits.

UNIT – IV

Synchronous Machines: Classification of synchronous machines, Analysis and design of Finite State Machines.

Logic Families: Performance metrics of logic gates, Basic Transistor-Transistor Logic and CMOS logic.

Converters: A/D and D/A converters and their types.

TEXT BOOKS:

1. G.K. Kharate -Digital Electronics, Oxford University Press

2. Aanand Kumar -Fundamentals of Digital Circuits, Prentice Hall of India

REFERENCE BOOKS:

1. Morris Mano, ―Digital design, Prentice Hall of India
2. R.P. Jain- Modern Digital Electronics, Tata Mc Graw Publishers
3. Floyd- Digital Fundamentals, Pearson Publication

ETCS217	DATA STRUCTURES	L	T	P	C
		3	1	0	4

Course Overview:

This course imparts the basic concepts of data structures and algorithms. It enables them to write algorithms for solving problems with the help of fundamental data structures. The course of data structures help organizing the data in variety of ways to solve the problem efficiently. The course introduces the basic concepts about stacks, queues, lists, trees and graphs. It also discusses about daily problems like searching and sorting techniques

Objectives and Expected Outcomes:

- For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
- For a given Search problem (Linear Search and Binary Search) student will able to implement it.
- For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
- Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
- Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

UNIT I

Introduction to Data Structures: Definition of data structures and abstract data types, Static and Dynamic implementations, Examples and real life applications; Arrays**:** ordered lists, representation of arrays, sparse matrices, polynomial arithmetic

Running time: Analysis of Algorithms and their complexities: Time Complexities, Big – Oh - notation, Running Times, Best Case, Worst Case, Average Case, Factors depends on running time, Introduction to Recursion, Divide and Conquer Algorithm, Time & Space Tradeoff.

UNIT II

The Stacks: ADT Stack and its operation, Array based implementation of stacks, Linked List based implementation of stacks, Examples: Infix, postfix, prefix representation, Conversions, Applications, Algorithms and their complexities

Queues and Lists: ADT Queue and its operation, Array based implementation of linear Queues, Circular implementation of Queues, Linked Lists: Singly linked lists: Representation of linked lists in memory, Traversing, Searching, Insertion into, Deletion from linked list Linked List

implementation of Queues and Stacks Lists, Straight / circular implementation of doubly linked Queues / Lists, Priority Queues, Applications, Algorithms and their complexities

UNIT III

Trees: Basic Terminology, Binary Trees and their representation, expression evaluation, Complete Binary trees, Extended binary trees, traversing binary trees, Searching, Insertion and Deletion in binary search trees (with and without recursion), AVL trees, Threaded trees, B+ trees, algorithms and their analysis.

Graphs: Terminology and Representations, Graphs & Multigraphs, Directed Graphs, Sequential representation of graphs, Adjacency matrices, Transversal Connected Component and Spanning trees, Shortest path, algorithms and their analysis.

UNIT IV

Sorting Algorithms: Introduction, Sorting by exchange, selection sort, insertion sort, Bubble sort, Straight selection sort, Efficiency of above algorithms, Shell sort, Performance of shell sort, Merge sort, Merging of sorted arrays& Algorithms; Quick sort Algorithm analysis, heap sort: Heap Construction, Heap sort, bottom – up, Top – down Heap sort approach;

Searching Algorithms: Straight Sequential Search, Binary Search (recursive & non–recursive Algorithms)

TEXT BOOKS:

- E. Horowitz and S. Sahani, ―Fundamentals of Data Structures‖, GalgotiaBooksource Pvt. Ltd.
- R. L. Kruse, B. P. Leung, C. L. Tondo, ―Data Structures and program design in C‖, PHI.

REFERENCES BOOKS:

- Schaum‘s outline series, ―Data Structure‖, TMH.
- Y. Langsamet. al., ―Data Structures using C and C++‖, PHI.
- Yashwant Kanetkar, ―Data Structure through C‖, BPB.

ETEC207	CIRCUITS AND SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OVERVIEW:

The objective of the course is to provide brief methodologies for analysis of Electrical Circuits and Networks to the students of various engineering disciplines. The course module includes introduction of signals, Circuit theory, Two - Port Networks, Network Synthesis

COURSE OBJECTIVE:

- To explain the basic concepts and laws of DC and AC electrical networks and solve them using mesh and nodal after successful completion of the course student will be able to apply concepts of electric network topology, analysis techniques.
- To introduce students with the fundamental concepts in graph theory.
- To analyze circuits in time and frequency domain.
- To explain concepts of driving point and transfer functions, poles and zeroes of network functions and their stability.
- To introduce open circuit, short circuit, transmission, hybrid parameters and their interrelationship.
- To synthesize the network using passive elements.

COURSE OUTCOME:

After successful completion of the course student will be able to

- Apply concepts of electric network topology, nodes, branches, loops to solve circuit problems including the use of computer simulation.
- Understand the basic concepts of graph and analyze the basic electrical circuits using graph theory.
- Apply time and frequency concepts of analysis and understand various functions of network and also the stability of network.

- Learn the various parameters and their interrelationship, able to solve numerical with series, cascade, and parallel connection using two port parameters.

UNIT I

Network Topology:

Principles of network topology, graph matrices, network analysis using graph theory.

Transient Response: Review of properties and applications of Laplace transform; Transient Response of RC, RL, RLC Circuits to various excitation signals such as step, ramp, impulse and sinusoidal excitations using Laplace transform.

UNIT II

Network Functions:

Terminal pairs or Ports, Network functions for one-port and two-port networks, poles and zeros of Network functions, Restrictions on pole and zero Locations for driving point functions and transfer functions, Time domain behavior from the pole-zero plot.

UNIT III

Characteristics and Parameters of Two Port Networks:

Relationship of two-port variables, short-circuit Admittance parameters, open circuit impedance, parameters, Transmission parameters, hybrid parameters, relationships between parameter sets, Inter-connection of two port networks, concept of transform impedance.

UNIT IV

Types of Filters and Their Characteristics:

Filter fundamentals, high-pass, low-pass, band-pass, and band-reject Filters.

Network Synthesis:

Positive real functions, synthesis of one port and two port networks, elementary idea of Active networks.

TEXT BOOKS

1. Van Valkenburg, ―Network analysis‖ PHI, 2000.
2. F.F.Kuo, ―Network Analysis & Synthesis‖ John Wiley & Sons Inc.

REFERENCE BOOKS:

1. Bhise, Chadda, Kulshreshtha, ― Engineering network analysis and filter design‖ Umesh Publication, 2000.
2. D. R. Choudhary, ―Networks and Systems‖ New Age International, 1999.
3. A. Chakrabarti, "Circuit Theory: Analysis and Synthesis", S. Chand Publications.
4. G.K. Mithal, ―Circuit Analysis‖, Khanna Publication.

ETEE 201	ELECTROMECHANICAL ENERGY CONVERSION	L	T	P	C
		3	1	0	4

COURSE OVERVIEW:

Electric machines are a technology of choice in many modern energy conversion applications, including energy storage systems. Interest in machines is steady increasing due in giant half to the pliability of controls offered by trendy computers and power electronic devices. In this course design of electromechanical energy conversion is developed. Upon completion of the course, a student‘s engineering talent ought to contain i) associate understanding of the essential principles of static and mechanical device energy conversion, ii) information of the utilization of organization theory applied to the associate analysis of rotating devices and iii) an understanding of the steady-state and dynamic characteristics of induction, static magnet synchronous, and wound rotor synchronous machines.

COURSE OBJECTIVE:

To provide a basic background in static and electromechanical energy conversion devices; intended for students with interests in the control of electrical and electromechanical systems with applications to electric energy systems.

COURSE OUTCOMES:

Students who successfully complete this course will have the ability to:

- Analyze transformers in the power conversion circuits.
- Understand and use the theory of electromechanical energy conversion to analyze actuators and simple electric machines
- Analyze AC machines, including motors and generators.
- Analyze DC machines, including motors and generators.
- Understanding of torque production in motors.

UNIT I

Magnetic Circuit and Induction: Magnetic Circuits, Magnetic Materials and their properties, static and dynamic emfs and force on current carrying conductor, AC operation of Magnetic Circuits, Hysteresis and Eddy current losses.

UNIT II

DC Machine : Basic theory of DC generator, brief idea of construction, emf equation, load characteristics, basic theory of DC motor, concept of back emf, torque and power equations,

load characteristics, starting and speed control of DC motors, applications.

UNIT III

Synchronous Machine: Constructional features, Armature winding, EMF Equation, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation Synchronous Motor: Starting methods, Effect of varying field current at different loads, V-Curves.

UNIT IV

Three-phase Transformer & Induction Machine: Three Phase Transformer: Review of Single phase transformer. Three Phase transformer: Basics & operation Induction Machine: Constructional features, Rotating magnetic field, Principle of operation Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator & its applications. Introduction of Single phase Induction Motor, Repulsion motor. AC Commutator Motors: Universal motor, single phase a.c. series compensated motor, stepper motors

TEXT BOOKS:

1. D.P.Kothari & I.J.Nagrath, ―Electric Machines‖, Tata Mc Graw Hill

2. Ashfaq Hussain―Electric Machines‖ Dhanpat Rai & Company

REFERENCE BOOKS:

1. P.S.Bimbhra, ―Electrical Machines‖, Khanna Publisher

2. Fitzerald,A.E.,Kingsley and S.D.Umans ―Electric Machinery‖, MC Graw Hill

ETEC263	ANALOG ELECTRONICS LAB	L	T	P	C
		0	0	2	1

Hands-on experiments related to the course contents ETEC210A by performing experiments as given below:

List of experiments:

- Introduction to digital electronics lab- nomenclature of digital ICs, specifications, study of the data sheet, concept of Vcc and ground, verification of the truth tables of logic gates using TTL ICs.
- Implementation of the given Boolean function using logic gates in both SOP and POS forms.
- Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.

- Implementation and verification of Decoder/De-multiplexer and Encoder using logic gates.
- Implementation of 4x1 multiplexer using logic gates.
- Implementation of 4-bit parallel adder using 7483 IC.
- Design, and verify the 4-bit synchronous counter.
- Design, and verify the 4-bit asynchronous counter.
- Static and Dynamic Characteristic of NAND and Schmitt-NAND gate(both TTL and MOS)
- Study of Arithmetic Logic Unit

NOTE: Ten experiments are to be performed, out of which at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed and setup by the course coordinator as per the scope of the syllabus.

Hands-on experiments related to the course contents ETEC233A by performing experiments as given below:

List of experiments:

- To study and plot the characteristics of a junction diode.
- To study Zener diode I-V characteristics.
- To study diode based clipping and clamping circuits
- To study half wave, full wave and bridge rectifier with filters
- To study the input and output characteristics of a transistor in its various configurations (CE and CB).
- To study and plot the characteristics of a JFET in its various configurations.
- To study and plot the characteristics of a MOSFET in its various configurations.
- To study various types of Bias Stabilization for a transistor.
- To study the gain and plot the frequency response of a single stage transistor amplifier.
- To measure gain and plot the frequency response of double stage RC coupled amplifier.
- To study Half & Full wave rectifier and measurement of ripple factor.

		L	T	P	C
ETEE 251	**ELECTRO MECHANICAL ENERGY CONVERSION LAB**	**0**	**0**	**2**	**1**

Hands-on experiments related to the course contents by performing experiments as given below:

- To obtain magnetization characteristics of a dc shunt generator.

- To obtain load characteristics of a dc shunt generator and component generator (a) Cumulatively compounded (b) Differential Compounded.
- To obtain efficiently of a dc shunt machine using Swinburn‘s test.
- To perform Hopkinson‘s test and determine losses and efficiently of dc machine.
- To obtain speed-torque characteristics of a dc shunt motor.
- To obtain speed control of dc separately excited motor using conventional Ward-Leonard/Static Ward-Leonard method.
- To study polarity and ratio test of single phase and 3-phase transformers.
- To obtain efficiently and voltage regulation of a single phase transformer by Sumpner‘s test.
- To obtain 3-phase to 2-phase conversion by Scott connection.
- To determine excitation phenomenon (B.H. loop) of single phase transformer using C.R.O.

ETEC253	CIRCUITS AND SYSTEMS LAB	L	T	P	C
		0	0	2	1

Hands-on experiments related to the course contents by performing experiments as given below:

A. Simulation based

- Introduction of circuit creation & simulation software like TINAPRO, P-Spice, Dr.-Spice/other relevant Software.
- Transient response of RC, RL circuit on any of above software.
- To find the resonance frequency, Band width of RLC series circuit using any of above software.
- To plot the frequency response of low pass filter and determine half-power frequency.
- To plot the frequency responses of high pass filter and determine the half-power frequency.

B. Hardware Based

- To calculate and verify "Z" & ―Y‖ parameters of a two port network.
- To determine equivalent parameter of parallel connections of two port network and study loading effect.
- To calculate and verify "ABCD" parameters of a two port network.
- To synthesize a network of a given network function and verify its respond

SEMESTER IV

		L	T	P	C
ETEC202	**SIGNALS AND SYSTEMS**	**3**	**1**	**0**	**4**

COURSE OVERVIEW:

The objective of the course is to provide brief methodologies for analysis of Signals and Systems to the engineering students. The course module includes introduction of signals and their elementary operations, Laplace and Fourier analysis, Systems and their analysis and Z-Transform.

COURSE OBJECTIVE:

The aim of the course

- Understanding the fundamental characteristics of commonly used signals and systems and their properties. At the end of the course the student should be able to describe signals mathematically and understand how to perform operations on signals.
- Development of mathematical skills to solve problems involving convolution and sampling and its reconstruction.
- Understanding sampling theorem, with time domain and frequency domain analysis of discrete time signals with DTFT, DTFT and Z-Transform.
- Understanding the time and frequency domain analysis of continuous time signals with Fourier series, Fourier transform and Laplace transform.
- Introducing students with various methods of inversion of Z-Transform such partial fraction, Long division and C-R method.

COURSE OUTCOME:

After successful completion of the course students will be able to

- Represent and classify various types of signals and systems.

- Analyze the spectral characteristics of continuous-time and discrete time signals using Fourier analysis and will be able to find Fourier transform for different signals.
- Classify systems based on their properties and determine the response of LTI systems.
- Analyze the system properties based on impulse response and Fourier analysis.
- Apply the Laplace transform and Z-Transform for analyse of continuous time and discrete time signals and systems.
- Understand the process of sampling and the effects of under sampling.

UNIT – I

Types of signals and Elementary operations: Signal Classification: Deterministic and Stochastic, discrete and continuous signals, analog and digital signals, periodic and a periodic, energy and power signals, causal and non-causal signals, one dimensional and multidimensional signals etc., impulse functional sequences, analog and discrete, singular functions. Signal representation in terms of singular functions, orthogonal functions and their use in signal representation.

UNIT-II

Laplace and Fourier analysis: Fourier series, Fourier and Laplace transforms: properties and applications, Signal characterization using fourier and Laplace transform, Convolution theorem: geometrical interpretation and applications.
Discretization of Analog Signals: sampling, sampling theorem and its proof. Effect of under Sampling, recovery of analog signals from sampled signal: reconstruction formula.

UNIT-III

Z-Transform: Introduction and properties of Z-transform, Methods of Z-inversion: Inverse Z- transform by Partial fraction, long-division method and C-R Theorem, Applications of Z-transform.
System Classification: linear and non-linear, time invariant and time varying, lumped and distributed, Deterministic and Stochastic. Casual and non-causal, Analog and Discrete/Digital, memory and memory less, 1 port and N – port, SISO, SIMO, MISO, MIMO.

UNIT-IV

System Modeling: System Models in terms of differential, equations, state variables, difference equations and transfer functions.
System Analysis: Linear time invariant system properties, elementary idea of response determination to deterministic and stochastic signals. Elementary concept of impulse response.

TEXT BOOKS

1. Simon Haykins – ―Signal & Systems‖, Wiley Eastern

REFERENCE BOOKS

1. I J NAGRATH, R. RANJAN, ―Signal and Systems‖, TMH, New Delhi.
2. Simon Haykin & Barry Van Veen, ― Signals and Systems‖, John Wiley &Son.
3. A.V.Oppenheim, A.S.Willsky &A. Nawab, ―Signals and Systems‖ Pearson Education

ETEC216	ADVANCED ANALOG ELECTRONICS LAB	L	T	P	C
		3	1	0	4

COURSE OVERVIEW:

This course is designed to teach and acquire the advance knowledge in analog electronics including multistage amplifiers, feedback amplifiers, Oscillators, Power amplifiers. The student will develop the ability to analyze and design analog electronic circuits. Students learn how BJT work at low and high frequencies, Power amplifiers and feedback amplifiers, different types of oscillators and their working, studying of various types of tuned amplifiers. The student will be able to design amplifier circuits and also can design amplifier circuits in the projects. Student will also be acquainted with the different types of feedback circuits and types of feedback circuit. He also gets to learn importance of feedback in designing.

COURSE OBJECTIVE:

In this course student will be introduced to multistage amplifier, its designing, hybrid modelling of various amplifiers like RC coupled amplifier etc. Feedback amplifiers and necessary condition for establishing feedback connections, Calculation of impedance of various feedback circuits.

Various oscillator circuits like sine oscillator, RC oscillator, crystal oscillator will be studied using hybrid modelling at low and high frequencies. Calculation of resonant frequencies will also be done. For studying large signal amplifiers, powers amplifiers are needed to be taught. Different types of power amplifiers like class A, B, AB and C Push-Pull amplifiers will also be studied. To have regulated power, different types of power supplies are required.

LEARNING OBJECTIVES:

While the students are involved with enjoyable lab experience, the educational pedagogy is pinpointed on vital learning objectives. After the effective finish of the course, learners should be able to recognize the advance analog electronics.

Students will be able to –

- Understand Multi stage amplification and calculation of gain.
- Importance of feedback system.
- Formulate hybrid model for amplifiers.
- Calculation of stability parameters.
- Effect of negative feedback.
- Design an oscillatory circuit.
- Regulation of power supply using diodes and transistors.

UNIT - I

Multistage Amplifiers: Classification of amplifiers, distortion in amplifiers, step response of an amplifier, Cascaded amplifiers, Design of multistage amplifiers, Calculation of gain Impedance and bandwidth.

UNIT – II

Feedback amplifiers: Introduction, feedback parameters, types of feedback: negative and positive, characteristics of feedback amplifiers, input & output resistance, types of feedback connections and their analysis.

UNIT – III

Oscillators: Sinusoidal oscillators, Barkhausen criteria, R-C oscillators, crystal oscillator, Analysis & design – crystal oscillator.

Power Supplies: Switched mode power supplies, Voltage Regulators, Introduction to Inverters, power conditioners, UPS, A.C. Voltage stabilizers

UNIT - IV

Power amplifiers: Classification of large signal amplifiers, Analysis and design with respect to efficiency, linearity and harmonic distortions of class A , class B and AB push-pull amplifiers, single ended power amplifiers.

TEXT BOOK:

1. R.L. Boylestad & L. Nashelsky ―Electronic Devices and Circuit Theory

REFERENCE BOOKS:

1. Spencer and Ghausi, Introduction to Electronic Circuit Design, Pearson Education.

2. A. Dutta, Semiconductor Devices and Circuits, Oxford University Press.

ETEC 264	ADVANCED ANALOG ELECTRONICS LAB	L	T	P	C
		0	0	2	1

Hands-on experiments related to the course contents ETEC216A by performing the experiments as given below:

- Study of lab equipment and components: CRO, Multimeter, Function Generator, Power supply- Active, and Passive Components & Bread Board.

- Application of Zener diode: Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.
- Characteristic of BJT: BJT in CB and CE configuration- Graphical measurement of h parameters from input and output characteristics. Measurement of Av, Ai, Ro and Ri of CE amplifier with potential divider biasing.
- Study of effects of an emitter bypass capacitor on low frequency response of CE amplifier.
- Feedback Amplifiers: Design of feedback amplifiers using BJTs.
- Oscillators: Study of Wein bridge and phase shift oscillator.
- Power Amplifiers: Measurement of efficiency of class B amplifiers.
- Design of amplifier with specified gain using op-amp in inverting and non-inverting mode.

		L	T	P	C
ETEE315	**POWER SYSTEM-I**	**3**	**1**	**0**	**4**

UNIT I

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power

UNIT II

Overhead Transmission Lines:

Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations.

Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of

transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

UNIT III

Overhead Lines Insulators: Types of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential. **Mechanical Design of Transmission Line:** Catenary curve, calculation of sag and tension, effects of wing and ice loadings, sag template, vibration dampers.
Insulated Cables: Types of cables, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables.

UNIT IV

Introduction to DC Transmission & Renewable Energy Systems

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid.

TEXT BOOKS:

1. J. Grainger and W. D. Stevenson, ―Power System Analysis‖, McGraw Hill Education, 1994.
2. C.L.Wadhava, ―Electrical Power Systems‖, New Age International.
3. M. L. Soni, P. V. Gupta and U. S. Bhatnagar, ―A course in Electrical Power‖, Dhanpat Rai& Sons, 1st edition.
4. O. I. Elgerd, ―Electric Energy Systems Theory‖, McGraw Hill Education, 1995.

REFERENCE BOOKS:

1. S. L. Uppal, ―Electrical Power‖, Khanna Publishers, 13th edition.
2. W. H. Stevension, ‖Elements of Power System Analysis‖, McGraw Hill.
3. Ashfaq Hussain, ―Electrical Power System‖ CBS Publishers and Distributors

Text/References:

1. R. Bergen and V. Vittal, ―Power System Analysis‖, Pearson Education Inc., 1999.
2. D. P. Kothari and I. J. Nagrath, ―Modern Power System Analysis‖, McGraw Hill Education, 2003.
3. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, ―Electric Power Systems‖, Wiley, 2012.

ETEE206	ELECTRICAL MACHINES	L	T	P	C
		3	1	0	4

UNIT I

Poly phase Induction Machines – I: Construction features, production of rotating magnetic field, phasor diagram, equivalent circuit, torque and power equations, torque-slip characteristics, no load and blocked rotor test efficiency. Induction generator.
Poly phase Induction Machines – II: Starting and speed control (with and without e.m.f. injection in the rotor circuit), deep bar and double cage induction motors, cogging and crawling.

UNIT II

Three Phase Transformer : Construction and working principle, three phase transformer connections and phasor groups , parallel operation , polarity test, open delta , three phase to two phase conversion (scott connection), three phase to six phase conversion , harmonics , inrush of magnetizing current. Applications of scott connection, open delta system.

UNIT III

Synchronous Machines I: Constructional features, armature windings, E.M.F. equation, winding coefficients, harmonics in the induced E.M.F., armature reaction, O.C. and S.C. tests, voltage regulation-Synchronous impedance method, MMF Method, Potier's triangle method and parallel operation, operation on infinite bus and cooling.

UNIT IV

Synchronous Machines II: Two reaction theory, power expressions for cylindrical and salient pole machines, performance characteristics.
Synchronous Motor-Principle of operation, starting methods, phasor diagram torque-angle characteristics, V-curves hunting and damping, synchronous condenser, reluctance motor.

TEXT BOOKS:

1. M.G.Say, ―Alternating Current machines‖, CBS Publishers.
2. P.S. Bimbhra, ―Electric Machinery‖, Khanna Publishers.

REFERENCE BOOKS:

1. P.S. Bimbhra, ―Generalized Theory of Electrical Machines‖, Khanna Publishers.
2. I.J. Nagrath and D.P. Kothari, ―Electrical Machines‖, Tata McGraw Hill.
3. Ashfaq Hussain – Electric Machines, Dhanpat Rai & Sons.

ETEE256A	ELECTRICAL MACHINES LAB	L	T	P	C
		0	0	2	1

Hands-on experiments related to the course contents by performing the experiments as given below:

- Load test on three phase squirrel cage/ slip ring Induction Motor
- No load & Blocked rotor test on three-phase squirrel cage Induction Motor
- Load test on single phase Induction Motor
- Load test on three phase Induction Generator
- Study of speed control of Induction Motor
- Load test on three phase Alternator
- Pre-determination of voltage regulation of three phase Alternator by EMF/MMF/ZPF Method.
- Synchronization/parallel operation of Alternators.
- V and inverted V curve of an auto synchronous motor and observation on reactive power.
- Determination Direct axis reactance and quadrature axis reactance of a salient pole Alternator by slip test.

INDUCTION MACHINES

1. Load test on 3 phase squirrel cage/ slip ring Induction Motor
2. No load & Blocked rotor test on 3-phase squirrel cage Induction Motor (Performance 3.determination using equivalent circuit and circle diagram)
3. Load test on 1 phase Induction Motor
4. Load test on 3 phase Induction Generator
5. Study of speed control of Induction Motor

SYNCHRONOUS MACHINES

1. Load test on 1/3 phase Alternator
2. Pre-determination of voltage regulation of 3 phase Alternator by EMF/MMF/ZPF Method.
3. Synchronization/parallel operation of Alternators.
4. V and inverted V curve of an auto synchronous motor and observation on reactive power
5. Determination Direct axis reactance and quadrature axis reactance of a salient pole

6. Alternator by slip test.

ETEC 305A	ELECTROMAGNETIC FIELD THEORY	C
		4

COURSE OVERVIEW:

To enable the students, to have a fair knowledge about the theory and problems of electromagnetism and waveguides.

COURSE OBJECTIVE:

The aim of this subject is to acquire the knowledge of Electromagnetic field theory that allows the student to have a solid theoretical foundation to be able in the future to design emission , propagation and reception of electro- magnetic wave systems ,to identify , formulate and solve fields and electromagnetic waves propagation problems in a multidisciplinary frame individually or as a member of a group , to provide the students with a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies,to acquire the knowledge of Electromagnetic field theory that allows the student to have a solid theoretical foundation to be able in the future to design emission , propagation and reception of electro- magnetic wave system ,to identify , formulate and solve fields and electromagnetic waves propagation problems in a multidisciplinary frame individually or as a member of a group and to provide the students with a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies

Course Outcome

- Ability to solve the problems in different EM fields.
- Ability to design a programming to generate EM waves subjected to the conditions
- Applications of EM Waves in different domains and to find the time average power density
- Ability to Solve Electromagnetic Relation using Maxwell Formulae

- Ability to Solve Electro Static and Magnetic to Static circuits using Basic relations
- Ability to Analyse moving charges on Magnetic fields
- Ability to Design circuits using Conductors and Dielectrics.

ETEC 305A	ELECTROMAGNETIC FIELD THEORY	L	T	P	C
		3	1	0	4

UNIT I

Electric Field and Current: Coulomb's law ,Electric field intensity, field due to a continuous volume charge distribution, field of a line charge, field of a sheet of charge, electric flux density, Gauss's law and applications, electric potential, the dipole, current density, continuity of current, metallic conductors, conductor properties and boundary conditions, the method of images, the nature of dielectric materials, boundary conditions for perfect dielectric materials, capacitance of two wire line, Poisson's and Lap lace‘s equations, uniqueness theorem.

UNIT II

Magnetic Field and Maxwell’s Equation: Biot - Savart law, Ampere's law, magnetic vector potentials, force on a moving charge, differential current element, force and torque on a closed circuit, the boundary conditions, the magnetic circuit, potential energy and forces on magnetic materials. Faraday's law, Maxwell's equations in point form and integral form Maxwell's equations for sinusoidal variations, retarded potentials.

UNIT-III

The Uniform Plane Wave: Wave motion in free space and perfect dielectrics, plane waves in lossy dielectrics. The Poynting vector and power considerations, propagation in good conductors, skin effect, reflection of uniform plane waves, SWR.

UNIT-IV

Transmission Lines and Waveguides: The Transmission line equations, graphical methods, Smith chart, time-domain and frequency-domain analysis. TE, TM, TEM waves, TE and TM modes in rectangular and circular waveguides, cut-off and guide wavelength, wave impedance and characteristic impedance, dominant modes, power flow in waveguides, excitation of waveguides, dielectric waveguides.

TEXT BOOKS:

1. M.N.O Sadiku, ―Elements of Electromagnetics‖ Oxford University Press.

REFERENCE BOOKS:

1. David K. Chang, ―Field and Waves Electromagnetics‖, Addison Wesley.
2. Hayt W H, J R Buck., ―Engineering Electromagnetics‖, Tata McGraw Hill, Fifth edition.

ETEC252A	MATLAB PROJECT LAB	L	T	P	C
		0	0	2	1

COURSE OVERVIEW:

The course provides a gentle introduction to the MATLAB computing environment, and is intended for beginning users and those looking for a review. It is designed to give students a basic understanding of MATLAB, including popular toolboxes. The course consists of interactive lectures and sample MATLAB problems given as assignments and discussed in class. No prior programming experience or knowledge of MATLAB is assumed. Concepts covered include basic use, graphical representations and tips for designing and implementing MATLAB code.

COURSE OBJECTIVE:

- On completion of this Subject/Course the student shall be able to
- Familiarize the student in introducing and exploring MATLAB software.
- Enable the student on how to approach for solving Engineering problems using simulation tools.
- Prepare the students to use MATLAB in their project works.
- Provide a foundation in use of this software for real time applications.

EXPECTED OUTCOME:

At the end of the course student will have ability to

- Express programming & simulation for engineering problems.
- Find importance of this software for Lab Experimentation.
- Articulate importance of software‘s in research by simulation work.
- Have in-depth knowledge of providing virtual instruments on MATLAB Environment.
- Write basic mathematical, electrical, electronic problems in MATLAB
- Simulate basic electrical circuit in Simulink.
- Connect programming files with GUI Simulink.

UNIT I

Introduction to MATLAB: Matlab Interactive Sessions,. Menus and the toolbar, computing with Matlab, Script files and the Editor Debugger Matlab Help System.

UNIT II

Matrix Computations: Matrix operations and functions : Transpose, dot product, matrix multiplication, matrix powers, matrix inverse, determinants, solutions to systems of linear equations : solution using matrix inverse, solution using matrix left division, special Matrices: Matrix of zeroes, matrix of ones, identity matrix, diagonal matrices

UNIT III

Symbolic Mathematics: Symbolic Algebra: Symbolic expressions, relational and logical operators, bitwise operations, symbolic plotting, simplification of mathematical expressions, operations on symbolic expressions, Equation solving, differentiation and integration.

UNIT II

Plotting: Introduction, two dimensional plots, basic plotting, line, color and mark style, axes scaling, annotating plots, other types of two dimensional plots, subplots.

Three dimensional plotting: Three dimensional line plots, surface plot, editing plots from menu bar, creating plots from the workspace windows.

TEXT BOOKS:

1. —Rudra Pratap‖, Getting started with MATLAB, Oxford university press.

2. —Delores M. Etter, David C. Kuncicky, Holly Moore — , Introduction to MATLAB 7, Pearson Publications

REFERENCE BOOKS:

1. —David F. Griffiths‖, An introduction to MATLAB

2. Jaydeep Chakravorty, —Introduction to MATLAB programming, toolbox and Simulink‖

LIST OF EXPERIMENTS

1. If X=[1,3,4], Y=[4,5,6] perform following operations :

(a) X+Y (b) X*Y‘ (c) X.*Y

2. Perform basic matrix operations:

(a) Sum (b) mean (c) zeros (d) ones (e) size (f) length (g) inverse

3. Sort numbers in ascending or descending order.

4. Compute the sum of n integers.

5. Find the factorial of 5 .

6. Generate the following row vector b=[1, 2, 3, 4, 5, 9,10], then transpose it to column vector.

7. Tabulate the functions y = 4 sin 3x and u =3 sin 4x for x = 0, 0.1, 0.2,. , 0.5.

8. Create a vector of 4 linearly spaced numbers from 1 to 12

9. Define a function (myfunction) that accepts an array of numbers x, and calculates the sum and mean of the array numbers.

10. Solve the following
system : x+y=1
x-
y+z=
0
x+y+
z=2

ETMC226A	FUNDAMENTALS OF MANAGEMENT	C
		3

Course Overview:

Technical skills alone do not meet the real-world work and the business requirements; they have to be supplemented by management training. In fact, most of the people find that their success depends as much on general management skills and understanding operational systems as on their technical expertise. To become complete professional, students need a firm foundation in these basic managerial skills.

Fundamentals of Management are a basic introductory and foundational management course for under graduates. This course is designed for students to equip themselves with key knowledge, skills and competencies in various aspects of management. This course enables the students to develop an understanding of management and organization and focuses on important management functions such as planning, organizing, leading and controlling for successful managerial activities. The students will learn how successful managers use organizational resources through organizational functions in order to effectively and efficiently achieve organizational objectives.

Specific techniques related to managerial functions are explored as well as the broad issues and trends influence the practice of contemporary management, globalization, technology, diversity, and competitive advantage. Special emphasis is on basics of all the departments in the organization like Human Resource Management, Marketing Management, Productions and Operations Management and Financial Management.

Objectives and Expected Outcomes:

The objective of this course is for each student to be able to know, comprehend, apply, analyze, synthesize and evaluate the basic fundamentals of managing organizations. Through the learning of this course on fundamentals of management, students will gain fundamental knowledge and skills for management in contemporary organizations. These include the ―How to‖ and ―Why‖. Students will also develop analytical and critical thinking skills in the context of contemporary organizations. This focuses on the entire organization from both a short term and long-term perspective for strategic vision, objectives, crafting a strategy and implementing it. Specifically, the learning objectives for the students are:

- Demonstrate basic knowledge of management and organization.
- Demonstrate a basic understanding of management functions such as planning, organizing, leading and controlling; and how successful managers effectively and efficiently use these functions and their business resources to achieve organizational objectives.
- Develop knowledge of fundamental management concepts and skills.
- Identify the key competencies needed to be an effective manager.
- Identify the most important components of human resource planning; outline a model of organizational staffing; recruitment; selection; orientation; human resource

planning and training.

ETMC226A	FUNDAMENTALS OF MANAGEMENT	L	T	P	C
		3	0	0	3

UNIT I

Meaning of management, Definitions of Management, Characteristics of management, Management vs. Administration. Management-Art, Science and Profession. Importance of Management. Development of Management thoughts. Principles of Management. The Management Functions, Inter-relationship of Managerial functions.
Nature and Significance of staffing, Personnel management, Functions of personnel management, Manpower planning, Process of manpower planning, Recruitment, Selection; Promotion - Seniority Vs. Merit. Training - objectives and types of training.

UNIT II

Production Management : Definition, Objectives, Functions and Scope, Production Planning and Control; its significance, stages in production planning and control. Brief introduction to the concepts of material management, inventory control; its importance and various methods.

UNIT III

Marketing Management - Definition of marketing, marketing concept, objectives & Functions of marketing. Marketing Research - Meaning; Definition; objectives; Importance; Limitations; Process. Advertising - meaning of advertising, objectives, functions, criticism.

UNIT IV

Introduction of Financial Management, Objectives of Financial Management, Functions and Importance of Financial Management. Brief Introduction to the concept of capital structure and various sources of finance.

TEXT BOOKS:

1. Principles and Practice of Management - R.S. Gupta, B.D.Sharma, N.S. Bhalla. (Kalyani Publishers)
2. Organisation and Management - R.D. Aggarwal (Tata Mc Graw Hill)

REFERENCE BOOKS:

1. Principles & Practices of Management – L.M. Prasad (Sultan Chand & Sons)
2. Management – Harold, Koontz and Cyrilo Donell (Mc.Graw Hill).
3. Marketing Management – S.A. Sherlikar (Himalaya Publishing House, Bombay).

4. Financial Management - I.M. Pandey (Vikas Publishing House, New Delhi)

5. Management - James A.F. Stoner & R.Edward Freeman, PHI.

SEMESTER V

ETEC 311A	MICROPROCESSOR SYSTEMS	C
		4

COURSE OVERVIEW:

Microprocessor is an essential course for undergraduates in the engineering program. The purpose of this course is to impart the rudiments of microprocessor and microcontroller systems. The student will be able to integrate these notions into their electronic designs for other courses where regulation can be realized via a microprocessor/controller implementation. Topics include Semiconductor memory devices and systems, microcomputer architecture, assembly language programming, I/O programming, interface design, peripheral devices, data communications, and data acquisition systems.

LEARNING OBJECTIVES:

- To introduce 8085 architecture and programming in assembly language
- To introduce basic concepts of interfacing memory and peripheral devices to a microprocessor.
- To introduce serial and parallel bus standards.
- To introduce 8051 microcontroller.
- To introduce various advanced processor architectures such as 80X86, Pentium and Multicore Processors.

EXPECTED OUTCOME:

- Understand the main components and working principals of the Intel 80x86 microprocessor and Intel 80x51 micrcontroller
- Program and debug in assembly language
- Understand the memory organization and memory interfacing
- Interface a microprocessor to external input/output devices and perform input/output device programming in assembly
- Understand the hardware and software interrupts and their applications
- understand the properties and interfacing of the parallel and serial ports

ETEC 311A	MICROPROCESSOR SYSTEMS	L	T	P	C
		3	1	0	4

UNIT I:

Introduction: Evolution of microprocessors, technological trends in microprocessor development. The Intel family tree, CISC Versus RISC, Applications of Microprocessors.
8086 CPU Architecture: Introduction to 8085, 8086 Block diagram; description of data registers, address registers; pointer and index registers, PSW, Queue, BIU and EU, 8086 Pin diagram descriptions, Generating 8086 CLK and reset signals using 8284, WAIT state generation, Microprocessor BUS types and buffering techniques, 8086 minimum mode and maximum mode CPU module

UNIT II:

8086 Instruction Set: Instruction formats, addressing modes, Data transfer instructions, string instructions, logical instructions, arithmetic instructions, transfer of control instructions; process control instructions; Assembler directives.
8086 Programming Techniques: Writing assembly Language programs for logical processing, arithmetic processing, timing delays; loops, data conversions. Writing procedures; Data tables, modular programming, Macros

UNIT III:

Main Memory System Design: Memory devices, 8086 CPU Read/Write timing diagrams in minimum mode and maximum mode, Address decoding techniques, Interfacing SRAMS; ROMS/PROMS. Interfacing and refreshing DRAMS, DRAM Controller – TMS4500.

UNITIV:

Basic I/O Interface: Parallel and Serial I/O Port design and address decoding. Memory mapped I/O Vs Isolated I/O Intel‘s 8255 and 8251- description and interfacing with 8086, ADCs and DACs, types, operation and interfacing with 8086, Interfacing Keyboards, alphanumeric displays, multiplexed displays, and high power devices with 8086.

Interrupts and DMA: Interrupt driven I/O. 8086 Interrupt mechanism; interrupt types and interrupt vector table, Intel‘s 8259, DMA operation, Intel‘s 8237, Microcomputer video displays. **TEXT BOOKS:**

1. D.V.Hall , Microprocessors and Interfacing , McGraw Hill
2. J Uffenbeck , The 8086/8088 family , (PHI).
3. Liu,Gibson , Microcomputer Systems – The 8086/8088 family

REFERENCE BOOKS:

1. B.Ram, ―Fundamentals of microprocessors and microcomputer‖ Dhanpat Rai
2. M. Rafiquzzaman, ―Microprocessor Theory and Application‖ PHI.
3. Naresh Grover, ―Microprocessor comprehensive studies Architecture, Programming

and Interfacing‖ Dhanpat Rai
4. Vaneet Singh and Gurmeet Singh, ―Microprocessor and Interfacing‖ Satyaprakashan

ETEC 353A	MICROPROCESSOR SYSTEMS LAB	L	T	P	C
		0	0	2	1

Hands-on experience enables to relate to the course contents with the practical aspect by performing the given experimental list below:

- a) Familiarization with 8085 & 8086 Trainer Kit.

  b) Familiarization with Digital I/O, ADC and DAC Cards

  c) Familiarization with Turbo Assembler and Debugger S/Ws.

- Write a program to arrange block of data in

  (i) Ascending

  (ii) descending order

- Write a program to find out any power of a number such that Z = X^n . Where n is programmable and X is unsigned number.
- Write a program to generate.

  (i) Sine Waveform (ii) Ramp Waveform (iii) Triangular Waveform Using DAC Card.

- Write a program to measure frequency/Time period of the following functions.

  (i) Sine Waveform (ii) Square Waveform (iii) Triangular Waveform using ADC Card.

- Write a program to increase, decrease the speed of a stepper motor and reverse its direction of rotation using stepper motor controller card.
- Write a programmable delay routine to cause a minimum delay = 2MS and a maximum delay = 20 minutes in the increments of 2 MS
- a) Use DOS interrupt to read keyboard string/character.

  b) Use BIOS interrupt to send a string/character to printer.

- Write a program to :

  (i) Create disk file

  (ii) Open, write to and close- a disk file.

  (iii) Open, read from and close a disk file.

  (iv) Reading data stamp of a file using BIOS interrupt.

- i) Erasing UVPROMs and EEPROMs

  ii) Reprogramming PROMs using computer compatible EPROM Programmer.

- Studying and Using 8086 In-Circuit Emulator.
- Write a Program to perform 8 Bit addition and subtraction using 8085
- Write a program to perform 1‘s and 2‘s complement of a number using 8085.
- Write a program to perform BCD addition of a given decimal numbers using 8085.

ETEC308A	CONTROL SYSTEM	C
		4

COURSE OVERVIEW:

This course is designed to provide essential knowledge **t**o give an outline for the analysis of linear control systems. This will provide a student time and frequency domain tools to design and study linear control systems. The various control systems like closed loop and open loop are studied with the help of real time examples. These systems can be represented by the mathematical differential equations advantages to provide the mathematical modelling of physical systems. The transfer functions give the behavior of the output of the system. The various methods of finding the transfer function block diagrams reduction and signal flow graph can be used. The study of AC servomotors, armature controlled and field controlled DC servomotors by deriving their transfer functions has been done in the course. A system can be fully utilized with the proper use of basic control actions- proportional, integral and derivative controllers, with the feedback effect to analyze the transient and steady state response of first and second order systems. A control system designed must be stable and controllable. The stability of the system is the basic necessity for the sustainability of the system, to keep a check on the stability - Routh‘s Stability criterion, root locus techniques, bode diagram, polar plots and other methods can be used. For studying the output of the system concept of state-state variable and state model with the time invariant and homogeneous state equations are taken for checking the controllability and observability of the system.

LEARNING OBJECTIVES:

While the students are involved with enjoyable lab experience, the educational pedagogy is pinpointed on vital learning objectives. After the effective finish of the course, learners should be able to recognize the basic of control system.

EXPECTED OUTCOME:

- Identify open and closed loop control system
- Importance of feedback system.
- Formulate mathematical model for physical systems.
- Simplify representation of complex systems using reduction techniques.
- Use standard test signals to identify performance characteristics of first and second- order systems.

- Apply different techniques for stability analysis.
- Analyze performance characteristics of system using Frequency response methods

ETEC308A	CONTROL SYSTEM	L	T	P	C
		3	1	0	4

UNIT - I

Definitions of Control Systems, Closed Loop and Open Loop Control system, Examples of Control Systems. Mathematical modelling of physical systems, differential equations of physical systems, transfer functions. Armature controlled and field controlled DC servomotors; AC servomotors and deriving their transfer functions; Transfer function from block diagrams and signal flow graphs.

UNIT - II

Basic Control Actions: Proportional, integral and Derivative controllers, effect of feedback on control system; Transient and steady state response of first order system; Second order system, Routh's Stability criterion, relative stability analysis; Static error co-efficient, position, velocity and acceleration error co-efficient.

UNIT – III

Root Locus Techniques Bode Diagram, Minimum and Non-Minimum phase systems; Determination of Transfer from Bode Diagram; Polar Plots; Nyquist Plot; Stability Analysis using; Constant M & N Loci.

UNIT - IV

Introduction to Compensators; lead, lag, lead-lag compensators, Concept of state- state variable and state model, Solution of time invariant, homogeneous state equation, controllability and observability, state transition matrix and its properties.

Text Books:

1. I. J. Nagrath, M. Gopal, ―Control System Engineering‖ New Age International.
2. N. K. Jain, ―Automatic Control System Engineering‖ Dhanpat Rai

Reference Books:

1. Ogata, ―Modern Control Engineering‖ EEE
2. Kuo, ―Automatic Control Systems‖ PHI

ETEC358A	CONTROL SYSTEM LAB	L	T	P	C
		0	0	2	1

Hands-on experience enables to relate to the course contents ETEC308A with the practical aspect by performing the given experimental list below:

- To study speed Torque characteristics of A.C. servo motor and DC servo motor.
- To demonstrate simple motor driven closed loop DC position control system.
- To study the lead, lag, lead-lag compensators and to draw their magnitude and phase plots.
- To study a stepper motor & to execute microprocessor or computer-based control of the same by changing number of steps, direction of rotation & speed.
- To optimize Ki, Kp, Kd for best control of temperature.
- To study behavior of 1 order, 2 order type 0, type 1 system.

MATLAB BASED

- Determine transpose, inverse values of given matrix.
- Plot the pole-zero configuration in s-plane for the given transfer function.
- Plot unit step response of given transfer function and find peak overshoot, peak time.
- Plot unit step response and to find rise time and delay time.
- Plot locus of given transfer function, locate closed loop poles for different values of k.
- Plot root locus of given transfer function and to find out S, WD, Wn at given root & to discuss stability.
- Plot bode plot of given transfer function and find gain and phase margins
- Plot the Nyquist plot for given transfer function and to discuss closed loop stability, gain and phase margin.

List of experiments:

1. To study speed Torque characteristics of

a. A.C. servo motor

b. DC servo motor.

2.a. To demonstrate simple motor driven closed loop DC position control system.

b. To study and demonstrate simple closed loop speed control system.

3. To study the lead, lag, lead-lag compensators and to draw their magnitude and phase plots.

4. To study a stepper motor & to execute microprocessor or computer-based control of the same by changing number of steps, direction of rotation & speed.

5. To optimize Ki, Kp, Kd for best control of temperature.

6. To study behavior of 1 order, 2 order type 0, type 1 system.

7. To study control action of light control device.

8. To study water level control using an industrial PLC.

9. To study motion control of a conveyor belt using industrial PLC

MATLAB based (any four expt.)

10. Introduction to MATLAB (Control System Toolbox), Implement at least any FOUR.

i. Different Toolboxes in MATLAB,

ii. Introduction to Control Systems Toolbox.

iii. Determine transpose, inverse values of given matrix.

iv. Plot the pole-zero configuration in s-plane for the given transfer function.

v. Plot unit step response of given transfer function and find peak overshoot, peak time.

vi. Plot unit step response and to find rise time and delay time.

vii. Plot locus of given transfer function, locate closed loop poles for different values of k.

viii. Plot root locus of given transfer function and to find out S, WD, Wn at given root & to discuss stability.

ix. Plot bode plot of given transfer function and find gain and phase margins

x. Plot the Nyquist plot for given transfer function and to discuss closed loop stability, gain and phase margin.

ETEC305A	MEASUREMENT & INTRUMENTATION	C 4

COURSE OVERVIEW:

The objective of the course is to study the basic concepts and definitions in measurement, oscilloscope, electronic instruments, generation & analysis of waveforms, frequency & time measurement and transducers & signal conditioning. It discusses about the importance of signal generators, analyzers in measurement and the importance and functioning of transducers & signal conditioning system.

COURSE OBJECTIVE:

The objective of the course is to study the methods of measurement, analog measurement of electrical quantities, AC potentiometer and digital measurement of electrical quantities. The measurement can be done by analog meters, which point toward electrodynamic ,thermocouple electrostatic & rectifier type ammeters & voltmeters. Electrodynamic wattmeter and three phase wattmeters are used to measure the power. Measurement of voltage, current , power ,energy, flux and iron losses is a important part of electrical and electronics systems, which can be completed with the various meters. AC and DC bridges play important role in the measurement of low, medium and high resistances**,** Measurement of Inductance & Capacitance. The students can explore to measure frequency and phase differences by Lissajous Patterns. These patterns are formed on the cathode ray oscilloscope. The course contains digital meter, pulse generators, signal generators, function generators, wave analyzers, distortion analyzers, spectrum analyzer, Harmonic analyzer, FFT analyzer and decade counting Assembly (DCA) for the measurement of frequency and time; and for analyzing the waveforms. Automation is the major contribution of engineering in the today‘s scenario and transducers play important role in this.

COURSE OUTCOMES:

- Identify the various parameters that are measurable in electronic instrumentation.
- Employ appropriate instruments to measure given set of parameters.
- Practice the construction of testing and measuring set up for electronic systems.
- To have a deep understanding about instrumentation concepts which can be applied to Control systems?
- Relate the usage of various instrumentation standards.

ETEC305A	MEASUREMENT & INTRUMENTATION	L	T	P	C
		3	1	0	4

UNIT I

Measurement & Errors: Methods of Measurement, Measurement System**,** Classification of instrument system, Characteristic of instrument & measurement system Errors in Measurement & its Analysis, Standards. Principles, Construction and application of moving coil, moving iron, electrodynamometer type, induction type instruments and extension of range of ammeter, voltmeter (shunt and multiplier).

UNIT II

AC & DC Bridges: Different methods of measuring low, medium and high resistances, Measurement of Inductance & Capacitance with the help of various DC & AC Bridges, Q Meter. **Magnetic Measurement:** Ballistic Galvanometer, Flux meter, Determination of

Hysteresis loop, Measurement of iron losses.

Measurement of power, Energy, phase and frequency. Radio frequency power measurements

UNIT III

Cathode Ray Oscilloscope: Basic CRO circuit (Block Diagram), Cathode ray tube (CRT) & its component, Application of CRO in measurement, Lissajous Pattern., Dual trace &dual beam

Oscilloscope. Sampling and storage oscilloscope. Introduction to digital meter, $3\frac{1}{2}$ bit (very low price concept) to $10\frac{1}{2}$ bit (very high price concept).

UNIT – IV

Transducers: Introduction and classification of transducers, strain gauges and their types, Resistance thermometers, thermistors , thermocouples, Linear variable differential transformer, Rotary variable differential transformer, capacitive transducer, Piezo-electric transducer, Opto- electronic transducers.

TEXT BOOK:

1. E.W. Golding & F.C. Widdis, ―Electrical Measurement &Measuring Instrument‖, A.W. Wheeler& Co. Pvt. Ltd. India.
2. A.K. Sawhney: ―Electrical & Electronic Measurement & Instrument ―,DhanpatRai& Sons , India .

REFERENCE BOOKS:

1. Forest K. Harries, ―Electrical Measurement― Willey Eastern Pvt. Ltd. India.
2. M.B. Stout, ―Basic Electrical Measurement‖ Prentice hall of India, India.
3. W.D. Cooper,‖ Electronic Instrument & Measurement Technique ―Prentice Hall International.
4. J.B. Gupta, ―Electrical Measurements and Measuring Instruments‖ S.K. Kataria & Sons

ETEC355A	MEASUREMENT & INTRUMENTATION LAB	L	T	P	C
		0	0	2	1

Hands-on experience enables to relate to the course contents ETEC305A with the practical aspect by performing the given experimental list below:

- Study blocks wise construction of an Analog Oscilloscope & Function generator.

- Study blocks wise construction of a Multimeter & frequency counter.
- Study Measurement of different components & parameters like Q of a coil etc. using LCRQ meter.
- Study of distortion factor meter and determination of the % distortion of the given oscillator
- Determine output characteristics of a LVDT and Measure displacement using LVDT
- Study characteristics of temperature transducer like Thermocouple, Thermistor & RTD with implementation of a small project using signal conditioning circuits like instrumentation amplifier.
- Measurement of Strain using Strain Gauge.
- To study differential pressure transducer & signal conditioning of output signal.
- Measurement of level using capacitive transducer.
- Study of Distance measurement using ultrasonic trans

ETEE304A	INDUSTRIAL ELECTRICAL SYSTEMS	C
		3

COURSE OVERVIEW:

The course will provide the basic knowledge on the electrical system components, residential, commercial electrical systems, industrial electrical systems industrial electrical system automation and illumination systems.

COURSE OBJECTIVE:

The industrial electrical system is a hands-on field that integrates computers with electrical science and math. Industrial electrical systems require individuals to know about wiring, circuit operation and logic controllers. This course prepares graduates for careers in building maintenance and electronics repair, working for construction and utility companies.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- Understand various components of industrial electrical systems.
- Analyze and select the proper size of various electrical system components.

		L	T	P	C

ETEE304A	INDUSTRIAL ELECTRICAL SYSTEMS	3	0	0	3

UNIT I

Electrical System Components

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

UNIT II

Residential and Commercial Electrical Systems

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT III

Industrial Electrical Systems

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components. DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks

UNIT IV

Industrial Electrical System Automation

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Illumination Systems

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation.

Text/Reference Books

1. S. L. Uppal and G. C. Garg, ―Electrical Wiring, Estimating & Costing‖, Khanna publishers, 2008.

2. K. B. Raina, ―Electrical Design, Estimating & Costing‖, New age International, 2007.

3. S. Singh and R. D. Singh, ―Electrical estimating and costing‖, Dhanpat Rai and Co.,1997.

4. H. Joshi, ―Residential Commercial and Industrial Systems‖, McGraw Hill Education,2008.

ETEC 303A	ANALOG AND DIGITAL COMMUNICATION	C
		4

COURSE OVERVIEW:

The objective of the course is to study Communication Systems in detail by understanding the baseband and band pass modulation.

COURSE OBJECTIVE:

In students will analyze and compare different analog modulation schemes for their efficiency and Band width, the behavior of a communication system in presence of noise, investigate pulse modulation system and analyze their system performance and analyze different digital modulation schemes and can compute the bit error performance

COURSE OUTCOMES:

- After successful completion of the course student will be able to
- Analyze and compare different analog modulation schemes for their efficiency and
- bandwidth
- Analyze the behavior of a communication system in presence of noise
- Investigate pulsed modulation system and analyze their system performance
- Analyze different digital modulation schemes and can compute the bit error performance
- Aim is to identify the functions of different components
- Learn about theoretical bounds on the rates of digital communication system and represent a digital signal using several modulation methods It also focuses on pulse modulation and demodulation

ETEC 303A	ANALOG AND DIGITAL COMMUNICATION	L	T	P	C
		3	1	0	4

UNIT I

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals, Noise in amplitude modulation systems, Frequency modulation systems. Pre-emphasis and De- emphasis,

UNIT II

Digital Modulation : Introduction to ASK, FSK, PSK(BPSK,QPSK,M-ary PSK), Constellation Diagram, , coherent and non-coherent detection of ASK, FSK, PSK , Probability of bit error for coherently detected BPSK , FSK and comparison of bit error performance for various modulation types, Error performance degradation in communication system.

UNIT III

Baseband Detection: Maximum likelihood receiver structure, matched filters, error performance of binary signaling, inter-symbol interference, Nyquist criterion for zero ISI & raised cosine spectrum, demodulation and detection of shaped pulses, channel characterization, eye pattern, Basis function and Grahm Schmitt Procedure. Matched filter receiver, derivation of its, impulse response and peak pulse signal to noise, correlation detector decision threshold and error probability for binary Unipolar (on – off) signaling.

UNIT - IV

Digital multiplexing : Fundamentals of time division multiplexing, electronic commutator, bit, byte interleaving E1 Carrier system, Synchronization and signaling of E1, TDM, PCM hierarchy.

Spread Spectrum Modulation: Introduction of spread spectrum, direct sequence spread spectrum with coherent BPSK, frequency spread spectrum techniques in CDMA. pseudo noise sequence, signal space dimensionality & processing gain, probability of error.

TEXT BOOKS:

1. B. P. Lathi, ―Modern Digital and Analog Communication System‖ Oxford University Press – 3rd Edition.

REFERENCE BOOKS:

1. Simon Haykin, ―Communication Systems‖ John Wiley & Sons Inc, 4th Edition
2. W. Tomasi, ―Electronic Communication Systems‖ Pearson Education, 5th Edition
3. Taub Schilling, ―Principles of Communication Systems‖ TMH, 2nd Edition.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley,1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000

ETEC359 A	ANALOG AND DIGITAL COMMUNICATION LAB	L	T	P	C
		0	0	2	1

Hands-on experiment Hands-on experiments related to the course contents ETEC 303A by performing experiments as given below

LIST OF EXPERIMENTS

Software based

- Generation of DSB-SC AM signal using balanced modulator.
- Generation of SSB AM signal.
- Frequency modulation using voltage controlled oscillator.
- To generate a FM Signal using Varactor & reactance modulation.
- Detection of FM Signal using PLL & foster seelay method.
- Generation & Detection of PAM,PWM, PPM
- To Study Super heterodyne AM receiver and measurement of receiver parameters viz. sensitivity, selectivity & fidelity.

Hardware Based

- Study of pulse code modulation and demodulation with parity & Hamming code.
- Study pulse data coding & decoding techniques for various formats.
- Study of ASK, FSK modulator and demodulator.
- Study of PSK & QPSK modulator and demodulator.
- To Study Super heterodyne AM receiver and measurement of receiver parameters viz. sensitivity, selectivity & fidelity.
- To study the circuit of PAM/PWM/PPM modulator & Demodulator.
- Study of Frequency Division Multiplexing/Demultiplexing with sinusoidal & audio inputs.
- Study of 4 channel Time Division Multiplexing system.

ETEE 312A	POWER SYSTEM II	C
		4

COURSE OVERVIEW:

This course is a maiden subject in the field of electric power systems. Electric power has

become progressively vital as a way of transmitting and transforming energy in manufacturing and in daily usage. Electric power systems are also at the heart of alternative energy systems, including wind and solar electric as renewable energy sources and conventional power generation from fossil fuels.

COURSE OBJECTIVE:

This introductory course begins with the simple representation of power system as per unit system. A review of three-phase power calculations, the per-unit system, and phasor algebra— basic tools used in modeling and how to solve nearly all types of power system problems. The course is designed to learn symmetrical components and use them to calculate balanced and unbalanced short-circuit faults, and open-circuit faults on three-phase power systems. In addition, students will learn load flow analysis of load flow equations using Gauss Seidel, Newton Raphson and Fast Decoupled method. This course linked power systems for a better understanding of symmetrical components at the ‗real-world' utility level. Steady state and transient stability of the system is always a concern in the power transmission. The course provides an awareness to check the stability by equal area criterion.

COURSE OUTCOME:

To enable the students to gain comprehensive knowledge on power system analysis problems. Students will be able to –

- To develop mathematical model of a given power system.
- To perform power flow analysis using numerical techniques.
- To analyze the behavior of the power system under faulted condition.
- To study the stability status of power system under steady state and transient condition.
- To gain practical aspects on power system analysis problems.

		L	T	P	C
ETEE 312A	**POWER SYSTEM II**	**3**	**1**	**0**	**4**

UNIT I

Power Flow Analysis

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution

of the power flow equations. Computational Issues in Large-scale Power Systems.

UNIT II

Stability Constraints in synchronous grids

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three-phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4th order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

UNIT III

Control of Frequency and Voltage

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers. Power flow control using embedded dc links, phase shifters.

UNIT IV

Power System Economics and Management

Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework.

Text Books:

1. Wadhwa C.L.‖ Electrical Power Systems‖, Sixth Edition, New Age International Publishers, New Delhi.

2. Nagarath I.J. and Kothari D.P. ―Modern Power System Analysis‖, Fourth Edition, Tata McGraw Hill Publishing company, New Delhi.

References Books:

1. Hadi Sadat, ―Power System Analysis‖, Tata McGraw Hill Publishing company, New Delhi.

2. Abhijit Chakrabarti and Sunita Halder, ―Power System Analysis Operation and Control‖, PHI Learning Private Limited, New Delhi.

3. John.J.Grainger, William D. Stevenson, ―Power System Analysis‖, Tata McGraw Hill Publishing company, New Delhi.1994.

4. O. I. Elgerd, ―Electric Energy Systems Theory‖, McGraw Hill Education, 1995.

5. A. R. Bergen and V. Vittal, ―Power System Analysis‖, Pearson Education Inc., 1999

6.. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, ―Electric Power Systems‖, Wiley, 2012.

ETEE351A	PRACTICAL TRAINING-I	L	T	P	C
		0	0	0	1

COURSE OBJECTIVE:

The object of practical training-I is to enable the student to the investigative study taken up under core branch, involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry.

COURSE OUTCOME:

This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

- In depth study of the topic assigned in the light of the Report prepared under practical training-I.
- Review and finalization of the Approach to the Problem relating to the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
- Final development of product/process, testing, results, conclusions and future directions.

SEMESTER VI

SMMC123A	**BUSINESS APPLICATIONS OF ECONOMICS**	**C**
		3

Overview:

"The Quest of knowledge is like searching for pearls in the depth of the ocean"

Anonymous.

The fundamental and unique course of ―Business Applications of Economics‖ would encourage the action learning and value addition to the potential business learners who are enthusiastic and passionate with the thought of working in International behemoths and soon-to-be-Indian behemoths of today. Also, then they need to apprehend about Business Economics jargons which are basically related to various disciplines like Management Accounting, Economics, Basic Finance, and the like. Study of the course on Economics gives practical insight to solve business dilemmas by using its tools for other disciplines.

Business Economics is one of the most important parts of economics. It has both theoretical as well as practical importance in today's business scenario. Different theories of microeconomics help in the study of various business problems which create a major impact on the performance of a firm in complex business world like today. The analysis of its applications has great importance in the fields, such as production, pricing, optimum allocation of resources, social welfare and etc. It provides a critical insight in business decision making and forward planning in addition to make these decisions appropriate enough to maximize the sale and growth of a firm.

To make this course student-friendly, the learning would be anecdotal, personal examples from the eyes of the instructor and including amazing CFOs and it will highlight their new roles in ever-growing and changing business ecosystem in this digital world & sensitizing them of principles of business economics at firm level.

Objective and Expected Outcome:

While going through this course, students would be exposed to business dilemmas as per the course boundaries which will be rationalized with new thinking and tools while delivering the

course. Also, this course focuses on recent examples of current market's simulation, merger, disruptive new models of business forms and its impact on new business ecosystem.

Students will appreciate dynamic micro economic principles in action based on the problem of scarcity and choice. Moreover, given uncertain and dynamic environment around us, they need to have a global mind set with Indian ethos and values.

On completion of these unique and over-encompassing principles of business economics, an appropriate acumen will take future managers locally and globally acceptable. Most specifically, this course will make learners-

- To overview various economic tools, theories and principles, the exciting concepts of Marginal Decisions and Incremental Decisions.
- To understand the factors influencing Customer's choice and how their decisions affect the goods market by affecting the demand, the supply and the price.
- To understand the various types of elasticities i.e., demand, price and income as consumer shifts from one market to another, these elasticities show the extent of change in the market conditions which further enhance an insight about the fluctuations in commodity market.
- In a free economy everyone has freedom regarding the consumption and production of goods and services, allocation and mobilization of resources, modes of production and quantity of production. For businessmen, this type of free economy knowledge microeconomics has a great importance.
- Profit maximization and cost minimization are the fundamental goals of a firm which, one can be understood through the dynamics of Cost Analysis & Price Output Decisions, and thereby leading to optimal cost, price decisions with the help of various interesting curves.
- It helps to comprehend with the concepts of market and its various forms which are influenced by the cost, revenue, demand and supply forces.

ETMC123A	BUSINESS APPLICATIONS OF ECONOMICS	L	T	P	C
		3	0	0	3

UNIT-I

Promotion of Entrepreneurship: Meaning, definition and functions of an entrepreneur, qualities of a good entrepreneur; Role of Entrepreneur in economic development; Government measures for the promotion of small scale industries with special reference to Haryana; Cultural factors in developing entrepreneurship.

UNIT - II

Ownership and Location of Industrial Units: Different forms of Industrial Organisation; Theories of Industrial location; Process of preparing project reports.
Size of Firm and Pricing: Concept of optimum firm, factors determining Optimum size. Technical, Managerial, Marketing Uncertainties and risk.Pricing Methods, Policies and procedures.

UNIT - III

Financing of Small Industries: Importance and need : Commercial Banks and term lending in India; Banks and under-writing of capital issues; Brief description about the role of other financial agencies viz; Industrial Finance Corporation of India. State Financial Corporation, Industrial Development Bank of India; Unit Trust of India.

UNIT - IV

Problems Faced by Small Enterprises: Problems connected with Marketing, Management of New Products; Power; Finance; Raw Material; Under-utilization of capacity; Causes of under – utilization; Rehabilitation of Sick Mills.

Government and Business

(a) Highlights of Industrial Policy and Licensing Policy.

(b) International Marketing with special reference to export documentation.

TEXT BOOKS:

1. Entrepreneurship of Small Scale Industries – Deshpande Manohar D. (Asian Publishers, New Delhi)
2. Environment and Entrepreneur – Tandon B.C. (Asian Publishers, New Delhi).

REFERENCE BOOKS:

1. The Industrial Economy of India – Kuchhal S.C. (Chaitanya, Allahabad).

ETEC314A	DIGITAL SIGNAL PROCESSING	C
		4

COURSE OVERVIEW:

The main objective of this subject is to help the students to mathematically analyze different types of signals and their associated systems.

LEARNING OBJECTIVES:

- Linear filtering using DFT and frequency analysis of signals using DFT.
- Introduction to discrete time systems implementation.

- To understand designing of FIR and IIR filters using window method.
- Introduction to design IIR filter in frequency domain.

EXPECTED OUTCOME:

- Students will be able to study data compression technique, real time computing and various other newly emerging techniques related to this field.
- Students can implement DSP algorithms on purpose-built hardware such as application specific integrated circuits.
- Learn how to run programs on MATLAB software.
- Applications of DSP include audio signal processing, audio compression, digital image processing, video compression and so on. With good knowledge of this subject, students can work on various real time projects.

ETEC314A	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	1	0	4

UNIT I

Discrete Transforms: Review of Z- and Inverse Z-transform and Inversion of Z-transform and solution of difference equations. Analysis of LTI systems in Z-domain, causality, stability, schur- cohn stability test relationship between Z-transform and Fourier transform.
DFT and FFT Computation: Properties of DFT, Linear filtering using DFT, Frequency analysis of signals using DFT, Frequency selective filters; all pass filters, minimum-phase, and maximum-phase and mixed-phase systems.

UNIT II:

Implementation of Discrete Time Systems: Direct form, cascade form, frequency sampling and lattice structures for FIR systems. Direct forms, transposed form, cascade form parallel form. Lattice and lattice ladder structures for IIR systems, Quantization of filter co-efficient structures for all pass filters.

UNIT III:

Design of FIR Filters: Characteristics of practical frequency selective filters. Filters design and specifications: Peak pass band ripple, minimum stop band attenuation.
Design of FIR Filters using windows: Kaiser Window methods, comparison of design methods for FIR filters, Gibbs phenomenon, and design of FIR filters by frequency sampling method, design of optimum equi ripple FIR filters, alternation theorem.

UNIT IV:

Design of IIR Filters: Design of IIR filters from analog filters, Design by approximation of derivatives, Impulse invariance method, Bilinear transformation method, characteristics of Butterworth filters, Frequency transformation, least square methods.

Design of IIR Filters in Frequency Domain: Chebyshev, and Elliptical analog filters and their design, Frequency transformation, least square methods, design of IIR filters in frequency domain.

Text Books:

1. John G. Proakis, ―Digital Signal Processing‖ PHI – 3rd Edition.

Reference Books:

1. S. K. Mitra, ―Digital Signal Processing‖ (PHI)
2. Johny Johnson, ―Introduction to Digital Signal Processing‖ PHI.
3. Salivahan, ―Digital Signal Processing‖ , TMH
4. Oppenheim A.V.and Schafer R.W., "Discrete Time Signal Processing‖, Pearson Education.

ETEC360A	DIGITAL SIGNAL PROCESSING LAB	L	T	P	C
		0	0	2	1

Hands-on experience related to the course contents by performing experiments as given below:

- To represent basic signals (Unit step, unit impulse, ramp, exponential, sine and cosine).
- To develop program for discrete convolution.
- To develop program for discrete correlation.
- To understand stability test.
- To understand sampling theorem.
- To design analog filter (low-pass, high pass, band-pass, band-stop).
- To design digital IIR filters (low-pass, high pass, band-pass, band-stop).
- To design FIR filters using windows technique.
- To design a program to compare direct realization values of IIR digital filter
- To develop a program for computing parallel realization values of IIR digital filter.
- To develop a program for computing cascade realization values of IIR digital filter
- To develop a program for computing inverse Z-transform of a rational transfer function.

LIST OF EXPERIMENTS

1. To represent basic signals (Unit step, unit impulse, ramp, exponential, sine and cosine).
2. To develop program for discrete convolution.
3. To develop program for discrete correlation.
4. To understand stability test.
5. To understand sampling theorem.
6. To design analog filter (low-pass, high pass, band-pass, band-stop).
7. To design digital IIR filters (low-pass, high pass, band-pass, band-stop).
8. To design FIR filters using windows technique.
9. To design a program to compare direct realization values of IIR digital filter
10. To develop a program for computing parallel realization values of IIR digital filter.
11. To develop a program for computing cascade realization values of IIR digital filter
12. To develop a program for computing inverse Z-transform of a rational transfer function.

ETEE403A	SWITCHGEAR AND PROTECTION	C
		4

COURSE OVERVIEW:

To introduce the students with basic concepts of Relays, Protection schemes, Switch gear and modern trends in protection for protecting the power system equipment

COURSE OBJECTIVE:

In spite of all care and precautions taken in the design, installation and operation of Power system and power equipment, abnormal conditions and faults do occur in the system. Some fault such as short circuits can prove highly damaging, not only to the components but also to the entire power system. However continuity of power supply is needed in day to day life. So study of switchgear and protection is essential. It is expected that the understanding of operational principles, selection and testing aspects of switchgear and protection system must be known by students which ultimately help them to maintain the reliability of electric supply in discharging their duties as a supervisor or a technician in substation, manufacturing industries and public service utilities

COURSE OUTCOMES:

- Acquire the knowledge of various abnormal conditions that could occur in power system
- Test the performance of different protective relays, Maintain protection systems used for protection of alternators and transformers.
- Ability to design various protective devices in power system for protecting equipment

and personnel.

- Knowledge of various types of existing circuit breakers, their design and constructional details.
- Knowledge of various conventional relays, their design and latest developments.
- Knowledge of standards and specifications related to switchgear and protection.

ETEE403A	SWITCHGEAR AND PROTECTION	L	T	P	C
		3	1	0	4

UNIT I

INTRODUCTION TO PROTECTION SCHEME: Need for Protective systems - Nature and causes of Faults -Types of faults - Effect of faults - fault statistics - Evolution of protective relays
- Zones of protection - Primary and Back -up Protection - Essential qualities of Protection - Classification of Protective schemes -Automatic reclosing - current transformer for Protection - potential transformer - summation transformer -phase – sequence current - segregating network - basic relay terminology.

UNIT II

RELAYS: General considerations - sensing of faults - construction of electro-magnetic attraction and induction types relays - Buchholz and negative sequence relay - concept of reset, pick up, inverse time and definite time characteristics, over current, over voltage, directional, differential and distance relays on R-X diagram.
Static Relays: Introduction, advantage and limitation of static relays, static over current, directional, distance and differential relays.

UNIT III

PROTECTION: Types & detection of faults and their effects, alternator protection scheme (stator,
Rotor, reverse power protection etc.) - Power transformer protection (external and internal faults protection), generator-transformer unit protection scheme, bus bar protection - Transmission line protection (current/time grading, distance), Pilot relaying schemes, power line carrier protection.

UNIT IV

SWITCHGEAR: Theory of current interruption- energy balance and recovery rate theory, arc quenching, recovery and restriking voltages - Types of circuit breakers. bulk oil and minimum oil, air break and air blast, sulphur hexafluoride (SF6) and vacuum circuit breakers

- Rating selection and testing of circuit breakers/operating mechanisms - LT switchgear, HRC fuses, types construction and applications.

TEXT BOOKS:

1. Badriram & Vishwakarma, ―Power System Protection‖, Tata McGraw-Hill Education.
2. Paithankar Y. G., S. R. Bhide., ―Fundamentals of power system protection‖ PHI Learning Pvt. Ltd.

REFERENCES BOOKS:

1. The Elementary Council, ―Power System Protection‖, Vol.1,2 &3, Peter PeregrinusLtd.Tata McGraw-Hill Education.
2. Ravindra Nath.B, and Chandar.M, ―Power systems protection and switchgear‖,New age international (P) Ltd.
3. Rao Sunil.S, ―Switchgear and protection‖. Khanna Publishers.
4. Paithankar.Y.G,‖ Transmission Network Protection: Theory and Practice‖, MarcelDeicker, Inc.
5. Van.A.R & Warrington.C, ―Protective Relays: Their Theory and Practice‖, Vol 1 & Vol 2, Chapman and Hall. Springer.
6. GEC Measurements, ―Protective Relays: Application Guide‖, GEC Measurements. ―J & P Switchgear handbook‖ Newnes-Butterworths.

ETEE362A	POWER SYSTEM LAB	L	T	P	C
		0	0	2	1

Hands-on experience related to the course contents ETEE403A by performing experiments as given below:

- To determine direct axis reactance (xd) and quadrature axis reactance (xq) of a salient pole alternator.
- To determine negative and zero sequence reactances of an alternator.
- To determine sub transient direct axis reactance (xd) and sub transient quadrature axis reactance (xq) of an alternator.
- To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation.
- To study the IDMT over current relay and determine the time current characteristics.
- To study percentage differential relay.
- To study Impedance, MHO and Reactance type distance relays.

- To determine location of fault in a cable using cable fault locator.
- To study ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.
- To study operation of oil testing set.

List of experiments:

1. To determine direct axis reactance (xd) and quadrature axis reactance (xq) of a salient pole alternator.
2. To determine negative and zero sequence reactances of an alternator.
3. To determine sub transient direct axis reactance (xd) and sub transient quadrature axis reactance (xq) of an alternator.
4. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation.
5. To study the IDMT over current relay and determine the time current characteristics.
6. To study percentage differential relay.
7. To study Impedance, MHO and Reactance type distance relays.
8. To determine location of fault in a cable using cable fault locator.
9. To study ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.
10. To study operation of oil testing set.

Simulation Based Experiments (using MATLAB or any other software).

11. To determine transmission line performance.
12. To obtain steady state, transient and sub-transient short circuit currents in an alternator.
13. To obtain formation of Y-bus and perform load flow analysis.
14. To perform symmetrical fault analysis in a power system.
15. To perform unsymmetrical fault analysis in a power system 16.

ETEE316A	POWER ELECTRONICS	C
		4

COURSE OVERVIEW:

The main aim of this subject is to introduce students to the basic theory of power semiconductor devices and passive components, their practical applications in power electronics, to familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications and to provide strong foundation for

further study of power electronic circuits and systems.

COURSE OBJECTIVE:

The objective of the course is to learn the characteristics of different types of power electronic devices such as thyristors, MOSFET, IGBT, DIAC, TRIAC etc, understand the operation of controlled rectifiers, understand the operation of choppers, understand the operation of inverters, understand the operation of AC voltage regulators, cyclo-converters and PWM techniques and to learn the operation of control circuits and applications of power electronic circuits.

EXPECTED OUTCOME:

By studying this subject student of Electrical Engineering will have detailed knowledge of various solid state devices and various converters as most of the equipment‘s and machines uses power electronic devices as by the use of power electronic devices the overall cost and size of machine and equipment is reduced.

ETEE316A	POWER ELECTRONICS	L	T	P	C
		3	1	0	4

UNIT I

Characteristics and switching behavior of different solid - state devices namely Power diodes, SCR, UJT TRAIC DAIC, MOSFET, GTO, IGBT, MCT and Power Transistors. Two transistor analogy SCR, Firing circuits of SCR and TRAIC, SCR gate characteristics.

SCR ratings, protection of SCR against over current , over voltage , high dV/dt , high dI/dt . Thermal protection methods of commutation, series and parallel operation of SCR.

UNIT II

Classification of rectifiers, phase controlled rectifier: Single phase half wave controlled. Fully controlled and half controlled rectifiers and their performance parameters.

Three phase half wave, full wave and half controlled rectifiers and their performance parameters. Effect of source impedance on the performance of single phase and three phase controlled rectifier. Dual converter.

UNIT III

DC to DC converter: principle of chopper operation, step up choppers, types of chopper circuits. AC to AC converters: principle of operation of step up and step down cycloconverter, three phase to single phase cycloconverter, three phase to three phase cycloconverter.

UNIT IV

Single phase voltage source inverter, three phase bridge inverters, voltage control in single phase inverters, PWM inverters, current source inverters.

Text Books:

1. Dr. P. S. Bimhra ―Power Electronics‖, Khanna Publishing, 4th edition.

Reference Books:

1. J. Michael Jakob, Power Electronics: Principles & Applications, Vikas Publishing House Pvt.Ltd.
2. Vithayathis, J, Power Electronics : Principles and Applications, TMH
3. M.D. Singh & K.B. Khnachandani, ―Power Electronics‖, Tata Mcgraw Hill.
4. P. C. Sen – Power Electronics, TMH.
5. M. H. Rashid, ―Power Electronics Circuits, Devices & Applications‖, PHI.

ETEE364A	POWER ELECTRONICS LAB	L	T	P	C
		0	0	2	1

Hands-on experience related to the course contents ETEE316A by performing experiments as given below:

- R, RC & UJT Triggering circuits
- Single phase Semi & Full converter
- Single phase AC voltage controller using Triac and SCRs
- Single phase series inverter (Basic)
- Single phase Parallel inverter
- Single phase Mc Murray inverter
- Voltage and Current commutated choppers
- Speed control of DC shunt motor (using Rectifier & Chopper)
- Speed control of TPIM using PWM inverter
- Single phase Cyclo-converter

List of Experiments:

1. R, RC & UJT Triggering circuits
2. Single phase Semi & Full converter
3. Single phase AC voltage controller using Triac and SCRs
4. Single phase series inverter (Basic)
5. Single phase Parallel inverter
6. Single phase Mc Murray inverter
7. Voltage and Current commutated choppers
8. Speed control of DC shunt motor (using Rectifier & Chopper)
9. Speed control of TPIM using PWM inverter
10. Single phase Cyclo-converter

ETEC401A	EMBEDDED SYSTEMS	C
		4

COURSE OVERVIEW:

This course is designed to provide indispensable knowledge for building efficient, high-value, smart embedded systems that radically transform the way in which people interact with and control their physical world. It is such a technology which imbibes the fusion of hardware and software programming. An embedded system consists of wide range of devices and sensors that allow information to be collected, shared, and processed in unprecedented ways. Aircraft, cars, household appliances, cellular telephones, consumer wearables and electronics and health monitoring devices all contain microprocessors that are being linked with other information processing devices and hence become ubiquitous component of our everyday lives. The landscape of embedded development uses single-chip micro-controllers like 8051, PIC and ARM micro controllers which is the brain of an embedded system.

The overall educational objective of this course is to allow students to discover how the computer interacts with its environment. It will provide hands-on experiences of how an embedded system could be used to solve problems. The focus of this introductory course is to understand, analysis and design.

COURSE OBJECTIVE:

In this course student will be introduced to the basics of micro controller, their different types and features**:** The Embedded System Design Process, different types of micro-controllers and application of micro controller and their Interfacing with LCD, ADC, DAC, Stepper Motor, Key Board and Sensors, protocols: RS-232, I^2C Bus, UART, USB, CAN. In this, the student begins by mastering simple concepts. Once the student truly understands simple concepts, he

or she can then embark on the creative process of design, which involves putting the pieces together to create a more complex system. True creativity is needed to solve complex problems using effective combinations of simple components. Embedded systems afford an effective platform to teach new engineers how engineering processes can be applied in the real world.

LEARNING OBJECTIVES:

Although the students are engaged with a fun and rewarding lab experience, the educational pedagogy is centered on fundamental learning objectives. After the successful conclusion of this class, students should be able to understand the basic components of a micro controller, write C language programs that perform I/O functions and implement in Embedded System debugging techniques.
Our goal is for students to learn these concepts:

1. Understanding how the computer stores and manipulates data.
2. The understanding of embedded systems using modular design and abstraction.
3. C programming: considering both function and style.
4. The strategic use of memory.
5. Debugging and verification using a simulator and on the real microcontroller.
6. Use and describe the implementation of a real-time operating system on an embedded computer system.

ETEC401A	EMBEDDED SYSTEMS	L	T	P	C
		3	1	0	4

UNIT-I

INTRODUCTION OF MICROCONTROLLER: Introduction, Complex Systems and Microprocessor, The Embedded System Design Process, Different types of microcontrollers: Embedded microcontrollers, External memory microcontrollers; Processor Architectures: Harvard V/S Princeton, CISC V/S RISC; micro-controllers memory types; micro-controllers features: clocking, I/O pins, interrupts, timers, and peripherals.

UNIT-II

THE 8051 ARCHITECTURE: Microcontroller 8051- Architecture, Pin Diagram, I/O Ports, Internal RAM and Registers, Interrupts, Addressing Modes, Memory Organization and External Addressing,

BASIC ASSEMBLY LANGUAGE PROGRAMMING CONCEPTS: Instruction Set : Data

Transfer and Logical Instructions. Arithmetic Operations, Decimal Arithmetic, Jump and Call Instructions, Assembly Language Programming, Programming Tools and Techniques, Programming the 8051.

APPLICATIONS OF MICROCONTROLLER- Interfacing with LCD, ADC, DAC, Stepper Motor, Key Board and Sensors.Protocols: RS-232, I^2C Bus, UART, USB, CAN.

UNIT – III

EMBEDDED SYSTEMS-Introduction, Classification, Processors, Hardware Units,

Software Embedded into System, Applications and Products of Embedded Systems, Structural Units in Processor, Memory Devices, I/O Devices, Buses, Interfacing of Processor Memory and I/O Devices, Bus protocols: I^2C bus and CAN bus; Internet-Enabled Systems
EMBEDDED SOFTWARE DEVELOPMENT TOOLS: An approach for SOC Design, System Architecture and Complexity, Host and Target machines, Linker, Locators for Embedded Software, Getting Embedded Software into the Target System; Uses of Target system or its emulator and In-Circuit Emulator , Issues in Embedded System Design: Debugging Techniques, Case Study of an Embedded System for a Smart Card, ACVM

UNIT- IV

INTRODUCTION TO REAL-TIME OPERATING SYSTEMS: Tasks and Task States, Tasks and Data, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment.

INTRODUCTION TO MICROCONTROLLERS:

PIC Microcontroller: Introduction to 16F87X, Features, Memory Organizations: Program Memory, Data Memory

ARM Processors: Introduction to ARM processor- processor and memory organization

TEXT BOOKS

- The 8051 Microcontroller and Embedded Systems, M.A. Mazidi and J. G. Mazidi, PHI.
- Embedded Systems, Raj Kamal, TMH.

REFERENCE BOOKS

- Computers and Components, Wayne Wolf, Elseveir.
- Embedding system building blocks, Labrosse, CMP publishers.
- Micro Controllers, Ajay V Deshmukh, TMH.
- Embedded System Design, Frank Vahid, Tony Givargis, John Wiley.
- An Embedded Software Primer, David E. Simon, Pearson Education.

ETEC451A	EMBEDDED SYSTEMS LAB	L	T	P	C
		0	0	2	1

- Write an Assembly language Programme (ALP) to generate 10 kHz square wave.
- Write an ALP to generate 10 kHz frequency using interrupts.
- Write an ALP to interface one Microcontroller with other using serial/parallel communication.
- Write an ALP for temperature & pressure measurement & to display on intelligent LCD display
- Write an ALP for PWM based speed control of stepper motor.
- Write an ALP for PWM based regulator of voltage.
- Write an ALP to send/receive the data from an computer to MC through serial communication
- Study of Development tools/environment for Microcontroller Programme.
- Develop an embedded system for traffic light controller using Micro controller
- Develop an embedded system for the automatic motion of a car (Model of car) & Subsequent display on LCD using Microcontroller.

List of Experiments:

8051 Micro Controller

1. Write an Assembly language Programme (ALP) to generate 10kHz square wave.
2. Write an ALP to generate 10 kHz frequency using interrupts.
3. Write an ALP to interface one Microcontroller with other using serial/parallel communication.
4. Write an ALP for temperature & pressure measurement & to display on intelligent LCD display

PIC Microcontroller

5. Write an ALP for PWM based speed control of stepper motor.
6. Write an ALP for PWM based regulator of voltage.
7. Write an ALP to send/receive the data from an computer to MC through serial communication

General

8. Study of Development tools/environment for Microcontroller Programme.

9. Develop an embedded system for traffic light controller using Micro controller
10. Develop an embedded system for the automatic motion of a car (Model of car) & Subsequent display on LCD using Microcontroller.

ETEC320A	IoT ARCHITECTURE AND PROTOCOLS	C
		3

COURSE OVERVIEW

The purpose of this course is to impart knowledge on IoT Architecture and various protocols, study their implementations

COURSE OBJECTIVES

- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and RealWorld Design Constraints
- To Understand the various IoT Protocols (Datalink, Network, Transport, Session, Service)

COURSE OUTCOMES:

Student will be able to

Implement Data and Knowledge Management and use of Devices in IoT Technology.

Understand State of the Art - IoT Architecture.

Classify Real World IoT Design Constraints, Industrial Automation in IoT.

ETEC320A	IoT ARCHITECTURE AND PROTOCOLS	L	T	P	C
		3	-	-	3

UNIT I

Introduction to IoT

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs , IoT & M2M Machine to

Machine, Difference between IoT and M2M, Software define Network

UNIT II

Network & Communication aspects

Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

UNIT III

Developing IoTs

Introduction to Python, Introduction to different IoT tools, developing applications through IoT tools, developing sensor based application through embedded system platform, Implementing IoT concepts with python

UNIT IV

Challenges in IoT

Design challenges, Development challenges, Security challenges, other challenges

Domain specific applications of IoT

Home automation, Industry applications, Surveillance applications, Other IoT applications

Text Books:

1. Vijay Madisetti, Arshdeep Bahga, ―Internet of Things: A Hands-On Approach‖
2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

REFERENCE BOOKS:

1. Pfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1- 4493- 9357-

ETEC356A	ELECTRONICS PROJECT DESIGN LAB	L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:

Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits; Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems, Electronic system design employing microcontrollers, PCB design and layout; System assembly considerations. Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application.

Course Outcomes:

At the end of the course, students will demonstrate the ability to

- Understand the practical issues related to practical implementation of applications using electronic circuits.
- Choose appropriate components, software and hardware platforms.
- Design a Printed Circuit Board, get it made and populate/solder it with components.
- Work as a team with other students to implement an application.
- The mini-project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.
- It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
- After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.
- The student is expected to exert on design, development and testing of the proposed work as per the schedule.
- Art work and Layout should be made using PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.
- The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing.

To create interest in hardware technology and the processes related to the circuit designing.

1. Introduction & hands on experience to use circuit creation & simulation software like TINAPRO,EAGLE and other software and design circuits For e.g.:
   i. Clipper
   ii. Clamper
   iii. Half Wave Rectifier

iv. Full Wave Centre tapped Rectifier

v. RLC resonance circuit

2. Design a circuit for a fixed/regulated power supply.
3. Convert the power supply circuit into PCB & simulates its 2D & 3D view.
4. PCB printing using screen printing or any other technique.
5. Etching of the above PCB.
6. UV exposure & Drilling of PCB.
7. Coating of etched PCB to protect it from oxidation.
8. Fabrication & placing of components as per above power supply circuit.
9. Testing of above circuit.

SEMESTER VII

ETEE401A	RENEWABLE ENERGY	C
		4

COURSE OVERVIEW:

The mission of the Bachelor of Science in Renewable Energy Engineering degree program is to prepare students for the challenges of designing, promoting and implementing renewable energy solutions within society's rapidly-changing energy-related industry cluster, particularly within Oregon and the Pacific Northwest. Graduates will have a fundamental understanding of energy engineering and a sense of social responsibility for the implementation of sustainable energy solutions.

COURSE OBJECTIVE:

- Graduates will excel as professionals in the various fields of energy engineering.
- Graduates will be known for their commitment to lifelong learning, social responsibility, and professional and ethical responsibilities in implementing sustainable engineering solutions.
- Graduates will excel in critical thinking, problem solving and effective communication.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

- Understand the basic physics of wind and solar power generation.

- Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy systems.
- Understand the energy scenario and the consequent growth of the power generation from Renewable energy sources.

ETEE401A	RENEWABLE ENERGY	L	T	P	C
		3	1	0	4

UNIT I

Introduction

Energy demand growth and supply: Historical Perspectives ; Fossil fuels: Consumption and Reserve ; Environmental Impacts of Burning of Fossil fuels ; Sustainable Development and Role of Renewable Energy Sources.

UNIT II

SOLAR ENERGY: The Sun as energy source and its movement in the sky; Solar Energy received on the Earth; Primary and Secondary Solar energy and Utilization of Solar Energy. Characteristic advantages and disadvantages.

SOLAR THERMAL ELECTRICITY GENERATION: Solar concentrators and tracking; Dish and Parabolic trough concentrating generating systems, Central tower solar thermal power plants; Solar Ponds

UNIT III

SOLAR PHOTOVOLTAIC SYSTEMS: Basic principle of power generation in a PV cell ; Band gap and efficiency of PV cells ; Manufacturing methods of mono- and poly-crystalline cells ; Amorphous silicon thin film cells Single and multi-junction cells ; Application of PV ; Brief ouline of solar PV stand-alone system design ; Storage and Balance of system.

WIND ELECTRICITY GENERATION: Types of turbines, Coefficient of Power, Betz limit, Wind electric generators, Power curve; wind characteristics and site selection; Windfarms for bulk power supply to grid; Potential of wind electricity generation in India and its current growth rate.

UNIT IV

BIOMASS ENERGY: Biomass: Sources and Characteristics; Wet biogas plants; Biomass gasifiers: Classification and Operating characteristics; Updraft and Downdraft gasifiers; Gasifier based electricity generating systems; Maintenance of gasifiers.

OCEAN ENERGY: Tidal power plants: single basin and two basis plants, Variation in generation level; Ocean Thermal Electricity Conversion (OTEC) ; Electricity generation from Waves : Shoreline and Floating wave systems.

GEOTHERMAL ENERGY: Geothermal sites in India; High temperature and Low temperature sites; Conversion technologies- Steam and Binary systems; Geothermal power plants.

GRID INTERCONNECTION: General nature of renewable energy sources and variation in availability; Impact on grid ; Allowable grid penetration in preserving reliability of supply ; Standalone systems ; Storage of electricity for autonomous supply ; Examples of design of remote supply systems.

References

1. 'Our Common Future', Report of the World Commission on Environment & Developme
2. John W. Twidell & Anthony D.Weir, 'Renewable Energy Resources'

3. Geofrey Boyle, ' Renewable Energy: Power for a Sustainable Future', OUP in assn with Open University, 1996.

ETEE402A	POWER SYSTEM OPERATION & CONTROL	C
		4

COURSE OVERVIEW:

This course aimed at the basic concepts of operation and control of power system. The necessity of substance lies in the basic behavior of the power system which depend on the voltage, frequency regulation in power systems-real power-frequency and reactive power-voltage control loop-system load variation, load curves and basic concepts of load dispatching, load forecasting, unit commitment, load shedding.

COURSE OBJECTIVE:

The load frequency control mechanism is the main part of the for the real power frequency control. The concept of control area-LFC of single area system-static and dynamic analysis of uncontrolled and controlled cases is discussed. The students prepared for the various issues occur in the power system operation and control by giving the knowledge of reactive power control and dynamic stability analysis; compensation, generation and absorption of reactive power ; methods of voltage control; phase angle compensation techniques ; economic dispatch problems The statement of economic dispatch problem with incremental cost curve-input and output characteristics of thermal and hydro plants ,hydrothermal scheduling of long and short terms- optimal operation of thermal units without and with transmission losses using penalty factor are discussed in detail in the course.

COURSE OUTCOMES:

- To learn the basics of power system control
- To control the power system frequency and voltage
- To study the economic operation of power system.
- An ability to use the relevant tools necessary for engineering practice

- When faced with a technical problem the student should be able to use applied scientific knowledge.

ETEE404A	ELECTRIC DRIVES	C
		4

COURSE OVERVIEW:

Nowadays, modern power electronics and drives are used in electrical as well as mechanical industry. The power converter or power modulator circuits are used with electrical motor drives, providing both DC or AC outputs and working from either a DC (battery) supply or from the conventional AC supply. Here we will highlight the most important aspects which are common to all types of drive converters. Although there are many different types of converters, all except very low-power ones are based on some form of electronic switching. The thyristor DC drive remains an important speed-controlled industrial drive, especially where higher maintenance cost associated with the DC motor brushes is tolerable. The controlled (thyristor) rectifier provides a low-impedance adjustable DC voltage for the motor armature, thereby providing speed control

COURSE OBJECTIVES:

The objective of the course is to understand the stable steady state operation and transient dynamics of motor-load system, learn characteristics and control of DC motors drives, induction motor drives & Synchronous motor drive, learn digital control of AC and DC drives. Students will learn basic concept of solid state controlled electric drive, permanent magnet machines, control of D.C. drives, control of A.C. motor drives and microprocessor control of drive.

Expected Outcome:

By studying this subject student of Electrical Engineering will have detailed knowledge of various drive systems used in field of traction, braking and motoring used in field of railways, aeronautics etc.

ETEE404A	ELECTRIC DRIVES	L	T	P	C
		3	1	0	4

UNIT I

DC motor characteristics: Review of emf and torque equations of DC machine, review of torque-speed characteristics
of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor Speed, flux weakening for high speed operation.

UNIT II

Closed-loop control of DC Drive : Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.

Multi-quadrant DC drive

Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

UNIT III

Chopper fed DC drive: Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.

Induction motor characteristics: Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.

UNIT IV

Scalar control or constant V/f control of induction motor : Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady- state performance analysis based on equivalent circuit, speed drop with loading, slip regulation. **Control of slip ring induction motor:** Impact of rotor resistance of the induction motor torque- speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery.

ETEC405A	**ARTIFICIAL INTELLIEGENCE**	**C**
		4

OVERVIEW:

The course introduces the theoretical building blocks necessary to create intelligent machines. While we may struggle to define intelligence in an absolute sense, we can agree upon multiple approaches toward creating AI; from an initial attempt at acting humanly to a broader context of acting rationally.

Solving problems which are seemingly simple for humans can seem like insurmountable hurdles for machines. Our ability to think and act accordingly to situations in the real world appears to be an amazing combination of different skills working in conjunction without us even realizing it. For instance, teaching a child to walk requires effort, but beyond a little

help, children learn how to find their balance, walk without falling and avoid any obstacles along the way. However, it

seems to take incredible amount of careful planning and execution to create a machine which can do the same on two legs, or for that matter, even four!

We attempt to unravel these special abilities that are crucial in making us appear _intelligent'. Our innate ability to perceive the environment and create internal representations for it, to be able to process colossal amounts of information systematically, to learn from the environment, and to plan a course of action for getting desired results is what inspires us to build machines capable of performing or surpassing human expertise.

OBJECTIVES AND EXPECTED OUTCOMES:

The course is oriented toward imparting a clear understanding of the problem-solving processes that we take for-granted. The course begins with an overview of the concept of intelligent agents and the various approaches for building them. The general ideas behind creating a machine that can learn are introduced here.

Next the core idea behind solving problems using search techniques is introduced. We learn how everyday problems can be represented as graph search or local search problems and how they can be tackled. Search strategies ranging from blind or uninformed search to heuristic or informed search are discussed. We notice how exploiting knowledge of the problem & its domain allows us to avoid hunting naively through large search-spaces, thereby increasing efficiency. We develop the idea of deriving heuristic estimates from knowledge about problems and our experience in solving those.

Knowledge representation is another key aspect of dealing with information in the real-world. We study various ways in which facts and rules about the world can be encoded systematically and be used to derive meaningful inferences or answer queries. Logic is introduced as one such mechanism for expressing information. Propositional logic and predicate logic are both covered in detail with emphasis to problem-solving in AI. Reasoning systems based on logic are also discussed here. Logic-based proof techniques can be used to verify claims based on existing knowledge and also derive new inferences by combining incoming facts & rules with existing knowledge. Techniques discussed here are forward-chaining, backward-chaining & resolution. Rule-based Expert systems are a direct application and are covered in detail here.

Real world always entails uncertainty and the concept of uncertainty is introduced. The cause of uncertainty and the ways of incorporating it into our problem-solving techniques is studied in detail. Some of the topics covered here include, Probabilistic reasoning, representing knowledge under uncertainty, Bayesian Networks, Exact and approximate inference in Bayesian Networks.

As always, we are fascinated by the idea of machines which can teach themselves or can be taught using examples from the environment. We study various learning paradigms here. The idea of supervised, unsupervised and reinforcement learning is covered. The course concludes with a discussion about the applications of AI across various domains. Specific examples of AI can be studied from domains like Robotics, Natural Language Processing, medicine, transport, security etc. The course is expected to introduce the students to the challenges

involved in designing intelligent systems and allow them to gain a thorough insight into the underlying components of such systems. The student will learn about the potential of this exciting field and explore various present-day applications of AI as it expands rapidly from specialized applications with limited scope to ubiquitous applications running our phones, homes, vehicles and so much more.

ETEC405A	ARTIFICIAL INTELLIEGENCE	L	T	P	C
		3	1	0	4

UNIT I

Scope of AI: Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques-search knowledge, abstraction.

Problem Solving (Blind): State space search; production systems, search space control; depth- first, breadth-first search.

Heuristic Based Search: Heuristic search, Hill climbing, best-first search, A* Algorithm, Problem Reduction, Constraint Satisfaction.

UNIT II

Knowledge Representation: Predicate Logic: Unification, Modus Ponens, Modus Tokens, Resolution in Predicate Logic, Conflict Resolution Forward Chaining, Backward Chaining, Declarative and Procedural Representation, Rule based Systems.

Structured Knowledge Representation: Semantic Nets: Slots, exceptions and default frames, conceptual dependency.

UNIT III

Handling Uncertainty: Non-Monotonic Reasoning, Probabilistic reasoning: Bayesian Inference, use of uncertainty factors.

Natural Language Processing: Introduction, Syntactic Processing, Semantic Processing, Pragmatic Processing.

UNIT IV

Learning: Concept of learning, learning automation, genetic algorithm, learning by inductions, neural nets.

Expert Systems: Need and justification for expert systems, knowledge acquisition, Case Studies: MYCIN, RI.

TEXT BOOKS:

1. Artificial Intelligence, E. Rich and K. Knight, TMH.

REFERENCES BOOKS:

1. Artificial Intelligence, P. H. Winston,Pearson Education.

2. Introduction to AI and Expert Systems, D. W. Patterson, PHI.

3. Principles of AI, N. J. Nilsson, Narosa Publishing House.

ETEC455A	ARTIFICIAL INTELLIEGENCE LAB	L	T	P	C
		0	0	2	1

OVERVIEW:

While AI applications can be developed in any number of different languages, certain language features make programming AI applications straightforward. Prolog is structured in such a way that AI program development is supported by Prolog language features. Other languages, such as Java, support AI programming through code libraries. This course will provide students with an introduction to AI via programming features that support basic AI applications. The main of this course is make students familiar with AI programming and be able to use it in future models to implement various AI applications.

OBJECTIVES AND EXPECTED OUTCOMES:

Upon a successful completion of this course students should be able to :

- Demonstrate working knowledge in Prolog in order to write simple Prolog programs
- Understand different types of AI agents Know various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms)
- Understand the fundamentals of knowledge representation (logic-based, frame-based, semantic nets), inference and theorem proving
- Know how to build simple knowledge-based systems
- Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information

LIST OF EXPERIMENTS

Write the following programs using PROLOG.

- Write a program to solve 8-queens problem.
- Solve any problem using depth first search.
- Solve any problem using best first search.

- Solve 8-puzzle problem using best first search
- Solve Robot (traversal) problem using means End Analysis.
- Solve traveling salesman problem.

ETEE457A	MINOR PROJECT	L	T	P	C
		0	0	0	2

- The minor-project is a team activity having 1-4 students in a team. This is simulation based/electronic product design work with a focusing on electrical electronic circuit design.
- The minor project may be a complete hardware or a combination of hardware and software. The software part in minor project should be less than 50% of the total work.
- Minor Project should cater to a small system required in laboratory or real life.
- It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
- After interactions with coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of minor- project.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
- The student is expected to exert on design, development and testing of the proposed work as per the schedule.
- Completed minor project and documentation in the form of minor project report is to be submitted at the end of semester.
- Students are expected to prepare Minor project on topics of general importance using new software and presentation tools. Students will also prepare a project report along with implementation and present it for the final evaluation.

ETEE463A	PRACTICAL TRAINING-II	L	T	P	C
		0	0	0	1

COURSE OBJECTIVE:

The object of practical training-II is to enable the student to the investigative study taken up under core branch, involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry.

COURSE OUTCOME:

This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

- In depth study of the topic assigned in the light of the Report prepared under practical training-I.
- Review and finalization of the Approach to the Problem relating to the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
- Final development of product/process, testing, results, conclusions and future directions.

ETEE452A	POWER SYSTEM SIMULATION LAB	L	T	P	C
		0	0	2	1

Hands-on experience related to the course contents ETEE402A by performing experiments as given below:

- Formation of Y-Bus by inspection method and analytical method.
- Formation of Z-Bus matrix.
- Power flow analysis by GS, NR and FDLF methods.
- Performance of transmission lines
- Economic Dispatch Problem-without losses
- Economic Dispatch Problem-with losses
- Automatic load frequency control
- Automatic voltage regulation

LIST OF EXPERIMENTS:

Use of MATLAB for the following

1. Formation of Y-Bus by inspection method and analytical method.
2. Formation of Z-Bus matrix.
3. Power flow analysis by GS, NR and FDLF methods.
4. Performance of transmission lines
5. Economic Dispatch Problem-without losses
6. Economic Dispatch Problem-with losses

7. Automatic load frequency control

7. Automatic voltage regulation.

SEMESTER VIII

ETEE422A	SMART ELECTRIC GRID	C
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COURSE OVERVIEW:

The aim of this course is to introduce about the smart grid technologies, their applications and control issues covering Smart Generation (Renewable and Microgrid), Smart Transmission (Integration of Renewable Energy Sources, Wide Area Measurements) and Smart Distribution (Demand Response Management and Power Quality Management).

COURSE OBJECTIVES:

The objectives of this course are to:

- Understand the challenging issues and architecture of smart grid.
- Understand the communication and wide area monitoring in smart grid.
- Rudimentary energy management issues in smart grid.
- Acquire the knowledge in computational intelligence and security issues in smart grid.
- Know the role of Power electronics and energy storage in smart grid.

COURSE OUTCOMES:

After completion of this course student will be able to:

- Know, list and classify the basic terms of a Power System Grid; explain the importance and objectives of the various dispersed generation units as well as that of the various energy management policies; distinguish them according to their priorities.
- Know, name, describe and classify the modern and innovative application fields of dispersed generation units; discuss relative merits.
- Know, describe by drawing a block diagram and explain the operation of the basic part of a smart grid (namely the Microgrid); quantify its operational, financial and environmental advantages using charts.
- Know, understand and explain the concept of a smart grid; identify the telecommunication.

ETEE422A	SMART ELECTRIC GRID	L	T	P	C
		3	1	0	4

UNIT I

Introduction to Smart Grid: Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions-Traditional Power Grid and Smart Grid –New Technologies for Smart Grid -Advantages –Indian Smart Grid –Key Challenges for Smart Grid.

UNIT II

Smart Grid Architecture: Components and Architecture of Smart Grid Design –Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs – Transmission Automation –Distribution Automation –Renewable Integration

Tools and Techniques for Smart Grid: Computational Techniques –Static and Dynamic Optimization Techniques –Computational Intelligence Techniques –Evolutionary Algorithms – Artificial Intelligence techniques.

UNIT III

Distribution Generation Technologies: Introduction to Renewable Energy Technologies – Micro grids –Storage Technologies –Electric Vehicles and plug –in hybrids –Environmental impact and Climate Change –Economic Issues.

UNIT IV

Communication Technologies and Smart Grid: Introduction to Communication Technology – Synchro Phasor Measurement Units (PMUs) –Wide Area Measurement Systems (WAMS).

Control of Smart Power Grid System: Load Frequency Control (LFC) in Micro Grid System – Voltage Control in Micro Grid System –Reactive Power Control in Smart Grid. Case Studies and Test beds for the Smart Grids.

TEXT BOOKS:

1. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press.
2. Gil Masters, Renewable and Efficient Electric Power System, Wiley-IEEE Press.

REFERENCE BOOKS:

1. A.G. Phadke and J.S. Thorp, ―Synchronized Phasor Measurements and their Applications‖, Springer Edition.

2. T. Ackermann, Wind Power in Power Systems, Hoboken, NJ, USA, John Wiley.

ETEE423A	ELECTRIC & HYBRID VEHICLES	C
		4

COURSE OVERVIEW:

What is a hybrid? A hybrid vehicle combines any two power (energy) sources. Possible combinations include diesel/electric, gasoline/fly wheel, and fuel cell (FC)/battery. Typically, one energy source is storage, and the other is conversion of a fuel to energy. The combination of two power sources may support two separate propulsion systems. Thus to be a True hybrid, the vehicle must have at least two modes of propulsion.

For example, a truck that uses a diesel to drive a generator, which in turn drives several electrical motors for all-wheel drive, is *not a hybrid* . But if the truck has electrical energy storage to provide a second mode, which is electrical assists, then it is a hybrid Vehicle.

These two power sources may be paired in series, meaning that the gas engine charges the batteries of an electric motor that powers the car, or in parallel, with both mechanisms driving the car directly.

COURSE OBJECTIVES:

Introduction to Hybrid Electric Vehicles, Conventional Vehicles, Hybrid Electric Drive-trains, Electric Propulsion unit, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, switched reluctance motor, Energy Storage Requirements in Hybrid and Electric Vehicles, Sizing the drive system, Design of a Hybrid Electric Vehicle , Energy Management Strategies.

Expected outcome:

The students will be able to

a. Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources.
b. Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
c. Choose proper energy storage systems for vehicle applications
d. Identify various communication protocols and technologies used in vehicle networks.

		3	**1**	**0**	**4**

UNIT –I

Introduction to Electric Vehicles : EV System - Components of an EV ; EV History ; EV Advantages - Efficiency Comparison , Pollution Comparison, Capital and Operating Cost Comparison ; EV Market.

Vehicle Mechanics : Laws of Motion , Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power , Velocity and Acceleration , Constant FTR, Level Road , Propulsion System Design.

UNIT – II

Energy Source: Battery , Battery Basics, Lead-Acid Battery, Alternative Batteries, Battery Parameters, Technical Characteristics, Targets and Properties of Batteries, Battery Modelling , Alternative Energy Sources: Fuel Cells Characteristics & types , Fuel Cell EV, Supercapacitors and Ultracapacitors , Flywheels.

UNIT –III

Electric Vehicle Drivetrain: EV Transmission Configurations, Transmission Components, Ideal Gearbox: Steady State Model, EV Motor Sizing: Initial Acceleration, Rated Vehicle Velocity, Maximum Velocity, Maximum Gradability

UNIT- IV

Hybrid Electric Vehicles: Types of Hybrids: Series and Parallel HEVs , Internal Combustion Engines, Reciprocating Engines , Gas Turbine Engine, Design of an HEV, Hybrid Drivetrains, Sizing of Components.

Text Books :

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003

References:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

2. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004

ETEE460A	**MAJOR PROJECT**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**6**

COURSE OBJECTIVES:

The undergraduate student in last semester is ready to apply and integrate the knowledge of variety of subjects which he/she had been taught in previous semesters.

EXPECTED OUTCOME:

- The major-project is a team activity having 1-4 students in a team. This is simulation based/electronic product design work with a focusing on electrical & electronic circuit.
- The major project may be a complete hardware or a combination of hardware and software. This part is the extension of minor project
- Major Project should design a system required in real life.
- It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
- After interactions with coordinator/supervisors and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of major project in extension with minor project.
- Students are expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
- The student is expected to exert on design, development and testing of the proposed work as per the schedule.
- Completed major project and documentation in the form of major project report is to be submitted at the end of semester.
- Students are expected to prepare Major project on topics of general importance using new software and presentation tools. Students will also prepare a project report along with implementation and present it for the final evaluation.