NETAJI SUBHAS UNIVERSITY

EVALUATION SCHEME & SYLLABUS FOR

BACHELOR OF TECHNOLOGY

Electrical and Electronics Engineering

(B. TECH-EEE)

On

Choice Based Credit System (Effective from the Session: 2023-24)

Netaji Subhas University
Pokhari, Near Bhilai Pahadi, Jamshedpur, Jharkhand

I SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BT 101	Engineering Mathematics-I	3	1	-	4	30	70	100
BT 102	Engineering Physics	4	-	-	4	30	70	100
BT 103	Programming in C	4	-	-	4	30	70	100
BT 104	Elements of Mechanical Engineering	3	-	-	4	30	70	100
BT 105	Basic of Electrical Engineering	3	1	-	4	30	70	100
BT 106	Professional Communication Skill	3	-	-	3	30	70	100
	Practical							
BT 107L	Engineering Physics **Lab**	-	-	4	2	15	35	50
BT 108L	Programming in C **Lab**	-	-	4	2	15	35	50
	Total	**20**	**2**	**8**	**27**	**210**	**490**	**700**

II SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BT 201	Engineering Mathematics-II	3	1	-	4	30	70	100
BT 202	Engineering Chemistry	4	-	-	4	30	70	100
BT 203	Elements of Civil Engineering and Mechanics	4	-	-	4	30	70	100
BT 204	Computer Aided Engineering Drawing	4	-	-	4	30	70	100
BT 205	Basic Electronics	4	-	-	3	30	70	100
BT 206	Software Engineering	3	1	-	3	30	70	100
	Practical							
BT 207L	Engineering Chemistry **Lab**	-	-	4	2	15	35	50
BT 208L	Workshop Practice	-	-	4	2	15	35	50
	Total	**22**	**2**	**8**	**26**	**210**	**490**	**700**

III Semester

S.No	Course Code	Course Details	Periods			Credits	Marks		
			L	T	P		IA	TE	TM
1	BT301	Engineering Mathematics–III	3	1	-	4	30	70	100
2	BTEEE302	Analog Electronics	4	-	-	3	30	70	100
3	BTEEE303	Circuit Analysis	4	-	-	4	30	70	100
4	BTEEE304	Electrical Machines I	3	-	-	3	30	70	100
5	BTEEE305	Electrical & Electronics Measurement	3	-	-	3	30	70	100
6	BTEEE306	Object Oriented Programming using C++	3	-	-	3	30	70	100
Practical									
1	BTEEE307L	Electrical & Electronics Measurement Lab	-	-	4	2	15	35	50
2	BTEEE308L	Object Oriented Programming using C++ Lab	**-**	**-**	**4**	**2**	**15**	**35**	**50**
3	BTEEE309L	Analog Electronics			**4**	**2**	**15**	**35**	**50**
Total			**20**	**1**	**12**	**26**	**225**	**525**	**750**

IV Semester

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BT401	Engineering Mathematics – IV	3	1	-	4	30	70	100
BTEEE 402	Electromagnetic & Field theory	3	-	-	3	30	70	100
BTEEE 403	Signal & System	3	-	-	3	30	70	100
BTEEE 404	Power system	3	-	-	3	30	70	100
BTEEE 405	Digital Electronics and Logic Design.	3	-	-	3	30	70	100
			-	-		30	70	100
BTEEE406	Data structure and its Algorithm	4			4			
	Practical							
BTEEE 407L	Electrical Machine Lab	-	-	2	2	15	35	50
BTEEE 408L	Digital Electronics and Logic Design Lab.	-	-	2	2	15	35	50
BTEEE 409L	Mini project.			2	2	15	35	50
	Total	**19**	**1**	**6**	**26**	**225**	**525**	**750**

V Semester

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BTEEE 501	Control system	3	0	0	3	30	70	100
BTEEE 502	Power system analysis	3	1	0	4	30	70	100
BTEEE 503X	Elective-I	3	0	0	3	30	70	100
BTEEE 504	Microprocessors & Microcontroller	3	0	0	3	30	70	100
BTEEE 505	Electrical Engineering Materials	3	1	0	4	30	70	100
BTEEE 506	Electrical Machine-II	3	0	0	3	30	70	100
	Practical							
BTEEE507L	Microprocessors & Microcontroller Lab	-	-	2	2	15	35	50
BTEEE 508L	Control system Lab	-	-	2	2	15	35	50
BTEEE509V	Comprehensive VIVA Voce	-	-	-	2	15	35	50
	Total	**18**	**2**	**4**	**26**	**225**	**525**	**750**

Elective – I

EEL 5031	**Digital Image processing**
EEL 5032	**Distribution system planning & Automation**
EEL 5033	**Micro Electro Mechanical Systems**
EEL 5034	**Energy Audit & Management**
EEL 5035	**Renewable Energy systems**
EEL 5036	**Restructuring in Power systems**

VI Semester

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BTEEE 601	Communication system	3	1	**0**	4	30	70	100
BTEEE 602	Switchgear & protection.	3	0	0	3	30	70	100
BTEEE 603	Power Electronics	3	0	0	3	30	70	100
BTEEE 604X	Elective-II	3	0	0	3	30	70	100
BTEEE 605X	Open Elective-I	3	0	0	3	30	70	100
BTEEE 606	Introduction to VLSI	3	1	0	4	30	70	100
	Practical							
BTEEE 607L	Power Electronics Lab	0	0	2	2	15	35	50
BTEEE 608L	Communication system Lab	0	0	2	2	15	35	50
BTEEE 609L	VLSI lab	0	0	2	2	15	35	50
	Summer Internship-(Credits will be counted in next Semester)							
	Total	**18**	**2**	**6**	**26**	**225**	**525**	**750**

Elective-II

EEL6041	**Process control**
EEL6042	**High voltage Engineering**
EEL6043	**Power system planning & Automation**
EEL6044	**Electro-Magnetics for Electrical machine.**
EEL6045	**Special Electrical machines-I**

Open Elective-I

EEL6051	**Biomedical Instrumentation.**
EEL6052	**Electrical Distribution systems**
EEL6053	**Power station Practice**
EEL6054	**Iot and its Application**
EEL6055	**Introduction to Matlab**

VII Semester

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BTEEE701	Electrical drives	3	1	0	4	30	70	100
BTEEE702X	Elective-II	3	0	0	3	30	70	100
BTEEE 703	Database management system.	3	0	0	3	30	70	100
BTEEE 704	Optical fiber communication.	3	1	-	4	30	70	100
BTEEE 705	HVDC & Flexible AC Transmission systems.	3	1	-	4	30	70	100
	Practical							
BTEEE706L	Project formulation	-	-	6	4	30	70	100
BTEEE707V	Summer internship Training Viva voce	-	-	-	2	15	35	50
BTEEE708L	Database management system lab	-	-	2	2	15	35	50
	Total	**15**	**3**	**8**	**26**	**210**	**490**	**700**

Elective-III

EEL7021	**Utilization of Electrical Energy**
EEL7022	**DSP and its Application to Power Electronics**
EEL7023	**Power system operation & control**
EEL7024	**Switched mode Power Conversion**

VIII Semester

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BT801	Financial Engineering	3	0	0	3	30	70	100
BTEEE802X	Elective-IV	3	0	0	3	30	70	100
BTEEE803X	Elective-V	3	0	0	3	30	70	100
BTEEE804V	Project Work	0	0	12	12	50	150	200
	Total	**9**	**-**	**12**	**21**	**140**	**360**	**500**

Elective-IV

Elective-V

EEL8021	Computer Applications in Power Systems.
EEL8022	Power quality
EEL8023	Wind Energy Conversion systems
EEL8024	Logic and Distributed Control system.
EEL8025	Optimal Control
EEL8026	CAD for Electrical Machines
EEL8027	Intelligent control
EEL8028	System identification and adaptive control

EEL8031	Power Electronics for Renewable Energy Systems
EEL8032	Electrical Machine Modeling and Analysis
EEL8033	Basics of Robotics
EEL8034	Inverters and Resonant Pulse Converters
EEL8035	Cycloconverter and AC Voltage Controllers
EEL8036	Solid State Power Controllers
EEL8037	Power system stability & control
EEL8038	EHV AC/DC Transmission

1st SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BT 101	Engineering Mathematics-I	3	1	-	4	30	70	100
BT 102	Engineering Physics	4	-	-	4	30	70	100
BT 103	Programming in C	4	-	-	4	30	70	100
BT 104	Elements of Mechanical Engineering	3	-	-	4	30	70	100
BT 105	Basic of Electrical Engineering	3	-	-	4	30	70	100
BT 106	Professional Communication Skill	3	-	-	3	30	70	100
	Practical							
BT 107L	Engineering Physics **Lab**	-	-	4	2	15	35	50
BT 108L	Programming in C **Lab**	-	-	4	2	15	35	50
	Total	**20**	**1**	**8**	**27**	**210**	**490**	**700**

ENGINEERING MATHEMATICS-I (BT 101)

Subject Code	**BT 101**	**IA Marks**	**30**
Number of Lecture Hours/Week	**04**	**Term End Exam Marks**	**70**
Total Number of Lecture Hours	**60**	**CREDITS**	**04**

Course Objectives:

To enable the students to apply the knowledge of Mathematics in various engineering fields by making them to learn the following:

- nth derivatives of product of two functions and polar curves.
- Partial derivatives
- Vector calculus
- Reduction formulae of integration; to solve First order differential equations.
- Solution of system of linear equations, quadratic forms.

Module - 1

Differential Calculus -1: Determination of n^{th} order derivatives, Leibnitz's theorem (without proof) - problems.

Taylor's and Maclaurin's theorems for function of one variable (statement only)- problems. Evaluation of Indeterminate forms.

Partial derivatives – Definition and simple problems, Euler's theorem (without proof) – problems, total derivatives, partial differentiation of composite functions-problems. Definition and evaluation of Jacobians

Hours – 12

Module -2

Differential Calculus -2

Polar Curves - angle between the radius vector and tangent, angle between two curves, Pedal equation of polar curves. Derivative of arc length - Cartesian, Parametric and Polar forms (without proof)- problems. Curvature and Radius of Curvature – Cartesian, Parametric, Polar and Pedal forms (without proof) - problems

Hours - 10

Module-3

Integral Calculus:

Reduction formulae - $\int Sin^n x\ dx$, $\int Cos^n x\ d$, $\int Sin^m x\ Cos^n x\ dx$, (m and n are positive integers), evaluation of these integrals with standard limits (0 to $\pi/2$) and problems.

First order Differential Equations:

Exact, reducible to exact and Bernoulli's differential equations. Orthogonal trajectories in Cartesian and polar form. Simple problems on Newton's law of cooling.

Hours - 12

Module-4

Linear Algebra

Rank of a matrix by elementary transformations, solution of system of linear equations - Gauss-elimination method, Gauss–Jordan method and Gauss-Seidel method, Linear transformation, Eigen values and Eigen vectors. diagonalisation of a square matrix. Reduction of Quadratic form

Hours - 11

Course outcomes:

- On completion of this course, students are able to

CO-1: Use partial derivatives to calculate rates of change of multivariate functions.

CO-2: Analyze position, velocity, and acceleration in two or three dimensions using the calculus of vector valued functions.

CO-3: Recognize and solve first-order ordinary differential equations, Newton's law of cooling

CO-4: Use matrices techniques for solving systems of linear equations in the different areas of Linear Algebra.

Text Books:

1. B.S. Grewal, **"Higher Engineering Mathematics"**, Khanna publishers, 42nd edition, 2013.

2. Erwin Kreyszig, **"Advanced Engineering Mathematics**, Wiley, 2013

Reference Books:

1. B.V. Ramana, **"Higher Engineering Mathematics"**, Tata Mc Graw-Hill, 2006
2. N.P. Bali and Manish Goyal, **"A text book of Engineering mathematics"**, Laxmi publications, latest edition.
3. H.K. Dass and Er. Rajnish Verma, **"Higher Engineering Mathematics"**, S.Chand publishing, 1st edition, 2011.

ENGINEERING PHYSICS (BT102)

Subject Code	**BT 102**	**IA Marks**	**30**
Number of Lecture Hours/Week	**04**	**Term End Exam Marks**	**70**
Total Number of Lecture Hours	**60**	**CREDITS**	**04**

Course Objectives:

The Objective of this course is to make students learn and understand basic concepts and principles of physics to analyze practical engineering problems and apply its solutions effectively and meaningfully. To understand building up of models, design issues, practical oriented skills and problem solving challenges arethe great task of the course. To know about shock waves and practical applications is the prime motto to introduce new technology at the initial stage of Engineering.

UNIT-I: Quantum Mechanics

Introduction to quantum physics, Black body radiation, Planck's law, Photoelectric effect, Compton effect, de-Broglie's hypothesis, Wave-particle duality, Davisson and Germer experiment, Heisenberg's Uncertainty principle, Born's interpretation of the wave function, Schrodinger's time independent wave equation, Particle in one dimensional box.

Hours-10

UNIT-II: Semiconductor Physics

Intrinsic and Extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature, Carrier generation and recombination, Carrier transport: diffusion and drift, Hall effect, p-n junction diode, Zener diode and their V-I Characteristics, Bipolar Junction Transistor (BJT): Construction, Principle of operation.

Hours-10

UNIT-III: Optoelectronics

Radiative and non-radiative recombination mechanisms in semiconductors, LED and semiconductor lasers: Device structure, Materials, Characteristics and figures of merit, Semiconductor photo detectors: Solar cell, PIN and Avalanche and their structure, Materials, working principle and Characteristics.

Hours-10

UNIT-IV: Lasers and Fibre Optics

Lasers: Introduction to interaction of radiation with matter, Coherence, Principle and working of Laser, Population inversion, Pumping, Types of Lasers: Ruby laser, Carbon dioxide (CO_2) laser, He-Ne laser, Applications of laser. Fibre Optics: Introduction, Optical fibre as a dielectric wave guide, Total internal reflection, Acceptance angle, Acceptance cone and Numerical aperture, Step and Graded index fibres, Losses associated with optical fibres, Applications of optical fibres.

Hours-10

UNIT-V: Electromagnetism and Magnetic Properties of Materials

Laws of electrostatics, Electric current and the continuity equation, Ampere's and Faraday's laws, Maxwell's equations, Polarization, Permittivity and Dielectric constant, Internal fields in a solid, Clausius-Mossotti equation, Ferroelectrics and Piezoelectric. Magnetization, permeability and susceptibility, Classification of magnetic materials, Ferromagnetism and ferromagnetic domains, Hysteresis, Applications of magnetic materials.

Hours-10

Course outcomes:

On Completion of this course, students are able to –

CO-1: Learn and understand more about basic principles and to develop problem solving skills and implementation in technology.

CO-2: Gain Knowledge about Modern physics and quantum mechanics will

Update the basic concepts to implement the skills.

CO-3: Study of material properties and their applications is the prime role to understand and use in engineering applications and studies.

CO-4: Study Lasers and Optical fibers and its applications are to import knowledge and to develop skills and to use modern instruments in the engineering applications.

CO-5: Understand Crystal structure and applications are to boost the technical skills and its applications.

CO-6: Expose shock waves concept and its applications will bring latest technology to the students at the first year level to develop research orientation programs at higher semester level.

CO-7: Understand basic concepts of Nano science and technology.

Text Books:

1. Wiley precise Text, Engineering Physics**,** Wiley India Private Ltd., New Delhi. Book series – 2014,
2. Dr. M.N. Avadhanulu, Dr. P.G.Kshirsagar, Text Book of Engineering Physics**,** S Chand Publishing, New Delhi – 2012

PROGRAMMING IN C (BT103)

Subject Code	**BT 103**	**IA Marks**	**30**
Number of Lecture Hours/Week	**04**	**Term End Exam Marks**	**70**
Total Number of Lecture Hours	**60**	**CREDITS**	**04**

Course Objectives:

- Design solutions to simple engineering problem by applying the basic programming principles of C language and basic mathematical knowledge.
- Choose a suitable C-construct to develop C code for a given problem.
- Recognize the bugs in the C program.
- Apply the C-language syntax rules to correct the bugs in the C program.
- Develop simple C programs to illustrate the applications of different data types such as arrays, pointers, functions.

Module 1

Basics of Computer Hardware and Software

Basics of Computer Architecture: processor, Memory, Input& Output devices

Application Software & System software: Compilers, interpreters, High level and low level languages, Introduction to structured approach to programming, Flow chart Algorithms, Pseudo code (*bubble sort, linear search - algorithms and pseudo code*)

Hours-10

Module 2

Program Basics

Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types, Constants, Console IO Operations, printf and scanf

Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence, Preprocessor directive

Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements. (Simple programscovering control flow)

Hours-10

Module 3

Arrays and strings

Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional ArrayString processing:

In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets). Linearsearch program, bubble sort program, simple programs covering arrays and strings

Hours-10

Module 4

Pointers

Basics of Pointer: declaring pointers, accessing data though pointers, NULL pointer,array access using pointers, pass by reference effect

Working with functions

Introduction to modular programming, writing functions, formal parameters, actual parameters Pass by Value, Recursion, Arrays as Function Parameters structure, union, Storage Classes, Scope and life time of variables, *simple programs using functions*

Hours-10

Module 5

Structure & Union

Introduction, Declaration and Initialization, Array of Structures, Unions.

Hours-4

Module 6

File Handling

File Operations: open, close, read, write, append Sequential access and random access to files: In built file handling functions (*rewind(),fseek(), ftell(),feof(), fread(), fwrite()*), *simple programs covering pointers and files.*

Hours-6

Course outcomes:
After the completion of this course, students will be able to:

CO1: Illustrate and explain the basic computer concepts and programming principles of C language.

CO2: Develop C programs to solve simple mathematical and decision making problems.

CO3: Develop C programs to solve simple engineering problems using looping constructs.

CO4: Develop C programs to demonstrate the applications of derived data types such as arrays, pointers, strings and functions.

Text Books

- Schaum Series, Gottfried B.S.,Tata McGraw Hill,Programming with C
- E. Balagurusamy, Mcgraw Hill,Programming in ANSI C
- Asok N Kamthane, Pearson,Programming in C
- Anita Goel, Pearson, Computer Fundamentals

ELEMENTS OF MECHANICAL ENGINEERING (BT104)

Subject Code	**BT104**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course objectives:

- Students belonging to all branches of Engineering are made to learn certain fundamental topics related to mechanical engineering so that they will have a minimum understanding of mechanical systems, equipment and process.

Module -1

Energy Resources: **Non-renewable and renewable energy resources, Petroleum based solid, liquid and gaseous fuels, Calorific values of fuels, Combustion and combustion products of fuels.**

Solar Power: Solar Radiation, Solar constant (definition only), Solar Thermal energy harvesting, ex: liquid flat plate collectors, solar ponds (principle of operation only), Solar photovoltaic principle.

Wind Power: principle of operation of a typical windmill.

Hydro Power: Principles of electric power generation from hydro power plants,

Nuclear Power: Principles of Nuclear power plants,

Bio Fuels: introduction to bio fuels, examples of various biofuels used in engineering applications, Comparison of biofuels with petroleum fuels in terms of calorific value and emission.

Hours-10

Module- 2

Turbines and IC Engines and Pumps Steam turbines: Classification, Principle of operation of Impulse and reaction turbines, Gas turbines: Classification, Working principles and Operations of Open cycle and closed cycle gas turbines.

Water turbines: Classification, Principles and operations of Pelton wheel, Francis turbine and Kaplan turbine

Internal Combustion Engines: Classification, I.C. Engines parts, 2 Stroke and 4 stroke Petrol engines, 4 stroke diesel engines. P-V diagrams of Otto and Diesel cycles. Problems on indicated power, brake power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency, and specific fuel consumption.

Hours-10

Module- 3

Machine Tools Operations: Turning, facing, knurling, Thread cutting, Taper Turning , Drilling, Boring, Reaming, Tapping, Counter Sinking, Counter Boring, - Plane milling, End milling, Slot milling. (No sketches of Machine tools, sketches to be used only for explaining operations.)

Hours-5

Module-4

Engineering materials and joining processes: Engineering Materials: Types and applications of Ferrous & Nonferrous metals and alloys,

Composites: Definition, Classification and applications(Air craft and Automobiles)

Soldering, Brazing and Welding:

Definitions, classification and method of soldering, Brazing and welding.

Differences between soldering, Brazing and Welding. Description of Electric ArcWelding and Oxy-Acetylene Welding.

Hours-10

Module-5

Refrigeration, Air-Conditioning:

Refrigerants: properties of refrigerants, list of commonly used refrigerants. Refrigeration – Definitions – Refrigerating effect, Ton of Refrigeration, Ice making capacity, COP, Relative COP, unit of Refrigeration. Principle and working of vapor compression refrigeration and vapour absorption refrigeration: Principles and applications of air conditioners, Room air conditioner.

Hours-10

Course outcomes:
Students shall demonstrate knowledge associated with,

CO-1: Various Energy sources, Boilers, Prime movers such as turbines and IC engines, refrigeration and air-conditioning systems
CO-2: Metal removal process using Lathe, drilling, Milling Robotics and Automation.
CO-3: Fair understanding of application and usage of various engineering materials.

Text Books:

1. V.K.Manglik, "Elements of Mechanical Engineering", PHI Publications, 2013. (Module-1,2,4,5)
2. Mikell P.Groover, "Automation, Production Systems & CIM", 3rd Edition, PHI (Module -3)
3. K.R.Gopalkrishna, "A text Book of Elements of Mechanical Engineering"-Subhash Publishers, Bangalore. (Module -1,2,3,4,5)

BASIC OF ELECTRICAL ENGINEERING (BT105)

Subject Code	**BT105**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	45	**CREDITS**	04

Course objectives:

- Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
- Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.
- Develop selection skill to identify the type of generators or motors required for particular application.
- Highlight the importance of transformers in transmission and distribution of electric power.
- Emphasize the effects of electric shock and precautionary measures.
- Improve the ability to function on multi-disciplinary teams.

Module -1

Ohm's law and Kirchhoff's laws, analysis of series, parallel circuit by independent voltage sources, concept of power and energy, definition of magnetic circuit and analogy between electric and magnetic circuits, faradays laws of electromagnetic induction, concept of Network Theorem.

Hours-10

Module -2

Single Phase A.C. Circuits: Average value, R.M.S. value, form factor and peak factor for sinusoidal wave form, Steady State Analysis of series R-L-C circuits. Concept of Reactance, Impedance, Susceptance, Admittance, Concept of Power Factor, Real, Reactive and Complex power, Illustrative Problems **Hours-10**

Module - 3

Single phase transformers: principle of operation, constructional features and emf equation. DC. Generator: principle of operation, constructional features, emf equation.
DC Motor: principle of operation, Back emf, torque equation.

Hours-10

Module- 4

Three phase Induction Motor: principle of operation, types; Synchronous Machines: principle of operation of Synchronous generator and motor. EMF equation, Voltage regulation, Applications and starting of Synchronous motor. Introduction to single-phase induction Motor.

Hours-10

Module-5

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Types of Wires and Cables, Earthing. Elementary calculations for energy consumption and battery backup.

Measuring Instruments: Construction and Principle of operation of dynamometer type wattmeter and single-phase induction type energy meter

Hours-10

Course outcomes:
After the completion of the course, the student should be able

CO-1: To predict the behavior of electrical and magnetic circuits.

CO-2: Select the type of generator / motor required for a particular application.

CO-3: Realize the requirement of transformers in transmission and distribution of electricpower and other applications.

CO-4: Practice Electrical Safety Rules & standards.

CO-5: To function on multi-disciplinary teams.

Text books:

- V. N. Mittal and Arvind Mittal;, " Basic Electrical Engineering" McGraw Hill
- Vincent DelToro, " Electrical engineering Fundamentals", PHI second edition 2011
- Bolestaad, :"Electronics Devices and Circuits Theory", Pearson Education India
- Edward Hughes, " Electrical Technology,", Pearson Education
- D.P. Kothari and Nagrath " Theory and Problems in electrical Engineering", PHI edition2011

PROFESSIONAL COMMUNICATION SKILL (BT106)

Subject Code	**BT106**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	45	**CREDITS**	03

Course Objective:
To enable students how to improve communication skills.

To develop Writing skills in preparing business letters, report, memos, and proposals. Todevelop Oratory skills through public speaking.

To understand importance of professional attire in corporate environment.

To get knowledge on various business etiquette and inculcate the etiquette for corporate fit.

Unit-I: Concepts of Communications

Introduction: Definition and Process of Communication - Forms of Verbal and Non-verbal Communication.
Barriers of Communication: Communication Barriers and Overcoming Communication Barriers - Guidelines for Effective Communication.
Business Writing: Direct and Indirect approaches to Business Writing - Five Main Stages ofWriting Business Messages. Exercise: Role Play, Square Talk Activity.

Hours-10

Unit-II: Written Business Communication

External Communication: The Seven C's of Letter writing - Kinds of Business Letters - Business Reports and Proposals - Purpose of Business Reports.

Internal Communication: Format and Principles of Writing Memos - General Warning - Cautions. Exercise: Preparation of Reports on different issues.

Hours-10

Unit-III: Oral Communication

Public Speaking: Types of Public Speaking - importance of Public Speaking.
Power Point Presentation: Planning the Presentation - Delivering the Presentation - Developing & Displaying Visual Aids - Handling Questions from the Audience.
Listening: Definition - Types of Listening Skills - Features of a Good Listener - Causes and effectsof Poor Listening.
Exercise: Elocution and Extempore

Hours-10

Unit-IV: Behavioral Techniques

Body Language: Facial Expressions - Body Posture - Gestures - Eye Movement - Touch and the useof Personal Space.
Business Attire and Grooming: Different types of Attire - Guidelines for Business Attire. Exercise: Power of Body Language, Charades.

Hours-5

Unit-V: Etiquettes

Etiquettes: Greeting Etiquette - Corporate Etiquette - Telephone Etiquette - E-mail Etiquette – Meeting Etiquette - Netiquette - Personal Etiquette - Social Etiquette - Dining Etiquette. Exercise: Introduction and Art of Conversation, Telephonic Activity.

Hours-5

Course Outcomes:
At the end of the course, the students would be able to:

CO-1: Develop knowledge, skills, and judgment around human communication that facilitate theirability to work collaboratively with others.

CO-2: Understand and practice different techniques of communication.

CO-3: Practice and adhere to the 7Cs of Communication.

CO-4: Familiarize with different types of Communication.

CO-5: Understand and practice Interview Etiquettes.

TEXT BOOKS:

- Meenakshi Raman and Prakash Singh, Business Communication, Oxford
- **Lesikar:** Basic Business Communication, TMH
- **David Irwin:** Effective Business Communications, Viva- Thorogood. Rajendra Pal, J S Korlaha
- **HI:** Essentials of Business Communication: Sultan Chand & Sons, New Delhi

2nd *SEMESTER*

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BT 201	Engineering Mathematics-II	3	1	-	4	30	70	100
BT 202	Engineering Chemistry	4	-	-	4	30	70	100
BT 203	Elements of Civil Engineering and Mechanics	4	-	-	4	30	70	100
BT 204	Computer Aided Engineering Drawing	4	-	-	4	30	70	100
BT 205	Basic Electronics	4	-	-	3	30	70	100
BT 206	Software Engineering	3	1	-	3	30	70	100
	Practical							
BT 207L	Engineering Chemistry **Lab**	-	-	4	2	15	35	50
BT 208L	Workshop Practice	-	-	4	2	15	35	50
	Total	**22**	**2**	**8**	**26**	**210**	**490**	**700**

ENGINEERING MATHEMATICS-II (BT201)

Subject Code	**BT201**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course objectives:

To enable students to apply the knowledge of Mathematics in various engineering fields by making them to learn the following

- Ordinary differential equations
- Partial differential equations
- Double and triple integration
- Laplace transform

Module – I

Linear differential equations with constant coefficients: Solutions of second and higher order differential equations - inverse differential operator method, method of undetermined coefficients and method of variation of parameters.

Hours-10

Module -II

Linear differential equations with variable coefficients: Solution of Cauchy's and Legendre's linear differential equations.

Nonlinear differential equations - Equations solvable for p, equations solvable for y, equations solvable for x, general and singular solutions, Clairauit's equations and equations reducible to Clairauit's form.

Hours-10

Module – 3

Partial Differential equations:

Formulation of Partial differential equations by elimination of arbitrary constants/functions, solution of non-homogeneous Partial differential equations by direct integration, solution of homogeneous Partial differential equations involving derivative with respect to one independent variable only.

Derivation of one-dimensional heat and wave equations and their solutions by variable separable method.

Hours-10

Module-4

Integral Calculus:

Multiple integrals: Beta and Gamma functions: definitions, Relation between beta and gamma functions and simple problems**.**

Evaluation of double and triple integrals. evaluation of double integrals by changing the order of integration and by changing into polar co-ordinates .Applications of multiple integrals to find area and volume.

Hours-10

Module-5

Laplace Transform

Definition and Laplace transforms of elementary functions.

Laplace transforms of $e^{at}f(t)$, $t^n f(t)$ and f(t) (without proof), t periodic functions and unit-step function- problems

Inverse Laplace Transform

Inverse Laplace Transform - problems, Convolution theorem to find the inverse Laplace transforms (without proof) and problems, solution of linear differential equations using Laplace Transforms.

Hours-10

Course outcomes:

On completion of this course, students are able to,

CO-1: Solve differential equations of electrical circuits, forced oscillation ofmass spring and elementary heat transfer.
CO-2: Solve partial differential equations fluid mechanics, electromagnetictheory and heat transfer.
CO-3: Evaluate double and triple integrals to find area, volume, mass andmoment of inertia of plane and solid region.
CO-4: Use curl and divergence of a vector valued functions in various applications of electricity, magnetism and fluid flows.

Text Books:

1. B. S. Grewal," Higher Engineering Mathematics", Khanna publishers,42nd edition, 2013.
2. Kreyszig, "Advanced Engineering Mathematics " -Wiley, 2013

Reference Books:

- B.V.Ramana "Higher Engineering M athematics" Tata Mc Graw-Hill, 2006
- N PBali and Manish Goyal, "A text book of Engineering mathematics" ,Laxmi publications, latest edition.
- H. K Das and Er. Rajnish Verma ,"Higher Engineering Mathematics", S. Chand publishing,1st edition, 2011.

ENGINEERING CHEMISTRY (BT202)

Subject Code	**BT202**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course objectives:

To provide students with knowledge of engineering chemistry for building technical competence in industries, research and development in the following fields

- Electrochemistry & Battery Technology.
- Corrosion & Metal Finishing.
- Fuels & Solar energy.
- Polymers.
- Water Technology & Nano Materials.

Module -1
Electrochemistry and Battery Technology

Electrochemistry: Introduction, Derivation of Nernst equation for electrode potential. Reference electrodes: Introduction, construction, working and applications of calomel and Ag / AgCl electrodes. Measurement of electrode potential using calomel electrode. Ion selective electrode: Introduction; Construction and working of glass electrode, determination of pH using glass electrode. Concentration cells: Electrolyte concentration cells, numerical problems.

Battery Technology: Introduction, classification - primary, secondary and reserve batteries. Characteristics - cell potential, current, capacity, electricity storage density, energy efficiency, cycle life and shelf life. Construction, working and applications of Zinc- Air, Nickel- metal hydride batteries. Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries.

Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell with H_2SO_4 electrolyte.

Hours-10

Module -2
Corrosion and Metal Finishing:

Corrosion: Introduction, electrochemical theory of corrosion, galvanic series. Factors affecting the rate of corrosion: ratio of anodic to cathodic areas, nature of metal, nature of corrosion product, nature of medium – pH, conductivity, and temperature. Types of corrosion- Differential metal, differential aeration (Pitting and water line) and stress. Corrosion control: Inorganic coatings-Anodizing of Al and phosphating; Metal coatings-Galvanization and Tinning. Cathodic protection (sacrificial anodic and impressed current methods).

Metal Finishing: Introduction, Technological importance. Electroplating: Introduction, principles governing-Polarization, decomposition potential and overvoltage. Factors influencing the nature of electro deposit-current density, concentration of metal ion & electrolyte; pH, temperature & throwing power of plating bath; additives- brighteners, levellers, structure modifiers & wetting agents. Electroplating of Nickel (Watt's Bath) and Chromium(decorative and hard). Electro less plating: Introduction, distinction between electroplating and electro less plating, electro less plating of copper & manufacture of double sided Printed Circuit Board with copper.

Hours-10

Module – 3
Fuels and Solar Energy:

Fuels: Introduction, classification, calorific value- gross and net calorific values, determination of

calorific value of fuel using bomb calorimeter, numerical problems. Cracking: Introduction, fluidized catalytic cracking, synthesis of petrol by Fishcher-Tropsch process, reformation of petrol, octane and cetane numbers., anti knocking agents, power alcohol & biodiesel.

Solar Energy: Introduction, utilization and conversion, photovoltaic cells- construction and working. Design of PV cells: modules, panels & arrays. Advantages & disadvantages of PV cells. Production of solar grade silicon: Union carbide process, purification of silicon (zone refining), doping of silicon-diffusion technique (n&p types).

Hours-10

Module - 4
Polymers:

Introduction, types of polymerization: addition and condensation, mechanism of polymerization-free radical mechanism taking vinyl chloride as an example. Molecular weight of polymers: number average and weight average, numerical problems. Glass transition temperature (Tg): Factors influencing Tg-Flexibility, inter molecular forces, molecular mass, branching & cross linking and stereo regularity. Significance of Tg. Structure property relationship: crystallinity, tensile strength, elasticity & chemical resistivity. Synthesis, properties and applications of PMMA (plexi glass), Polyurethane and polycarbonate. Elastomers: Introduction, synthesis, properties and applications of Silicone rubber.

Hours-10

Module-5
Water Technology and Nanomaterials:

Water Technology: Introduction, boiler troubles with disadvantages & prevention methods-scale and sludge formation, priming and foaming, boiler corrosion(due to dissolved O2, CO2 and MgCl2). Determination of DO, BOD and COD, numerical problems on COD. Sewage treatment: Primary, secondary (activated sludge method) and tertiary methods. Softening of water by ion exchange process

Nano Materials: Introduction, properties (size dependent). Synthesis-bottom up approach (sol-gel, precipitation, gas condensation & chemical vapour condensation processes). Nano scale materials-carbon nano tubes, nano wires, fullerenes, dendrimers, nano rods, & nano composites.

Hours-10

Course outcomes:

On completion of this course, students will have knowledge in:

CO-1: Electrochemical and concentration cells. Classical & modern batteries and fuel cells.

CO-2: Causes & effects of corrosion of metals and control of corrosion. Modification of

surface properties of metals to develop resistance to corrosion, wear, tear, impact etc. by electroplating and electro less plating.

CO-3: Production & consumption of energy for industrialization of country and living standards of people. Utilization of solar energy for different usefulforms of energy.

CO-4: Replacement of conventional materials by polymers for various applications.

CO-5: Boiler troubles; sewage treatment and desalination of sea water, and

CO-6: Over viewing of synthesis, properties and applications of nanomaterials.

Text Books:

1. B.S.Jai Prakash, R.Venugopal, Sivakumaraiah & Pushpa Iyengar. **"Chemistry for Engineering Students"**, Subhash Publications,Bangalore.
2. R.V.Gadag & A.Nityananda Shetty., **"Engineering Chemistry"**, I K International Publishing House Private Ltd. New Delhi.
3. P.C.Jain & Monica Jain.,**"Engineering Chemistry"**, Dhanpat Rai Publications, New Delhi.

Reference Books:

1. O.G.Palanna,**"Engineering Chemistry"**, Tata McGraw Hill Education Pvt.Ltd. New Delhi, Fourth Reprint.
2. G.A.Ozin & A.C. Arsenault, **"Nano chemistry A Chemical Approach to Nanomaterial's"**, RSC publishing, 2005.
3. **"Wiley Engineering Chemistry"**, Wiley India Pvt. Ltd. New Delhi. Second Edition.

ELEMENTS OF CIVIL ENGINEERING AND MECHANICS(BT203)

Subject Code	**BT203**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives:

The objectives of this course is to make students to learn basics of Civil Engineering

concepts and infrastructure development, solve problems involving Forces, loads and Moments and know their applications in allied subjects. It is a pre-requisite for several courses involving Forces, Moments, Centroids, Moment of inertia and Kinematics.

Module 1: Introduction to Civil Engineering & EngineeringMechanics

Introduction to Civil Engineering

Scope of different fields of Civil Engineering - Surveying, Building Materials, Construction Technology, Geotechnical Engineering, Structural Engineering, Hydraulics, Water Resources and Irrigation Engineering, Transportation Engineering, Environmental Engineering.

Infrastructure: Types of infrastructure, Role of Civil Engineer in the Infrastructural Development, Effect of the infrastructural facilities onsocio-economic development of a country. Roads: Classification of Roads and their functions, Comparison of Flexible and Rigid Pavements (Advantages and Limitations)

Bridges: Types of Bridges and Culverts, RCC, Steel and Composite Bridges

Dams: Different types of Dams based on Material, Structural behavior and functionality with simple sketches.

Introduction to Engineering Mechanics: Basic idealizations - Particle, Continuum and Rigid body; Newton's laws-Force and its characteristics, types of forces-Gravity, Lateral and its distribution on surfaces, Classification of force systems, Principle of physical independence, superposition, transmissibility of forces, Introduction to SI units. Couple, Moment of a couple, Characteristics of couple, Moment of a force, Equivalent force - Couple system; Numerical problems on moment of forces and couples, on equivalent force - couple system.

Hours-15

Module 2: Analysis of Concurrent Force Systems

Concepts: Resultants and Equilibrium

Composition of forces - Definition of Resultant; Composition of coplanar - concurrent force system, Parallelogram Law of forces, Principle of resolved parts; Numerical problems on composition of coplanar concurrent force systems.

Equilibrium of forces - Definition of Equilibrant; Conditions of static equilibrium for different force systems, Lami's theorem; Numerical problems on equilibrium of coplanar – concurrent and non-concurrent force systems.

Application- Static Friction in rigid bodies in contact

Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; Impending motion on horizontal and inclined planes; Numerical Problems on single and two blocks on inclined planes

Hours-15

Module - 3 Analysis of Non-Concurrent Force Systems

Concepts: Resultants and Equilibrium

Composition of coplanar - non-concurrent force system, Varignon's principle of moments; Numerical problems on composition of coplanar non-concurrent Force system. Application- Support Reaction in beams Types of Loads and Supports, statically determinate beams, Numerical problems on support reactions for statically determinate beams with Point load (Normal and inclined) anduniformly distributed and uniformly varying loads and Moments.

Hours-10

Module 4 Centroids and Moments of Inertia of EngineeringSections:
Centroids

Introduction to the concept, centroid of line and area, centroid of basic geometrical figures, computing centroid for–T,L,I,Z and full/quadrant circular sections and their built up sections. Numerical problems **Moment of Inertia** Introduction to the concept, Radius of gyration, Parallel axis theorem, Perpendicular axis theorem, Moment of Inertia of basic planar figures, computing moment of Inertia for – T, L, I, Z and full/quadrant circular sections and their built up sections. Numerical problems

Hours-10

Module 5: Kinematics
Concepts and Applications

Definitions – Displacement – Average velocity – Instantaneous velocity – Speed – Acceleration - Average acceleration – Variable acceleration – Acceleration due to gravity – Newton's Laws of Motion. Rectilinear Motion–Numerical problems. Curvilinear Motion – Super elevation – Projectile Motion – Relative motion – Numerical problems. Motion under gravity – Numerical problems.

Hours-15

Course outcomes

After a successful completion of the course, the student will be able to:

CO-1: Know basics of Civil Engineering, its scope of study, knowledge about Roads, Bridges and Dams;

CO-2: Comprehend the action of Forces, Moments and other loads on systems of rigid bodies

CO-3: Compute the reactive forces and the effects that develop as a result of the external loads

CO-4: Locate the Centroid and compute the Moment of Inertia of regular cross- sections.

CO-5: Express the relationship between the motion of bodies and

CO-6: Equipped to pursue studies in allied courses in Mechanics.

TEXT BOOKS

- Elements of Civil Engineering and Engineering Mechanics by M.N. Shesha Prakash and Ganesh. B. Mogaveer, PHI Learning, 3rd Revised edition (2014)
- Engineering Mechanics-Statics and Dynamics by A Nelson, Tata McGraw Hill Education Private Ltd, New Delhi, 2009.
- Elements of Civil Engineering (IV Edition) by S.S. Bhavikatti, New Age International Publisher, New Delhi, 3rd edition 2009.

REFERENCES

1. Engineering Mechanics by S.Timoshenko, D.H.Young, and J.V.Rao, TATA McGraw-Hill Book Company, New Delhi
2. Beer FP and Johnson ER, "Mechanics for Engineers- Dynamics and Statics"- 3rd SI Metric edition, Tata McGraw Hill. - 2008

COMPUTER AIDED ENGINEERING DRAWING (BT204)

Subject Code	**BT204**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course objectives:

- Engineering drawing is an important tool for all Engineers and for many others professionals. It is the language of Engineers. Engineering Drawing communicates all needed information from the engineer who designed a part to the workers who will manufacture it.
- The aim of the subject is to equip students with the fundamentals of Computer Aided Engineering Drawing and to further the ability to communicate information by graphical means.

Module -1
Introduction to Computer Aided Sketching

Introduction, Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning and free hand practicing. Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. of HP, VP, RPP & LPP. 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 viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line conventions, material conventions and lettering.

Hours-15

Module -2

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 (No application problems).

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 (No problems on punched plates and composite plates).

Hours-15

Module-3

Projections of Solids (First angle Projection only)

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions (No problems on octahedrons and combination solid).

Hours-5

Module-4

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. (No problems on sections of solids)Development of lateral surfaces of above solids, their frustums and truncations. (No problems on lateral surfaces of trays, tetrahedrons, spheres and transition pieces).

Hours-10

Module-5

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 and combination of solids (Maximum of three solids).

Hours-15

Course outcomes:

After studying this course,

CO-1: Students will be able to demonstrate the usage of CAD software.

CO-2: Students will be able to visualize and draw Orthographic projections,Sections of solids and Isometric views of solids.

CO-3: Students are evaluated for their ability in applying various concepts to solvepractical problems related to engineering drawing.

TEXT BOOKS:

1. Engineering Drawing – N.D. Bhatt & V.M. Panchal, 48th edition, 2005 Charotar Publishing House, Gujarat.
2. "Computer Aided Engineering Drawing"by Dr. M H Annaiah, Dr C N Chandrappa and Dr B Sudheer Premkumar Fifth edition, New Age International Publishers

REFERENCE BOOKS:

- Computer Aided Engineering Drawing – S. Trymbaka Murthy, - I.K.
- International PublishingHouse Pvt. Ltd., New Delhi, 3rd revised edition-2006.
- Engineering Graphics - K.R. Gopalkrishna, 32nd edition, 2005- Subash Publishers Bangalore.

BASIC ELECTRONICS (BT205)

Subject Code	BT205	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	45	CREDITS	03

Course Objectives:

- To study in detail about construction of several electronic devices.
- To analyse the characteristics of various electronic devices and circuits.
- To understand the internal structure and characteristics of Op-amp.
- To learn about the linear and non-linear applications of Op-amp.

UNIT – I: Semi-Conductors and Diodes:

Conductors, Semiconductors, Intrinsic Semiconductors, Extrinsic Semi-Conductors. Diode Theory: Basic Ideas, The ideal Diode, Forward and Reverse Bias, Diode Equation, Volt-Ampere Characteristic. Special diodes: symbol of zener diode, operation, V-I characteristics, symbol of photo diode, working principle, LED symbol and principle. **Hours-10**

UNIT – II: Rectifiers:

Half-wave Rectifier, Full-wave and Bridge Rectifier, derivation of Ripple factor, efficiency of Half-wave, full-wave and Bridge rectifiers. Merits and demerits of Half-wave, full-wave and Bridge rectifiers, Comparisons of rectifiers. **Hours-10**

UNIT- III: Bipolar Junction Transistors:

Symbols of pnp and npn transistors and their working principles, Transistor currents, input and output characteristics of Common base configuration, Common Emitter configuration Transistor Switch, Amplifiers: working principles of Common base amplifier, Common Emitter amplifier, Common collector amplifier and their applications.

UNIT- IV
Characteristics of Op-Amps:

Hours-15

Introduction to OP-amp, Op-amp Block Diagram, ideal and practical Op-amp specifications, 741 op- amp & its features, Op-Amp parameters & Measurement, Input & Out put off set voltages & currents, slew rates, CMRR, PSRR.

Hours-7

UNIT-V: Applications of Op-Amps:

Inverting and non-inverting amplifier, Integrator and differentiator, Comparators.

Hours-3

Course Outcomes:

Students will be able to

CO-1: Understand the semiconductor physics of the intrinsic, p and n materials.

CO-2: Understand the function and operation of diodes, transistors and amplifiers.

CO-3: Students will be aware of the architecture, functions & their applications of IC 741 OP-Amp

Text Books:

1. Electronic Principles, Albert Malvino and David J Bates, 7th Edition, Tata McGraw –Hill.

2. Electronic Devices and Circuits Theory, Boyelstad, Pearson Education, 8th Edition, September 2011.

3. Op-Amps and Linear Integrated Circuits , - Ramakanth A. Gayakwad, PHI, 4th Edition, 2009

4. Linear Integrated Circuits – D. Roy Chowdhury, New Age International Pvt.Ltd., 2nd Edition, 2003.

SOFTWARE ENGINEERING (BT206)

Subject Code	BT206	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	50	CREDITS	03

Course Objectives:

- Understand the software life cycle models
- Understand the importance of the software development process
- Understand the importance of modeling and modeling languages
- Design and develop correct and robust software products

Unit-I

Introduction:

Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.

Hours-10

Unit-II

Software Requirement Specifications (SRS) Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS.

Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.

Hours-10

Unit-III

Software Design: Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and

Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

Hours-10

Unit-IV

Software Testing: Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.

Hours-10

Unit-V

Software Maintenance and Software Project Management Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.

Hours-10

Course Outcomes:

At the end of the course the student should be able to:

CO 1: Identify the need for engineering approach to software development and various processes of requirements analysis for software engineering problems.

CO 2: Analyze various software engineering models and apply methods for design and development of software projects.

CO 3: Work with various techniques, metrics and strategies for Testing software projects.

CO 4: Identify and apply the principles, processes and main knowledge areas for Software Project Management

CO 5: Proficiently apply standards, CASE tools and techniques for engineering software projects

Text books:

1. R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
2. Rajib Mall, Fundamentals of Software Engineering, PHI Publication.
3. K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
4. 4. Pankaj Jalote, Software Engineering, Wiley
5. Deepak Jain,"SoftwareEngineering:Principles and Practices", Oxford University Press.

3RD SEMESTER

S.No	Course Code	Course Details	Periods			Credits	Marks		
			L	T	P		IA	TE	TM
1	BT301	Engineering Mathematics–III	3	1	-	4	30	70	100
2	BTEEE302	Analog Electronics	3	0	0	3	30	70	100
3	BTEEE303	Circuit Analysis	3	1	0	4	30	70	100
4	BTEEE304	Electrical Machines I	3	0	0	3	30	70	100
5	BTEEE305	Electrical & Electronics Measurement	3	0	0	3	30	70	100
6	BTEEE306	Object Oriented Programming using C++	3	0	0	3	30	70	100
Practical									
1	BTEEE307L	Electrical & Electronics Measurement Lab	0	0	2	2	15	35	50
2	BTEEE308L	Object Oriented Programming using C++ Lab	0	0	2	2	15	35	50
3	BTEEE309L	Analog Electronics Lab	0	0	2	2	15	35	50
Total			18	2	6	26	225	525	750

ENGINEERING MATHEMATICS – III (BT-301)

Subject Code	**BT301**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS - 04**	04

Course objectives:

This course will enable students to

- Comprehend and use of analytical and numerical methods in different engineering fields
- Apprehend and apply Fourier Series
- Realize and use of Fourier transforms and Z-Transforms
- Use of statistical methods in curve fitting applications
- Use of numerical methods to solve algebraic and transcendental equations, vector integration and calculus of variation

UNIT – I

VECTOR DIFFERENTIATION

Scalar and vector point functions – Del applied to scalar point functions – Directional derivative – Del applied to vector point functions – Physical interpretation of divergence and curl – Del applied twice to point functions – Del applied to products of point functions.

Hours-10

UNIT – II

VECTOR INTEGRATION

Integration of vectors – Line integral, circulation, work done – Surface integral, flux – Green's theorem in the plane – Stoke's theorem – Volume integral – Gauss divergence theorem (all theorems without proofs) – Irrotational and solenoidal fields.

Hours-10

UNIT – III

PARTIAL DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS

Introduction – Formation of partial differential equations by eliminating arbitrary constants and functions – Solutions of a partial differential equations by direct Integration – Linear equations of the first order (Lagrange's linear equations).

Applications: Method of separation of variables – Vibrations of a stretched string: Wave equation – One dimensional heat flow equation ($\partial u/\partial t=c^{(2)} (\partial^2 u)/(\partial x^2)$), and two dimensional heat flow equation (i.e. Laplace equation : $(\partial^2 u)/(\partial x^2)+(\partial^2 u)/(\partial y^2)=0$).

Hours-10

UNIT – IV

FOURIER SERIES

Introduction – Euler's formulae – Conditions for a Fourier expansion – Functions having points of discontinuity – Change of interval – Even and odd functions – Half range series – Parseval's formula.

Hours-10

UNIT – V

FOURIER TRANSFORMS

Introduction – Definition – Fourier integral theorem (without proof) - Fourier sine and cosine integrals – Fourier transforms – Properties of Fourier transforms – Convolution theorem – Parseval's identity for Fourier transforms – Relation between Fourier and Laplace transforms

– Fourier transforms of the derivatives of a function – Applications of transforms to boundaryvalue problems.

Hours-10

Course Outcomes:

The student will be able to:

CO– 1: Apply gradient, divergence & curl to scalar and vector point functions and also physically interpret their meaning.

CO- 2: Apply the concepts of Vector calculus & the corresponding theorems to evaluate line, surface and flux integrals.

CO- 3: Solve both first & higher order partial differential equations by different techniques and apply to two dimensional heat conduction equations, vibrations of a string etc.

CO- 4: Apply infinite Fourier series to represent discontinuous function which occurs in signal processing & electrical circuits.

CO- 5: Apply the principles of Fourier transforms to Boundary value problems.

Test Books:

1. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
2. Jain, Iyenger & Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi.
3. JN Kapur, Mathematical Statistics, S. Chand & company Ltd.
4. BS Grewal, Higher Engineering Mathematics, Khanna Publishers.

ANALOG ELECTRONICS (BTEEE-302)

Subject Code	**BTEEE302**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	03

Course objectives:

This course will enable students to:

- Recall and explain various BJT parameters, connections and configurations.
- Explain and Demonstrate BJT Amplifier, Hybrid Equivalent and Hybrid Models.
- Recall and Explain construction and characteristics of JFETs and MOSFETs.

- Explain various types of FET biasing, and demonstrate the use of FET amplifiers.
- Demonstrate and Construct Frequency response of BJT and FET amplifiers at various frequencies.
- Define Demonstrate and Analyze Power amplifier circuits in different modes of operation.
- Demonstrate and Apply Feedback and Oscillator circuits using FET**.**

Module-I

BJT AC Analysis: BJT AC Analysis: BJT Transistor Modeling, The re transistor model, Common emitter fixed bias, Voltage divider bias, Emitter follower configuration. Darlington connection DC bias; The Hybrid equivalent model, Approximate Hybrid Equivalent Circuit Fixed bias, Voltage divider, Emitter follower configuration; Complete Hybrid equivalent model, Hybrid π Model

Hours-15

Module-II

Field Effect Transistors: Construction and Characteristics of JFETs, Transfer Characteristics, Depletion type MOSFET, Enhancement type MOSFET. FET Amplifiers: JFET small signal model, Fixed bias configuration, Self bias configuration, Voltage divider configuration, Common Gate configuration. Source Follower configuration, cascade configuration.

Hours-15

Module-III

BJT and JFET Frequency Response: Logarithms, Decibels, Low frequency response – BJT Amplifier with RL, Low frequency response FET Amplifier, Miller effect capacitance, High frequency response – BJT Amplifier, High frequency response FET Amplifier, Multistage Frequency Effects**.**

Hours-10

Module-IV

Feedback and Oscillator Circuits: Feedback concepts, Feedback connection types, Practical feedback circuits, Oscillator operation, FET Phase shift oscillator, Wein bridge oscillator, Tuned Oscillator circuit, Crystal oscillator, UJT construction, UJT Oscillator.

Hours-10

Module-V

Power Amplifiers: Definition and amplifier types, Series fed class A amplifier, Transformer coupled class A amplifier, Class B amplifier operation and circuits, Amplifier distortion, Class C and Class D amplifiers. Voltage regulators: Discrete transistor voltage regulation Series and Shunt Voltage regulators.

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Hours-10

Course Outcome:

- Ability to analyze PN junction in semiconductor devices under various conditions.
- Ability to design analyzes simple rectifiers and voltage regulators.
- Ability to design and analyze simple rectifiers and voltage regulators using diodes.
- Ability to describe the behavior of special purpose diode.
- Ability to design and analyze simple BJT and MOSFETS

Reference Books

S. No.	Name of authors/books/publisher
1	David Bell, Electronic Devices & Circuits, Oxford Publications
2	Schultz, Grob's, Basic Electronics, TMH
3	Millman, Electronics Devices and Circuits, ed.3, TMH
4	Cathey, Electronics Devices and Circuits,ed.3,TMH
5	J. Millman and A. Grabel, Micro electronics, TMH, International
6	B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, NewDelhi
7	A. S. Sedra and K. C. Smith, Microelectronic Circuits, Saunder's College, Publishing
8	Salivahnan, Electronics Devices and Circuits, ed.3,TMH.

CIRCUIT ANALYSIS (BTEEE-303)

Subject Code	**BTEEE303**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

COURSE OBJECTIVES:

- To learn techniques of solving circuits involving different active and passive elements.
- To analyze the behavior of the circuit's response in time domain.
- To analyze the behavior of the circuit's response in frequency domain.
- To understand the significance of network functions.

Module-I

Basic concepts: Circuit, Network, Nodes, Branch, Loop, Mesh, Planar and Non-Planar network, Active and Passive Networks, KCL, KVL, ohm's law, voltage division and current division rule. Network theorem (DC): Superposition theorem, Thevenin's and Norton's theorem, maximum power transfer theorem.

Hours-10

Module-II

Inductance and Capacitance: Energy storage devices, Inductance, Power and Energy in an inductor, Capacitance, Power and Energy in a Capacitor, Filters: Classification of filters, Characteristics of ideal filters

Hours-10

Module-III

Series resonance circuit, Frequency response of a series resonant circuit, Q factor, Bandwidth, selectivity, Effect of Q on bandwidth and selectivity, Relation between bandwidth and Q, Impedance of a series resonant circuit, Resonance by variation of L and C, Parallel resonant circuit and effect of resistance of a capacitance, Frequency response of parallel resonant circuit

Hours-15

Module-IV
Introduction to transient response of first order circuit with DC excitation.
The Laplace Transforms:
Definition, Properties of the Transform, Performing the inverse transform, Initial-value and final value Theorems. Solving Differential equation with Laplace transform, Application of Laplace Transform

Hours-15

Module-V
Two port networks: one port network, two port network, impedance and admittance parameter, symmetry and reciprocity.
Graph theory: Terminology, Incidence Matrix, Tie-set, cut -set

Hours-10

Course Outcomes:

- Gain the knowledge on basic network elements
- will analyze the RLC circuits behavior in detail
- analyze the performance of periodic waveforms
- gain the knowledge in characteristics of two port network parameters (Z, Y, ABCD, h & g)
- analyze the filter design concepts in real world applications

Reference Books:

S. No.	Name of authors/books/publisher
1	J. Ed minster & M. Nahvi, Electric Circuits (SIE), 5/e, Scaum's Out Line.
2	Nagsarkar & Sukhija, Circuits & Networks, Oxford
3	John Bird, Electric Circuit Theory & Technology, ELSEVIER
4	D. Roy Chodhary, Network & Systems, New Age
5	Ghosh & Chakrabarti, Network Analysis and Synthesis, (TMH)
6	A. Chakarvorty, Circuit Theory, Publisher Dhanpat Rai & Co.(Pvt.)Ltd.

ELECTRICAL MACHINES I (BTEEE-304)

Subject Code	BTEEE304	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	60	CREDITS	03

COURSE OBJECTIVES: The Objective of this course is to build a firm foundation of Electrical Transformers and Induction Machines

Module-I

(I) Magnetic circuits: Magnetic circuits, magneto motive force magnetic field strength, permeability, reluctance, analogy between electric and magnetic-circuits, B-H curve, hysteresis, permanent magnet and their applications, Reluctance, faraday law of Electromagnetic induction.

(II) Electromechanical energy conversion

Module-II

DC Generators: DC Generators: Introduction, construction, types, emf equation, lap and wave windings, armature reaction, commutation, methods of improving commutation, various characteristics of generator, voltage build up, losses and efficiency, condition for maximum efficiency.

Hours-10

Module-III

DC Motors: Working Principle of DC Motors, Back emf, Electro-magnetic Torque Developed in DC Motor, Types of DC Motors, Starting of DC Motors, Three-point Shunt Motor Starter, Four-point Starter, Speed Control of DC Motors, and Losses in a DC Machine, Swinburne's Test, and Hopkinson's Test.

Hours-15

Module-IV

Single-Phase Transformers: Working Principle of a Transformer, construction, An Ideal Transformer Equation, Losses in a Transformer, Effects of Voltage and Frequency Variations on Iron Losses, Efficiency of a Transformer, Condition for Maximum Efficiency, Auto-transformer

Hours-15

Module-V

Three-Phase Transformers: Merits of Three-phase Transformer over Bank of Three Single-phase Transformers, Types of Tap-changers, Cooling of Transformers. Difference between Power and Distribution Transformers, Power Transformer and its Auxiliaries.

Hours-15

Course Outcomes:

After successful completion of this course students will be able to:

- Understand the working of different types of transformers and Induction machines.
- Analyze the equivalent circuit of induction motor & transformers and evaluate their performances.
- Understand various tests to be performed on transformers and induction machines to evaluate their performances.
- Analyze the working of three phase transformer, auto transformer and parallel operation of transformers.

Reference Books

S. No.	Name of authors'/books/publisher
1	M.G .Say, The Performance and Design of AC machines, Pitman & Sons.
2	Guru, Electric Machinery,3e, Oxford
3	R. K. Srivastava, Electrical Machines, Cengage Learning.
4	P. S. Bimbhra , Electrical Machinery, Khanna Pub.
5	Stephen J Chapman, Electric Machinery Fundamentals, Mc Graw-Hill
6	Husain Ashfaq, Electrical Machines, Dhanpat Rai & Sons

ELECTRICAL & ELECTRONICS MEASUREMENT (BTEEE-305)

Subject Code	**BTEEE305**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	03

COURSE OBJECTIVES:

This course covers the fundamentals of instrumentation used in industry. Emphasis is on electric, electronic, and other instruments. Upon completion, students should be able to install, maintain, and calibrate instrumentation

Module-I

Fundamentals of Measurement: Purpose of measurement and significance of measurement, various effects of electricity employed in measuring Instruments. True Value, Errors (Gross, Systematic and Random); Static Characteristic of instruments (Accuracy, Precision, Sensitivity, Resolution and threshold). Classification of Instruments (based upon mode of measurement- Indicating, Recording and Integrating Instruments), the three forces in an electromechanical indicating instrument. Comparison between gravity and spring. Errors in Measurements.

Hours-10

Module II: Analog Ammeters, Voltmeters and Watt meters:

PMMC and MI Instruments (Attraction type), Construction, Torque Equation, Range Extension of PMMC, Errors, Advantages and Disadvantages. Electrodynamometer type wattmeter Advantages and disadvantage Measurement of three phase power, vibrating reed frequency meter.

Hours-15

Module III: DC and AC Bridges:
Measurement of resistance, Wheatstone Bridge, Kelvin's Bridge, Kelvin's Double Bridge, Measurement of inductance, Capacitance, Maxwell's Bridge, De-sauty Bridge, Anderson Bridge, Schering Bridge, Wien Bridge
Hours-15

Module IV: Instrument Transformers and Transducers
Current Transformer and Potential Transformer. Measurement of Temperature, RTD, Thermistors, LVDT, Strain Gauge, Piezoelectric Transducers, DC & AC tachometer generator.

Hours-10

Module V: Electronic Instruments

Digital Voltmeters, Digital Energy meter, CRO, measurement of voltage and frequency, Lissajous Patterns, Harmonic Distortion Analyzer. Digital Energy Meter. Digital Multi-meter, Meggers.Digital Storage Oscilloscope.

Hours-10

Course Outcome:

After the completion of this subject, students shall be able to

- Develop the knowledge of theoretical and mathematical principles of electrical measuring instruments.
- Examine various real life situations in domestic or industrial scenario where measurements of electrical quantities are essential.
- Choose the proper type and specification of measuring procedure and measuring instruments for different industrial/commercial/domestic application.
- Assess fault conditions in electrical installations and identify necessary remedial measures.
- Design new sensing and measuring schemes for various electrical and electronic applications.

Reference Books:

- A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & sons.
- Electrical Measurement & Measuring Instruments, E.W. Golding & F.C. Wides, Wheeler Publishing.
- Electronic Instruments, H.S. Kalsi, Tata Mc-Graw hill, 2nd Edition.
- Sensors & Transducers, D. Patranabis, PHI, 2nd edition.

- Digital Instrumentation, A.J. Bouwens, Tata Mc-Graw hill.
- Modern Electronic instrumentation & Measuring instruments, A.D. Heltric & W.C. Copper, Wheeler Publication. Instrument transducers, H.K.P. Neubert, Oxford University press

OBJECT ORIENTED PROGRAMMING USING C++ (BTEEE-306)

Subject Code	**BTEEE306**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	03

Course Objectives:

- Introduces Object Oriented Programming concepts using the C++language.
- Introduces the principles of data abstraction, inheritance and polymorphism;
- Introduces the principles of virtual functions and polymorphism
- Introduces handling formatted I/O and unformatted I/ O
- Introduces exception handling

UNIT–I

Object-Oriented Thinking: Different paradigms for problem solving, need for OOP paradigm, differences between OOP and Procedure oriented programming, Overview of OOP concepts-Abstraction, Encapsulation, Inheritance and Polymorphism.

C++ Basics: Structure of a C++ program, Data types, Declaration of variables, Expressions, Operators, Operator Precedence, Evaluation of expressions, Type conversions, Pointers, Arrays, Pointers and Arrays, Strings, Structures, References. Flow control statement- if, switch, while, for, do, break, continue, go to statements. Functions Scope of variable Parameter passing, Default arguments, inline functions, Recursive functions, Pointers of functions. Dynamic memory allocation and de-allocation operators-new and delete, Preprocess or directives.

Hours-15

UNIT-II

C++ Classes and Data Abstraction: Class definition, Class structure, Class objects, Class scope, this pointer, Friends to a class, Static class members, Constant member functions, Constructors and Destructors, Dynamic creation and destruction of objects, Data abstraction, ADT and information hiding.

Hours-15

UNIT-III

Inheritance: Defining a class hierarchy, Different forms of inheritance, Defining the Base and Derived classes, Access to the base class members, Base and Derived class construction, Destructors, Virtual base class.

Virtual Functions and Polymorphism: Static and Dynamic binding, virtual functions, Dynamic

binding through virtual functions, Virtual function call mechanism, Pure virtual functions, Abstract classes, Implications of polymorphic use of classes, Virtual destructors.

Hours-15

UNIT-IV

C++ I/O: I/O using C functions, Stream classes hierarchy, Stream I/O, File streams and String streams, Overloading operators, Error handling during file operations, Formatted I/O.

Hours-10

UNIT-V

Exception Handling: Benefits of exception handling, Throwing an exception, The try block, Catching an exception, Exception objects, Exception specifications, Stack unwinding, Rethrowing an exception, Catching all exceptions.

Hours-05

TEXTBOOKS:

1. The Complete Reference C++, 4thEdition, Herbert Schildt, Tata Mc Graw Hill.
2. Problem solving with C++: The Object of Programming, 4thEdition, Walter Savitch, Pearson Education.

COURSE OUTCOMES:

CO-1: Creating simple programs using classes and objects in C++.
CO-2: Implement Object Oriented Programming Concepts in C++.
CO-3: Develop applications using stream I/O and file I/O.
CO-4: Implements implegraphical user interfaces.
CO-5: Implement Object Oriented Programs using templates and exceptional handling concepts.

4TH SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BT401	Engineering Mathematics – IV	3	1	-	4	30	70	100
BTEEE 402	Electromagnetic & field theory	3	-	-	3	30	70	100
BTEEE 403	Signal & System	3	-	-	3	30	70	100
BTEEE404	Power system	3	-	-	3	30	70	100
BTEEE 405	Digital Electronics and Logic Design.	3	-	-	3	30	70	100
BTEEE406	Data structure and its Algorithm	3	1		4	30	70	100
	Practical							
BTEEE407L	Electrical Machine Lab	-	-	2	2	15	35	50
BTEEE408L	Digital Electronics and Logic Design Lab	-	-	2	2	15	35	50
BTEEE409L	Mini project			2	2	15	35	50
	Total	**18**	**2**	**6**	**26**	**225**	**525**	**750**

ENGINEERING MATHEMATICS – IV (BT-401)

Subject Code	**BT401**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objective:

- The knowledge of Mathematics is necessary for a better understanding of almost all the engineering and science subjects.
- Here our intention is to make the students acquainted with the concept of basic topics from Mathematics, which they need to pursue their engineering degree in different disciplines.
- The statistical methods of studying data samples, hypothesis testing and statistical quality control, control charts and their properties.

UNIT – I: FUNCTIONS OF A COMPLEX VARIABLE

Introduction – Limit of a complex function – Derivative of (z) – Analytic functions – Harmonic functions – Applications to flow problems. Complex Integration – Cauchy's theorem – Cauchy's integral formula – Series of complex terms (Statements of Taylor's and Laurent's Series without proof) – Zeros of an analytic function – Residues – Calculation of residues – Evaluation of real definite integrals (Integration around the unit circle, Integration around the small semi-circle

, Indenting the contours having poles on the real axis).

Geometric representation of (z), Some standard transformations ($= z + c, w = cz, w = \frac{1}{z}$, $w = \frac{az+b}{cz+d}$). **15 Hours**

UNIT – II: FINITE DIFFERENCES & INTERPOLATION

Finite differences – Forward differences – Backward differences – Central differences – Differences of a polynomial – Factorial notation – Other difference operators – To find one or more missing terms – Newton's interpolation formulae – Central difference interpolation formulae – Interpolation with unequal intervals – Lagrange's interpolation formula – Inverse interpolation. **15 Hours**

UNIT – III: NUMERICAL DIFFERENTIATION AND INTEGRATION

Numerical differentiation – Formulae for derivatives – Maxima and minima of a tabulated function – Numerical integration – Newton-Cotes quadrature formula – Trapezoidal rule – Simpson's $\frac{1}{3}^{rd}$ –rule , Simpson's $\frac{3}{8}^{th}$ –rule.

Hours-10

UNIT – IV: Z – TRANSFORMS

Introduction – Definition – Some standard Z-transforms – Linearity property –Damping rule – Some standard results – Shifting U_n to the right, Shifting U_n to the left – Two basic theorems (Initial value theorem and Final value theorem) – Convolution theorem – Convergence of Z-transforms – Two sided Z-transform of U_n – Evaluation of inverse Z-transforms (Power series method, Partial fraction method, Inverse integral method) – Applications to difference equations. **Hours-10**

UNIT – V: SAMPLING THEORY

Introduction – Sampling distribution – Testing a hypothesis – Level of significance – Confidence limits – Test of significance of large samples (Test of significance of single mean, difference of means) – Confidence limits for unknown – Small samples – Students t-distribution – Significance test of a sample mean – Significance test of difference between sample means – Chi-Square (χ^2) Test – Goodness of fit.

Hours-10

Course Outcomes:
At the end of the course student will be able to

CO-1: Understand, interpret and use the basic concepts: Analytic function, harmonicfunction, Taylor and Laurent Series, Singularity, Residues and evaluation ofimproper integrals.

CO-2: Familiarize the concepts of Finite Differences and Interpolation techniques.

CO-3: Familiarize the concept of Differentiation and Integration by numerical methods.

CO-4: Understand the characteristics and properties of Z-transforms and its applications.

CO-5: Analyze the Statistical data by using statistical tests and to draw valid inferences about the population parameters.

REFERENCE BOOKS:

1. **Dr. N.P. Bali, Dr. Ashok Saxena, Dr. N.Ch. S. Narayana**, "*A Text book on EngineeringMathematics*", Laxmi Publications (P)Ltd., New Delhi.
2. **H. K. Dass**, "*Advanced Engineering Mathematics*", S. Chand and Company Ltd.
3. **Erwin Kreyszig**. "*Advanced Engineering Mathematics*", John Wiley and Sons, New York.
4. **Dr. B.S. Grewal**, "*Higher Engineering Mathematics*", 43rd edition, Khanna Publishers,New Dehli

ELECTROMAGNETIC & FIELD THEORY (BTEEE402)

Subject Code	BTEEE402	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	45	CREDITS	03

Course objective:

- To introduce the basic mathematical concepts related to electromagnetic vector fields.
- To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
- To impart knowledge on the concepts of magneto statics, magnetic flux density, scalar and vector potential and its applications.
- To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s equations.
- To impart knowledge on the concepts of Concepts of electromagnetic waves and Transmission lines.

Module-I

Introduction: Vector Relation in rectangular, cylindrical, spherical and general curvilinear coordinate system. Concept and physical interpretation of gradient, Divergence and curl, Green’s Stoke’s and Helmholtz theorems. Electrostatics: Electric field vectors-electric field intensity, flux density & polarization. Electric field due to various charge configurations. The potential functions and displacement vector Gauss’s law, Poisson’s and Laplace’s equation and their solution. Uniqueness theorem. Continuity equation. Capacitance and electrostatics energy. Field determination by method of images. Boundary conditions. Field mappings and concept of field cells.

Hours-10

Module-II

Magneto statics: Magnetic field vector: Magnetic field intensity, flux density & magnetization, Bio-Savart’s law, Ampere’s law, Magnetic scalar and vector potential, self & mutual inductance Energy stored in magnetic field, Boundary conditions, Analogy between electric and magnetic field, Field mapping and concept of field cells

Hours-15

Module-III

Time Varying Fields: Faraday’s law, Displacement currents and equation of continuity Maxwell’s equations, Uniform plane wave in free space, dielectrics and conductors, skin effect sinusoidal time variations reflections, refraction & polarization of Upstanding wave ratio. Pointing vector and power considerations

Hours-15

Module-IV

Transmission Lines: The high-frequency circuit. LCR ladder model. The transmission Lin equation. Solution for loss-less lines Wave velocity and wave impedance. Reflection and Transmission coefficients at junctions. VSWR.

Hours-05

Course Outcome:

- Understand the basic mathematical concepts related to electromagnetic vector fields. .
- Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.
- Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.
- Understand the concepts related to Faraday ‘s law, induced emf and Maxwell ‘s equations.
- Apply Maxwell ‘s equations to solutions of problems relating to transmission lines and uniform plane wave propagation.

TextBooks/References:

- Hayt: Engineering Electromagnetics, 7/e, (With CD), MGH
- Matthew N. O. Sadiku: Principles of Electromagnetics, 4th ed., Oxford
- G. S. N. Raju: Electromagnetic Field Theory and Transmission Lines, Pearson.
- J. D. Kraus: Electromagnetic. 5th edition, MGH. 1999
- S. Baskaran and K. Malathi: Electromagnetic Field and Waves, Scitech Pub.
- R. S. Kshetrimayum, Electromagnetic Field Theory, Cengage Learning.
- V.V. Sarwate: Electromagnetic Field and Waves, Willey Eastern Ltd.
- Bhag Guru: Electromagnetic Field Theory Fundamentals, Cambridge Uni. Press.

Signal & System (BTEEE403)

Course code	BTEEE403	IA Marks	30
Number of Lecture Hours	04	Term End Marks	70
Total number of Lecture hours	45	Credits	03

Course objective:
This course trains students for an intermediate level of fluency with signals and systems in both continuous time and discrete time, in preparation for more advanced subjects in digital signal processing (including audio, image and video processing), communication theory, and system theory, control and robotics

Module-I
Introduction to Continuous Time Signals and Systems-Basic continuous time signals, Unit step, Unit ramp, Unit impulse and periodic signals with their mathematical representation and characteristics. Inversion, Shifting and Scaling of signals, Introduction to various types of systems, Causal, Stable, Linear and Time invariant systems. Analogous System-Linear mechanical elements, Force-voltage and force-current analogy, modeling of mechanical and electro-mechanical systems

Hours-10

Module-II

Fourier Transform Analysis-Exponential form and compact trigonometric form of Fourier series, Fourier symmetry, Fourier Transform: Properties, Applications to network analysis.

Hours-05

Module-III

Laplace Transform-Review of Laplace Transform, Initial and Final Value theorems, Inverse Laplace Transform, Convolution theorem, Application of Laplace Transform to analysis of networks, Waveform synthesis and Laplace Transform of complex waveforms.

Hours-15

Module-IV

State–Variable Analysis-Introduction, State Space representation of linear systems, Transfer Function and State Variables, State Transition Matrix, Solution of State Equations for homogeneous and non-homogeneous systems, Applications of State-Variable technique to the analysis of linear systems

Hours-10

Module-V

Z-Transform Analysis-Concept of Z-Transform, Z-Transform of common functions, Inverse Z Transform, Initial and Final Value theorems, Applications to solution of difference equations, Pulse Transfer Function.

Hours-05

Course outcome:
After successful completion of this subject, students shall be able to:

- Understand mathematical description and representation of continuous and discrete time signals and systems.
- Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system.
- Understand and resolve the signals in frequency domain using Fourier series and Fourier transform**.**
- Understand the limitations of Fourier transform and need for Laplace transform

Reference Books:

1. Oppenhiem, Wilsky, Nawab, "Signals & Systems", PHI
2. M E Van-Valkenberg; " Network Analysis", Prentice Hall of India
3. Choudhary D. Roy, "Network & Systems", Wiley Eastern Ltd.
4. A. Anand Kumar, " Signals & Systems", PHI
5. David K. Cheng; "Analysis of Linear System", Narosa Publishing Co .
6. Donald E. Scott, "Introduction to circuit Analysis" Mc. Graw Hill
7. B. P. Lathi, "Linear Systems & Signals" Oxford University Press, 2008.
8. I. J. Nagrath, S.N. Saran, R. Ranjan and S. Kumar, "Signals and Systems", Tata Mc. Graw Hill, 2001.
9. Taan S. Elali & Mohd. A. Karim, "Continuous Signals and Systems with MATLAB" 2nd Edition, CRC Press.

POWER SYSTEM (BTEE404)

Subject Code	BTEEE404	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	45	CREDITS	03

Course Objective:

- To introduce the students to the general structure of the network for transferring power from generatin g stations to the consumers.
- To expose the students to the different electrical & mechanical aspects of trhe power network along wi th its environmental and safety constraints.
- To familiarize the students with the price structure of Indian power market.

Module-1

Generation of Electric Power Conventional Sources (Qualitative): Hydro station, Steam Power Plant, Nuclear Power Plant and Gas Turbine Plant. Non-Conventional Sources (Qualitative): Ocean Energy, Tidal Energy, Wave Energy, wind Energy, Fuel Cells, and Solar Energy, Cogeneration and energy conservation and storage

Hours-05

Module-2

Economics of Generation: Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, Load duration curve, number and size of generator units. Base load and peak load plants. Cost of electrical energy-fixed cost, running cost, Tariff on charge to customer.

Hours-10

Module-3

Overhead Line Insulators & Insulated Cables: Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, testing of insulators. Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables.

Hours-10

Module-4

Inductance & Capacitance Calculations of Transmission Lines: Line conductors, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance. Corona: Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona, interference between power and Communication lines.

Hours-10

Module-5

A.C. Distribution: Introduction, AC distribution, Single phase, 3-phase, 3 phase 4 wire system, bus bar arrangement, Selection of site for substation. Voltage Drop Calculations (Numerical Problems) in A.C. Distributors for the following cases: Power Factors referred to receiving end voltage and with respect to respective load voltages.

DC Distribution: Classification of Distribution Systems. - Comparison of DC vs. AC and Under- Ground vs. Over- Head Distribution Systems. - Requirements and Design features of Distribution Systems. -Voltage Drop Calculations (Numerical Problems) in D.C Distributors for the following cases: Radial D.C Distributor fed one end and at the both the ends (equal/unequal Voltages) and Ring Main Distributor.

Hours-10

Course Outcome:

- At the end of the course, a student will be able to:
  Ability to design and analyze the real time electrical transmission system with respect to various electr ical parameters considering environmental and economic obligations
- Develop the ability to implement the appropriate safety equipments for design of electrical power syst em with enhancing the efficiency of the transmission and distribution system with environment friendl y technology.
- Ability to implement the knowledge of basic mathematical,
  physical and electrical principles to formulate significant electrical hazards .
- Judge the suitability of installing overhead and underground power transmission strategies considering electrical mechanical, environmental, performance, safety and economic constraints
- Chose the appropriate type of power generating station following norms and guidelines related to cost, environment, societal and ethical issues. Also review the different tariff systems available and determi ne the one most appropriate for a given scenario to optimize the revenue earned.

Reference Books:

1 Dr. S. L. Uppal Electrical Power
2 Soni – Gupta - Bhatnagar A course in Electrical Power
3 Prof. G. D. Rai Non-Conventional Energy sources
4 Prof. Arora and Dr. V. M. Domkundwar A course in Power Plant Engineering
5 J B Gupta Power System
6 C L Wadhwa Power System
7 Asfaq Hussain Power System

DIGITAL ELECTRONICS & LOGIC DESIGN (BTEEE405)

Subject Code	BTEEE405	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	45	CREDITS	03

Course Objective:

- To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
- To prepare students to perform the analysis and design of various digital electronic circuits.

Module I

Binary Codes and Boolean algebra Analog and Digital, Binary Number System. Addition, Subtraction, Multiplication, Division of binary numbers, Subtraction using 2's complement method. Binary codes: weighted and non-weighted codes, self-complementary codes, BCD, Excess-3, Gray codes, Alphanumeric codes, ASCII Codes. Boolean algebra Boolean Laws and Expression using Logic Gates, Realization of different gates using Universal gates, DE Morgan's Theorem, Duality Theorems.

Hours-05

Module II

Boolean function minimization Techniques Standard forms: SOP, POS, Simplification of Switching function & representation (Maxterm & Minterm), Boolean expression & representation using logic gates, Propagation delay in logic gate. Karnaugh map: K-map(up to 5 variables), mapping and minimization of SOP and POS expression, Don't care condition, conversion from SOP to POS and POS to SOP form using K-map, Minimization of multiple output circuits, Quine Mc-cluskey method minimization technique, prime implicate table, Don't care condition.

Hours-05

Module III

Combinational Circuits Design Adder & Subtract or (Half and Full), Parallel Binary adder, BCD Adder, Binary multipliers, Code Converters, parity bit generator, Comparators, Decoder, BCD to 7segment Decoder, Encoders, Priority Encoders, Multiplexers, De Multiplexers

Hours-05

Module IV

Sequential Circuits Elements Introduction to sequential circuit, Flip-flop & Timing Circuits: SR latch, Gated latch string state logic, Edge triggered flip-plop: - D, JK, T Flip-flop, flip-flop asynchronous inputs ,characteristic table of Flip-flop, excitation table of Flip-flop, master slave JK flip flop, inter conversion of Flip-flop. Study of timing parameters of flip-flop. Shift registers: buffer register, controlled buffer register. Data transmission in shift resistor SISO, SIPO, PISO, PIPO, Bidirectional shift register, universal shift registers. Counter: Classification, Ripple or asynchronous counter, Effect of propagation delay in ripple counters, up-down counter, Design of Mod-n counter, synchronous counter, Ring counter, Johnson counter. Introduction to FSM. Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator**.**

Hours-15

Module V

Logic Families and VLSI Design flow Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA, Logic implementation using Programmable Devices VLSI Design flow. Design entry, Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL Constructs and codes for combinational and sequential circuits

Hours-15

Course outcome:

After studying this course the students would gain enough knowledge

- Have a thorough understanding of the fundamental concepts and techniques used in digital electronics.
- To understand and examine the structure of various number systems and its application in digital design.
- The ability to understand, analyze and design various combinational and sequential circuits.
- Ability to identify basic requirements for a design application and propose a cost effective solution.
- The ability to identify and prevent various hazards and timing problems in a digital design.
- To develop skill to build, and troubleshoot digital circuits

Text Books:

1. Kharate "Digital Electronics" OXFORD Publication
2. Anand Kumar 'Fundamentals of Digital Circuits'. PHI Publications
3. R.P. Jain-'Modern Digital Electronics' IIIrd Edition- Tata Mc Graw Hill, Publication
4. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition
6. Bhaskar VHDL BASED DESIGN ,PEARSON EDUCATION

DATA STRUCTURE AND ITS ALGORITHM (BTEEE406)

Subject Code	BTEEE406	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	45	CREDITS	03

Course Objective:

- Assess how the choice of data structures and algorithm design methods impacts the performance of programs.
- Choose the appropriate data structure and algorithm design method for a specified application.
- Write programs using object-oriented design principles.
- Solve problems using data structures such as linear lists, stacks, queues, hash tables, binary trees, heaps, tournament trees, binary search trees, and graphs and writing programs for these solutions.
- Solve problems using algorithm design methods such as the greedy method, divide and conquer, dynamic programming, backtracking, and branch and bound and writing programs for these solutions.

Module I

Basic concepts and notations: Data structures and data structure operations, Complexity Analysis: Mathematical notation and functions, algorithmic complexity and time space trade off, Big O Notation, The best, average & worst cases analysis of various algorithms. Arrays: Linear & Multidimensional Arrays, Representation & traversal. Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Merge sort and Quick sort, Counting Sort. Linear search and Binary search on Sorted arrays.

Hours-15

Module II

Abstract Data Types (ADTs) Stack: Push; Pop, stack representation using array and linked list, Applications of Stack, Recursion. Queue: Representation using array and linked list, Insertion and Deletion operations, circular queue, DE queue, priority queue. Linked Lists & their types. (Single, Double, Circular linked lists), Operations on Varieties of Linked Lists (Search and Update) with applications

Hours-10

Module III

Introduction to Trees, Binary tree - definitions and properties; binary tree traversal algorithms with and without recursion., Binary Search Tree - creation, insertion and deletion operations, Threaded tree (One way and Two way). AVL tree balancing; B-tree.

Hours-05

Module IV

Graph Algorithms: Graphs and their Representations, Graph Traversal Techniques: Breadth First Search (BFS) and Depth First Search (DFS), Applications of BFS and DFS, Minimum Spanning Trees (MST), Prim's and Kruskal's algorithms for MST, Connected Components Dijkstra's Algorithm for Single Source Shortest Paths, Floydd's Algorithm for All-Pair Shortest Paths Problem

Hours-10

Module V

Hashing techniques, Hash function, Address calculation techniques- common hashing functions Collision resolution, Linear probing, quadratic probing, double hashing, Bucket addressing. Rehashing.

Hours-05

Course Outcomes: At the end of the course the student will be able to:

- Understand the concept of ADT
- Identify data structures suitable to solve problems
- Develop and analyses algorithms for stacks, queues
- Develop algorithms for binary trees and graphs
- Implement sorting and searching algorithms
- Implement symbol table using hashing techniques

TextBooks/References:

1. Data Structures Using C – A.M. Tenenbaum (PHI)
2. Introduction to Data Structures with Applications by J. Tremblay and P. G. Sorenson (TMH)
3. Data Structures, Algorithms and Application in C, 2nd Edition, Sartaj Sahni
4. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.
5. Data Structure and Program Design in C by C.L. Tondo.
6. Data Structures with C++, J. Hubbard, Schaum's Outlines, and TMH.
7. Data Structures and Algorithms in C, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.
8. Data Structures and Algorithm Analysis in C, 3rd Edition, M.A. Weiss, Pearson.
9. Classic Data Structures, D. Samanta, 2nd Edition, PHI.
10. Data Structure Using C by Pankaj Kumar Pandey.
11. Data Structure with C, Tata McGraw Hill Education Private Limited by Seymour Lipschutz.
12. Data Structure through C in Depth, BPB Publication, by S.K. Srivastava.
13. Data Structure and algorithm Analysis in C 2nd Edition, PEARSON Publishing House, Mark Allen Weiss

5TH SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BTEEE 501	Control system	3	0	0	3	30	70	100
BTEEE 502	Power system analysis	3	1	0	4	30	70	100
BTEEE 503X	Elective-I	3	0	0	3	30	70	100
BTEEE 504	Microprocessors & Microcontroller	3	0	0	3	30	70	100
BTEEE 505	Electrical Engineering Materials	3	1	0	4	30	70	100
BTEEE 506	Electrical Machine-II	3	0	0	3	30	70	100
	Practical							
BTEEE507L	Microprocessors & Microcontroller Lab	-	-	2	2	15	35	50
BTEEE 508L	Control system Lab	-	-	2	2	15	35	50
BTEEE509V	Comprehensive VIVA Voce	-	-	-	2	15	35	50
	Total	**18**	**2**	**4**	**26**	**225**	**525**	**750**

CONTROL SYSTEM (BTEEE501)

Subject Code	**BTEEE503**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	45	**CREDITS**	03

Course Objective:

- To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.
- To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system
- Formulate different types of analysis in frequency domain to explain the nature of stability of the system.

Module I

Concepts of system, open loop and closed loop systems, Benefits of Feedback, Mathematical Modeling and representation of physical systems, analogous systems. Transfer functions for different types of systems, block diagrams; Signal flow graphs and Mason's gain formula.

Hours-10

Module II

Time domain performance criterion, transient response of first order, second order systems; Steady state errors: static and dynamic error constants, system types, steady state errors for Unity and non-unity feedback systems, performance analysis for P, PI and PID controllers. Concept of stability by Routh stability criterion, root-loci and root contours.

Hours-10

Module III

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability Criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop Frequency response.

Hours-10

Module IV

Compensation - lag, lead and lag-lead networks, design of compensation networks using time Response and frequency response of the system.

Hours-5

Module V

Concepts of state, state variables, state variable representation of system, dynamic equations, Merits for higher order differential equations and solution. Concept of controllability and Observability and techniques to test them.

Hours-10

Course outcome:

- At the end of the course, a student will be able to
  categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form.
- Characterize any system in Laplace domain to illustrate different specification of the system using tran sfer function concept.
- Interpret different physical and mechanical systems in terms of electrical system to construct equivale nt electrical models for analysis.
- Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions.

Textbook/References:

[1].J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009
[2].M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
[3].B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
[4]. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.

MICROPROCESSORS & MICROCONTROLLER (BTEEE504)

Subject Code	**BTEEE504**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	45	**CREDITS**	03

Course Objective:

- To understand the concepts of Architecture of 8086 microprocessor
- To understand the design aspects of I/O and Memory Interfacing circuits
- To understand the architecture and programming of ARM processor

Module-I

THE 8086 MICROPROCESSOR - Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation. **Hours-8**

Module-II

8086 SYSTEM BUS STRUCTURE - 8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure - Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors. **Hours-8**

Module-III

MICROCONTROLLER - Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Programming 8051 Timers – Interfacing Microcontroller - Serial Port Programming - Interrupts Programming – LCD & Keyboard - External Memory Interface- Stepper Motor.

Hours-9

Module-IV

INTRODUCTION TO EMBEDDED SYSTEMS - Complex systems and microprocessors– Embedded system design process – Instruction sets preliminaries - ARM Processor – CPU: programming input and output supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance.

Hours-10

Module-V

EMBEDDED COMPUTING PLATFORM DESIGN AND OPTIMIZATION The CPU - Bus-Memory devices and systems–Designing with computing platforms – platform level performance analysis - Components for embedded programs-Models of programs Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Analysis and optimization of program size- Program validation and testing.

Hours-10

Course outcome:

- Ability to design and implement programs on 8086 microprocessor
- Ability to design I/O circuits and Memory Interfacing circuits
- Ability to design and develop components of ARM processor

Textbooks/References:

- Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007
- Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2 nd Edition, Pearson Education, 2011
- Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, 3rd Edition “Morgan Kaufmann Publisher (An imprint from Elsevier), 2012

POWER SYSTEM ANALYSIS (BTEEE502)

Subject Code	**BTEEE502**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	50	**CREDITS**	04

Course Objective:

- To compute inductance and capacitance of different transmission lines.
- To understand performance of short, medium and long transmission lines.
- To examine the traveling wave performance and sag of transmission lines.
- To understand the type of insulators for overhead lines and understand the type of cables for power transmission

Module I

Per Unit System and Faults per Unit meaning and its calculation. Need and advantages of per unit system, Selection of base quantities, per unit impedance for 1-φ and 3 – φ system. Change of base value. Faults causes and consequences. Classification of faults and statistics of occurrence.Fortescue theorem, Method of symmetrical components (positive, negative and zero sequences). Symmetrical component transformation. Sequence networks for generators, lines and transformers. Sequence network for power system. Balanced and Unbalanced faults, computation of fault currents**.**

Hours-15

Module II

Load Flow Analysis Review of the structure of power system and its components, Bus classification, formulation of Ybus matrix, power flow equations. Gauss – Seidel method, algorithm, derivation of iterarative equation, modification for PV bus, Advantages and disadvantages, acceleration factor. Newton – Raphson method, algorithm, power mismatch vector, size of Jacobian matrix and its elements. Advantages and disadvantages.

Hours-9

Module III

Power system Stability Concept of power system stability and its classification. Dynamic equation of synchronous machine. Swing equation and power angle curve. Single machine infinite bus system. Large signal stability, Equal area criteria, derivation. Critical clearing angle and effect of clearing Time on stability. Methods for improvement of transient stability. Introduction to Multi –Machine transient stability.

Hours-9

Module IV

Economic Operation of Power Systems Input-output characteristics of thermal and hydro plants, Optimum generator allocations without and with transmission losses, calculation of penalty factors, incremental transmission loss, transmission loss coefficients and their calculations.

Hours- 9

Module V

Load Frequency Control Concept of load frequency control, load frequency control of single area system, effect of governor droop and load damping, block diagram representation of single area system, steady state frequency error, and dynamic response.

Hours-8

Course Outcomes:

After successful completion of the course, students will be able to:

CO Description

CO1: Illustrate power system components using single line diagram and usage of per Unit system.

CO2: Calculate symmetrical components and Examine different types of faults (both Symmetrical and unsymmetrical).

CO3: Formulate nodal admittance (Y-bus) matrix, and develop load flow equations and find its solution.

CO4: Illustrate the concept of stability, power angle curve, and swing equation and Diagnose steady-state and transient stability of the power system.

Textbooks/References:

[1].J Grainger and W.D. Stevenson, "Power System Analysis "" , McGraw Hill Education , 1994.

[2].A.J. Wood and B.F. Wollenberg, "Power Generation, Operation and Control", John Wiley and Sons,2011.

[3]. D.P. Kothari and I.J. Nagrath, "Modern Power System Analysis "" ,McGraw Hill Education 2003

[4]. O.L. Elgerd, "Electric energy systems theory "" , McGraw Hill Education , 1995.

[5]. Soni Gupta & Bhatnagar , " A course in Electric Power "" , Dhanpat Rai & Sons.

[6]. A R Bergen and V Vittal , " Power system analysis "" , Pearson Education Inc, 1999.

ELECTRICAL ENGINEERING MATERIALS (BTEEE505)

Subject Code	BTEEE505	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	50	CREDITS	04

Course Objective:

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

- To gain knowledge in applications properties strengthening mechanisms in structural steels and super alloys and stainless steels
- To develop a fundamental understanding of various electrical and electronic materials
- To be able to understand and importance of bio materials.

Module-I

Conductivity of Metal: Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, energy levels of a molecule, emission of electrons from metals, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials, thermal properties, thermal conductivity of metals, thermoelectric effects.

Hours-10

Module-II

Dielectric Properties: Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, significance of the loss tangent, dipolar relaxation, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, Ferro electricity, piezoelectricity.

Hours-10

Module-III

Magnetic properties of Materials: Introduction, Classification of magnetic materials, diamagnetism, Para magnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance**.**

Hours-5

Module-IV

Semiconductors: energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, the Einstein relation, hall effect, thermal conductivity of semiconductors, electrical conductivity of doped materials.

Hours-5

Module-V

Insulators-properties – visual – electrical – mechanical- thermal - chemical properties - Classification based on operating temperature as per IS. Properties and application of fibrous material-impregnated fibrous-bitumen-wax-insulating liquid-enamel-varnish-ceramics-mica-asbestos-glass-rubber-synthetic resin-thermo-plast resin-Polyethylene-Teflon-PVC-Gas Insulating materials- air-Nitrogen-SF6 - Dielectric materials - Polarization-applications-capacitors.

Hours-10

Module-VI

Ceramics: properties, application to conductors, insulators & capacitors Plastics: Thermoplastics, rubber, thermostats, properties. Materials for solar cells, fuel cells and battery. Materials for coatings for enhanced solar thermal energy collection and solar selective coatings, Cold mirror coatings, heat mirror coatings,

antireflection coatings, and sintered alloys for breaker and switch contacts.

Hours-10

Course Outcome:

- To select and design components based on their properties and requirements.
- Awareness about the electrical and electronic materials.
- Knowledge about bio materials like, titanium and stainless steel based.

Textbooks/References:

1. C.S.Indulkar and S. Thiruvengadam, S., "An Introduction to Electrical Engineering
2. Kenneth G. Budinski, "Engineering Materials: Prentice Hall of India, New Delhi
3. Superalloys-II edited by C.T. SIMS, N.S. Stoloff and W.C. Hagel A Wiley-Inter science publication John Wiley and sons, New York, 1972.

ELECTRICAL MACHINE-II (BTEEE506)

Subject code	**BTEEE506**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number ofLecture Hours	45	**CREDITS**	03

Course objective:

- To make students conversant about the underlying energy conversion theory between electrical and m echanical systems by introducing electromechanical energy conversion principles.
- To expose the students to the concepts of various types of electrical machines and applications of elect rical machines.
- To acquaint the student with the concept of generation of electricity in power plant.

Module I

Fundamentals of A.C. Machines Fundamental principles of A.C. machines: E.M.F equation of an elementary alternator, single & three phase, factors affecting the induced emf, full pitch & fractional pitch windings, Winding factors, armature reaction, concept of time phasor & space phasor.

Hours-10

Module-II

Synchronous Generator Various types and construction, cylindrical rotor theory, phasor diagram, open circuit & short circuit characteristics, armature reaction, synchronous reactance, SCR, load characteristics, potier reactance, voltage regulation, E.M.F. method, MMF method, ZPF method, power angle characteristics. Theory of salient pole machine: Blondel"s two reaction theory, phasor diagram, direct axis And quadrature axis synchronous reactance, power angle characteristics, slip test, parallel Operation: Synchronizing method, effect of wrong synchronization, load sharing between Alternators in parallel, transient & sub-transient reactance's**.**

Hours-15

Module-III:
Synchronous motor General physical consideration, torque & power relations in salient and non-salient pole motors, V-curves & inverted V-curves, effect of change of excitation, synchronous Condenser, stating of synchronous motor, performance characteristics of synchronous motor, Hunting.

Hours-8

Module-IV
Single phase Induction motors Induction type, Double revolving field theory, equivalent circuit, characteristics & starting of single-phase motor, shaded pole machine, synchronous type, hysteresis motor, reluctance motor.

Hours-7

Module V
Single phase special type of machines Switched reluctance motor, PMBLDC motor, tachometer, two phase control motor, Synchro.

Hours-5

Course Outcome:
At the end of the course, a student will be able to:

- Understand the construction and principle of operation of synchronous machines.
- Analyze the effects of excitation and mechanical input on the operation of synchronous Machine.
- Understand the operation principles of Reluctance motor, shaded pole, Hysteresis Motor, and Universal motor, PMBLDC, tachometer, Synchro and identify the suitable Applications.
- Analyze single phase induction motors and identifies the suitable methods of starting

TextBooks/References:

[1] Electric Machines by I.J.Nagrath & D.P.Kothari,Tata Mc Graw Hill, 7th Edition.2005
[2] Electrical machines by PS Bhimbra, Khanna Publishers.
[3] Electric machinery by A.E. Fitzgerald, C.Kingsley and S.Umans, Mc Graw Hill Companies, 5th edition.
[4] Electric Machinery Fundamentals by Stephen Chapman Mc Graw Hill Company.
[5] Theory of Alternating Current Machinery- by Langsdorf, Tata McGraw-Hill Companies, 2nd edition.
[6] Performance and Design of AC Machines by M G. Say, BPB Publishers.

Digital Image processing (EEL5031) ELECTIVE-I

Module-I
Digital Image Representation – Fundamental steps in Image Processing)– Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - color models.

Module-II

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering – Frequency Domain: 2D Fourier Transform – Smoothing and Sharpening frequency domain filters.

Module-III

Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering. Segmentation: Edge detection Edge Linking and Boundary detection – Region based segmentation- Morphological processing- erosion and dilation.

Module-IV

Compression: Fundamentals – Image Compression models – Error Free Compression – Lossy compression– Image Compression standards

Module-V

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors –Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

Textbooks/References:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.

Distribution system planning & Automation (EEL5032)

Module-I

Distribution Systems Planning: Introduction, Distribution system planning, Factors affecting system planning, Present distribution planning techniques, Distribution system planning in the future, Future nature of distribution planning, Central role of the computer in distribution planning, Impact of Dispersed Storage and Generation, Load characteristics, Load forecasting, long term forecasting, Technological forecasting.

Module-II

Design Of Sub Transmission Lines and Distribution substations: Sub-transmission, Distribution substations, Sub-station bus schemes, Sub-station location, Rating of distribution substation, Substation service area with 'n' primary feeders, Comparison of four and six feeder patterns.

Module-III

Design Considerations of Primary and Secondary Systems: Radial type and loop type primary feeders, Primary network, Primary feeder voltage levels, Primary feeder loading, Radial feeders with uniformly distributed load and non-uniformly distributed loads, Secondary voltage levels, Secondary banking, and Secondary Networks-Secondary mains Voltage drops and power loss calculations three phase balanced primary lines, non-three phase primary lines.

Module-IV

Distribution Automation Problems of existing Distribution System, Need for Distribution Automation, Characteristics of Distribution System, Distribution Automation (Objectives, Functions, Benefits), Communication Requirements for DA, Remote Terminal Unit (RTU), Network reconfiguration, Improvement in Voltage Profile, Capacitor Placement in Distribution System for Reactive Power Compensation, Algorithm for location of capacitor.

Module-V

SCADA SYSTEM Introduction, Block Diagram, Components of SCADA, Functions of SCADA, and SCADA applied to Distribution Automation, Advantages of DA through SCADA, Requirements and Feasibility, DA Integration Mechanisms, Communication Protocols in SCADA System

Textbooks/References:

1. Dr M K Khedkar and Dr G M Dhole, "A Textbook of Electric Power Distribution automation", University Science Press, 1 st Edition 2011.
2. Turan Gonen , "Electric Power Distribution system Engineering", CRC press, 3rd edition, 2014
3. A.S. Pabla, "Electric Power Distribution " Tata Mc Graw-hill Publishing Company, 6 th edition, 2011.
4. Control and Automation of Electrical Power Distribution systems by James North cote and Robert Wilson, CRC press, 1st edition 2006.

Micro Electro Mechanical Systems (EEL5033)

Module-I

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.

Module-II

Working Principles of Microsystems: Introduction, Microsensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers, Microfluidics.

Engineering Science for Microsystems Design and Fabrication: Introduction, Molecular Theory of Matter and Inter-molecular Forces, Plasma Physics, Electrochemistry.

Module-III

Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermo mechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis.

Module-IV

Scaling Laws in Miniaturization:

Introduction, Scalingin Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

Module-V

Overview of Micromanufacturing:

Introduction, Bulk Micromanufacturing, Surface Micromachining, The LIGA Process, Summary on Micromanufacturing.

Textbooks/References:

- Tai-Ran Hsu, MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering, 2nd Ed, Wiley.
- Hans H. Gatzen, Volker Saile, JurgLeuthold, Micro and Nano Fabrication: Tools and Processes, Springer, 2015.
- Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, Microelectromechanical Systems (MEMS), Cengage Learning.

ENERGY AUDIT AND MANAGEMENT (EEL 5034)

Module-I

Energy Scenario: Primary and Secondary Energy, Conventional and non-conventional energy, Energy Security, Energy Conservation and its importance, Energy conservation Act., Thermal Energy basics, Energy Audit its definition & methodology, Energy Audit Instruments, Benchmarking for energy performance, Energy Action Planning, Duties and responsibilities of Energy Manager; Energy financial management, Project Management, Energy monitoring and targeting, pinch technology. Fuels and Combustions, Types of fuels, Important properties of fuels, calorific values, proximate and ultimate analysis of fuel, storage, handling & preparation of coal properties of gaseous fuels, combustion and combustion calculations, 3T's of combustion, Burners, Turndown ratio, draft.

Module-II

Boilers: Introduction, different types and their classification, performance evaluation of boilers, Thermal efficiency and its determination by direct and indirect method, Blow-down, boiler water treatment, external water treatment, feed water preheating, combustion air preheating, excess air control, energy saving opportunities in boilers. Fluidized bed boilers: principles of fluidization, circulating fluidized bed, bubbling bed boilers, pressurized fluid bed combustion, advantages of fluidized bed combustion boilers. Industrial furnaces- Types & classifications of furnaces, shanky diagram, Performance and its evaluation of a typical furnace, Heat losses in a furnace, furnace efficiency, Determination using direct and indirect methods, fuel economy measures in furnaces, Heat distribution in a reheating furnace, furnace draught, optimum capacity utilization, waste heat recovery from flue gases

Module-III

Fans and Blowers: Difference between fans, blowers and compressors, Fan types, a centrifugal fans, arial flow fans, fan laws, fan design and selection criteria's, flow control strategies, fan performance, assessment, energy saving opportunities in fans. Pumps & Pumping System: Types of pumps, pump curves, factors affecting pump performance, flow control strategies, Energy conservation opportunities in pumping system

Module-IV

Cooling Towers, flow control strategies, Energy saving options in cooling towers. Refrigeration System: Introduction, types of refrigeration system, Performance assessment of a refrigeration system, COP, factor affecting performance, energy savings opportunities in refrigeration systems. Compressed Air System:

Compressor Type, free air delivery, efficiency of compression, leak test, energy efficiency opportunities in compressed air systems

Textbook/References:

1. Technical Literature published by Petroleum Conservation Research Association Energy Management Supply & Conservation by Dr. Clive Beggs ,BudseworthHeinemann-2002

2. Handbook of Energy Engineering Website of Bureau of Energy Efficiency , The Fiarmout Press Inc by Albert Treemann & Paul Mehta

Renewable Energy systems (EEL5035)

Module-I

RENEWABLE ENERGY (RE) SOURCES Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

Module-II

power in the Wind – Types of Wind Power Plants (WPPs)–Components of WPPs- Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.

Module-III

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds. - Thermal Energy storage system with PCM- Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.

Module-IV

Bio mass resources –Energy from Bio mass: conversion processes-Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

Module-V

Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell : Principle of working- various types – construction and applications. Energy Storage System- Hybrid Energy Systems.

Textbooks/References:

1. Alternative Energy Systems & Applications by B.K.Hodge, Wiley, 2010 ISBN 978-0-470-14250-9
2. Renewable Energy Technologies, edited by J.C.Sabonnadiere, Wiley, 2009,ISBN 978-1-84821-135-3

3.Sustainable Energy Systems and Applications, Springer, 2011, 978-0-387-95860-6

6TH SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BTEEE 601	Communication system	3	1	0	4	30	70	100
BTEEE 602	Switchgear & protection.	3	0	0	3	30	70	100
BTEEE 603	Power Electronics	3	0	0	3	30	70	100
BTEEE 604X	Elective-II	3	0	0	3	30	70	100
BTEEE 605X	Open Elective-I	3	0	0	3	30	70	100
BTEEE 606	Introduction to VLSI	3	1	0	4	30	70	100
	Practical							
BTEEE 607L	Power Electronics Lab	0	0	2	2	15	35	50
BTEEE 608L	Communication system Lab	0	0	2	2	15	35	50
BTEEE 609L	VLSI lab	0	0	2	2	15	35	50
	Summer Internship-(Credits will be counted in next Semester)							
	Total	**18**	**2**	**6**	**26**	**225**	**525**	**750**

Communication System (BTEEE601)

Subject Code	**BTEEE601**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	50	**CREDITS**	04

Course objective:

- To understand basic analog and digital communication system theory and design, with an emphasis on wireless communications methods.

Module I

Amplitude modulation Frequency domain representation of signals, Need of Modulation, normal AM, modulation index, Generation and demodulation- envelop and synchronous detector, DSB-SC, Generation and demodulation, SSB: Generation and Demodulation, Concept of VSB modulation, Frequency Division multiplexing.

Hours-8

Module –II

Representation of FM and PM signals, Spectral characteristics of angle modulated signals, Frequency deviation and modulation index, Narrowband FM, Generation of wideband FM- Armstrong method, direct method, Demodulation of WBFM using PLL.

Hours-7

Module-III

Review of probability and random process, Type of Noise, Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

Hours-5

Module-IV

Sampling Theorem, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM) - their generation and detection, Time Division Multiplexing. Pulse code modulation (PCM), Differential pulse code modulation (DPCM), Delta modulation, Noise considerations in PCM, Digital Modulation – ASK, BPSK, BFSK

Hours-15

Module- V

Types of optical fibers - step index and graded index, multimode and single mode; Attenuation and Dispersion in fibers; Optical transmitters – LEDs and Laser Diode; Optical Receivers- PIN and APDs, Fiber optic links. Transmitter and Receiver antennas, Line of Sight Systems, Satellite Link-G/T Ratio of earth station, VSATS and GPSS, TDMA, FDMA, CDMA.

Hours-15

Course Outcome:

After completion of this course, students 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 analyse their system performance

TextBooks/References:

- Haykin S., "Communications Systems", John Wiley and Sons,
- Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education,
- Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill,
- Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering' 'John Wiley
- Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers
- Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill,
- Keiser Gerd, "Optical Fiber Communication", 2nd Edition, McGraw Hill
- Liao, "Microwave Devices and circuits", prentice Hall of India

SWITCHGEAR & PROTECTION (BTEEE602)

Subject Code	**BTEEE602**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	45	**CREDITS**	03

Course objective:

- Understand the various types of faults that can occur in power systems (such as short circuit, open circuit, earth fault).
- Explore the construction and components of protective relays used for transmission line protection.
- Study the design and components of protective relays dedicated to transformer and Busbar protection.
- Investigate the protection requirements and mechanisms for alternators and motors in power systems. Compare and contrast the features, applications, and advantages/disadvantages of various circuit breaker types to facilitate informed selection and usage in power systems

Module-I

Introduction To Power System Protection: Different types of faults and cause of fault, Normal and abnormal operating conditions, Requirements of protective systems, Different protection zones, Primary and backup protection, Function of protective relay, Basic tripping mechanism of a relay, Relay operating criteria, Important definitions of protective relaying, PSM, TSM, Different types of relay, Instrument transformer, Introduction to static and digital relays.

Hours-8

Module-II

ProtectionofTransmissionLine Overcurrent protection:-Introduction,Protectingelement for over current, Fuse, Thermal Relays, Over Current Relays, Protection of lines by over current relays, Different types of relay characteristics, Relay coordination, Non directional & Directional over current relay, Limitations of O.C. relays , Feeder protection, Definite time & IDMTO.C. Relays for Protection of feeder, Distance Protection:-Impedance, Reactance, MHO Relay, Performance of Distance Relay During Normal Load and Power Swing, Comparison of Distance Relays, Distance Protection of Transmission line, Reasons for Inaccuracy of Distance Relay Reach in transmission line, Effect of Arc Resistance on Reach of Distance Relays, Three Step Protection, Trip contact configuration, 3-stepprotectionofdoubleendfedline,Carrier aided protection of transmission lines, Elements of carrier aided protection, Numerical protection of transmission line.

Hours-10

Module-III

Transformer and Bus-Bar Protection Faults in transformer, Zone of Protection, Overcurrent Protection, simple Differential Protection, Percentage Differential Protection, REF protection, Inter-turn Faults, Incipient Faults, Buchholz relay, Over-fluxing Phenomenon, Bus-zone Protection, Faults in bus bar, Protection of Busbar using backup relay, Differential Protection of Busbar, Protection of three phase Busbar.

Hours-5

Module-IV

Generator and Induction Motor Protection Induction motor protection:-Faults and abnormal condition in induction motor, Protection of small induction motor, Protection of large induction motor, Numerical protection of induction motor. Generator protection:-Faults and abnormal conditions in generator,Differentialprotection,Merz-price protection, Stator E/Rotor E/F, Field Failure, Overload, Over Voltage, Reverse Power, Under Frequency over frequency , Miscellaneous Protection.

Hours-7

Module-V

Conventional and Modern Circuit breaker. Theory of circuit Interruption ,Fault clearing and interruption of current, Phenomena of arc, Essential properties of arc, Arc interruption theory, Losses from plasma, Circuit constants& circuit conditions, Re-striking voltage transient Characteristics of re-striking voltage, Current chopping, duties of switchgear, Classification of switchgear, Air Circuit Breaker(ACB), Air Blast Circuit Breaker (ABCB),Oil circuit breaker,bulkoil & minimum oil, Arc quenching system in oil circuit breaker, Recent development in circuit breakers, Modern trends, Vacuum circuitbreakers,SF6circuitbreakers, DC circuit breaker, Rating of circuit Breakers, Testing of MCB,ELCB& Circuit Breakers.

Hours-15

Course Outcome:

- Identify the various types of faults and need of protection in powers system.
- Explain the construction and working of different types of protective relay for protection of transmission lines.
- Explain the construction and working of different types of protective relayfor protection of transformer and Busbar
- Explain protection of alternator & motors.

Textbooks/References:

- Switchgear And Protection– S. S. Rao, Khanna publication, 2008.
- Power System Protection- Static Relays by T.S.M. Rao Tata McGraw Hill,1993.
- Fundamentals Of Power System Protection-Y. G. Parithankar and S. R. Bhide by PHI,2003.
- Power system protection and switchgear by Oza, Nair, Mehta, Makwana,2010.
- Protection of power systems by Blackburn,2014.
- Power System Protection & Switchgear by B. Ram, McGraw Hill,2011.

- Modern Power System Protection– Divyesh Oza, TMH Publication,2020

POWER ELECTRONICS (BTEEE603)

Subject Code	**BTEEE603**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	45	**CREDITS**	03

Course Objective:

- To understand different power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of AC to DC Converters.
- To study the operation, switching techniques and basic topologies of DC-DC Converters
- To learn the different modulation techniques of PWM inverters and to understand commutation techniques.
- To study the operation of AC voltage controller and various configurations.

Module I

Power Semiconductor Devices Diode, Thyristors, MOSFET, IGBT, GTO constructional features, I-V Characteristics; Firing Circuit for thyristors; protection of thyristors and gate drive circuit, Turn on techniques, Voltage and current commutation of a thyristors.

Hours-10

Module II

AC-DC Converters Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristors rectifier with R, R-L and R-L-E load; effect of source inductance, Three-phase full-bridge thyristors Rectifier with R, R-L and R-L-E load; freewheeling effect, power factor improvement.

Hours-10

Module III

DC-DC Buck and Boost Converter Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio Control of output voltage. Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage

Hours-10

Module IV

Single-Phase Voltage Source Inverter Power circuit of single-phase voltage source inverter, switch states and instantaneous output Voltage, square wave operation of the inverter, concept of average voltage over a switching Cycle, sinusoidal pulse width modulation, modulation index and output voltage.

Hours-10

Module V

Three-Phase Voltage Source Inverter Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, 120- degree conduction, 180-degree Conduction, three-phase sinusoidal pulse width modulation.

Hours-05

Course outcome:

- Relate basic semiconductor physics to properties of power devices, and combine circuit mathematics a nd characteristics of linear and non-linear devices.
- Describe basic operation and compare performance of various power semiconductor devices, passive c omponents and switching circuits
- Design and Analyze power converter circuits and learn to select suitable power electronic devices by a ssessing the requirements of application fields. Formulate and analyze a power electronic design at the system level and assess the performance.
- Identify the critical areas in application levels and derive typical alternative solutions, select suitable p ower converters to control Electrical Motors and other industry grade apparatus.
- Recognize the role power electronics play in the improvement of energy usage efficiency and the appli cations of power electronics in emerging areas.

Text/References Books:

[1].M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
[2].N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”,
John Wiley & Sons, 2007.
[3].R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science
&Business Media, 2007.
[4].L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.

Introduction to VLSI (BTEEE606)

Subject Code	BTEEE606	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	50	CREDITS	04

Course Objective:

- To learn basic CMOS Circuits.
- To learn CMOS process technology.
- To learn techniques of chip design using programmable devices.
- To learn the concepts of designing VLSI Subsystems.

MODULE-1

Introduction: Review of MOSFET characteristics, scaling and small-geometry effects, and MOSFET capacitances. MOS resistor, MOS current source, current mirror circuits. MOS voltage source, linear voltage and current converters.

Hours-10

MODULE-2

CMOS operational amplifier (OPAMP) design: Differential amplifier, level shifter, source follower, output stage voltage and power amplifiers. Cascade OP-AMP. Compensation techniques. Analog Filters: Switched capacitor (SC) fundamentals, first order SC circuits, second-order SC circuits and cascade design. Analog to digital and digital to analog converters, speed of conversion and over sampling issues.VLSI Interconnects: Distributed RC model, transmission line model. Future inter connect technologies**.**

Hours-15

MODULE-3

Digital VLSI Circuit Design: MOS inverters, CMOS inverter, state characteristics, switching characteristics, power dissipation issues. CMOS logic gates: NAND, NOR, XOR, CMOS logic design of half and full adders. CMOS transmission gates, pseudo-nMOS, domino logic gates.

Hours-15

MODULE-4

Sequential MOS Logic Circuits: The SR latch circuit, clocked latch and flip-flop, CMOS D-latch and edge-triggered circuits, Schmitt trigger circuit, Comparator. Dynamic Logic Circuits: Pass transistor logic, synchronous dynamic circuit techniques.

Hours-05

MODULE -V

Semiconductor Memories: ROM circuits, SRAM circuits, DRAM circuits, drivers and buffers, Buffer scaling and design issues

Hours-05

Course Outcome:

After the completion of the course the student will be able to

- Identify the various IC fabrication methods.
- Express the Layout of simple MOS circuit using Lambda based design rules.
- Apply the Lambda based design rules for subsystem design
- Differentiate various FPGA architectures.
- Design an application using Verilog HDL.
- Concepts of modeling a digital system using Hardware Description Language.

Textbook/References:

1.Sung-Mo Kang, Yusuf Leblebici Charlwood kim, Digital Integrated Circuits: Analysis and Design, 4th Edition, McGraw Hill Education, 2016.

2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2nd Edition, McGraw Hill Education, 2016.

3. Jan M RABAEY, Digital Integrated Circuits, 2nd Edition, Pearson Education, 2003.

4. Neil H.E. Weste and David Harris, CMOS VLSI Design: A circuits and systems perspective, 4th Edition, Pearson Education, 2015.

Elective -II

PROCESS CONTROL (EEL6041)

Module-I

Introduction to Process Control and Automation, Review of Systems: Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances. Transient response. Block diagrams.

Module-II

Stability Analysis: Frequency response, design of control system, process identification.

PI Controller tuning - Zigler-Nichols and Cohen-Coon tuning methods, Bode and Nyquist stability criterion. Process identification.

Module-III

Special Control Techniques: Advanced control techniques, cascade, ratio, feed forward, adaptive control, Smith predictor, internal model control, model-based control systems.

Module-IV

Multivariable Control Analysis: Introduction to state-space methods, Control degrees of freedom analysis and analysis, Interaction, Bristol arrays, Niederlinski index - design of controllers, Tuning of multivariable PI controllers, Design of multivariable DMC and MPC.

Module-V

Sample Data Controllers: Basic review of Z transforms, Response of discrete systems to various inputs. Open and closed loop response to step, impulse and sinusoidal inputs, closed loop response of discrete systems. Design of digital controllers. Introduction to PLC and DCS.

Textbook/References:

1. D.R. Coughanour, S.E. LeBlanc, Process Systems analysis and Control, McGrawHill, 2nd Edition, 2009.
2. D.E. Seborg, T.F. Edger, and D.A. Millichamp, Process Dynamics and Control, John Wiley and Sons, 2nd Edition, 2004.
3. B.A.Ogunnaike and W.H.Ray, Process Dynamics, Modelling and Control, Oxford Press, 1994
4. B.W. Bequette, Process Control: Modeling, Design and Simulation, PHI, 2006
5. S. Bhanot, Process Control: Principles and Applications, Oxford University Press, 2008.

HIGH VOLTAGE ENGINEERING (EEL6042)

Module-I

Introduction to High voltage engineering: Electric field stresses. Gas/ Vaccum as insulator, Liquid dielectrics. Solids and composites, Estimation and control of Electric stress, Numerical methods for electric field computation. Surge voltages, their distribution and control, Applications of insulating materials in transformers, rotating machines, circuit breakers, cables, power capacitors and bushings.

Module-II

Breakdown in Dielectric materials: Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids. Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice

Module-III

Generation & measurement of high voltages and currents: Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Tripping and control of impulse generators. Measurement of High Direct Current voltages, Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements.

Module-IV

Over voltages and insulation co-ordination: Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.

Module-V

Testing of materials & electrical apparatus: Measurement of D.C Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements. Testing of Insulators and bushings, Testing of Isolators and circuit breakers, testing of cables, Testing of Transformers, Testing of Surge Arresters, Radio Interference measurements.

Textbooks/References:

1. High Voltage Engineering by M.S.Naidu and V. Kamaraju, TMH Publications.
2. High Voltage Engineering by C.L.Wadhwa, New Age Internationals (P) Ltd.
3. High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl,by Elsevier
4. High Voltage Insulation Engineering by Ravindra Arora, Wolfgang New Age Internationals (P) Ltd
5. High voltage Engineering, Theory and Practice , Mazen Abdel Salam, Hussein Anis, Ahdan EI-Morshedy, Roshdy Radwan, Marcel Dekker

POWER SYSTEM PLANNING & AUTOMATION (EEL6043)

Module-I

Economic operation: Economic dispatch problem of thermal units without and with losses– Gradient method-Newton's method –Base point and participation factor method.

Module-II

Unit Commitment Solution Methods: Introduction to unit commitment, methods of unit commitment: Priority-List Methods, Dynamic- Programming Solution, Forward DP Approach, Lagrange relaxation solution

Module-III

Hydro-thermal co-ordination: Hydroelectric plant models –short term hydrothermal scheduling problem-gradient approach.

Module-IV

Optimal Power Flow: Solution of OPF, gradient method, Newton's method, linear programming method with only real power variables, linear programming with AC power flow variables, security-constrained optimal power flow.

Module-V

Power system security: Contingency analysis – linear sensitivity factors – AC power flow methods – contingency selection – concentric relaxation – bounding-security constrained optimal power flow. The control problem: The two-area system, Tie-line Bias control; steady state Instabilities: Torsional Oscillatory Modes-Damper windings and negative damping, effect of AVR loop: AGC Design using Kalman method-state variable form of the dynamic model, Optimum control Index, state Trajectories, the RICCATTI equations, preventive and emergency control, computer control.

Textbooks/References:

1. Allen J.Wood and Wollenberg B.F., 'Power Generation Operation and control', John Wiley & Sons, Second Edition,1996
2. Electric Energy systems Theory - An Introduction' Olle I Elgard, TMH Second Edition
3. Kirchmayer L.K., 'Economic Control of Interconnected Systems', John Wiley & Sons, 1959
4. Nagrath, I.J. and Kothari D.P., 'Modern Power System Analysis', TMH, New Delhi, 2006.

ELECTRO-MAGNETICS FOR ELECTRICAL MACHINE (EEL6044)

Module-I

Domain of Machines, Review of Field Theory, Field Theorems, Uniqueness Theorem, Poynting Theorem, Approximation Theorem, Problem of Slotting, Eddy Current Phenomena, Polyphase Induction Machines., Laminated Iron Cores, Unlaminated Iron Cores, Simulation of Armature Winding Maxwell's Equations in Integral Form, Maxwell's Equations in Point Form, General Equations for One Type of Field, Maxwell's Equations for Fields in Moving Media, Scalar Electric and Magnetic Potentials, Vector Magnetic Potential, Periodic Fields, Field Equations in Phasor Form, Retarded Potentials, Continuity Equation and Relaxation Time.

Module-II

Uniqueness Theorem for Laplace and Poisson Equations, Example of a Cuboid., Helmholtz Theorem, Generalised Poynting Theorem, Components of Power Flow Components of Force, Approximation Theorems, Potential Distribution for Rectangular Double-Slotting.

Module-III

Eddy Current Machines (Solid Rotor Induction Machines), Two-Dimensional Model, Field Components Eddy Current Density, Eddy Current Loss, Force Density, Mechanical Power Developed, Rotor Power Input, Eddy Currents in Large Plates due to Alternating Excitation Current, Single-Phase Excitation, Polyphase Excitation, Eddy Currents in Cores with Rectangular Cross-Sections, Distribution of Current Density in Circular Conductors, Eddy Currents in Laminated Rectangular Cores.

Module-IV

Two-Dimensional Fields in Anisotropic Media, Cage or Wound Rotor Induction Machines, Rotor Parameters, Induction Machines with Skewed Rotor Slots, Air-Gap Field, Fields in the Anisotropic Rotor Region, Determination of Arbitrary Constants.

Module-V

Introduction ,Tooth-Ripple Harmonics in Solid-Rotor Induction Machines ,Physical Description, Slip/Torque Characteristics ,Idealised Configuration, Field Distribution in Stator Slots, Vector Magnetic Potential, Magnetic Field Intensity, Field Distribution in the Air Gap ,Field Distribution in the Solid Rotor, Machine Performances, Eddy Current Loss ,Force Density ,Mechanical Power Developed, Rotor Input Power, Torque ,Three-Dimensional Fields in Solid-Rotor Induction Machines ,Idealized Model, Field Distributions ,Effects of Finite Machine Length, Effect of Different Rotor and Stator Lengths ,Performance Parameters.

SPECIAL ELECTRICAL MACHINES (EEL6045)

Module-I

Introduction to all kinds of special machines, stepper motor, reluctance motors, hysteresis motors, brush-less motors etc. Constructional features, Principle of operation, Variable reluctance motor, Hybrid motor, Single and multi-stack configurations, Torque equations, Modes of excitations, Characteristics, Drive circuits, Microprocessor control of stepping motors, Closed loop control.

Module-II

Synchronous Reluctance Motors: Constructional features, Types, Axial and Radial flux motors, Operating principles, Variable Reluctance and Hybrid Motors, Voltage and Torque Equations, Phasor diagram, Characteristics. Constructional features, Rotary and Linear SRMs, Principle of operation, Torque production, Steady state performance prediction, Analytical method, Power Converters and their controllers, Methods of Rotor position sensing, Sensor less operation, Closed loop control of SRM, Characteristics.

Module-III

Permanent Magnet Synchronous Motors Permanent Magnet materials, Magnetic Characteristics, Permeance coefficient, Recoil of a magnet, Principle of operation, Ideal PMSM, EMF and Torque equations, Armature reaction MMF.

Module-IV

Brushless D.C. Motors Principle of Operation, Types, Magnetic circuit analysis, EMF and torque equations, Commutation, Power Controllers, Motor characteristics and control, Torque/speed characteristics.

Textbooks/References:

1. Miller, T. J. E. “Brushless permanent magnet and reluctance motor drives”, Clarendon Press, Oxford, 1989
2. J. E. Miller (Ed.), “Electronic Control of Switched Reluctance Motor”, Newman Power Engineering Series, 2001.
3. Paul Acamley, “Stepping Motor – A Guide to Theory and Practice”, IEE London. 2002.
4. B. K. Bose, “Modern power electronics and AC drives”, Prentice Hall of India, N J, 2002.

Open Elective-I

BIOMEDICAL INSTRUMENTATION (EEL6051)

Module-I

Physiology and transducers Cell and its structure, Resting and Action Potential, Nervous system: Functional organization of the nervous system, Structure of nervous system, neurons, synapse, transmitters and neural communication, Cardiovascular system, respiratory system, Basic components of a biomedical system, Transducers, selection criteria, Piezo-electric, ultrasonic transducers, Temperature, measurements - Fiber optic temperature sensors.

Module-II

Electro – Physiological measurements Electrodes: Limb electrodes, floating electrodes, pre-gelled disposable electrodes, Micro, needle and surface electrodes, Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier. ECG, EEG, EMG, ERG, Lead systems and recording methods, Typical waveforms. Electrical safety in medical environment: shock hazards, leakage current-Instruments for checking safety parameters of biomedical equipment

Module-III

Non-electrical parameter measurements Measurement of blood pressure, Cardiac output, Heart rate, Heart sound Pulmonary function measurements, spirometer, Photo Plethysmography, Body Plethysmography, Blood Gas analysers: pH of blood, measurement of blood pCO2, pO2, finger-tip oximeter, ESR, GSR, measurements, Standard HL7.

Module-IV

Radiographic and fluoroscopic techniques, X rays, Computer tomography, Mammography, MRI, fMRI, Ultrasonography, Endoscopy, Thermography, Different types of biotelemetry systems and patient monitoring.

Module-V

Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart Lung machine, Audio meters, Dialyzers, Lithotripsy.

Textbooks/References:

1. R.S.Khandpur, ‘Hand Book of Bio-Medical instrumentation’, Tata McGrawHill PublishingCoLtd., 2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, ‘Bio-Medical InstrumentationandMeasurements’, II edition, Pearson Education, 2002 / PHI
3. J.Webster, ‘Medical Instrumentation’, John Wiley & Sons, 1995
4. L.A. Geddes and L.E.Baker, ‘Principles of Applied Bio-Medical Instrumentation’, JohnWiley&Sons, 1975.

ELECTRICAL DISTRIBUTION SYSTEMS (EEL6052)

Module-I

GENERAL CONCEPTS: Introduction to distribution systems, Load modelling and characteristics - Coincidence factor, contribution factor loss factor, Relationship between the load factor and loss factor - Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics

Module-II

DISTRIBUTION FEEDERS: Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system.

Module-III

SUBSTATIONS: Location of Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

Module-IV

SYSTEM ANALYSIS: Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.

Module-V

PROTECTION: Objectives of distribution system protection, types of common faults and procedure for fault calculations - Protective Devices: Principle of operation of Fuses, Circuit Reclosures, line sectionalizes, and circuit breakers. Coordination: Coordination of Protective Devices: General coordination procedure

Module-VI

COMPENSATION FOR POWER FACTOR IMPROVEMENT: Capacitive compensation for power-factor control - Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), Power factor correction, capacitor allocation - Economic justification - Procedure to determine the best capacitor location VOLTAGE CONTROL: Voltage Control: Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation.

Textbooks/References:

1. Turan Gonen, “Electric Power Distribution system, Engineering”, Mc Graw-hill Book Company
2. A.S. Pabla ,“Electric Power Distribution”, Tata Mc Graw-hill Publishing company.
3. S. Sivanagaraju, V.Sankar, “Electrical Power Distribution and Automation”, Dhanpat Rai & Co.
4. V. Kamaraju, “Electrical Power Distribution Systems”, Right Publishers.

POWER STATION PRACTICE(EEL6053)

Module-I

Overview of Electrical Energy Generation System

Structure of power systems, Power system scenario in India, concept of Regional and National GRID, overview of Conventional and Non-conventional power generation Factors connected with generating stations, connected load, Maximum demand, demand factor, Load factor, diversity factor, Plant capacity and utilization factor, Load curve, load duration curve, base load and peak load stations.

Module-II

Thermal Power Stations

Introduction, Site Selection, Use of Rankine Cycle, Layout of Modern Thermal Power plant, Essential and non-essential auxiliaries, Fuel and Ash Handling, Water Treatment arrangement, Draught Systems, Cost of generation.

Module-III

Hydro Power Stations

Introduction, Hydrology, Flow duration curve, Power duration curve, Mass curve, Site Selection, Types of hydro plants, Their field of use, problems, Pumped storage plants & their utilities, Surge tank, Speed Governing of hydro turbines.

Module-IV

Nuclear Power Stations

Introduction, Basics of Nuclear Energy Conversion, Site Selection, Layout and subsystems of Nuclear Power Plant, Boiler Water Reactor (BWR), Pressurized Water Reactor (PWR), Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactor (FBR), CANDU Reactor, Safety measures and Nuclear Waste Disposal in Nuclear power Plants

Module-V

Cogeneration, Captive Power Generation & Sustainable Development

Introduction, Definition & Scope, cogeneration technologies, industries suitable for cogeneration Captive generation-advantages and constraints, Type of captive power plants, financing of captive power plants, Energy problems, prospects of changes in energy supply, Agenda for sustainable development CASE STUDY based on Cogeneration / Captive Power Generation

Textbooks/References:

1)Elements of Power Station design M.V. Deshpande
2)Generation, Distribution and Utilization of Electrical Energy C. L. Wadhwa
3)Electric Power Generation, Transmission and Distribution S. N. Singh
4)Principles of Power Systems V. K. Mehta
5)Generation and utilization of electrical Energy S. Sivanagaraju, M. Balasubba Reddy,D. Srilatha

IOT & ITS APPLICATION(EEL6054)

Module-I for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Module-II

IoT & Web Technology, The Internet of Things Today, Time M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module-III

IoT Architecture -State of the Art – Introduction, State of the art, Architecture. Reference Model Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views

Module-IV

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Module-V

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

Textbooks/References:

1. Vijay Madisetti and ArshdeepBahga, “Internet of Things: (A Hands-on Approach)”, Universities Press (INDIA) Private Limited 2014, 1st Edition
2. Michael Miller, “The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World”, Pearson Education 2015.
3. Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, Apress Publications 2013, 1st Edition.
4. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice”, Wiley 2014.
5. CunoPfister, “Getting Started with the Internet of Things”, O‟Reilly Media 2011.

Introduction to MATLAB(EEL6055)

Module-I

Introduction Basic features A minimum MATLAB session Starting MATLAB Using MATLAB as a calculator Quitting MATLAB Getting started Creating MATLAB variables Overwriting variable Error messages Making corrections Controlling the hierarchy of operations or precedence Controlling the appearance of floating-point number. Managing the workspace Keeping track of your work session Entering multiple statements per line. Miscellaneous commands.

Module II

Getting help Mathematical functions, Examples Basic plotting, overview. Creating simple plots. Adding titles, axis labels, and annotations. Multiple data sets in one plot Specifying line styles and colours Exercises Introduction Matrix generation, entering a vector Entering a matrix. Matrix indexing. Colon operator Linear spacing Colon operator in a matrix.

Module-III

Creating a sub-matrix. Deleting row or column Dimension Continuation Transposing a matrix. Concatenating matrices Matrix generators Special matrices . Exercises Array operations and Linear equations Array operations Matrix arithmetic operations. Array arithmetic operations Solving linear equations. Matrix inverse Matrix functions. Introduction to programming in MATLAB. Introduction The MathWorks Inc. MATLAB 7.0 (R14SP2). The MathWorks Inc., 2005.

Module-IV

M-File Scripts, Examples, Script side-effects, M-File function Anatomy of a M-File function. Input and output arguments, Input to a script file. Output commands Control flow. The ‘‘if...end’’ structure Relational and logical operators. The ‘‘for...end’’ loop. The ‘‘while...end’’ loop, other flow structures, Operator precedence Saving output to a file Debugging M-file, Introduction, debugging process, preparing for debugging, setting breakpoints, running with breakpoints Examining values, Correcting and ending debugging, Ending debugging, Correcting an M-file

Textbooks/References:

1. S. J. Chapman. MATLAB Programming for Engineers. Thomson, 2004.
2. C. B. Moler. Numerical Computing with MATLAB. Siam, 2004.
3. C. F. Van Loan. Introduction to Scientific Computing. Prentice Hall, 1997.
4. D. J. Higham and N. J. Higham. MATLAB Guide. Siam, second edition edition, 2005.
5. K. R. Coombes, B. R. Hunt, R. L. Lipsman, J. E. Osborn, and G. J. Stuck. Differential Equations with MATLAB. John Wiley and Sons, 2000.
6. A. Gilat. MATLAB: An introduction with Applications. John Wiley and Sons, 2004.
7. J. Cooper. A MATLAB Companion for Multivariable Calculus. Academic Press, 2001.
8. J. C. Polking and D. Arnold. ODE using MATLAB. Prentice Hall, 2004.
9. D. Kahaner, C. Moler, and S. Nash. Numerical Methods and Software. Prentice-Hall, 1989.
10. J. W. Demmel. Applied Numerical Linear Algebra. Siam, 1997.
11. D. Houcque. Applications of MATLAB: Ordinary Differential Equations. Internal communication, Northwestern University

7th semester

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BTEEE701	Electrical drives	3	1	0	4	30	70	100
BTEEE702X	Elective-III	3	0	0	3	30	70	100
BTEEE 703	Database management system.	3	0	0	3	30	70	100
BTEEE 704	Optical fiber communication.	3	1	-	4	30	70	100
BTEEE 705	HVDC & Flexible AC Transmission systems.	3	1	-	4	30	70	100
	Practical							
BTEEE706L	Project formulation	-	-	6	4	30	70	100
BTEEE707V	Summer internship Training Viva voce	-	-	-	2	15	35	50
BTEEE708L	Database management system lab	-	-	2	2	15	35	50
	Total	**15**	**3**	**8**	**26**	**210**	**490**	**700**

ELECTRICAL DRIVES (BTEEE701)

Subject Code	**BTEEE701**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	50	**CREDITS**	04

Course Objective:

- To expose students to the operation, application and control of power conversion systems emplo ying electric drive to cater to industrial needs.
- To familiarize the operation principles, and design of starting, braking, and speed control arrang ements for electric motors and their applications.
- To provide strong foundation to asses performance of different industrial drives considering issu es such as, energy efficiency, power quality, economic justification, environmental issues, and p ractical viabilities.

Course Outcomes:

- At the end of the course, a student will be able to:
- Examine various applications in industrial and domestic areas where use of electric drives are es sential.
- Classify types of electric drives systems based on nature of loads, control objectives, performanc e and reliability.
- Combine concepts of previously learnt courses such as, electrical machines, Control and power electronics to cater to the need of automations in industries.
- Select most suitable type and specification of motor drive combination for efficient conversion a nd control of electric power.
- Identify the critical areas in application levels, and derive typical solutions.
- Design and justify new control and power conversion schemes for implementing alternative solu tions considering the critical and contemporary issues**.**

Module-I

Concept, classification, parts and advantages of electrical dives. Types of Loads, Components of load t oques, Fundamental torque equations, Equivalent value of drive parameters for loadswith rotational and translational motion. Determination of moment of inertia, Steady statestability, Transient stability. Mult iquadrant operation of drives. Load equalization.

Hours-10

Module-II

Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating f or continuous, short time and intermittentduty, equivalent current, torque and power methods of determi nation of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors.

Hours-10

Module-III

Effect of starting on Power supply, motor and load. Methods of stating of electric motors. Acceleration t ime Energy relation during stating, methods to reduce the Energy loss during starting.Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking.

Hours-10

Module-IV

Modeling of DC motors, State space modeling, block diagram & Transfer function, Single phase, three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. Power facto r, supply harmonics and ripple in motor current chopper-controlled DC motor drives

Hours-05

Module-V

Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor ci rcuit, slip power recovery scheme. Pulse width modulated inverter fed and current source inverter fed in duction motor drive. Volts/Hertz Control, Vector or Field oriented control.

Hours-05

Module-VI

Variable frequency control, Self Control, Voltage source inverter fed synchronous motor drive, Vector c ontrol. Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor dri ve Industrial application: Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives**.**

Hours-10

DATABASE MANAGEMENT SYSTEM (BTEEE703)

Subject Code	**BTEEE703**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	45	**CREDITS**	03

Course objective: The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS

Module I

Introduction: Overview, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and Database Language and Interfaces, Data Definitions Language, DML, Overall Database Structure. Data Modeling Using the Entity Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables, Extended ER Model, Relationship of Higher Degree.

Hours-15

Module II

Relational data Model and Language: Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus. Introduction on SQL: Characteristics of SQL, Advantage of SQL. SQL Data Type and Literals. Types of SQL Commands. SQL Operators and Their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL.

Hours-10

Module III

Data Base Design & Normalization: Functional dependencies, normal forms, first, second, 8 third

normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design.

Hours-05

Module IV

Transaction Processing Concept: Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling. Distributed Database: Distributed Data Storage, Concurrency Control, Directory System.

Hours-10

Module V

Concurrency Control Techniques: Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction, Case Study of Oracle.

Hours-05

Course Outcome:

- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Design ER-models to represent simple database application scenarios
- Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.
- Improve the database design by normalization.
- Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

Reference Books:

- Korth, Silbertz, Sudarshan," Database Concepts", McGraw Hill
- Date C J, "An Introduction to Database Systems", Addision Wesley
- Elmasri, Navathe, " Fundamentals of Database Systems", Addision Wesley
- O'Neil, Databases, Elsevier Pub.
- RAMAKRISHNAN"Database Management Systems",McGraw Hill
- Leon & Leon,"Database Management Systems", Vikas Publishing House
- Bipin C. Desai, "An Introduction to Database Systems", Gagotia Publications
- Majumdar & Bhattacharya, "Database Management System", TMH
- R.P. Mahapatra, Database Management System, Khanna Publishing House

OPTICAL FIBER COMMUNICATION (BTEEE704)

Subject Code	BTEEE704	IA Marks	30
Number of Lecture Hours/Week	03	Term End Exam Marks	70
Total Number of Lecture Hours	50	CREDITS	4

COURSE OBJECTIVES:

1. To realize the significance of optical fiber communications.
2. To understand the construction and characteristics of optical fiber cable.
3. To develop the knowledge of optical signal sources and power launching.
4. To identify and understand the operation of various optical detectors.
5. To under the design of optical systems and WDM.

Module I

OVERVIEW OF OPTICAL FIBER COMMUNICATION: Introduction, The general Optical Fiber communication system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays. Cylindrical fibers- Modes Fiber materials, Fiber fabrication techniques, fiber optic cables, Classification of Optical Fibers: Single mode fibers, Graded Index fibers.

Hours-10

Module-II

SIGNAL DISTORTION IN OPTICAL FIBERS: Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity determination, Group delay, Types of Dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, Intermodal dispersion, pulse broadening. Optical fiber Connectors- Connector types, Single mode fiber connectors, Connector return loss. Introduction to Optical Fibers splicing.

Hours-10

Module- III

OPTICAL SOURCES: Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures surface emitting LED-Edge emitting LED-quantum efficiency and LED power-light source materials modulation of LED.LASER diodes- modes and threshold conditions-Rate equations-external quantum efficiency resonant frequencies-structures and radiation patterns-single mode laser-external modulation temperature effects. **Hours-10**

Module- IV

OPTICAL DETECTORS AND RECEIVERS: Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors. Optical receiver operation-Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration.

Hours-10

Module -V

OPTICAL SYSTEM DESIGNS: Considerations, Component choice, Multiplexing, Point-to- point links, System considerations, and Link power budget with examples. Rise time budget with examples. WDM – Passive DWDM Components-Elements of optical networks-SONET/SDH

Hours-10

Textbooks/References:

1. Optical Fiber Communications – Gerd Keiser, Tata Mc Graw-Hill International edition, 4th Edition, 2008.

2. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education, 2005.

2. Text Book on Optical Fibre Communication and its Applications – S.C.Gupta, PHI, 2005.

3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Ediition, 2004.

4. Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004.

COURSE OUTCOMES: At the end of the course the student will be able to:

1. Understand and analyze the constructional parameters of optical fibers.
2. Be able to design the optical system.
3. Estimate the losses due to attenuation, absorption, scattering and bending.
4. Compare various optical detectors and choose suitable one for different applications

HVDC & FLEXIBLE AC TRANSMISSION SYSTEMS. (BTEEE705)

Subject Code	BTEEE705	IA Marks	30
Number of Lecture Hours/Week	03	Term End Exam Marks	70
Total Number of Lecture Hours	50	CREDITS	4

Course objective:

- To determine the interference caused by Corona and to measure its magnitude.
- To develop the empirical formula to determine the Corona loss occurring in EHV AC transmission Line
- To calculate the Electrostatic field and to understand its effects over humans, animal and plants
- To Provide In-depth understanding of different aspects of Extra High Voltage AC transmission system design and Analysis.

Module-I

EHV AC Transmission: Need of EHV transmission lines, power handling capacity and surge impedance loading. Problems of EHV transmission, Bundled Conductors: geometric mean radius of bundle, properties of bundle conductors. Electrostatic fields of EHV lines and their effects, corona effects: Corona loss, audio and radio noise**.**

Hours-10

Module-II

Load Frequency Control: Introduction to control of active and reactive power flow, turbine speed governing system. Speed governing characteristic of generating unit and load sharing between parallel operating generators Method of Load Frequency Control: Flat frequency, flat tie line and tie line load bias control. Automatic generation control (description of block diagram only).

Hours-10

Module-III

Voltage Control: No load receiving end voltage and reactive power generation. Methods of voltage control. Synchronous phase modifier Shunt capacitors and reactors, saturable reactors, Thyristorised static VAR compensators- TCR, FC-TCR and TSC- TCR

Hours-10

Module-IV

FACTS: Introduction to FACTS controllers, types of FACTS controllers, Brief description of STATCOM, Thyristors controlled series capacitors and unified power flow controller**.**

Hours-10

Module-V

HVDC Transmission: Types of D.C. links, advantages and disadvantages of HVDC transmission. Basic scheme and equipment of converter station. Ground return Basic principles of DC link control and basic converter control characteristics. Application of HVDC transmission.

Hours-10

Course outcome:

After the completion of this subject, students will able to:

- Students will understand the effects of corona like Audible noise.
- Students can calculate voltage gradient of bundled conductors
- Student can calculate Line inductance and capacitances of bundled conductors.
- Students learn about the trends in EHV AC Transmission

Text Books /Reference:

- E. W. Kimbark: Direct Current Transmission, Vol. 1, Wiley Interscience.
- K. R. Padiyar: HVDC Power Transmission System, Wiley Eastern Ltd.
- J. Arrillaga: H.V.D.C Transmission, Peter Peregrines.
- Arrillaga HVDC et. al, : Computer Modeling of Electrical Power System. John Wiley.

Elective-III

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UTILIZATION OF ELECTRICAL ENERGY (EEL7021)

Module-I

Illumination terminology: Solid and plane angle, Luminous Flux, Luminous Intensity, Lumen, Candle Power, Lux, Lamp Efficiency, Specific Consumption, Glare, Space, Height Ratio, Utilization Factor, Maintenance Factor, Absorption Factor, Reflection Factor, Law of Inverse Squares and Lambert's Cosine Law

Module-II

Incandescent Lamp, Low Pressure Mercury Vapour Lamps (Fluorescent Tube), High Pressure Mercury Vapour (HPMV) Lamps, High Pressure Sodium Vapour (HPSV) Lamps, Compact Fluorescent Lamps (C.F.L.), Halogen Lamps, Metal Halide lamp, electronic ballasts

Module-III

Requirements of heating element materials, Resistance and Arc heating, Resistance Heating: Direct (Salt Bath Furnace), Indirect Resistance Heating (Resistance Ovens), Arc Heating and its applications, Types of Arc furnace -Direct and Indirect, Methods of Temperature Control, Induction Heating and its applications, Types

of induction furnace Core Type (Ajax Wyatt) and Coreless type Induction Furnace. Source, Power modulator, Electric motor, Control unit and Load Electrical characteristics, Mechanical factors, Nature of load torque, Size and cost. Comparison of DC & AC Drive and Individual & Group Drive Speed Torque Characteristics of the Motor.

Module-IV

Dielectric Heating and its applications, Quality of a good weld, welding defects, Principle of Resistance Welding, Types of Resistance welding – Spot, Seam, Butt, Projection, Percussion and flash butt welding, Principle of Electric Arc welding, Types of Arc welding Machines: a. DC Welding Machines–MG Set, AC Rectified welding unit. b. AC welding Machines–welding Transformer. Requirements of ideal Traction System. Traction Mechanics: Types of Services, Speed Time Curve. Supply system: DC System, Composite System, Single Phase ac system with low and normal frequency and 3 phase system

Module-V

Domestic electrical appliances, Electric iron. Electric toaster. Electric water heater. Microwave oven. Fans (Ceiling and Table fan) Washing Machine. Grinder/ Mixer/ juicer. Vacuum Cleaner. Flour Mill etc. Air conditioner, Concept of Star System for energy conservation.

Textbooks/References:

1. A course in Utilization of Electrical Energy, *G. Garg*
2. A course in Electrical Drives, *S. K. Pillai*
3. Utilization of electrical energy, *Taylor*

Module-I

Introduction: Signals – Classification – Continuous& Discrete Time Signals – Basic Operations on Signals & Sequences – Elementary Signals - Discrete Time Systems &Properties of System, Impulse response of DT-LTI system, Linear Convolution. Sampling of Continuous Time Signals – Sampling Theorem – Aliasing & it's Effects, Signal reconstruction.

Module-II

The z-Transform: Relation between Laplace Transform &The Z-Transform, Properties of Z transform, ROC and its properties, One Sided Z-transform, Z-Transform of basic sequences, Inverse z-Transform, Analysis of LTI Systems using z Domain, Applications of z Transforms.

Module-III

Implementation Discrete Time Systems: Block diagram / signal flow graph representation of DT System, Structures for realization of FIR & IIR Systems – Direct, Cascade, Parallel & Linear phase. Fourier series& Fourier Transform of DT signals: Discrete Time Fourier series, Discrete Time Fourier Transforms – Properties, Analysis of DT-LTI systems using DTFT

Module-IV

Discrete Fourier Transform and Fast Fourier Transform: DFT- Relationship of DFT & other transforms, Properties, Frequency spectrum using DFT, Analysis of LTI system using DFT, DFT as Linear Transformation. FFT– DIT Radix-2 FFT, DIFRadix-2 FFT, Computation of Inverse DFT using FFT. Representation of Numbers in digital system (Floating point, Fixed-point representation), Types of arithmetic in digital system, Quantization effect & Errors therein, Concept of Limit Cycle Oscillations & Scaling

Module-V

Architecture of DSP: Features of Processors– Types of architecture, DMA, MAC, Pipelining etc., introduction to DSP architecture. Peripherals available in DSP IC chips, requirements of on chip hardware for power electronics applications

Textbooks/References:

1. A.Nagoor Kani , "Digital Signal Processing" 2nd Edision, TMH

2. Proakis, Manolakis, Proakis, Manolakis, “Digital Signal Processing: Principles, Algorithm & Application”, 4th edition, Pearson
3. Oppeheim, Schafer, “Discrete Time Signal Processing”, Pearson education publication, 2nd Edition, 2003.
4. D. Williamson, “Discrete Time Signal Processing”, Springer, 2002

POWER SYSTEM OPERATION & CONTROL(EEL7023)

Module-I

Power scenario in Indian grid – National and Regional load dispatching centers –requirements of good power system - necessity of voltage and frequency regulation – real power vs frequency and reactive power vs voltage control loops - system load variation, load curves and basic concepts of load dispatching - load forecasting - Basics of speed governing mechanisms and modeling - speed load characteristics - regulation of two generators in parallel.

Module-II

Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases - LFC of two area system - tie line modelling – block diagram representation of two area system - static and dynamic analysis - tie line with frequency bias control – state variability model - integration of economic dispatch control with LFC.

Module-III

Generation and absorption of reactive power - basics of reactive power control – Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop - static and dynamic analysis – stability compensation – voltage drop in transmission line - methods of reactive power injection - tap changing transformer, SVC (TCR + TSC) and STATCOM for voltage control.

Module-IV

Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - base point and participation factors method - statement of unit commitment (UC) problem

- constraints on UC problem – solution of UC problem using priority list – special aspects of short term and long-term hydrothermal problems.

Module-V

Need of computer control of power systems-concept of energy control centers and functions – PMU - system monitoring, data acquisition and controls - System hardware configurations - SCADA and EMS functions - state estimation problem – measurements and errors - weighted least square estimation - various operating states - state transition diagram.

Textbooks/References:

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010
2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016.
3. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.
4. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.
5. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
6. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

SWITCHED MODE POWER CONVERSION (EEL7024)

Module-I

Introduction To Switch Mode Power Converters About Switch Mode Power Conversion, SMPS requirements. Cuk converters - and their principles of operation; continuous and discontinuous modes of operation.

Module-II

Thyristor Commutation Techniques Review of Recent developments in power devices for switch mode power

supplies. Selection of devices, Commutation: Load Commutation, Resonant Pulse Commutation, Complementary Commutation, Impulse Commutation, External Pulse Commutation

Module-III

Transformer-Isolated Converters Single-switch and multi-switch transformer-isolated DC-DC converters. Flyback and forward converters; transformer isolated half-bridge, full bridge converters. Push-pull converters. Voltage fed and current-fed converters

Module-IV

Magnetic Component Design Magnetic core materials and performance; basic inductor and transformer design; practical magnetic design; design aspects to be considered for designing transformers for specific applications – flyback, push-pull converters

Module-V

Switching Regulator Control, Soft-Switched Dc-Dc Power Converters Small-signal models for switching regulators. Performance analysis and design of closed-loop system under different control methods, and operating modes. Measurement of small signal transfer functions. Soft Switched DC-DC Power Converters - Motivation. Hard-switching vs soft-switching.

Textbooks/References:

1. N Mohan, T M Undeland and W P Robbins, "Power Electronics: Converters, Applications and Design", Wiley , 3rd Edition, 2007
2. Abraham Pressman, Keith Billings, Taylor Morey, "Switching Power Supply Design", McGraw-Hill.3rd Edition, 2009
3. K. Kit Sum, Switch Mode Power Conversion: Basic Theory and Design 1st Edition, Kindle Edition,2017

8TH SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
BT801	Financial Engineering	3	0	0	3	30	70	100
BTEEE802X	Elective-IV	3	0	0	3	30	70	100
BTEEE803X	Elective-V	3	0	0	3	30	70	100
BTEEE804V	Project Work	0	0	12	12	50	150	200
	Total	**9**	**0**	**12**	**21**	**140**	**360**	**500**

FINANCIAL ENGINEERING (BT801)

Subject Code	**BTEEE-801**	**IA Marks**	30
Number of Lecture Hours/Week	03	**Term End Exam Marks**	70
Total Number of Lecture Hours	45	**CREDITS**	03

Course Objective:

- The objective of the course is to provide basic understanding of economics and management to engineering students with following aspects:
- To impart knowledge, with respect to concepts, principles and practical applications of economics which govern the functioning of a firm/organization.
- To help the students to understand the fundamental concepts and principles of management; the basic roles, skills, functions of management and basic knowledge of various functional areas.

Module-I:

Fundamentals of Economics:

Wealth, Welfare and Scarce Definitions of Economics; Micro and Macro Economics; Demand- Law of Demand, Elasticity of Demand, Types of Elasticity and Factors determining price elasticity of Demand: Utility- Law of Diminishing Marginal Utility, its limitations and exceptions.

Hours-15

Module-II:

Forms of Business Organizations:

Features, merits and demerits of Sole Proprietorship, Partnership and Joint Stock Company- Public Enterprises and their types.

Hours-5

Module-III:

Introduction to Management:

Functions of Management- Taylor's Scientific Management; Henry Fayol's Principles of Management; Human Resource Management –Basic functions of Human Resource Management (in brief). Production Management: Production Planning and Control, Plant Location, Break-Even Analysis- Assumptions, limitations and applications.

Hours-15

Module-IV:

Financial Management:

Types of Capital: Fixed and Working Capital and Methods of Raising Finance; Final Accounts- Trading Account, Statement of Profit and Loss and Balance Sheet (simple problems)

Hours-5

Module-V:

Marketing Management and Entrepreneurship:

Marketing Management: Functions of marketing and Distribution Channels.

Entrepreneurship: Definition, Characteristics and Functions of an Entrepreneur

Hours-5

Course outcomes:

On completion of this subject students will be able to

CO-1: Understand needs, functions, roles, scope and evolution of Management

CO-2: Understand importance, purpose of Planning and hierarchy of planning and also analyze its types

CO-3: Discuss Decision making, Organizing, Staffing, Directing and Controlling

CO-4: Select the best economic model from various available alternatives

CO-5: Understand various interest rate methods and implement the suitable one.

TEXT BOOKS:

1.A.R. AryaSri, Managerial Economics and Financial Analysis, TMH Publications, new Delhi, 2014

2. S.C. Sharma and Banga T. R., Industrial Organization & Engineering Economics, khanna Publications, Delhi-6, 2006

3. S.N.Maheswari, SK Maheswari, Financial Accounting Fifth Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2012

ELECTIVE-IV

Computer Applications in Power Systems. (**EEL8021)**

Module-I

Models of power system components, network model using graph theory, formation of Z bus, transmission line models, regulating transformer, line load ability, capability curves of alternator.

Module-II

Control of load bus voltage using reactive power control variable, SVC & SVS, Regulated shunt compensation, series and shunt compensation, Uniform series and shunt compensation and effect on load ability of transmission lines.

Module-III

Sensitivity analysis- General sensitivity relations, generation shift distribution factors, line outage distribution factors, compensated shift factors, sensitivity associated with voltage-VAR, sensitivities relating load bus voltage changes in terms of PV bus voltage changes, sensitivity relating changes in reactive power generation for changes in PV Bus Voltage.

Module-IV

Power system security – Security functions, Security level, contingency analysis, security control, economic dispatch using LP formulation, pre-contingency and post- contingency, corrective rescheduling.

Module-V

Voltage stability - Difference between voltage and angle stability, PV Curve for voltage stability assessment, proximity and mechanism, modal analysis using reduced Jacobian, participation factor, effect of series and shunt compensation on voltage stability , effect of load mode

Reference Books:

1. Power Generation, Operation and Control by A.J. wood and B.F. Wollenberg John Wiley & Sons Inc. 1984.
2. Computer methods in power systems analysis – by stage G.W. and E.L. Abiad A.H. Mc Graw Hill.
3. Computer Techniques in Power Systems Analysis- Pai M.A. Tata Mc Graw Hill.
4. Computer Modeling of Electrical Power Systems, Arrillaga J. Arnord C.P Harker B.J. John Wiley & Son
5. Computer Aided Power Systems Analysis Kusic G.L. 2nd Edition, CRC Press
6. Modern Power Systems Analysis Nagrath I.J. and Kothari D.P. Tata Mc Graw Hill.
7. Power System Analysis Grainger J.J. & Stevnson W.D. Mc Graw Hill.
8. Power System Stability and control –P Kundur ,IEEE Press 1994.
9. Advance Power Systems Analysis and Dynamics Singh L.P. John Wiley.

Power Quality (EEL8022)

Module-I

Introduction to Power Quality: Definition of power Quality, power quality terminology, power quality issues, Susceptibility Criteria, Responsibility of supplier and users of elect power, Standards.

Module-II

Power Frequency Disturbance: Common power frequency disturbances, voltage sags, cures of low frequency disturbances, voltage tolerance.

Module-III

Electrical Transients: Transient system model, Examples of models & response, Types and causes of transients, Examples of transient wave forms.

Module-IV

Harmonics: Definition, number, odd and even harmonics, causes of harmonics, Individual & total distortion, Harmonics signatures, Effect of harmonics, Guide lines for harmonic voltage & current limitation, Harmonic current mitigation. Electromagnetic Interference: Electric and magnetic fields, Electromagnetic interference terminology, Power frequency fields, High frequency interference, EMI Mitigation, Cable shielding to minimize EMI, Health concerns of EMI

Module-V

Grounding & Bonding: Introduction, National electric code grounding requirements, Essentials of grounding system, Ground electrodes, Earth resistance tests, Earth ground grid system, Power Ground system, Signal reference ground, Signal reference ground methods, Single and multi-point grounding, Ground loops. Power Quality Measurement: Power quality measurement devices, power quality measurements, Number of test locations, Test duration, Instrument setup, Instrument set up guidelines.

Module-VI

Power Factor: Introduction, Active and Reactive power, Displacement and true power factor, power factor improvement, correction, penalty, voltage rise due to capacitance, application of synchronous condensers and static VAR compensators. Distributed Generation and Power Quality: Resurgence of DG, DG technologies, Interface to the utility system, Power quality issues, Operating conflicts.

Reference Books:

1. Power Quality by C.Sankaran, CRC publication
2. Electrical Power Systems Quality by Roger C.Dugan , TMH publication
3. Harmonics and Power Systems by Francisco C. De La Rosa, CRC Publication

Wind Energy Conversion Systems (EEL8023)

Module-I

Review on wind resource assessment: Wind regime modelling, measurement instruments, Weibull parameters, height dependency, wind resources worldwide and in India, wind energy forecast.

Module-II

Wind turbine: Review on basic aerodynamics, air foils, types and characteristics of wind turbine, turbine design, blade element theory, Betz limit, wake analysis, wind turbine rotor design considerations, number of blades, blade profile, 2/3 blades and teetering, coning, power regulation, wind turbine loads, aerodynamic loads in steady operation, wind turbulence, and tower shadow, wind turbine components, braking, yaw system, tower, others.

Module-III

WTGS: Fixed speed and variable speed systems. Electrical machines for wind energy systems, synchronous and asynchronous generators and power electronics. Integration of wind energy systems to electrical networks, converters, inverters, directly connected, wind energy storage solutions.

Module-IV

Control systems: requirements, components and strategies. Small wind turbines special considerations and designs, testing, noise issues, Off-shore turbines.

Module-V

Implementation: Site selection and turbine spacing, rotor selection, Annual Energy Output (AEO), optimal placement of wind turbine in a wind park, ICT based monitoring and control of wind Farms ,installed costs, payback time, Levelized Energy Cost (LEC), simulation-oriented case studies.

Text books /Reference:

1. oshua Earnest and Tore Wizelius, “Wind Power Plants and Project Development”, PHI Learning Pvt. Ltd., New Delhi, 2011.
2. J. F. Manwell, J. G. McGowan and A. L. Rogers, “Wind Energy Explained – Theory, Design and Application”, Wiley, 2009.
3. Earnest Joshua, “Wind Power Technology”, Second edition, PHI Learning Pvt. Ltd., New Delhi, 2015.
4. Johnson G. L., “Wind Energy Systems”, Prentice Hall, 1994 (published by the author online).
5. Spera D. A., “Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering”, ASME Press, New York, 2009.
6. Voker Quashning, “Understanding Renewable Energy Systems”, Earthscan, Second edition, 2016.

7. Tony Burton, David Sharpe, Nick Jenkins, Ervin Bossanyi, "Wind Energy Handbook" JOHN WILEY & SONS, LTD , Second Edition,2011.

8. Freris. L. L., "Wind Energy Conversion Systems", Prentice Hall 1990.

Logic & Distributed Control system (EEL8024)

Module-I
PROGRAMMABLE LOGIC CONTROLLER 9 Evolution of PLCs – Components of PLC – Architecture of PLC – Discrete and analog I/O modules – Programming languages -Ladder diagram – Function block diagram (FBD) - Programming timers and counters

Module-II
Instructions in PLC – Program control instructions, math instructions, data manipulation Instructions, sequencer and shift register instructions – Case studies in PLC

Module-III
Basic building blocks of computer-controlled systems – Data acquisition system – Supervisory control – Direct digital control- SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures

Module-IV
DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities

Module-V
Operator interfaces - Low level and high level operator interfaces – Displays - Engineering interfaces – Low level and high level engineering interfaces – Factors to be considered in selecting DCS – Case studies in DCS

Textbook/References:

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition,2010
2. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1986
3. D. Popovic and V.P.Bhatkar,' Distributed computer control for industrial Automation' Marcel Dekker, Inc., Newyork, 1990.
4. T.A. Hughes, Programmable Controllers, Fourth edition, ISA press, 2005
5. . Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols:DNP3,4. 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
6. E.A.Parr, Programmable Controllers, An Engineer's Guide, Elsevier, 2013.

Optimal control (EEL8025)

Module-I

Mathematical preliminaries, Static optimization, Calculus of variations, Solution of general continuous time optimal control problem.

Module-II

Continuous time Linear Quadratic Regulator design - Riccati equation, Optimal tracking problem, Free final time problems, Minimum time problem.

Module-III

Constrained input control and Pontryagin's maximum principle, Bang-Bang control, Principle of optimality, Dynamic Programming, Discrete LQR using Dynamic Programming.

Module-IV

Continuous control and Hamilton-Bellman-Jacobi Equation.

Textbooks/References

1. . E. Kirk, *Optimal Control Theory: An Introduction*, Prentice-Hall, 2004.
2. B.D.O. Anderson and J.B. Moore, *Optimal Control: Linear Quadratic Methods*, Dover Publications, 2014.
3. F.L. Lewis, D. Vrabie and V.L. Syrmos, *Optimal Control*, 3rd edition, Wiley & Sons, 2012

CAD FOR ELECTRICAL MACHINE(EEL8026)

Module-I DESIGN STEPS

Input/Output Data – Constraints – Electrical Materials – Magnetic Circuit and Ampere Turns calculation - Types of Enclosures

Module-II DC MACHINE DESIGN

Armature main dimensions – Winding and core – Poles – Field – Commutator – Interpole – Simulation - Design Optimization.

Module-III TRANSFORMER

Magnetic frame – HV/LV Windings – Performance Calculations – Tank Design – Simulation – Design Optimization.

Module-IV AC MACHINE DESIGN

Stator Main Dimension – Stator Winding – Rotor Design – Ampere Turns Calculation – Performance Calculations – Simulation – Design Optimization.

TEXTBOOKS/REFERENCES:

1. Theory & Practice Of Electrical Machine Design , Dr. N.K. Datta, S.Kataria Publications
2. Design of Electrical Machines, K. G. Upadhyay, PHI

INTELLIGENT CONTROL (EEL8027)

Module-I

ANN Models & Architecture:

Biological foundations, ANN models, Types of activation function, introduction to network architecture, multilayer feed forward network (MLFFN), Kohonen self-organizing map, radial basis Function network (RBFN), recurring neural network.

Module-II

Learning Processes:

Supervised and unsupervised learning, error-correction learning, Hebbian learning, Boltzman learning, single layer and multilayer perception model, least mean square algorithm, back propagation algorithm, Application in forecasting and pattern recognition and other engineering problems.

Module-III

Fuzzy Control System:

Fuzzy sets, fuzzy set operations, properties, membership functions, fuzzy to crisp conversion, measures of fuzziness, fuzzification and defuzzification methods, application in engineering problems. Simple fuzzy logic controllers with examples, special forms of fuzzy logic models, classical fuzzy control problems.

Module-IV

Genetic & PSO Algorithm:

Genetic Algorithm: Types of reproduction operators, crossover & mutation Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO) - Graph Grammer Approach - Example Problems

System identification and adaptive control (EEL8028)

Module-I

Introduction and overview of Systems Identification, Adaptive Control and applications. Parameter Estimation: Least Square, Generalized and Recursive Least Square, Estimator properties including error bounds and convergence, MES, ML and MAP estimators, Nonlinear Least Squares.

Module-II

Model Structures and Predictors. Recursive Identification of Linear dynamic systems: RLS, ELS, IV, RML, Stochastic Approximation, Extended Kalman Filter, generalized prediction error framework and its application to ARMA and state models, convergence analysis, Time varying parameters.

Module-III

Nonlinear System Identification. Adaptive schemes. Adaptive control theory. Applications. Situations when constant Gain feedback is insufficient. Robust control. The adaptive control problem. The model following problem. MRAS based on stability theory. Model following when the full state is measurable. Direct MRAS for general linear systems. Prior knowledge in MRAS.

Module-IV

MRAS for partially known systems. Use of robust estimation methods in MRAS. The basic idea. Indirect self-tuning regulators. Direct Self-tuning regulators. Linear Quadratic STR. Adaptive Predictive control. Prior knowledge in STR.

Module-V

Linear-in-the-parameters model. Least squares estimation. Experimental conditions. Recursive estimators. Extended least squares. Robust estimation methods (dead zone, projection).Implementation issues. Nonlinear

System Identification Techniques

Textbooks/References:

1. K.J. Astrom and B. Wittenmark, *Adaptive Control*, Pearson
2. L. Ljung, *System Identification Theory for the user*, Prentice-Hall, 2007
3. K.S. Narendra and A.M. Annaswamy, *Stable Adaptive Systems*,, Prentice-Hall, 1989.
4. Miroslav Krsti, Ioannis Kanellakopoulos, and Petar V. Kokotovic, *Nonlinear and Adaptive Control Design*, Wiley-Interscience, 1995

ELECTIVE-V

POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS(EEL8031)

Module-I

Introduction: Potential of renewable energies in India's future Power generation, Need of power electronics for power generation from renewable energies.

Module-II

Solar PV Systems: Solar PV characteristics, Grid requirement for PV, Power electronic converters used for solar PV, Control techniques, MPPT, Grid connected and Islanding mode, Grid synchronization, PLLs, battery charging in PV systems.

Module-III

Wind Energy Conversion: Wind Turbine characteristics, Grid requirement for Wind, PMSM and DFIG for wind generators, Power electronic converters for PMSM and DFIG, Control techniques, MPPT, Grid connected and Islanding mode. *Other renewable energy systems*: Fuel Cells, Biogas, Biomass etc

Module-IV

Power electronic converters and control for Microgrids and Smart grids

Textbooks/References:

1. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, "Grid Converters for Photovoltaic and Wind Power Systems" Wiley-IEEE Press, January 2011.
2. Suleiman M. Sharkh, Mohammad A. Abu-Sara, Georgios I. Orfanoudakis, Babar Hussain, "Power Electronic Converters for Microgrids" Wiley-IEEE Press, April 2014.
3. Fang Lin Luo, Hong Ye, "Advanced DC/AC Inverters: Applications in Renewable Energy" CRC Press.
4. Sudipta Chakraborty, Marcelo G. Simões, William E. Kramer, "Power Electronics for Renewable and Distributed Energy Systems" Springer 2013.

ELECTRICAL MACHINE MODELING AND ANALYSIS(EEL8032)

Module-I BASIC CONCEPT OF MODELLING

Basic Two - pole Machine representation of Commutator machines, 3 phase synchronous machine with and without damper bars and 3 - phase induction machine, Kron's primitive Machine - voltage, current and Torque equations. DC Machine modeling: Mathematical model of separately excited D.C motor –Steady State analysis - Transient State analysis - Sudden application of Inertia Load - Transfer function of Separately excited D.C Motor - Mathematical model of D.C Series motor, Shunt motor - Linearization Techniques for small perturbations

Module-II REFERENCE FRAME THEORY

Reference frame theory Real time model of a two phase induction machine-Transformation to obtain constant matrices - three phase to two phase transformation - Power equivalence. Dynamic modeling of three phase Induction Machine Generalized model in arbitrary reference frame - Electromagnetic torque - Derivation of commonly used Induction machine models - Stator reference frame model - Rotor reference frame model Synchronously rotating reference frame model -Equations in flux linkages - per unit model

Module-III SMALL SIGNAL MODELLING

Small Signal Modeling of Three Phase Induction Machine Small signal equations of Induction machine – derivation - DQ flux linkage model derivation - control principle of Induction machine. Symmetrical and Unsymmetrical 2 phase Induction Machine Analysis of symmetrical 2 phase induction machine - voltage and torque equations for unsymmetrical 2 phase induction machine - voltage and torque equations in stationary reference frame variables for unsymmetrical 2 phase induction machine - analysis of steady state operation of unsymmetrical 2 phase induction machine - single phase induction motor - Cross field theory of single - phase induction machine.

Module-IV MODELLING OF SYNCHRONOUS MACHINE.

Synchronous machine inductances – voltage equations in the rotor's dq0 reference frame - electromagnetic torque - current in terms of flux linkages - simulation of three phase synchronous machine- modeling of PM Synchronous motor

Module-V DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINE

Dynamic performance of synchronous machine, three -phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria.

Textbooks/References

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis& control", Pearson Publications, First edition, 2002
2. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive systems", IEEE Press, Second Edition.
3. P.S.Bimbra, "Generalized Theory of Electrical Machines" Khanna publications, Fifth edition – 1995
4. Chee Mun Ong –"Dynamic simulation of Electric machinery using MATLAB / Simulink", Prentice Hall of India Publications

BASICS OF ROBOTICS(EEL8033)

Module-I

Introduction To Robotics: Introduction to Robotics and Automation, laws of robot,brief history of robotics, basic components of robot, robot specifications, classification of robots, human system and robotics, safety measures in robotics, social impact, Robotics market and the future prospects, advantages and disadvantages of robots

Module-II

Robot Anatomy And Motion Analysis: Anatomy of a Robot, Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Wok volume/envelope, Robot kinematics: Introduction to direct and inverse kinematics, transformations and rotation matrix.

Module-III

Robot Drives And End Effectors: Robot drive systems: Hydraulic, Pneumatic and Electric drive systems, classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, gripper force analysis and gripper design, 1 DoF, 2 DoF, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to-point control, playback with continuous path control, and intelligent control.

Module-IV

Path Planning: Definition-Joint space technique, Use of P-degree polynomial-Cubic,polynomialCartesian space technique, parametric descriptions, straight line and circular paths, position and orientation planning.

Module-V

Robotics Applications: Material Handling: pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, ariel and underwater applications, robotic for computer integrated manufacturing. Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, Humanoids, Cobots, Autonomous robots, and Swarm robots

Textbook/References:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education,2009.
2. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming andApplications", McGraw Hill, Special Edition, (2012)
3. Ganesh S Hegde, “A textbook on Industrial Robotics”, University science press, 3rdedition, 2017.
4. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – AnIntegrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
5. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence",McGraw Hill, 1987

SOLID STATE POWER CONTROLLERS(EEL8034)

Module-I
Line Commutated Converters: Phase control, single phase semi-converter & fully controlled converter, three phase semi controlled & fully controlled converter, dual converters, power factor improvement methods, effect of source inductance, twelve pulse converter and design of converter circuits.

Module-II
Inverters: Principle of operation, performance parameters, single phase bridge inverters and three phase inverters.

Module-III
Voltage Control of Single-Phase Inverters: Single/multiple, pulse/SPWM/ modified SPWM methods, voltage control of three phase inverter, SPWM/third harmonic PWM/Space vector modulation, harmonic reduction, current source inverter, comparison between VSI & CSI.

Module-IV
Multilevel Inverters: Introduction, types, diode clamped, flying capacitor, cascaded multilevel inverters, features & applications.

Module-V
DC-DC Converters: Principle of operation, analysis of step-down and step-up converters, classification of chopper & chopper circuit design.

Textbooks/References:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications, and Design", 3rdEdition,Wiley India Pvt Ltd, 2011
2. Rashid M.H, "Power Electronics: Circuits Devices and Applications", 3rd Edition, Pearson, 2011.
3. K. Bose, "Modern Power Electronics & AC Drives", PHI, 2012

POWER SYSTEM STABILITY & CONTROL(EEL8035)

Module-I
Introduction to power system stability problems Definition of stability, classification of stability, Rotor angle stability, frequency stability, voltage stability, mid-term and longterm stability, classical representation of synchronous machine in a single machine infinite bus system (SMIB), equal area criterion to asses stability of a SMIB system, limitations of classical model of synchronous machines.

Module-II
Modeling of power system components for stability analysis Synchronous machine modeling: sub-transient model, two axis model, one axis (flux decay) model, classical model. Excitation systems modeling: DC excitation, AC excitation and static excitation. Prime mover and energy supply systems modeling. Transmission line modeling, load modeling. Methods of representing synchronous machines in stability

analysis.

Module-III
Small signal stability Fundamental concepts, state space representation, Modal analysis: eigen properties, participation factors, stability assessment. Effects of excitation system on stability, power system stabilizer and its design, Angle and voltage stability of multi-machine power systems and phenomenon of sub

synchronous resonance.

Module-IV
Transient stability: Fundamentals of transient stability, numerical solutions: simultaneous implicit and partitioned explicit methods, simulation of dynamic response, analysis of unbalanced faults, direct method of transient stability, transient energy function method, Methods of improving transient stability.

Module-V
Voltage stability Classification of voltage stability, modeling requirements, voltage stability analysis: static and dynamic, sensitivity analysis, modal analysis, voltage collapse and its prevention.

Textbook/References:

1. Power system stability and control",P.Kundur, TataMcGraw Hill.
2. "Power system dynamics",K. R.Padiyar,BSP publications
3. "Power system stability", M.A.Pai and Peter W.Sauer, Pearson Education.
4. Topics on small signal stability analysis", M.A.Pai,K.Sen gupta and K. R.Padiyar, Tata-McGraw hills.
5. "Power system stability",Paul M.Anderson and A.A. Fouad, Wiley-interscience.