श्री माता वैष्णो देवी विश्वविद्यालय
Shri Mata Vaishno Devi University
School of Electrical Engineering
Sub Post Office, Kakryal, Katra 182320 (Jammu & Kashmir)

Courses of Study

(Detailed Course Contents)

B. Tech. (Electrical Engineering)

(2024-2025)

Shri Mata Vaishno Devi University

Kakryal, Katra 182320 Jammu & Kashmir

VISION

Establishment of a Scientific & Technical University of Excellence to nurture young and talented human resources for the service of Indian Society & world at large and preserving the integrity and sanctity of human values.

MISSION

The mission of the University is the pursuit of Education, Scholarship and Research at the highest International level of excellence.

OBJECTIVES

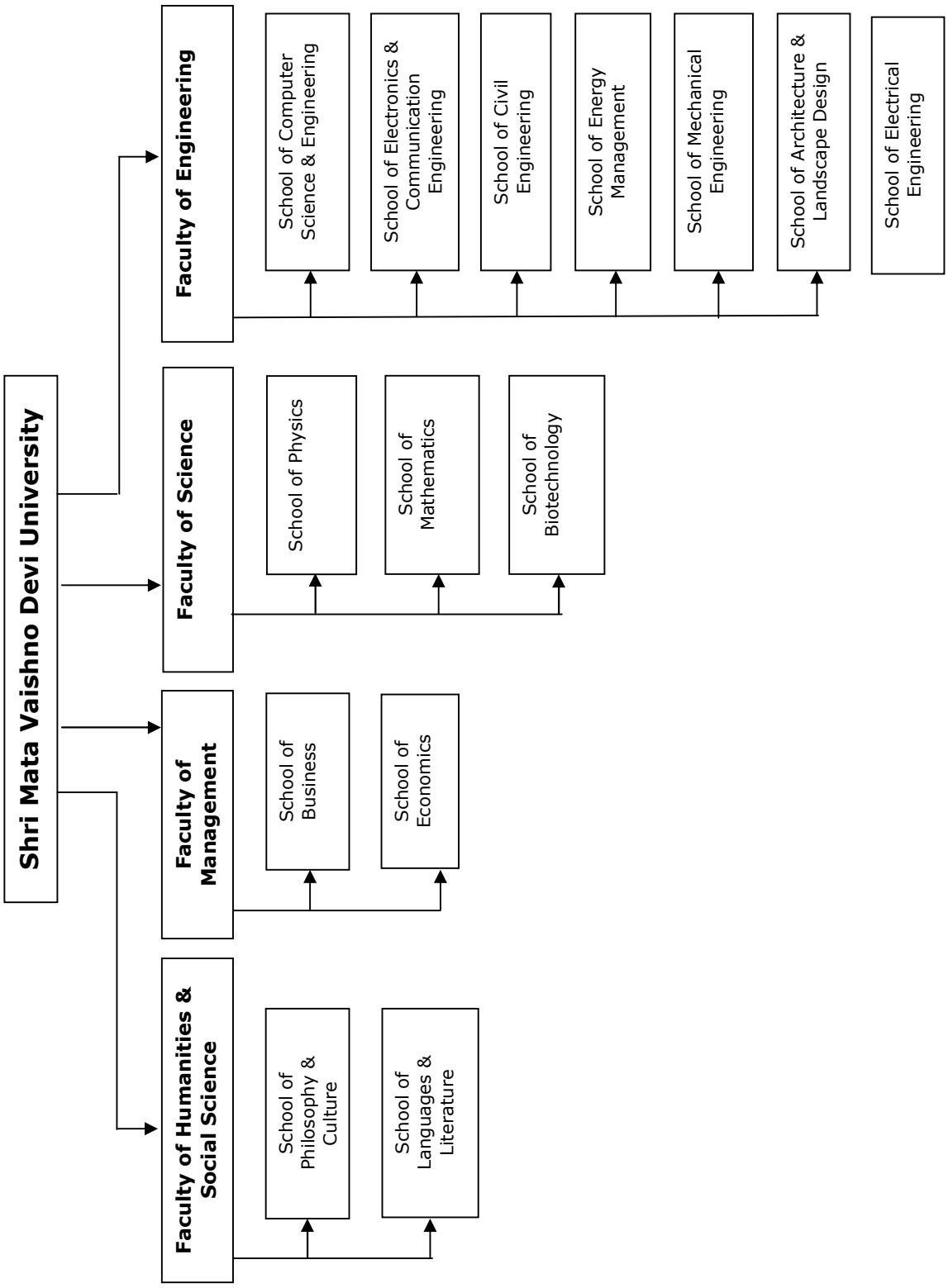
- Provide education and training of excellent quality, both at undergraduate and postgraduate level.
- Ensure that the University achieves and maintains an international standing in both teaching and research
- Promote study and research in new and emerging areas and encourage academic interaction of the faculty and the students at national and international levels.
- Encourage close collaboration with industry and facilitate the application of research for commercial use and for the benefit of society.

University Campus Address	Shri Mata Vaishno Devi University Kakryal, Katra 182 320 J&K, INDIA Phone:01991-285634, 285524 Fax: 01991-285694
Public Relations Officer Address	Public Relations Office, ShriMataVaishnoDeviUniversity Kalika Dham, Near raiwlay Station, Jammu 180004J&K, INDIA Telefax: 0191-2470067

Website: www.smvdu.ac.in

CONTENTS

Academic Structure of the University



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Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Electrical Engineering

Objectives
The School of Electrical Engineering has been set up to impart training of the highest standards to the students, advancement in electrical engineering academics, research and development within and in close collaboration with industry, society and leading institutions while developing visionaries who can create a better society with a passion for technology.

Programs Offered

The school currently offers a 4 year (8 semesters) B.Techprogramme in Electrical Engineering. The purpose of B. Tech programme is:

- To impart program-oriented knowledge in Electrical Engineering required for solving engineering problems so as to comprehend, analyze design and create novel products and solutions for the country.
- Provide opportunities at individual level for developing a professional with an ability to apply his/her knowledge and skills for the advancement of society in Electrical Engineering.
- To address technological requirements of society through the inventions in Electrical Engineering and interdisciplinary research.
- To develop human potential to its fullest extent so that intellectually capable and competent leaders can emerge in a range of professions with special emphasis in Electrical Engineering.

POs & PEOs of Programs

Engineering knowledge
Graduates will have a thorough grounding in the key principles and practices of Electrical Engineering and will have applied their skills and knowledge of foundational principles to the design and implementation of practical systems.

Problem analysis
Graduates will be successfully employed in the Electrical Engineering and allied professions and will be actively engaged in learning, understanding and applying new ideas and technologies in the Electrical Engineering field.

Design/development of Solutions
To develop among students ability to apply in depth knowledge of one or more specializations within the relevant branch of engineering.

Conduct Investigations of Complex Problems
To develop among students the awareness of and the competence to be savvy users of latest technology in operation.

Conduct Investigations of Complex Problems
To develop among students the ability to work with others, in professional and social settings.

The Engineer & Society
To develop an understanding among students of the human, social and business context in which they will utilize their electrical engineering skills.

Environment & Sustainability
To develop a global view among students so that they can appreciate diversity in the world and in intellectual pursuits.

Individual & Team Work
To impart knowledge from other engineering programmes, required for complete understanding of multi-disciplinary applications in the field of electrical engineering.

Ethics
Develop consciousness and commitment towards professional ethics, responsibilities and norms of engineering practices so as to become good citizens.

Communication
Proficiency in communication, both verbal and written forms, to be able to compete globally, and communicate effectively on complex engineering activities.

Project Management &Finance
Demonstrate the knowledge gained in lifelong learning, and hence participate and succeed in competitive examinations, higher studies, and broadest context of technological change.

Life-Long Learning
Willingness and ability to take up administrative responsibilities involving both project and financial management confidently.

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Shri Mata Vaishno Devi University

School of Electrical Engineering

Sub Post Office, Kakryal, Katra 182320 (Jammu & Kashmir)

Program Structure for B.Tech.(EE)-Batch 2023& 2024

Semester I

Course Type	Course Code	Course Title	L	T	P/S	Credits
BSC 1	MTL BS101	Engineering Mathematics-I	3	1	0	4
BSC 2	BTL BS101	Applied Chemistry	3	0	0	3
BSC 2	BTP BS101	Applied Chemistry Lab	0	0	2	1
ESC 1	CSL ES101	Introduction to C Programming	3	0	0	3
ESC 1	CSP ES101	C Programming Lab	0	0	2	1
ESC 2	MEL ES101	Introduction to Engineering Mechanics	3	1	0	4
ESC 2						
SEC 1	MEM SE101	Engineering Workshop	1	0	2	2
AEC 1 / VAC 1		Ability Enhancement /Value Added Course				2
		Total Credits				**20**

Semester II

Course Type	Course Code	Course Title	L	T	P/S	Credits
BSC 3	MTL BS102	Engineering Mathematics II	3	1	0	4
BSC 4	PHL BS102	Engineering Physics	3	0	0	3
BSC 4	PHP BS102	Engineering Physics Lab	0	0	2	1
DCC 1	EEL DC102	Electrical Measurements and Instrumentation	3	0	0	3
DCC 1	EEP DC102	Electrical Measurements and Instrumentation Lab	0	0	2	1
DCC 2	EEL DC104	Network Analysis & Synthesis	3	1	0	4
SEC 2	EEM SE102	MATLAB/Simulink	1	0	2	2
AEC 2	XXX VAXX	Ability Enhancement Course				2
VAC 2	XXX AEXX	Value Added Course				2
MAC 1	PCN MA102	Universal Human Value-II	2	0	0	0
		Total Credits				**22**

Semester III

Course Type	Course Code	Course Title	L	T	P/S	Credits
BSC 5	BTL BS201	Introduction to Biology for Engineers	3	0	0	3
ESC 3	ECL ES203	Digital Electronics	3	0	0	3
ESC 3	ECP ES203	Digital Electronics Lab	0	0	2	1
DCC 3	EEL DC201	Electrical Machines – I	3	0	0	3
DCC 3	EEP DC201	Electrical Machines Lab - I	0	0	2	1
DCC 4	EEL DC203	Signal & Systems	3	1	0	4
DCC 5	EEL DC205	Electronic Devices & Circuits	3	0	0	3
DCC 5	EEL DC205	Electronic Devices & Circuits Lab	0	0	2	1
SEC 3	EEP SE103	Skill Enhancement Course – 3 / Electrical Workshop				2
PR	EEI PR201	Summer Internship - I				1
VAC 3		Value Added Course				2

		Total Credits				**24**

Semester IV

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC 6	EEL DC202	Electrical Machines - II	3	0	0	3
DCC 6	EEP DC202	Electrical Machines Lab - II	0	0	2	1
DCC 7	EEL DC204	Analog Integrated Circuits	3	0	0	3
DCC 7	EEL DC204	Analog Integrated Circuits Lab	0	0	2	1
DCC 8	EEL DC206	Microprocessors & Microcontrollers	3	0	0	3
DCC 8	EEP DC206	Microprocessors & Microcontrollers Lab	0	0	2	1
DCC 9	EEL DC208	Electric System Design	3	1	0	4
DCC 10	EEL DC210	Electromagnetic Field Theory	3	1	0	4
VAC 4	BTL VA202	Environmental Science & Education	2	0	0	2
		Total Credits	**88**			**22**

Semester V

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC 11	EEL DC301	Control Systems	3	0	0	3
DCC 11	EEP DC301	Control System Lab	0	0	2	1
DCC 12	EEL DC303	Power System - I	3	0	0	3
DCC 12	EEP DC303	Power Systems Lab - I	0	0	2	1
DCC 13	EEL DC305	Power Electronics	3	0	0	3
DCC 13	EEP DC305	Power Electronics Lab	0	0	2	1
DEC 1		School Elective – I	3	1/0	0/2	4
DEC 2 / GEC 1		School Elective – II/Generic Elective - I	3	1/0	0/2	4
PR	EEI PR301	Summer Internship – 1I				1
DCC	EED PR301	Project Work – I				2
		Total Credits				**23**

Semester VI

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC 14	EEL DC302	Power System - II	3	0	0	3
DCC 14	EEP DC302	Power System Lab - II	0	0	2	1
DCC 15	EEL DC304	AI and ML in Electrical Engineering	3	0	0	3
DCC 15	EEP DC304	AI & ML Lab	0	0	2	1
DEC 3	EEE DE3xx	School Elective – III	3	1/0	0/2	4
DEC 4 / GEC 2		School Elective – IV/Generic Elective -II	3	1/0	0/2	4
AEC		Management / Entrepreneurship/Economy	3	0	0	3
DCC	EED PR302	Project Work –II				2
MAC 3	PCN MA302	Indian Knowledge System	2	0	0	0
		Total Credits	**132**			**21**

Semester VII

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC 16	EEL DC401	Switchgear & Protection	3	1	0	4
DEC 5	EEX DE4xx	School Elective – V	3	1/0	0/2	
DEC 6 / GEC 3	EEX DE4xx / EEX GE4XX	School Elective – VI/ Generic Elective – III	3	1/0	0/2	4
PR	EEI PR401	Summer Internship – III				2
DCC/PR	EED PR401	Project Work –III				4
		Total Credits	**150**			**18**

Semester VIII

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC/PR	EED PR402/ EEI PR402	Major Project / Internship (Industrial or In-house Project)				10
		Total Credits	**160**			**10**

Honor in Power Electronics & Drives

Course Type	Course Code	Course Title	L	T	P/S	Credits
	EEM DE305	Semiconductor Power Devices & Applications	3	0	2	4
	EEM DE307	Microcontrollers and applications in Power Converters	3	0	2	4
	EM DE306	Electric Drives for Electric Vehicles	3	0	2	4
	EEE DE308	Pulsewidth modulation for Power Convereters	3	1	0	4
	EEE DE405	Switch Mode Power Supplies	3	1	0	4
	EEM DE407	FACT Devices	3	0	2	4
	EEE DE404	Power Quality Improvement Techniques	3	1	0	4

Honor in System & Control

Course Type	Course Code	Course Title	L	T	P/S	Credits
	EEM DE301	Digital Signal Processing	3	0	2	4
	EEE DE303	Stochastic Techniques	3	1	0	4
	EEM DE302	Advanced Control Systems	3	0	2	4
	EEE DE304	Advanced System Engineering	3	1	0	4
	EEE DE401	Smart Grid	3	1	0	4
	EEE GE403	System Reliability	3	1	0	4
	EEE GE402	Communication Techniques in Smart Grid	3	1	0	4

Minor Specialization in Electrical System

GEC	EEM GE101	Fundamentals of Electrical Engineering	3	0	2	4
GEC	EEM	Fundamentals of Semiconductor Power Devices	3	0	2	4
GEC	EEL GE303	Electrical Materials	3	1	0	4
GEC	EEM GE208	Electric System Design	3	0	2	4
GEC	EEL GE	Non-conventional Energy Sources	3	1	0	4

GEC	EEM GE102	Electrical Measuring Instruments & Instrumentation	3	0	2	4
GEC	EEM GE204	Analog Integrated Circuits	3	0	2	4
GEC	EEM GE301	Control Systems	3	0	2	4
GEC	EEM GE305	Power Electronics	3	0	2	4
GEC	EEL GE	Mathematical Modeling of Electric Vehicles	3	1	0	4

List of Departmental Electives

DEC	EEL DE301	Non-Conventional Energy Resources	3	1	0	4
DEC	EEL DE303	Electrical Materials	3	1	0	4
DEC	EEL DE305	Industrial Electrical Systems	3	1	0	4
DEC	EEL DE307	Electrical Machine Design	3	1	0	4
DEC	EEL DE309	Power Electronics	3	1	0	4
DEC	EEL DE311	Sensors & Actuators	3	1	0	4
DEC	EEL DE302	Advanced Electrical Machine	3	1	0	4
DEC	EEL DE304	Advanced Control Systems	3	1	0	4
DEC	EEL DE306	Power System Analysis and Control	3	1	0	4
DEC	EEL DE308	Electric Drives	3	1	0	4
DEC	EEL DE310	Power Utilisation and Traction	3	1	0	4
DEC	EEL DE312	Internet of Things	3	1	0	4
DEC	EEL DE314	Digital Control Systems	3	1	0	4
DEC	EEL DE316	Digital Design with HDL	3	1	0	4
DEC	EEL DE318	Digital Signal Processing	3	1	0	4
DEC	EEL DE320	VLSI Technology	3	1	0	4
DEC	EEL DE401	Power Plant Engineering	3	1	0	4
DEC	EEL DE403	Advanced Power Electronics	3	1	0	4
DEC	EEL DE405	Biomedical Instrumentation	3	1	0	4
DEC	EEL DE407	Electric Vehicle	3	1	0	4
DEC	EEL DE409	FACTS Devices	3	1	0	4
DEC	EEL DE411	Embedded Systems	3	1	0	4
DEC	EEL DE413	HVDC Transmission Systems	3	1	0	4
DEC	EEL DE415	Robotics & Automation	3	1	0	4
DEC	EEL DE417	High Voltage Engineering	3	1	0	4
DEC	EEL DE419	Modelling and Analysis of Electric Distribution System	3	1	0	4
DEC	EEL DE421	Switch Mode Power Supply	3	1	0	4
DEC	EEL DE423	Electrical Energy Conservation and Auditing	3	1	0	4
DEC	EEL DE425	Power System Optimisation	3	1	0	4

Course Code : **MTS BS101**
Course Title : **Engineering Mathematics-I**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **BSC-1**
Pre-requisite Courses (if any) : **Basic Mathematics**

Detailed Syllabus

UNIT-I Differential Calculus: Partial Differentiation, asymptotes, concavity, convexity, point of inflexion, curvature, radius of curvature, curve tracing, envelopes and evolutes, change of variables, Jacobian, expansion of functions of several variables, chain rule, mean value theorem, Taylor series with remainder term, maxima & minima, saddle point.

UNIT-II Integral Calculus: Fundamental theorem of Integral calculus, reduction formulae, properties of definite integral, applications to length, area, volume, surface of revolution. Moments, centre of gravity, improper integrals, β-γ functions.

UNIT-III Matrices: Elementary row and column transformation, linear dependence, rank of a matrix, consistency of system of linear equations, solution of linear system of equations, characteristic equations, Cayley Hamilton theorem, eigen values and eigen vectors, diagonalization, complex matrices.

Course Outcomes

CO1 Introduce the basic concept of differential calculus to understand the different subjects of engineering as well as basic sciences.
CO2 Enable the students to develop the concept of partial differentiation to understand their applications in engineering
CO3 Understand the fundamentals of Integral calculus to understand their applications to length, area, volume, surface of revolution, moments and centre of gravity
CO4 Understand the improper integrals and Beta and Gamma functions and their applications
CO5 Understand the idea of Linear Algebra which are useful to all branches of engineering.

Course Code : **EEL ES101**
Course Title : **Fundamentals of Electrical Engineering**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **ESC Engineering Science Core**
Pre-requisite Courses (if any) :

Detailed Syllabus

COURSE CONTENTS

Unit I: Introduction to Electrical Engineering: (8 contact Hours)
DC and AC circuits, Active and passive two terminal elements, Ohms law. Basics of Electromagnetism, Voltage-Current relations for resistor, inductor, capacitor. Kirchhoff's laws, current division, voltage division, Mesh analysis, Nodal analysis, Source Transformation, Ideal sources –equivalent resistor, Inductive, capacitive networks, Star Delta transformation

Unit II: Circuit Theorems: (10 contact Hours)
Concepts of Circuit Theorems, Superposition Theorem, Thevenin theorem, Maximum power transfer theorem, Norton theorem

Unit III: AC Fundamentals and Principles: (10 contact Hours)
ac voltages , waveforms and basic definitions, relationship between frequency, speed and number of poles, root mean square and average values of alternating currents and voltage, form factor and peak factor
phasor representation of alternating quantities, the J operator and phasor algebra, analysis of ac circuits with single basic network element, single phase series circuits, single phase parallel circuits, single phase series parallel circuits, power in ac circuits, power factor.

Unit IV: Resonance:
(6 contact Hours)
Simple series, parallel & series-parallel circuits containing R-L, R-C, R-L-C parameters
Active, Apparent & Reactive power, Resonance in series & parallel circuits
Unit V: Transformers: (6 contact Hours)
Principles of operation, Constructional Details, Ideal Transformer and Practical Transformer, Losses, Transformer Test, Efficiency and Regulation Calculations.

Recommended Books::
- Basic Electrical Engineering – D C Kulshreshtha; McGraw Hill Education, 1 st Revised Edition, 2011
- Basic Electrical Engineering – V.N. Mittle and Arvind Mittal; Tata McGraw Hill Publishing
- Electrical Technology – B. L. Theraja, Tata McGraw Hill Publishing

Course Outcomes:

1. Understanding of the basics of electrical engineering
2. The ability to analyse the AC and DC electrical circuits
3. The ability to apply different methods for electrical circuit analysis for solving the design problems
4. The ability to apply simplified methods such as electrical theorems for circuit analysis
5. Understanding of the resonance in electrical circuits and its significance

Course Code : **EEP ES101**
Course Title : **Fundamentals of Electrical Engineering Lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Engineering Science Core**
Pre-requisite Courses (if any) :

List of Experiments

1. To study the front panel control of Multimeter.
2. To study the front panel control of DC Multiple Power Supply.
3. To study the front panel control of Cathode Ray Oscilloscope (CRO).
4. To study the front panel control of Function Generator.
5. Verification of Kirchoff's Voltage Law.
6. Verification of Kirchoff's Current Law.
7. Verification of Superposition Theorem.
8. Verification of Thevenin's Theorem.
9. Verification of Norton's Theorem.
10. Verification of Maximum Power Transfer Theorem.
11. Verification of Reciprocity Theorem.

Course Code : **CSL ES101**
Course Title : **Introduction to 'C' Programming**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **ESC-1**

Detailed Syllabus

Introduction: Concept of problem solving, Problem definition, Program design, Techniques of Problem Solving (Flowcharting, algorithms, pseudo code), Structured programming concepts
Fundamentals: C character set, Tokens, identifiers and keywords, constants and variables, Data types, Data Type Modifiers Structure of a C Program, , Types of Statements: declarations, arithmetic statements and arithmetic operations, , Operators: Arithmetic, relational and equality, logical, assignment and compound assignment, Operators classification based on number of operands: Unary, Binary and Ternary (conditional, unary operations), operator's precedence & associativity, library functions, single character input and output, entering and writing data.

Control Statements: Statement and blocks, Decision making structures: if else and its types, Looping structures: while, for, do while, Case control structures: switch, break and continue statements, nested control structures.

Arrays: Definition, types, initialization, processing an array, 2 Dimension Arrays, Sorting, Searching, Copy, Insertion, Deletion of elements in array.

Functions and pointers: Functions definition, prototype, passing parameters, recursion, pointers, pointers and arrays, pointers and Functions,

String: Operations on String, built in functions, string and functions

User defined data types and Additional Features of C: Structures, Array of Structures, Array within Structures, Structures within Structures, Union, Enumerations, Pre-processor Directives

Reference Books:

1. Gottfried, Byron S., "Programming with C", Tata McGraw Hill

2. Balagurusamy, E., "ANSI C", Tata McGraw-Hill

3. Yashwant Kanetker, "Let us C", BPB

4. C, The Complete Reference, Scholdt, TMH

5. Programming with C, S. Kaicher, Macmillan

6. C For Yourself, Asian Inst. of Tech AIT

7. Structured Programming Approach Using C, B. Forouzen, Thomas Learning

Course Outcomes

CO1	Knowledge and understanding of programming.
CO2	Ability to write simple programs in C language by using basic control structures (conditional statements, loops, switches, branching, etc.).
CO3	Understanding the concept of programming using functions, arrays, strings, pointers and structures, and implement the various operations on them.
CO4	Ability to create a programmable model for a problem given. Course Contents

Course Code : **EEL DC 102**
Course Title : **Electrical Measurement and Instrumentation**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **DCC**

Unit I
Measurement system, Characteristics of instruments, Methods of measurement, Errors in measurement & measurement standards, Review of indicating and integrating instruments: Voltmeter, Ammeter (PMMC, moving iron and attracted disc type), Extension of range using shunt and series resistance.

Unit II
Measurement of Resistance, Inductance and Capacitance: Measurement of low, Medium and high resistances, Insulation resistance measurement (Wheat-stone's, Kelvin's, Carey Foster's bridge), AC bridges for inductance (Maxwell's, Hey's, Anderson's, Owen's Bridge) and capacitance measurement (Desaunty's, Wien's, Schering Bridge).

Unit III
Potentiometers and Instrument Transformers: Principle and operation of D.C. Crompton's potentiometer, Current and Potential transformer, Design considerations and testing.

Unit IV
Electrical and Electronics Measurements: Multi-meter, Wattmeter & energy meter, Three-phase Wattmeter, Time, Frequency and phase angle measurements using CRO, Electronic voltmeter, Digital counters, Frequency meter, Digital counters, Frequency meter, Spectrum and wave analyzer, Storage oscilloscope.

Unit V
Instrumentation: Definition, classification and selection of transducers, Strain gauges, Thermistors, Thermocouples, LVDT, Inductive & capacitive transducers, Piezoelectric and Hall-effect transducers, Measurement of motion, force, pressure, temperature, flow and liquid level.
Smart Metering: Basic concepts of smart sensors and application, Data acquisition systems, True RMS meter, Clamp meter, Digital multi-meter.

Text/ Reference Books:
1. A K Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons, India
2. BC Nakra& K. Chaudhary, "Instrumentation, Measurement and Analysis," Tata McGraw Hill 2nd Edition
3. Purkait, "Electrical & Electronics Measurement & Instrumentation", TMH
4. Forest K. Harris, "Electrical Measurement", Willey Eastern Pvt. Ltd. India
5. M. Stout , "Basic Electrical Measurement", Prentice Hall of India
6. WD Cooper, "Electronic Instrument & Measurement Technique", Prentice Hall International
7. EW Golding and F.C. Widdis, "Electrical Measurement &Measuring Instrument", AW Wheeler & Co. Pvt. Ltd. India

Course Outcomes:
1. To introduce the basic principles of all measuring instruments.
2. Measurement of R, L and C using different measuring instruments and understand their operation and characteristics.
3. Identify and effective use of potentiometer and instrument transformers.
4. Understand the different types of electrical and electronics measuring instruments.

Understand the basic concepts of smart and digital metering and measurement of other entities

Course Code	**: EEL DC104**
Course Title	**: Network Analysis & Synthesis**
L-T-P/S=Credits	**: 3-1-0 =4**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**:Mathematics-I.**

Detailed Syllabus

Unit I
Network Graph Theory: Concept of network graph terminology used in network graph, Relationship between twigs and links, planar and non planar graph, Tree, Property of a tree in a graph, Co-tree, Link, Basic loop and basic cut-set, Formation of incidence matrix, Cut-set matrix, Tie set matrix, Duality, Network Theorems: Reciprocity theorem, Millman's theorem, Compensation theorem, Tellegen's Theorem.

Unit II
Laplace Transformation: Definition, Inverse LT, Properties of LT, Solution of linear differential equations, Transformed circuit components representation, Independent source, Resistance, inductance and capacitance parameters, Transfer functions.
Transient Circuit Analysis: Initial conditions, Natural response and forced response, Transient response and steady state response for arbitrary inputs, Transient response of RL, RC and RLC networks.

Unit III
Two Port Networks: Transform impedances network functions of one port and two port networks, Concept of poles and zeros, Characterization of LTI two port networks; Z, Y, ABCD, g and h parameters, Reciprocity and symmetry, Inter-connections of two port networks, Analysis of ladder networks.

Unit IV
Network Synthesis- Causality and stability, Hurwitz polynomial, Positive real function, Frequency response of reactive one ports, Synthesis of LC, RC and RL driving point immittance functions using Foster's and Cauer's methods.

Unit V
Filters- Passive and active filter fundamentals, Determination of pass and attenuation bands constant, Low pass filters, High pass filters, constant K-type filters, Band pass filters, Band stop filters, M-derived filters, lattice filters.

Text/ Reference Books:
1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall.
2. C. K. Alexander and M. N. O. Sadiku, "Fundamentals of Electric Circuits", McGraw Hill Education.
3. A. Chakrabarti, "Circuit Theory", Dhanpat Rai & Co.
4. D. Roy Choudhary, "Networks and Systems", Wiley Eastern Ltd.
5. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education.

Course Outcomes:
1. Understand the graph theory and its application in Electrical Network
2. Obtain the transient and steady-state response of electrical circuits.
3. Analyse two port circuit behavior.
4. Familiarization with network synthesis and stability of system.
5. Understand the basics and analysis for filters.

Course Code : BTL BS111
Course Title : Applied Chemistry
L-T-P/S=Credits : 3-0-0 =3
Course Category : Basic Science
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Chapter I: Atomic and Molecular Structure: Principles of atomic structure (Review), molecular orbitals of diatomic molecules. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.
Chapter II: Intermolecular forces and periodic properties: Ionic, dipolar and van Der Waals interactions, Equations of state of real gases and critical phenomena. Effective nuclear charge, penetration of orbitals, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.
Chapter III: Use of free energy in chemical equilibria: Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and EMF. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Corrosion causes, effects and prevention.
Chapter IV: Instrumental methods of chemical analysis and applications: Spectroscopy: Principle of spectroscopy, Principle and simple applications of UV-Visible spectroscopy. Flame spectroscopy, Atomic absorption spectroscopy, Infrared spectroscopy, Principle and simple application of nuclear magnetic resonance and magnetic resonance imaging. Chromatography: Types, Principle and applications.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Engineering Chemistry, Satya Prakash, Manisha Agrawal, Khanna Publishers	2001
2	Chemistry: Principles and Applications, M. J. Sienko and R. A. Plane, McGraw Hill	1980
3	A textbook of engineering Chemistry, Shashi Chawla, Dhanpat Rai	2017
Reference Books		
1	Fundamentals of Molecular Spectroscopy, C. N. Banwell, McGraw Hill	2017
2	University chemistry, B. H. Mahan, Chaukhamba Auriyantaliya,	2012

Course Outcome

Sr	Course Outcome	CO
1	To provide students with a comprehensive understanding of embedded systems architecture, components, and programming.	CO1
2	To introduce students to the design methodologies and development tools used in embedded systems development.	CO2
3	To familiarize students with real-time operating systems (RTOS) and their applications in embedded systems.	CO3
4	To enable students to design, implement, and test embedded systems projects using microcontrollers and development boards.	CO4
5	To prepare students for careers in embedded systems engineering and related fields through hands-on experience and practical projects.	CO5

Course Code : BTP BS111
Course Title : Applied Chemistry Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Basic Science
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Determination of the enthalpy of neutralization of hydrochloric acid with sodium hydroxide
2	Determination of integral enthalpy of solution of salts (endothermic and exothermic)
3	Determination of the rate constant of a reaction
4	Verification of Lambert-Beer's Law for potassium dichromate/potassium permanganate solution
5	Determine the pH of the given aerated drinks fruit juices, shampoos andsoaps using digital pH meter and pH paper
6	Determine the pH of the given aerated drinks fruit juices, shampoos andsoaps using digital pH meter and pH paper
7	Estimation of hardness of water using EDTA titration
8	Standardization of KMnO4 solution by Mohr's salt
9	Conductometric titration for a) Determination of the strength of a given HCl solution by titration against a standard NaOH solution. b) Analysis of a mixture of strong and weak acid by strong base
10	Thin layer chromatographic separation
11	Synthesis and purification of polymer/drug

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Engineering Chemistry, Satya Prakash, Manisha Agrawal, Khanna Publishers	2001
2	Chemistry: Principles and Applications, M. J. Sienko and R. A. Plane, McGraw Hill	1980
3	A textbook of engineering Chemistry, Shashi Chawla, Dhanpat Rai	2017
Reference Books		
1	Fundamentals of Molecular Spectroscopy, C. N. Banwell, McGraw Hill	2017
2	University chemistry, B. H. Mahan, Chaukhamba Auriyantaliya,	2012

Course Outcome

Sr	Course Outcome	CO
1	To provide students with a comprehensive understanding of embedded systems architecture, components, and programming.	CO1
2	To introduce students to the design methodologies and development tools used in embedded systems development.	CO2
3	To familiarize students with real-time operating systems (RTOS) and their applications in embedded systems.	CO3
4	To enable students to design, implement, and test embedded systems projects using microcontrollers and development boards.	CO4
5	To prepare students for careers in embedded systems engineering and related fields through hands-on experience and practical projects.	CO5

Course Code : **BTL BS102**
Course Title : **Biology for Engineers**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Basic Science**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :

Detailed Syllabus

Introduction to Basic Biology: Cell, Cell theory, Cell shapes, structure of a Cell, prokaryotic and eukaryotic Cell, Plant Cell and animal Cell, protoplasm, Plant Tissue and Animal Tissue. Cell cycle (16 hours)
Introduction to Bio-molecules: Carbohydrates, proteins, Amino acid, nucleic acid (DNA and RNA) and their types. Enzymes and their application in Industry. Large scale production of enzymes by Fermentation (18 hours)
Gene structure and recombinant DNA technology: Prokaryotic gene and Eukaryotic gene structure, gene replication, Transcription and Translation in Prokaryotes and Eukaryotes. Recombinant DNA technology and introduction to cloning. (18 hours)
Applications of Biology: Brief introduction to Production of vaccines, Enzymes, antibodies, Cloning in microbes, plants and animals, Basics of biosensors, biochips, Bio fuels. Tissue engineering and its application, transgenic plants and animals, Stem cell and applications. Bio engineering (production of artificial limbs, joints and other parts of body). (20 hours)

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Essential Cell Biology Fifth edition by Bruce Alberts, Karen Hopkin, Alexander Johnson, David Morgan, Martin Raff, Keith Roberts, Peter Walter, WW Norton & Co	2019
2	Karp's Cell Biology Eighth edition by Gerald Karp, Janet Iwasa, Wallace Marshall; Wiley	2018
3	Biology for Engineers by T Johnson press	2011
Reference Books		
1	The Cell: A Molecular Approach Fifth edition by Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, M.A.	2009
2	Lehninger: Principles of Biochemistry, 8th edition by David L. Nelson and Michael. M. Cox; W. H. Freeman and Company.	2021

Course Outcome

Sr	Course Outcome	CO
1	To understand the detailed structure of the cell and cell cycle.	CO1
2	To understand the structure and function of biomolecules and their importance	CO2
3	To illustrate about genes and genetic materials (DNA & RNA) present in living organisms and how they replicate, transfer & preserve vital information in living organisms	CO3
4	To demonstrate the concept of biology and its uses in combination with different technologies for the production of medicines and production of transgenic plants and animals.	CO4

Course Code	**: EEL DC201**
Course Title	**: ELECTRICAL MACHINES-I**
L-T-P/S=Credits	**: 3-0-0 =3**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**:Network Analaysis & synthesis**

Unit I

Basics of Magnetic Circuits: Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; linear and nonlinearmagnetic circuits, B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; Statically and Dynamically induced EMF, Torque, Hysteresis, Core losses, Faraday's law of EMI Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

Unit II

Transformer Basics: Principle construction and operation of single phasetransformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency, **Transformer Tests:** Open & Short circuit tests, Polarity test, Sumpners test,Separation of hysteresis and eddy current losses, **Parallel operation:** Parallel operation of single phase transformer, **Auto Transformers:** Construction, Principle, Applications, Comparison with twowinding transformers.

Unit III

Three Phase Transformers: Construction, various types of connection and theircomparative features**, Parallel operation:** Paralleloperation of three phase transformers, **Performance of Transformers:** Excitation phenomenon in transformers,Three phase to six phase conversion, No load and on load tap changing of transformers, Three winding transformers, Cooling methods of transformers.

Unit IV

Basic Concepts of the Rotating Electrical Machines: Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, commutator, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil, Armature winding and commutation, lap and wave windings, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Unit V

D.C. Generators & Motors: EMF equation, Working principle, Construction, Methods of excitation, voltage build-up in a shunt generator, critical field resistance and critical speed, Armature reaction, Effect of brush shift, Compensating winding, Characteristics of various types of generators, Applications D.C. Motors: Torque equation, Characteristics of various types of motors, Applications, Direct testing, Regenerative Testing, 4-point starter, 3-point starter, Speed control of series motors, Speed control of shunt motors.

Text/ Reference Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Course Outcomes:

1. Understand the concepts of magnetic circuits.
2. Understand how a transformer is manufactured and how does it work.
3. Analyse three phase transformer and phase conversion.
4. Understand the construction and principle of operation of DC machines.
5. Analyse the differences in operation of different dc machine configurations.

Course Code	**: EEP SE103**
Course Title	**: ELECTRICAL WORKSHOP**
L-T-P/S=Credits	**: 0-0-4 =2**
Course Category	**: SEC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

1. Introduction of Electrical Safety precautions, Electrical Symbols, abbreviations commonly used in Electrical Engg. and familiarization with tools used in Electrical Works.
2. Name of Appliance use in daily life and their power rating.
3. Making of a circuit in which bulb is getting ON/OFF by two way switch.
4. Making of circuit in which intensity of bulb gets controlled by the use of Fan Regulator.
5. Making the extension board with the help of
    i. One switch and two socket
    ii. Two socket and their individual switch
6. Making switch board that directs electricity from one or more sources of supply to several smaller region.
7. To fabricate half wave rectifiers with filters on PCB.
8. To fabricate full wave rectifiers with filters on PCB.
9. To study wire up a circuit used for Godown wiring
    i. By using two switches
    ii. By using three switches
10. Working, Maintenance and Repair of Electrical equipment i,e Electric Iron , Electric Toaster ,Water heater, Air coolers and Electric Fans etc.
11. To study and demonstrate Vp(peak voltage),Vpp(peak to peak voltage), Time, frequency and phase using CRO.
12. To study different types of earthing and protection devices e.g. MCBs, ELCBs and fuses.
13. To make the connection of fan regulator with lamp to study the effect of increasing and decreasing resistance in steps on the lamp.

Course Code : EEL DC 202
Course Title : ELECTRICAL MACHINES-II
L-T-P/S=Credits : 3-0-0 =3
Course Category : DCC
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Unit I

Fundamentals of AC machines windings: Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single- turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding,

Pulsating and revolving magnetic fields: Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current, Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Unit II

Three Phase Induction Machines: Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Cogging and crawling of induction motor**,** Generator operation: Self-excitation. Doubly-Fed Induction Machines.

Unit III

Single-phase induction motors: Constructional features, double revolving field theory, equivalent circuit, determination of parameters, Split-phase starting methods and applications.

Unit IV:

Synchronous machines

Synchronous Generator: Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance method, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Synchronous Motor: Principle of operation, effect of load on a synchronous motor, equivalent circuit and phasor diagram, power developed in synchronous motor, synchronous motor with different excitation, different torques in synchronous motor, effect of varying excitation on armature current and power factor, V-curves, Hunting, Starting methods of synchronous motor.

Unit V

Special Electric Motors: Stepper motor, Reluctance motor, hysteresis motor, Schrage motor, AC series motor, Universal Motor, etc.

Text/ Reference Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Course Outcomes:

1. Understand the concepts of rotating magnetic fields.
2. Understand the operation of induction machines
3. Analyse different types of single phase induction motor.
4. Understand the construction and operation of Synchronous machines.
5. Analyse the special types of electric motors.

Course Code	**: EEL DC 203**
Course Title	**: Signal and Systems**
L-T-P/S=Credits	**: 3-1-0=4**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I

Introduction to Signals and Systems: Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability, Examples.

Unit II

Behavior of continuous and discrete-time LTI systems: Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Unit III

Fourier Series and Transform: Fourier series representation of periodic signals, Waveform Symmetries, Calculation of FourierCoefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain,magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform(DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.

Unit IV

Laplace and z- Transforms: Review of the LaplaceTransform for continuous time signals and systems, system functions, poles and zeros of systemfunctions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Unit V

Sampling and Reconstruction: The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: idealinterpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuousand discrete time systems. Introduction to the applications of signal and system theory: modulationfor communication, filtering, feedback control systems.

Text/ Reference Books:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.
6. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
7. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

Course Outcomes:

1. Understand the concepts of continuous time and discrete time systems.
2. Analyse systems in complex frequency domain.
3. Understand sampling theorem and its implications.

Course Code : EEL DC204
Course Title : Analog Integrated Circuits
L-T-P/S=Credits : 3-0-0 =3
Course Category : Department Core
Pre-requisite Courses (if any) : Electrical Circuit Analysis, Electronic Devices & Circuits
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Introduction to Linear Integrated Circuits: Overview of linear integrated circuits (ICs) and their applications, Classification of linear ICs: operational amplifiers, voltage regulators, etc, Characteristics of operational amplifiers (op-amps), Ideal op-amp model and basic op-amp circuits **(2 weeks).**

Op-Amp Characteristics and Specifications: DC and AC characteristics of op-amps, Input and output voltage ranges, offset voltage, and offset null, Common-mode rejection ratio (CMRR) and slew rate, Frequency response and bandwidth **(2 weeks).**

Op-Amp Configurations and Applications: Inverting and non-inverting amplifier configurations, Summing and difference amplifier configurations, Integrator and differentiator circuits, Instrumentation amplifiers and active filters **(2 weeks).**

Frequency Response of Op-Amp Circuits: Effects of finite gain and bandwidth on op-amp circuits, Compensation techniques for frequency response improvement, Stability analysis and pole-zero analysis of op-amp circuits, Phase margin and gain margin **(2 weeks).**

Feedback Amplifiers and Oscillators: Feedback amplifier configurations: voltage and current feedback, Stability criteria for feedback amplifiers, Wien bridge and phase-shift oscillators, Crystal oscillators and voltage-controlled oscillators (VCOs) **(2 weeks).**

Voltage Regulators and Power Supplies: Linear voltage regulators: series and shunt regulators, Adjustable voltage regulators and voltage reference circuits, Switching voltage regulators: buck, boost, and buck-boost converters, Practical considerations in power supply design **(2 weeks).**

Special Topics in Linear Integrated Circuits: Comparators and Schmitt triggers, Analog-to-digital converters (ADCs) and digital-to-analog converters (DACs), Voltage-controlled amplifiers (VCAs) and logarithmic amplifiers, Current mirrors and current sources, Design and implementation of a linear integrated circuit project, Presentation and demonstration of project outcomes, Advanced topics based on student interest and current trends **(2 weeks).**

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	**Analog Integrated Circuit Design,** Tony Chan Carusone, David A. Johns, and Kenneth W. Martin, Wiley	2013
2	**Design with Operational Amplifiers and Analog Integrated Circuits,** Sergio Franco, McGraw Hill	2011
3	**Op-Amps and Linear Integrated Circuits,** Ramakant A. Gayakwad, Pearson Education	2015
Reference Books		
1	**Linear Integrated Circuits,** D. Roy Choudhury and Shail B. Jain, New Age International	2009

Course Outcome

Sr	Course Outcome	CO
1	Students will demonstrate an understanding of the principles and operation of linear integrated circuits.	CO1
2	Students will be able to analyze and design operational amplifier-based circuits for various applications.	CO2
3	Students will acquire practical skills in simulating, prototyping, and testing linear integrated circuits.	CO3
4	Students will be prepared to apply their knowledge of linear integrated circuits to solve real-world engineering problems	CO4
5	Students will develop effective communication and teamwork skills through laboratory experiments and projects.	CO5

Course Code : EEP DC204
Course Title : Analog Integrated Circuits Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Department Core
Pre-requisite Courses (if any) : Electrical Circuit Analysis, Electronic Devices & Circuits
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Op-Amp Characteristics and Basic Circuits
2	Inverting and Non-Inverting Amplifiers
3	Summing and Difference Amplifiers
4	Integrator and Differentiator Circuits
5	Active Filters and Instrumentation Amplifiers
6	Oscillator Circuits and Voltage Regulators
7	Comparator and Schmitt Trigger Circuits
8	ADC and DAC Circuits

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	**Analog Integrated Circuit Design,** Tony Chan Carusone, David A. Johns, and Kenneth W. Martin, Wiley	2013
2	**Design with Operational Amplifiers and Analog Integrated Circuits,** Sergio Franco, McGraw Hill	2011
3	**Op-Amps and Linear Integrated Circuits,** Ramakant A. Gayakwad, Pearson Education	2015
Reference Books		
1	**Linear Integrated Circuits,** D. Roy Choudhury and Shail B. Jain, New Age International	2009

Course Outcome

Sr	Course Outcome	CO
1	Students will demonstrate an understanding of the principles and operation of linear integrated circuits.	CO1
2	Students will be able to analyze and design operational amplifier-based circuits for various applications.	CO2
3	Students will acquire practical skills in simulating, prototyping, and testing linear integrated circuits.	CO3
4	Students will be prepared to apply their knowledge of linear integrated circuits to solve real-world engineering problems	CO4
5	Students will develop effective communication and teamwork skills through laboratory experiments and projects.	CO5

Course Code : EEL DC304

Course Title : AI and ML in Electrical Engineering
L-T-P/S=Credits : 3-1-0 =4
Course Category : Department Core
Pre-requisite Courses (if any) : Engineering Mathematics, Signal & Systems, Electronic Devices & Circuits, Programming Languages
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Introduction to Artificial Intelligence and Machine Learning: Overview of artificial intelligence and machine learning, Types of machine learning: supervised, unsupervised, and reinforcement learning, Applications of AI and ML in electrical engineering domains **(2 weeks).**

Fundamentals of Machine Learning: Regression and classification algorithms, Evaluation metrics: accuracy, precision, recall, F1-score, Cross-validation and hyperparameter tuning, Feature engineering and selection techniques **(2 weeks).**

Supervised Learning in Electrical Engineering: Regression techniques for forecasting and estimation, Classification methods for fault detection and classification, Case studies in power system load forecasting and fault diagnosis **(2 weeks)**.

Unsupervised Learning in Electrical Engineering: Clustering algorithms for data segmentation, Dimensionality reduction techniques: PCA, t-SNE, Anomaly detection and novelty detection methods, Case studies in customer segmentation and anomaly detection in electrical grids **(2 weeks)**.

Reinforcement Learning and Control Systems: Introduction to reinforcement learning and Markov decision processes, Basics of control theory and feedback control systems, Application of reinforcement learning in control systems optimization, Case studies in optimal power flow and adaptive control **(2 weeks)**.

AI and ML Applications in Power Systems: Smart grid technologies and their challenges, Predictive maintenance and asset management using AI and ML, Demand response and energy management systems, Case studies in power system optimization and control **(2 weeks)**.

MATLAB based Project Work and Advanced Topics: Design and implementation of AI and ML projects in electrical engineering, Presentation and demonstration of project outcomes, Advanced topics based on student interest and current research trends **(2 weeks)**.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	**Artificial Intelligence: A Modern Approach,** Stuart Russell and Peter Norvig, Pearson Education	2022
2	**Electric Power Systems: A Conceptual Introduction,** Alexandra von Meier**, Wiley**	2006
3	**Pattern Recognition and Machine Learning,** Christopher M. Bishop	2006
Reference Books		
1	**Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow"** by Aurélien Géron	2006

Course Outcome

Sr	Course Outcome	CO
1	Students will understand the fundamental concepts of artificial intelligence and machine learning.	CO1
2	Students will be able to apply AI and ML techniques to solve problems in electrical engineering domains.	CO2
3	Students will acquire practical skills in implementing and evaluating AI and ML algorithms for electrical engineering applications	CO3
4	Students will be prepared to analyze and interpret results obtained from AI and ML models in electrical engineering contexts	CO4
5	Students will develop critical thinking and problem-solving skills through hands-on projects and case studies	CO5

Course Code : EEL DC301
Course Title : Microprocessors & Microcontrollers
L-T-P/S=Credits : 3-0-0 =3
Course Category : Department Core
Pre-requisite Courses (if any) : Electronic Devices & Circuits, Digital Electronics, C Programming
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Introduction to Microprocessors: Overview of microprocessors and microcontrollers, Evolution of microprocessor architecture, Basic architecture and components of a microprocessor system, Introduction to the Intel 8085 microprocessor **(2 weeks).**

8085 Microprocessor Architecture: Architecture and organization of the Intel 8085 microprocessor, Memory and I/O interfacing, Instruction set architecture (ISA) and programming model,Addressing modes and instruction execution **(2 weeks)**.

8085 Microprocessor Programming: Programming techniques: assembly language programming, Instruction set overview and programming examples, Arithmetic and logic operations, Control flow instructions and subroutines **(2 weeks)**.

Interfacing Peripherals with 8085: Interfacing memory devices: RAM and ROM, Interfacing input/output (I/O) devices: keyboard, display, and ADC, Interrupts and interrupt-driven I/O operations, Timer and counter programming **(2 weeks)**.

Introduction to Microcontroller: Difference between microprocessors and microcontrollers, Overview of popular microcontroller families: Intel 8051, AVR, PIC, ARM Cortex-M, Architecture and features of the Intel 8051 microcontroller **(2 weeks)**.

8051 Microcontroller Programming: Assembly language programming for the Intel 8051, Instruction set architecture and addressing modes, Programming examples: I/O operations, arithmetic operations, and control instructions, Timer and counter programming in the 8051 **(2 weeks)**.

Interfacing Peripherals with 8051: Interfacing I/O devices: keypad, LCD display, and serial communication, Analog-to-digital conversion using the 8051, Pulse-width modulation (PWM) generation, Interfacing external memory devices. Design and implementation of embedded systems projects using microcontrollers, Real-time operating systems (RTOS) and multitasking, Introduction to advanced microcontroller families and emerging trends **(2 weeks)**.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	**Microprocessor Architecture, Programming, and Applications with the 8085"**, Ramesh S. Gaonkar, Penram International	2013
2	**The 8051 Microcontroller and Embedded Systems: Using Assembly and C"**, Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay, Pearson Education	2005
3	**Microcontroller Theory and Applications: HC12 and S12"** by Daniel J. Pack and Steven F. Barrett, Pearson Education	2007
Reference Books		
1	**Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers"** by Jonathan W. Valvano, Createspace	2012

Course Outcome

Sr	Course Outcome	CO
1	Students will understand the architecture and organization of microprocessors and microcontrollers	CO1
2	Students will be able to program microprocessors and microcontrollers using assembly language and high-level languages	CO2
3	Students will acquire practical skills in interfacing peripheral devices with microprocessors and microcontrollers	CO3
4	Students will be prepared to design and implement embedded systems using microcontrollers for various applications	CO4

5	Students will develop problem-solving and debugging skills through hands-on experiments and projects	CO5

Course Code : EEP DC301
Course Title : Microprocessors & Microcontrollers Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Department Core
Pre-requisite Courses (if any) : Electronic Devices & Circuits, Digital Electronics, C Programming
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	8085 Microprocessor Arithmetic Operations
2	8085 Microprocessor Control Flow Instructions
3	8085 Microprocessor I/O Interfacing
4	8051 Microcontroller I/O Operations
5	8051 Microcontroller Timer Programming
6	8051 Microcontroller Serial Communication
7	Interfacing Keypad and LCD with 8051
8	ADC Interfacing with 8051
9	PWM Generation using 8051
10	Real-time Embedded Systems Project

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	**Microprocessor Architecture, Programming, and Applications with the 8085"**, Ramesh S. Gaonkar, Penram International	2013
2	**The 8051 Microcontroller and Embedded Systems: Using Assembly and C"**, Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay, Pearson Education	2005
3	**Microcontroller Theory and Applications: HC12 and S12"** by Daniel J. Pack and Steven F. Barrett, Pearson Education	2007
Reference Books		
1	**Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers"** by Jonathan W. Valvano, Createspace	2012

Course Outcome

Sr	Course Outcome	CO
1	Students will understand the architecture and organization of microprocessors and microcontrollers	CO1
2	Students will be able to program microprocessors and microcontrollers using assembly language and high-level languages	CO2
3	Students will acquire practical skills in interfacing peripheral devices with microprocessors and microcontrollers	CO3
4	Students will be prepared to design and implement embedded systems using microcontrollers for various applications	CO4
5	Students will develop problem-solving and debugging skills through hands-on experiments and projects	CO5

Course Code	**: EEE DE 303**
Course Title	**: Electric Materials**
L-T-P/S=Credits	**: 3 -1-0=4**
Course Category	**: DEC/GEC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I

Atomic Structure and Interatomic Bonding: Electrons in Atoms, Bonding Forces and Energies, Bonding Type of bonds.

Dielectric Materials: Dielectric properties in static field, Permittivity, Dipole moment, Polarization and dielectric constant, Electric conductivity in solid, liquid and gaseous dielectrics, Piezoelectric materials, Ferroelectric material, Pyroelectric materials, Anti-ferromagnetic materials.

Dielectric in alternating field, Leakage currents, Dielectric loss, Dielectric strength, Breakdown voltage.

Unit II

Magnetic Properties of Materials: Magnetic field, Lenz's law and induced dipole moments, Classification of magnetic materials, Special purpose materials, Feebly magnetic materials, Hysteresis loops for different ferromagnetic materials, Factor effecting hysteresis, Soft and hard magnetic materials, Ferrites, Permanent magnets

Unit III

Semiconductor Materials: Classification of material as semiconductor, Intrinsic and extrinsic semiconductors, Working application of semiconductors, Photovoltaic cell, Varistors, LCD, LDR, Advantages of semiconductor materials used in electrical industries.

Unit IV

Materials for Electrical Applications: Materials used for resistors, rheostats, heaters, Conductor materials used for overhead transmission line, underground cables, electrical machine winding, Electrical, Mechanical, Thermal and Visual properties of insulating material, Effect of moisture on insulation.

Unit V

Special Purpose Materials and Processes: Thermocouple material, Soldering materials, Fuse and contact material, Structural Materials, Refractory Materials, Radioactive Materials, Galvanization and Impregnation processes, Processing of electronic materials, Properties and applications of mineral oils, Testing of transformer oil.

Text/ Reference Books:

1. T. K. Basak, *"A course in Electrical Engineering Materials,"* New Age Science Publications.
2. A. J. Dekker, *"Electrical Engineering Materials,"* Prentice-hall, Inc.
3. C. S. Indulkar and S. Thiruvengadam, *"Electrical Engineering Material,"* S. Chand & Company Ltd.
4. N. Alagappan and N. Kumar, *"Electrical Engineering Materials,"* TTTI Madras, McGraw Hill Education.

Course Outcomes:

1. To introduce the basic principles atoms, energies and dielectric materials.
2. Understand the magnetic properties of materials.
3. Understand the mechanism of conduction in semiconductor.
4. Recognize the various material used in electrical application.
5. Identify and effective special purpose material in electrical industry and testing of transformer oil.

Course Code	**: EEL DC 301**
Course Title	**: Control System**
L-T-P/S=Credits	**: 3-0-0=3**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I

Introduction to control problem: Industrial Control examples. Mathematical models of physical systems. Control hardware and theirmodels. Transfer function models of linear time-invariant systems.Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagramalgebra.

Unit II:

Time Response Analysis: Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit III

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

Unit IV

Introduction to Controller Design: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustnessof control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Unit V

State variable Analysis : Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of stateequations. Eigenvalues and Stability Analysis. Concept of controllability and observability.Pole-placement by state feedback.Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems.Stability of linear discrete-time systems.

Introduction to Optimal Control and Nonlinear Control: Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts andanalysis.

Text/References:

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

Course Outcomes:

1. Understand the modelling of linear-time-invariant systems using transfer function and state space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Design simple feedback controllers...

Course Code	**: EEL DC 303**
Course Title	**: Power System-I**
L-T-P/S=Credits	**: 3-0-0=3**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**:Electrical Machines**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I

Evolution of Power Systems: Single line diagram of Power system, Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator.

Generation of Electric Power: Conventional and Renewable Energy Sources, Distributed Energy Resources, Energy Storage.

Supply System: Different kinds of supply system and their comparison, choice of transmission voltage.

Transmission Lines: Configurations, types of conductors, resistance of line, skin effect, Kelvin's law, Proximity effect.

Unit II

Over Head Transmission Lines: Calculation of parameters of single phase, three phase, single circuit and double circuittransmission lines, Representation and performance of short, medium and long transmission lines, Ferranti effect, Surge impedance loading.

Unit III

Corona and Interference: Phenomenon of corona, corona formation, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona and interference Electrostatic and electromagnetic interference with communication lines.

Overhead line Insulators: Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency.

Unit IV

Mechanical Design of transmission line: Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers.

Insulated cables: Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance ofsingle phase and three phase cables, dielectric loss, heating of cables.

Unit V

Distribution Systems:

Distribution system layout, Introduction of Distribution System, Primary & Secondary distribution, Design consideration, distribution system losses, Classification of Distributed system- Radial Ring interconnected systems, Stepped distribution.

Introduction to DC Transmission and Distribution.

Text/ Reference Books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994
2. C.L. Wadhwa, "Electrical Power System", New age international Ltd. Third Edition
3. B. R. Gupta, "Power System Analysis and Design", Third Edition, S. Chand & Co.
4. S. Sivanagaraju& S. Satyanarayana, "Electric Power Transmission and Distribution", Pearson Education
5. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill.
6. T.A. Short, "Electric Power Distribution Handbook", CRC

Course Outcomes:

1. Understand the concepts of power systems and various power system components.
2. Understand the electrical circuit parameters of transmission lines.
3. Understand Concept of corona and Insulators
4. Understand the mechanical design of transmission line and cables.
5. Understand concepts of distribution system.

Course Code	**: EEL DC 305**
Course Title	**: POWER ELECTRONICS**
L-T-P/S=Credits	**: 3-0-0 =3**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I

Power switching devices: Diode, Thyristor, MOSFET, IGBT: I-V Characteristics, Firing circuit for thyristor, Gate drive circuits for MOSFET and IGBT,Working and Characteristics of GTO, Working and Characteristics of DIAC, Working and Characteristics of TRIAC.

Unit II

AC-DC Converters (Thyristor rectifiers): Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-loadand highly inductive load, Operation and analysis of Single phase uncontrolled and controlled rectifiers with RLE load,Three-phase full-bridge uncontrolled and controlled rectifiers with R-load and highly inductive load; Estimation of RMS load voltage, RMS load current and input power factor, power factor improvement methods for phase controlled rectifiers, effect of source inductance Input current wave shape.

Unit III

DC-DC converters: Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, Principle of step up and step down operation, Time ratio control for Chopper, Single quadrant DC chopper, Two quadrant and four quadrant DC choppers, analysis and waveforms at steady state.

Unit IV

DC-AC Converters (Inverter): Power circuit of single-phase voltage source inverter, Single phase half-bridge inverter, Single phase full-bridge inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage, Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages.

Unit V

AC-AC Converters : AC Voltage regulator, Single phase half wave AC voltage controller with R load, Single phase full wave AC voltage controller with R load, Single phase full wave AC voltage controller with R-L load, Single phase to single phase (circuit step-up and step-down) cycloconverter, Three-phase to single-phase (halfwave) Cycloconverter, Three-phase to three-phase (half-wave) Cycloconverter.

Text/References:

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.
5. PS Bhimbra, "Power Electronics", Khanna Publishers, 2019.

Course Outcomes:

1. Understand the differences between signal level and power level devices.
2. Analyse controlled rectifier circuits.
3. Analyse the operation of DC-DC choppers.

4. Analyse the operation of voltage source inverters.
5. Analyse the working and operation of cycloconverter.

Course Code	**: EEL DC 302**
Course Title	**: Power System-II**
L-T-P/S=Credits	**: 3-0-0 =3**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**:Power System-I**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I

Representation of Power System Components: Synchronous machines, Transformers, Transmission lines, One-line diagram, Impedance and reactance diagram, Per unit system.

Symmetrical Components: Symmetrical Components of unbalanced phasors, Power in terms of symmetrical components, Sequence impedances and sequence networks (positive, negative and zero sequences).

Unit II

Symmetrical Fault Analysis: Transient if R-L series circuit, Calculation of 3-phase short circuit current and reactance of Synchronousmachine, Internal voltage of loaded machines under transient conditions.

Unsymmetrical Faults: Analysis of single line to ground fault, Line-to-line fault and Double Line to ground fault on a generators and power system network.

Formation of Zbus using singular transformation and algorithm, Computer method for short circuitcalculations.

Unit III

Load Flows: Introduction, Bus classifications, Bus admittance matrix (Y_{BUS}), Load flow equations, Loadflow solution using Gauss Siedel, Newton-Raphson method, Approximation to N-R method, Fast decoupled method.

Unit IV

Power System Stability: Stability and Stability limit, Steady state stability study, Swing equation, Transient stability studies by equal area criterion and step-by-step method, Factors affecting steady state and transient stability, Stability improvement methods, Continuation power flow analysis.

Unit V

Control of Frequency and Voltage: Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing, Automatic Generation Control, Generation and absorption of reactive power by various componentsof a Power System.

Monitoring and Control: Overview of Energy Control Centre Functions: SCADA systems, Phasor Measurement Units andWide-Area Measurement Systems, State-estimation, Contingency Analysis.

Text/ Reference Books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education.
2. T. K. Nagsarkar& M. S. Sukhija, "Power System Analysis," Oxford University Press.
3. Hadi Sadat, "Power System Analysis," Tata McGraw Hill.
4. A. J. Wood and B.F. Wollenberg, "Power Generation, Operation and Control," John Wiley & Sons.
5. O. I. Elgerd, "Electric Energy Systems Theory," McGraw Hill Education.
6. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis," McGraw Hill Education.

Course Outcomes:

1. Use numerical methods to analyses a power system in steady state
2. Evaluate fault currents for different types of faults.
3. Understand methods to control the voltage, frequency and power flow.
4. Understand the stability of synchronous grid.
5. Understand the monitoring and control of a power system.

Course Code	**: EEL DC 208**
Course Title	**: Electric System Design**
L-T-P/S=Credits	**: 3-1-0 =4**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

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

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

Unit III
Industrial Electrical Systems I: HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit IV
Industrial Electrical Systems II: DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Unit V
Industrial Electrical System Automation: Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text/ Reference Books:

1. S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
3. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
4. Web site for IS Standards.
5. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

Course Outcomes:

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

Course Code	**: EEE DE 401**
Course Title	**: Power Plant Engineering**
L-T-P/S=Credits	**: 3-1-0 =4**
Course Category	**: DEC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I
Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.

Unit II
Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit III
Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Unit IV
Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Unit V
Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text/ Reference Books:
1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

Course Outcomes:
1. Understand the principles of operation for different power plants and their economics.

Course Code	**: EEE DE 409**
Course Title	**: FACTS Devices**
L-T-P/S=Credits	**: 3-1-0 =4**
Course Category	**: DEC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I

Transmission Lines and Series/Shunt Reactive Power Compensation: Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Unit II

Thyristor-based Flexible AC Transmission Controllers: Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

Unit III

Voltage Source Converter based (FACTS) controllers: Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation.

STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

Unit IV

Power Quality Problems in Distribution Systems: Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. DSTATCOM.

Unit V

Dynamic Voltage Restorer and Unified Power Quality Conditioner: Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.

Text/ Reference Books:

1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999.
2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
3. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983.
4. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.
5. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991.

Course Outcomes:

1. Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
2. Understand the working principles of FACTS devices and their operating characteristics.
3. Understand the basic concepts of power quality.
4. Understand the working principles of devices to improve power quality.

Course Code	**: ECL ESXXX**
Course Title	**: Digital Electronics**
L-T-P/S=Credits	**: 3-0-0 =3**
Course Category	**: ESC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit-I

Basic concepts of Boolean Algebra: Review of number systems - Binary, Hexadecimal, conversion from oneto another, complement arithmatic, Signed and unsigned numbers and their arithmetic operations. BCD,Excess-3, Gray and Alphanumeric codes. Review of Boolean algebra, De-Morgan's Theorems, Standard Formsof Boolean Expressions, Minimization-Techniques: K-MAPS, VEM Technique, Q-M (Tabulation) method.

Unit-II

Logic Gates & families: Logic Families: TTL, MOS, CMOS, Bi-CMOS; Performance parameters of IC families:input and output loading, fan-in, fan-out, tri-state, current drive, voltage levels, noise margins, power-speedtradeoff; Unused inputs; Interfacing between logic families.

Unit-III

Combinational Logic Circuits: Problem formulation and design of Basic Combinational Logic Circuits,Combinational Logic Using Universal Gates. Basic Adders, ALU, Parity-Checkers and Generators, Comparators,Decoders, Encoders, Code Converters, Multiplexer (Data Selector), De-multiplexers

Sequential Circuits: Latches, Flip-flops (SR, JK, T, D, Master/Slave FF,) Edge-Triggered Flip-Flops, Flip-FlopOperating Characteristics, Basic Flip-Flop Applications, Asynchronous Counter Operation, Synchronous CounterOperation, Up/Down Synchronous Counters.

Unit-IV

Shift registers & Memories

Shift Register Functions, Serial In - Serial Out Shift Registers, Serial In - Parallel Out Shift Registers, Parallel In- Serial Out Shift Registers, Parallel In - Parallel Out Shift Registers, Bidirectional Shift Registers,Basics ofSemiconductor Memories, Random-Access Memories (ROM), Read Only Memories (ROMs), ProgrammableROM's (PROMs and EPROM's), PAL, PLA.

Unit-V

A/D and D/A convertor

Characteristics of ADC, Types of ADC- SAR, Dual Slope, Flash ADC. Characteristics of DAC, R-2R Ladder,Weighted Resistance Type

Circuit and electrical interfacing considerations

Transmission line effect, reflection, crosstalk, Noise sources, shielding and decoupling

Text/ Reference Books:

1. "Digital Fundamentals" by Thomas L. Floyd, Prentice Hall, Inc
2. "Digital Systems - Principles and Applications" by Tocci, R. J. and Widner, Prentice Hall,
3. Switching and finite automata theory: Z V Kohavi.–TMH
4. Digital Logic Circuit Analysis & Design, by Victor P. Nelson, H. Troy Nagle, Bill D. Carroll and J. David
5. Irwin, Prentice Hall,
6. Digital logic and computer design: M Morris Mano –PHI
7. Modern digital electronics: R.P. Jain. TMH
8. *Digital Design: Principles and Practices, by* Wakerly J F, Prentice-Hall,
9. "Digital Experiments Emphasizing Systems and Design," by David Buchla, Prentice Hall, Inc.

Course Code	**: EEL DC 210**
Course Title	**: Electromagnetic Field Theory**
L-T-P/S=Credits	**: 3-1-0 =4**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**: Engineering Physics**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I: Introduction
Vector Analysis, Coordinate System, Gradient, Divergence, Curl, Laplacian in rectilinear, Cylindrical, Spherical Coordinate System, Line, surface and volume integrals, Divergence Theorem, Stoke's theorem

Unit II: Time varying fields and Maxwell's equations
Introduction, The Equation of Continuity For Time-Varying Fields, Inconsistency Of Ampere's Law, Maxwell's Equation in Integral and differential form, Physical Significance of Maxwell Equation, Boundary conditions.

Unit III: ELECTROMAGNETIC WAVES
Solution For Free-Space Conditions, Uniform Plane Waves & Propagation, The Wave Equations For A Conducting Medium, Sinusoidal Time Variations, Conductors And Dielectrics, Polarization, Reflection By A Perfect Conductor Normal Incidence & Oblique Incidence, Reflection By A Perfect Dielectric — Normal Incidence & Oblique Incidence, Reflection At The Surface Of A Conductive Medium.

Unit IV: RADIATION
Potential Functions And Electromagnetic Field, Potential Functions For Sinusoidal Oscillations, Alternating Current Element, Power Radiated By Current Element, Application To Short Antennas, Radiation From A Monopole Or Dipole.

Unit V: Transmission Line
Circuit theory analysis of Transmission Line, Loss less and Lossy transmission lines, Reflection coefficient, Transmission Coefficient, VSWR, Input Impedance, Matching of Transmission Line, pulse excitation. Group Velocity and Phase velocity.

Recommended Books:

1. Fields & Wave Electromagnetics, DK Cheng
2. Electromagnetic Waves and Radiating Systems, Jordan &Balmin
3. Elements of Electromagnetics, Sadiku
4. Engineering Electromagnetics: W H Hayt& J A Buck
5. Advanced Engineering Electromagnetics: C A Balanis

Course Outcome

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

Course Code	**: PHL BSxx**
Course Title	**: Engineering Physics**
L-T-P/S=Credits	**: 3-0-0 =3**
Course Category	**: BSC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Force and electric field due to continuous charge distribution, Field lines-Flux-Gauss's Law (differential andintegral forms) and its applications, Electric potential, Work done in assembling a charge distribution.

Force Law-line current, surface current and volume current densities (Equation of Continuity), Biot-Savart law,Properties of B, Magnetic flux-Div B, Curl B, Magnetic vector potential A, Ampere's law (differential and integralrforms), Faraday's laws of electromagnetic induction, displacement current, Modified Ampere's law, Four Maxwell'sequations in differential and integrarformsı

Electromagnetic Spectrum, Brief introduction to black body radiation, Photo-electric Effect and Compton Effect,Wave particle duality (de-Broglie waves), Davisson-Germer Experiment, Concept of wave function and its physicalsignificance, Phase and Group velocities, Uncertainty Principle.

Bohr Theory of atom (with finite and infinite nuclear mass), Derivation of time dependent and time independentSchrödinger wave equations, Expectation values and operators (momentum, energy and angular momentumoperators) and commutators, Particle in a box of infinite height (One dimensional).

Free electron theory-Free electron gas, Energy levels and density of states in one dimension, Band theory ofsolids, Classification ofmetals, semiconductors and insulators on the basis of band theory.

Recommended Books:

1. Introduction to Electrodynamics, D.J. Griffiths, Pearson.
2. Electromagnetics, B. B. Laud, New Age International Publisher..
3 Ferspectives of Modern Physics, Arthur Beiser, Tata McGraw Hills,
4. Introduction to Solid State Physics, Charles Kittel, Wiley
5. Solid State Physics, S.O. Pillai, Wiley
6. Fundamentals of Physics, Resnick Halliday, Wiley

Course Code	**: MTL BSXX**
Course Title	**: Engineering Mathematics-II**
L-T-P/S=Credits	**: 3-1-0 =4**
Course Category	**: BSC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I

Vector Calculus: Beta & Gamma functions. Differentiation of vector functions of scalar variables. Gradient of a scalar field, Divergence & Curl of a vector field and their properties. Line & surface integrals. Green's theorem, Stokes' theorem & Gauss' theorem both in vector & Cartesian forms (statement only) with simple applications.

Unit II

Ordinary Differential Equation: Formation of ODE's, definition of order, degree and solution, ODE's of first order, method of separation of variables, homogenous and non-homogenous equations and their solution, exactness and integrating factor, Bernoulli's general linear ODE's of nth order, operator method, method of undetermined coefficients, method variation of parameters, solution of simple simultaneous ODE's.

Unit III

Partial Differential Equation: Formation of partial differential equations (PDE), Solution of PDE by direct integration. Lagrange's linear equation. Non-linear PDE of first order. Method of separation of variables. Heat, Wave & Laplace's equations (Two dimensional Polar & Cartesian Co-ordinates).

Text/ Reference Books:

1. E. Kreysig, Advanced Engineering Mathematics, Wiley 10th edition 2011.
2. Frank Ayres, Vector Analysis, Mc Graw Hills, 6th edition 2011.
3. T. Marsden and W.H. Freeman,VectorCalclus, Freeman, 6 edition 2011.
4. G. Simons, Differential Equations with Applications, TMH, McGraw-Hill Higher Education; 2 edition 1991.
5. S.L. Ross, Differential Equations, Wiley 3 rd edition 1984.
6. R. Zalman, A Course in Ordinary and PDEs, Academic Press, 1st edition 2014.

Course Outcomes:

1. Understand the concepts of vector calculus like directional derivative, gradient, divergence and curl, and their applications.
2. Learn and apply the concepts of vector integral calculus for the computation of work done, circulation, and flux.
3. Formulate the differential equations concerning physical phenomena like electric circuits, wave motion, heat equation etc.
4. Learn various methods of solution of ordinary and partial differential equations.
5. Solve various partial differential equations arising in heat conduction problems and wave propagation problems.

Course Code	**: MEL SE101**
Course Title	**: Introduction to Engineering Mechanics**
L-T-P/S=Credits	**: 3-1-0 =4**
Course Category	**: ESC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I
Force and Force Systems: Coplanar, Concurrent and Non-Concurrent Force Systems, Resultant and Resolutions, Forces in Space, Vectors, Operations on Force using Vectors, Moment of Force, Varignon's Theorem, Couple and Its Properties, Resultant of a Spatial Force System.

Unit II
Equilibrium-Equilibrium of a Particle, External & Internal Forces, Equilibrium of a Rigid Body, Types of Supports, Structural Members and Beams, Reactions of Beams. Properties of Lines, Areas and Solids: Centre of Gravity, Centroid of Lines (Basic and Composite Areas), Built-Up Sections, Product of Inertia, Mass Moment of Inertia.

Unit III
Trusses, Frames and Mechanisms: Connected Bodies, Two Force and Three Force Members, Trusses, Method of Joints, Method of Sections, Determinateness of Truss, Rigid and Non-Rigid Frames, Simple Mechanisms, Space Frames.

Unit IV
Friction: Type of Friction, Characteristics of a Dry Friction, Equilibrium on Rough Inclined Place, The Wedge, The Screw Jack, Journal Bearing, Axle Friction, Thrust Bearing, Disc Friction, Clutches.

Unit V
Introduction to Dynamics, Kinematics and Kinematics of Particle in Rectilinear and Curvilinear Motions, Projectile, Kinematics and Kinematics of a Rigid Body. Usage of D'Alembert's Principle, Work and Energy, Impulse and Momentum Principles.

Text/ Reference Books:

1. Jurnarkar, S.B. and Shah, H.J.–Applied Mechanics, Charotar
2. Merium and Kraige–Engineering Mechanics, John Wiley & Sons.
3. Sharma, S.M.–Engineering Mechanics, Kirti Publications, Jammu.
4. Engineering Mechanics by Huges and Martin, E.L.B.S. and Macmillan.
5. Beer and E.R. Johnstons–Vector Mechanics, McGraw-Hill, New York.

Course Outcomes:

1. To acquire basic knowledge related to Forces and Equilibrium conditions.
2. To analyses various systems existing in static equilibrium, e.g., blocks, wedges, ladders, trusses, etc.
3. To understand and apply the concepts of Centroid and Moment of Inertia on areas and rigid bodies
4. To predict the effect of force on various Engineering systems in Dynamics.

Course Code	**: MB BSxx**
Course Title	**: Entrepreneurship Management**
L-T-P/S=Credits	**: 3-0-0 =3**
Course Category	**: AEC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Entrepreneurial culture - establishing entrepreneurial system - idea processing, personal, financial informationand intelligence - rewards and motivation - concept bank - role of industrial fair - Theories of entrepreneurship- entrepreneurial traits - types of entrepreneurs - behavioural patterns of entrepreneurs – entrepreneurialmotivation. Business proposals: Pre-feasibility study - criteria for selection of product - ownership – capitalbudgeting - project profile preparation - matching entrepreneur with the project - feasibility report preparationand evaluation Entrepreneurship Development ; resources and capabilities; resource type; environment ofentrepreneurship development ;technological ,social, macro and micro economic factors, competition,ecological aspects etc. entrepreneurial strategies; E–entrepreneurship; Intrapreneurship; business modelsand strategies; venture capital financing; Industry innovation problems, new and emerging businessopportunities in global dynamic environment. Ethical decision making, ethical dilemmas. Construction ofbusiness plans. Entrepreneurship development programs in India - training institutions - institutions provided
technical, financial marketing assistance - role of consultancy organizations.

Recommended Bookss:

1. Dollionger "Entrepreneurship Development", Pearson (Latest Edition).
2. Vasant Desai "Dynamics of Entrepreneurship Development in Mgt", Himalaya (Latest Edition).
3. Charantimath P.M. "Entrepreneurship Development in Small Business Enterprises", Pearson (Latest Edition).
4. Saji Kumar "Impact of Globalisation on SMEs Industries", ICFAI (Latest Edition).
5. Singh B.N.T. "Industrial Development under Structural adjustment Programme", D.D. Publication.
6. Bhatia B.S. and Batra G.S. "Entrepreneurers and Small Business Management", D.D. Publisher.

Course Code	**: PH BSxx**
Course Title	**: Engineering Physics Lab**
L-T-P/S=Credits	**: 0-0-2 =1**
Course Category	**: BSC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

List of Experiments

1. To study the Measuring Instruments (Vernier Calipers, Screw Gauge & Spherometer) 2. To find the angle of prism by rotating the telescope method.
3. To find the refractive index of the material of the given prism using a spectrometer.
4. To determine the refractive index of the given liquid (water) using a hallow prism and spectrometer.
5. To study the Newton's Interference Rings and to determine the wavelength of Sodium light.
6. To determine the Wave Length of Sodium Light using a plane diffraction grating.
7. To determine the frequency of A.C. mains with a Sonometer using non magnetic wire. 8. To draw the characteristics curves of a Semiconductor Diodes (Si or Ge).
9. To study the V-I characteristics of a Zener Diode.
10. To study the performance of a Half-wave, Full-wave & Bridge wave rectifier without filters.
11. To verify Stefan's law by estimating the temperature of a torch bulb filament from resistance measurement.
12. To study the Hall Effect and to calculate the Hall Coefficient and Charge Carrier Concentration of a given sample.
13. To study the dependence of Refractive Index(μ) of the material of the prism on the Wavelength(λ) of light; and hence(1) to determine the Dispersive Power of the material of prism;(2)to verify the Cauchy Relationship $\mu=a+b/\lambda 2$,and to estimate the values of a & b(3)to plot a graph of $d\mu/d\lambda$ versus λ.
14. To determine the band gap by measuring the resistance of a Thermistor at different temperatures.
15. To determine the energy band gap of a semiconductor diode (Ge) using Four Probe Method.
16. To study the wavelength of He-Ne Laser.

Course Code : PCAL MA102
Course Title : Universal Human Values-II
L-T-P/S=Credits : 2-0-0 =2
Course Category : Mandatory Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :

Detailed Syllabus

Unit I
1. What is Value Education? 2. Knowledge and Skill 3. Value and Virtue 4. Moral Agency and the Notion of Dharma 5. Freedom of Will and Determinism **(14 hours)**

Unit II
6. Understanding Human Existence: Human Being and Human Person 7. The Basic Human Aspirations: Continuous Happiness and Prosperity 8. Understanding harmony at the level of Individual, Family and Society **(13 hours)**

Unit III
9. Understanding harmony at the level of Nature 10. Cardinal Human Virtues such as Compassion, Wisdom, Justice, Tolerance, Nonviolence, Service to Humanity with the help of suitable illustrations **(13 hours)**

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Das, Gurucharan (1990), The Difficulty of Being Good (Chapter 3), New Delhi: Penguin Books.	1990
2	Frankfurt, Herry G. (1971). Freedom of the Will and the Concept of a Person. The Journal of Philosophy, 68 (1): 5 – 20.	1971
3	Gaur, R.R. et. al. (2006), A Foundation Course in Human Values and Professional Ethics. New Delhi: Excel Books.	2006

Course Outcome

Sr	Course Outcome	CO
1	Understand the relevance of human values and peaceful co-existence	CO1
2	Widen their perspectives in moral decision making	CO2
3	Develop right understanding with respect to the basic aspirations of human life	CO3
4	Gain holistic understanding of the interrelatedness of individual, family, society and nature	CO4
5	Enhance clarity, assurance & purposefulness of life	CO5

Course Code	**: CSP ES101**
Course Title	**: 'C' Programming Lab**
L-T-P/S=Credits	**: 0-0-2 =1**
Course Category	**: ESC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

List of Experiments

1. Write a program to know the number of bytes of data type contains
2. Write a program to display the ASCII code of a variable on the screen
3. Write a program to find the sum of digits of a 4 digit number
4. Write a program to reverse a 4 digit number
5. Write a program to swap the values of two variables with/without using third variable 6. Write a program to display if a number is even or odd
7. Write a program to display that a person is eligible for voting
8. Write a program to display greatest among two/ three numbers
9. Write a program to read number between 1-7 & display corresponding day of week
10. Write a program to read marks of five subjects and compute percentage and display grade of 8 students based on percentage
11. Write a program to check whether the year entered is leap year or not
12. Write a program to print the relation between 2 numbers as equal to, less than or greater than
13. Write a program to read lower case character and display it in upper case
14. Write a program to convert Celsius into Fahrenheit
15. Write a program to swap the values to two variables with the help of temporary variable
16. Write a program to make a calculator
17. Write a program to print 1 to 10 in ascending and descending order on screen
18. Write a program to print sum of all even/ odd numbers between 1 to n
19. Write a program to print multiplication table of n
20. Write a program to find factorial of a number
21. Write a program to find sum of all numbers between m to n
22. Write a program to read a number and print each digit on separate line
23. Write a program to find the sum of digits of a number
24. Write a program to reverse a number
25. Write a program to find if the number is Palindrome or not
26. Write a program to read +ve numbers from user till user enters 0 & display for each number whether it is even or odd
27. Write a program to read character from user till user enters special character and display count of vowels and digits
28. Write a program to print all leap years between year m to n
29. Write a program to read a number and find if it is an Armstrong number or not
30. Write a program to print all prime number between n to m
31. Write a program using switch case to read one number and perform 1. Sum of digit 2. Reverse of number 3. Number is palindrome or not
32. Write a program using switch case to read operator and perform (+, -, /, *) operators of operands
33. Write a program to sort an array of type integer
34. Write a program to reverse an array element in the array
35. Write a program to check if the array is palindrome or not
36. Write a program to insert an element in sorted array at its right place
37. Write a program to delete all the duplicate numbers from the array
38. Write a program to read temperature recorded for the month of September. Display the highest and lowest temperature recorded

39. Write a program to read total marks of 90 students. Find the average marks scored by the class. Display the number of students having marks below average and total number of students marks equal to or above average.
40. Write a program to read n numbers in an array. Display the count of total –ve numbers, +ve numbers and total zero. Your program must derive m which should be added to all –ve numbers so as they are converted to either zero or +ve number.
41. Write a program to sum the two arrays into another array.
42. Write a program to add two matrix using multi-dimensional arrays
43. Write a program to multiply to matrix using multi-dimensional arrays
44. Write a program to find transpose of a matrix
45. Write a program to find the length of a string
46. Write a program to find the total number of vowels in the string
47. Write a program to find the number of vowels, consonants, digits and white space in string using Switch - case
48. Write a program to concatenate two strings
49. Write a program to find the total number of words in a sentence
50. Write a program to reverse a sentence
51. Write a program to remove all characters in a string except alphabet
52. Write a program to sort elements in different orders in string
53. Write a program to insert a character in a string
54. Write a program to delete a character in a string
55. Write a program to insert a word in a string
56. Write a program to search a word in a string
57. Write a program to delete a word in a string
58. Write a program to find the length of each string in a 2-dimensional array
59. Write a program to find sort each string in a 2-dimensional array
60. Write a program to display prime numbers between intervals using function
61. Write a program to check prime or Armstrong number using user-defined function 62. Write a program to check whether a number can be expressed as sum of two prime numbers using function
63. Write a program to find the sum of n natural numbers using function
64. Write a program to calculate factorial of a number using function
65. Write a program to reverse a sentence using function
66. Write a program to calculate power of a number using function
67. Write a program to convert binary number to decimal and vice-versa using function 68. Write a program to store information (name, roll and marks) of student using structure
69. Write a program to add two distances (in inch-feet) system using structure
70. Write a program to add two complex numbers by passing structure to a function
71. Write a program to calculate between two time period using structures and functions
72. Write a program to store information of 10 students using structure and display the roll no, name and total marks of each student structures and functions
73. Write a program to swap numbers of an array using call by reference
74. Write a program to find largest number in an array using function
75. Write a program to multiply two matrices by passing matrix to function

Course Code	**: MEL SE101**
Course Title	**: Engineering Workshop**
L-T-P/S=Credits	**: 1-0-2 =2**
Course Category	**: SEC-1**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

List of Experiments

Course Outcomes

CO1 Study and practice on machine tools and their applications so that students should know and operate the machine tools and perform various processes in welding, sheet metal, smithy and machines shop.

CO2 Students should understand the functioning and applications ofcutting tools, machines, processes ; like fabrication of joints using arc welding, seam joints, forging and taper turning

CO3 Students should document the job performed, safety precautions observed while performing experiment on different machine tools.

CO4 Students should perform the jobs, safety precautions taken while performing the experiments using various tools/ machine tools.

Carpentry shop:Tools and Equipment, Making of Various Joints, Pattern Making. **Foundry Shop**: Tools and Equipments, Preparation of Moulds of Simple Objects Using Single Piece, Two Piece and Match Plate Patterns.

Fitting Shop:Tools And Equipments, Practice in Chipping, Filing and Drilling, Making of V, Dovetail and Square Joints of M.S Flat.

Welding Shop:Tools and Equipments, Making of Various Joints Using Gas Welding and Arc Welding (MIG Welding) ,Bead Formation in Horizontal, Vertical and Overhead Positions, Brazing and Soldering Operations.

Sheet Metal Shop:Tools and Equipments, Making Tray, Cone, etc. with GI Sheet Metal Machine Shop:Introduction to Various Lathe Operations and Practice on Milling, Drilling Machines, etc.

Reference Books:

1. Raghuvanshi, B. S. - Workshop Technology–Vol 1, Dhanpat Rai & Sons, New Delhi. 2. Gupta, R. B. - Production Technology, Satyaprakashan, New Delhi.
3. Swarn Singh - Workshop Practice, Kataria& Sons, New Delhi.
4.Upadhyay, R. – Manufacturing Practice, Kataria& Sons, New Delhi.
5. Narayana, K L Kannaiah P. - Manual on Workshop Practice, Scitech Publishers, Chennai

Course Code	**: ECP ESXX**
Course Title	**: Digital Electronics Lab**
L-T-P/S=Credits	**: 0-0-2 =1**
Course Category	**: ESC-3**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

List of Experiments

1. Study of PIN diagram of various ICs & to test the logic gates and verify their truth table.
2. Implementation of Half adder, Full adder & Half subtracter using NAND gates only.
3. Implementation of Boolean functions of three and four variables using 74153 (4:1) Mux.
4. Implementation of De-multiplexer, decoder and encoder.
5. To add two 4 bit binary numbers using 7483.
6. To compare two 4 bit binary number using 7485 (magnitude comparator).
7. To verify the operation of different modes of shift Register using 7495.
8. To design an asynchronous counter of any modulus using JK FF's (7473).
9. To design a synchronous counter of any arbitrary count using 7473.
10. Design of BCD to seven-segment display using logical gates ICs.
11. To study and verification by truth tables of SR, JK, MSJK, D & T flip flops.
12. To design and test non-sequential counter and study of shift registers.

Course Code	**: EEP DC201**
Course Title	**: Electrical Machine-I Lab**
L-T-P/S=Credits	**: 0-0-2 =1**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

List of Experiments

1. To perform open-circuit and short-circuit test on a single-phase transformer and also find out its efficiency.
2. To find the polarity of Primary and secondary windings.
3. To measure voltage ratio of Primary and secondary windings.
4. To plot the magnetisation characteristics of a separately excited DC generator running at rated speed.
5. To study the speed control of DC motor below the normal range by armature resistance control and to plot speed Vs armature voltage characteristics.
6. To study speed control of DC motor above the normal range by field control and to plot speed Vs field current characteristics.
7. To obtain the performance characteristics of a DC series motor by a load test
   a. Armature current Vs Speed
   b. Armature current Vs Torque
   c. Torque Vs Speed
8. To study DC motor starter (DC Three-point starter).
9. To study DC Machine.
10. To perform parallel operation on two single-phase transformers.
11. To study voltage relationship of three phase transformer in various connections.
12. To perform Scott-connection on two single-phase transformer for three-phase-two-phase conversion.
13. To perform Sumpner's (Back to back test) on Single phase transformer to calculate losses and efficiency.

Course Code	**: EEP DC202**
Course Title	**: Electrical Machine-II Lab**
L-T-P/S=Credits	**: 0-0-2 =1**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

List of Experiments

1.Speed control of Three-phase Induction Motor by changing number of Stator Poles.

2.To perform No-Load test and Blocked-rotor test on Three-phase Induction Motor.

3.To study starting methods of Induction motor.

4.To perform load test on the three-phase Squirrel cage Induction motor and plot the following characteristics:

a. Efficiency Vs Output power
b. Torque Vs Output Power
c. Load current Vs Output power
d. Power factor Vs Output power
e. Torque Vs Speed

5.To perform load test on three-phase Slip ring Induction Motor.

6.To-perform load test on single-phase Split-phase type Induction motor and plot the following characteristics

a. Efficiency Vs Output power
b. Torque Vs Output Power
c. Load current Vs Output power
d. Power factor Vs Output power
e. Torque Vs Speed

7.Open-circuit test and short-circuit test of three-phase alternator for voltage regulation by using synchronous impedance method.

8.To obtain V-curves and inverter-V curves of a synchronous motor.

Course Code	**: EEP DC102**
Course Title	**: Electrical Measurement and Instrumentation Lab**
L-T-P/S=Credits	**: 0-0-2 =1**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

List of Experiments

Note: Minimum ten experiments are to be performed from the following list:

1.Hay's Bridge:

A. Determination of unknown inductance and Q factor using Hay's Bridge method.

2. De Sauty's & Schering Bridge:

A. Determination of unknown capacitance using De Sauty's Bridge method.
B. Determination of unknown capacitance using De Schering Bridge method.

3.Maxwell's Bridge:

A. To determine unknown Inductance using Maxwell's Inductance Bridge.
B. To determine unknown Inductance and Q-factor using Maxwell's Inductance-capacitance Bridge.

4.Kelvin Bridge:

A. To determine the value of unknown resistance using Kelvin Bridge.

5.Wein Bridge:

A. Determination and verification of input frequency by Wein Bridge.
B. Study of the Wein Bridge Oscillator and visualize effect on output frequency with variation in RC combination.

6.LVDT:

A. Study of Input-Output characteristics of LVDT.
B. Determination of linear range of operation of LVDT.
C. Determination of sensitivity of LVDT.
D. Measurement of phase difference between LVDT Secondaries.

7.LDR :

A. Study and plot the characteristics of Light Dependent Resistor (LDR).

8.Temperature Transducers:

A. Characteristics of IC Temperature Sensor.
B. Characteristics of Platinum RTD.
C. Characteristics of NTC Thermistor.
D. Characteristics of NTC Bridge circuit.
E. Characteristics of K-type Thermocouple.
F. Temperature controlled Alarm System (NTC).
G. Temperature controlled Alarm System (Bridge NTC).

9.Energy Meter:

A. Calibration of Energy Meter using Wattmeter.
B. Calibration of Energy Meter using external Wattmeter.
C. Calibration of Energy Meter using Volt/Amp meter.
D. Calibration of Energy Meter using external Volt/Amp meter.
E. Wrong calibration of Energy Meter using Wattmeter or Volt/Amp meter.

14. Calibration of Voltmeter & Ammeter:

A. Calibration of Voltmeter using DC potentiometer.
B. Calibration of Ammeter using DC potentiometer.
C. Calibration of Voltmeter using Crompton DC potentiometer.
D. Calibration of Ammeter using Crompton DC potentiometer.

10.Measurement of Power using Three Voltmeter and Three Ammeter:

A. To calculate the Power and Power factor in a Single-phase circuit using Three Volmeters.
B. To calculate the Power and Power factor in a Single-phase circuit using Three Ammeters.

11.Measurement of Power by using CT & PT:

A. To measure high value of AC current by a low range of AC Ammeter and Current Transformer.
B. To measure high value of AC voltage by a low range of AC Voltmeter and Potential Transformer.
C. To measure power using CT and PT.

12.Measurement of Power using Two Wattmeter Method:

A. Study of three phase circuit parameters.
B. Measurement of the power in a three phase AC circuit by two Wattmeter method using Resistive (R) load only.
C. Measurement of the power in a three phase AC circuit by two Wattmeter method using Resistive and Inductive (R-L) load.

Course Code	**: EEP DC305**
Course Title	**: Power Electronics Lab**
L-T-P/S=Credits	**: 0-0-2 =1**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**: MATLAB**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

List of Experiments

1. To study the V-I characteristics of SCR.
2. To study the V-I characteristics of UJT.
3. To study the V-I characteristics of MOSFET.
4. To study the V-I characteristics of IGBT.
5. To study the V-I characteristics of DIAC.
6. To study the V-I characteristics of TRIAC.
7. To study the V-I characteristics of PUT.
8. To study the class B commutation circuit.
9. To study the class C commutation circuit.
10. To study the class D commutation circuit.
11. To study the class F commutation circuit.
12. Study of R triggering circuit.
13. Study of RC (half-wave) triggering circuit.
14. Study of RC (full-wave) triggering circuit.
15. Study of the SCR triggered by UJT.
16. Study of the SCR triggered by 555IC.
17. Study of the SCR triggered by Op-Amp 741C.
18. Study of the UJT relaxation oscillator.
19. To study the ramp and pedestal triggering circuit with anti-parallel SCR in AC load.
20. To study the voltage commutated chopper.
21. To study the Bedford inverter.
22. Study of the single-phase PWM inverter using MOSFET and IGBT.
23. To study the half-wave controlled rectifier with R and RL load.
24. To study the full-wave controlled mid-point rectifier with R and RL load.
25. To study the fully controlled Bridge rectifier with R and RL load.

Course Code	**: EEP DC303**
Course Title	**: Power System Lab**
L-T-P/S=Credits	**: 0-0-2 =1**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**: MATLAB**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

List of Experiments

Note: Minimum ten experiments are to be performed from the following list:

1. Calculate the parameters of single phase transmission line.
2.. Calculate the parameters of three phase single circuit transmission line.
3. Calculate the parameters of three phase double circuit transmission line.
4. Determine the ABCD constant for transmission line.
5. Simulate the Ferranti effect in transmission line.
6. Calculate the corona loss of transmission line.
7. Calculation of sag & tension of transmission line.
8. Calculation of string efficiency of insulator of transmission line.
9. Calculation for grading of underground cables.
10. Simulate the skin effect in the transmission line.
11. Calculation of ground clearance of transmission line.
12. Calculate the parameters for underground cable.

Course Code	**: EEP DC302**
Course Title	**: Power System-II Lab**
L-T-P/S=Credits	**: 0-0-2 =1**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**: MATLAB**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

List of Experiments

Note: Minimum ten experiments are to be performed from the following list:

1. To perform Symmetrical fault analysis.
2. To perform Unsymmetrical fault analysis.
3. To understand Formation of bus admittance matrix.
4. To solve Gauss Seidel power flow analysis.
5. To solve Newton-Raphson power flow analysis.
6. To solve Fast decoupled load flow analysis.
7. To study Stability analysis of power system using continuation power flow.
8. To perform an experiment for determination of power angle curve.
9. Write a Program for swing curve when the fault is cleared.
10. To study Swing curve for sustained fault and critical clearing angle & time.
11. Study of Automatic Generation Control using Simulink model.

Course Code	**: EEE DE 407**
Course Title	**: ELECTRIC VEHICLES**
L-T-P/S=Credits	**: 3-1-0 =4**
Course Category	**: DEC**
Pre-requisite Courses (if any)	**: Electrical Machines**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

UNIT - I

INTRODUCTION TO VEHICLES

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, Mathematical models to describe vehicle performance

UNIT II

ELECTRIC VEHICLES

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and limitations of electric vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Resistance, Transmission efficiency, Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refueling Systems.

UNIT III

ENERGY SOURCES

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.

UNIT IV

MOTORS AND DRIVES

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics. Power Converters – rectifiers, inverters and converters.

UNIT V

HYBRID VEHICLES AND HYBRIDIZATION

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

Text/ Reference Books:

TEXT BOOKS:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

REFERENCES:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

Course Outcomes:

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

1. Explain the basic concepts of Conventional, Electric, Hybrid EV and Autonomous Vehicles.
2. Compare various energy storage and EV charging systems.
3. Understand the different strategies related to energy storage systems.
4. Understand the models to describe hybrid vehicles and their performance.
5. Select drive systems and various communication protocols for EV.

Course Code	**: EEL DC 401**
Course Title	**: Switchgear and Protection**
L-T-P/S=Credits	**: 3-1-0 =4**
Course Category	**: DCC**
Pre-requisite Courses (if any)	**: Power System-I & II**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

UNIT – I CIRCUIT BREAKERS

Introduction to Fundamentals of Power system Protection, Restriking Phenomenon & Elementary principles of arc interruption, Arc interruption theories, Recovery, Restriking Voltage and Recovery voltages Average and Max. RRRV , Current Chopping, Resistance Switching, CB ratings and Specifications, Types of circuit breakers, Oil Circuit breakers, Air Blast Circuit Breakers, SF6 circuit breakers, Vacuum circuit breakers

UNIT- II ELECTROMAGNETIC & STATIC RELAYS:
Introduction to relays, Attracted armature type relay ,Balanced Beam relay, Induction Disc and Induction Cup relays, Relays Classification, Instantaneous DMT & IDMT Relays, Directional relays, Differential Relays, Percentage Differential Relays , Impedance relay, Reactance relay, Mho and Off-Set Mho relays, Static Relays

UNIT - III: GENERATOR & TRANSFORMER PROTECTION
Introduction , Protection of Alternators , Merz-Price circulating current scheme , Modified differential protection for alternators , Balanced earth-fault protection , Stator inter-turn protection , Protection of transformers , Percentage Differential Protection , Buchholtz relay Protection

UNIT-IV: FEEDER AND BUS-BAR PROTECTION & GROUNDING:
Introduction , Differential protection , Time-graded overcurrent protection , Differential pilot-wire protection , Translay Relay , Three-zone distance relay protection using Impedance relays,. Carrier Current Protection of Lines , Phase-Comparison Carrier Protection , Protection of Bus bars , Differential protection of Busbar , Voltage Differential Protection Relay , Grounding & its Types , System Grounding , Neutral Grounding , Solid Grounding , Resistance Grounding , Reactance Grounding , Peterson coil Grounding , Voltage Transformer Earthing

UNIT -V: PROTECTION AGAINST OVER VOLTAGES
Introduction , Generation of Over Voltages in Power Systems , Protection against Lightning over Voltages , Valve type Arrester , Zinc-Oxide Lighting Arresters , Insulation Coordination , Volt-Time Characteristics , BIL , Standard Impulse Test Wave , Lightning Arrester Types , Rod gap arrester , Horn gap arrester , Multi gap arrester: ,. Expulsion type lightning arrester , Valve type lightning arrester

Text Books

1. Sunil S Rao , "Switchgear Protection and Power Systems" , Khanna Publishers, 1st edition, 2002

2. Badari Ram, D N Viswakarma, "Power System Protection and Switchgear" , TMH Publications, 2nd edition, 2014

Reference Books

1. Paithankar and S.R.Bhide, "Fundamentals of Power system protection" , Prentice Hall of India Pvt. Ltd., 2nd edition, 2003

2. Ravindranth. B and Chander, "Power System Protection and Switch Gear", New Age International (P) Ltd., 2nd edition, 2014.

3. Ravindra P. Singh, "Switch Gear and Power system Protection", Prentice Hall of India Pvt. Ltd., 2nd edition, 2014 4. J.B.Gupta, "Switchgear and Protection" , S.Chand publications, 2nd edition, 2013

Web Links

1. https://nptel.ac.in/courses/108101039

2. https://nptel.ac.in/courses/108107167

Course Outcomes

CO1 Understand the operation of switchgear equipment and Protective relays and the grounding practices

CO2 Apply electromagnetic principles in switchgear equipment and in protective relays. (L3) CO3 Apply protective relays for Protection of electrical equipment and grounding practices for Protection against Over Voltages.

CO4 Analyze switchgear equipment, protective relays and protection of various electrical equipment.

CO5 Examine various grounding practices and Protection against Over Voltages in the power system.

CO6 Ability to understand the concepts of switchgear devices, protective relays, protection of power system components, various grounding practices, Protection against Over Voltages and submit a report.

Course Code	**: EEE DE 306**
Course Title	**: Power system operation and control**
L-T-P/S=Credits	**: 3-1-0 =4**
Course Category	**: DEC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

UNIT – I: LOAD FREQUENCY CONTROL:

Basics of speed governing mechanism and modeling – speed - load characteristics – load sharing between two synchronous machines in parallel. Control area concept. Load Frequency Control of a single area system. Static and dynamic analysis of uncontrolled and controlled cases. Integration of economic dispatch control with LFC. Two - area system – modeling - static analysis of uncontrolled case - tie line with frequency bias control of two-area system - state variable model.

UNIT– II: REACTIVE POWER VOLTAGE CONTROL:

Basics of reactive power control, Excitation systems – modelling. Static and dynamic analysis: stability compensation generation and absorption of reactive power. Methods of voltage control – tap changing transformer. System level control using generator voltage magnitude setting. Tap setting of OLTC transformer. MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

UNIT – III: ECONOMIC OPERATION OF POWER SYSTEMS:

Statement of economic dispatch problem – cost of generation-Incremental cost curve - co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. Economic Aspects of Power Generation: Load curve, load duration and integrated load duration curves – load demand, diversity, capacity, utilization and plant use factors - NumericalProblems.

UNIT – IV UNIT COMMITMENT:

Statement of Unit Commitment problem – constraints, spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints. Solution methods – Priority list methods - forward dynamic programming approach. Numerical problems on priority-list method using full- load average production cost and Forward DP method.

UNIT–V COMPUTER CONTROL OF POWER SYSTEMS:

Need for computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions – SCADA and EMS functions.

TEXT BOOKS:

1. D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.

2. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Ltd, New Delhi, 30th reprint,2007.

REFERENCE BOOKS:

1. Chakrabarti & Haldar, "Power System Analysis: Operation and Control", Prentice Hall of India, 2004 Edition.

2. C.L.Wadhwa, 'Power System Analysis', New Age International- 6th Edition, 2010,

3. Robert Miller, James Malinowski, 'Power System Operation', Tata McGraw Hill Publishing Company Ltd, New Delhi, 3E, JUN-09.

4. P. Kundur, Neal J. Balu, 'Power System Stability & Control', IEEE, 1998.

5. Power System Analysis by Hadi Saadat – TMH Edition.

COURSE OUTCOMES:

1. Know importance of frequency and real power control.
2. Know the reactive power control methods and importance of reactive power.
3. Compare unit commitment and economic dispatch and their importance.
4. Understand real time control of power systems.

Course Code	**: EEE DE 417**
Course Title	**: High Voltage Engineering**
L-T-P/S=Credits	**: 3-1-0 =4**
Course Category	**: DEC**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS

Causes of over voltages and its efects on power system – Lightning, switching surges and temporary over voltages, Corona and its efects – Bewley latice diagram- Protection against over voltages.

UNIT II DIELECTRIC BREAKDOWN

Properties of Dielectric materials – Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics- Aplications of insulating materials in electrical equipments.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS

Generation of High DC voltage: Rectifers, voltage multipliers, vandigraf generator: generation of high impulse voltage: single and multistage Marx circuits – generation of high AC voltages: cascaded transformers, resonant transformer and tesla coil- generation of switching surges – generation of impulse curents – Trigering and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters – Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps – High curent shunts- Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION

High voltage testing of electrical power aparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Cordination& testing of cabiltys.

Text Book

1 High Voltage Engineering M.S. Naidu, V.Kamaraju McGraw Hill 5th Edition, 2013.

Reference Books

1 High Voltage Engineering Fundamentals E. Kuffel, W.S. Zaengl, J. Kuffel Newnes 2nd Edition, 2000

2 High Voltage Engineering Wadhwa C.L. New Age International 3rd Edition, 2012

3 High-Voltage Test and Measuring Techniques Wolfgang Hauschild Eberhard Lemke Springer 1st Edition2014

4 High Voltage Engineering Farouk A.M. Rizk CRC Press 1st Edition2014

5 Fundamental of High Voltage Engineering Ravindra Arora, Bharat Singh Rajpurohit Wiley 2019

Course Outcomes:

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

- Explain conduction and breakdown phenomenon in gases, liquid dielectrics and breakdown phenomenon in solid dielectrics.
- Summarize generation of high voltages and currents
- Outline measurement techniques for high voltages and currents.
- Summarize overvoltage phenomenon and insulation coordination in electric power systems.
- Explain non-destructive testing of materials and electric apparatus, high-voltage testing of electric apparatu

Course code : EEE DE304
Course Title : ADVANCED CONTROL SYSTEMS
L-T-P/S=credits : 3-1-0=4
Course category :Department Elective

Detailed Syllabus

Module 1
State Space Representation of Systems
Introduction to state space and state model concepts- State equation of linear continuous time
systems, matrix representation- features- Examples of electrical circuits and dc servomotors.
Phase variable forms of state representation- Diagonal Canonical forms- Similarity transformations to diagonal canonical form.

Module 2
State Space Analysis
State transition matrix- Properties of state transition matrix- Computation of state transition matrix using Laplace transform and Cayley Hamilton method.
Derivation of transfer functions from state equations.
Solution of time invariant systems: Solution of time response of autonomous systems and forced systems.
State space analysis of Discrete Time control systems: Phase variable form and Diagonal canonical form representations- Pulse transfer function from state matrix- Computation of State Transition Matrix (problems from 2nd order systems only).

Module 3
State Feedback Controller Design
Controllability & observability: Kalman's, Gilbert's and PBH tests.- Duality principle
State feedback controller design: State feed-back design via pole placement technique
State observers for LTI systems- types- Design of full order observer.

Module 4
Nonlinear Systems
Types and characteristics of nonlinear systems- Jump resonance, Limit cycles and Frequency Entrainment, Describing function method: Analysis through harmonic linearization- Determination of
describing function of nonlinearities.Application of describing function for stability analysis of autonomous system with single nonlinearity (relay, dead zone and saturation only).

Module 5
Phase Plane and Lyapunov Stability Analysis
Phase plots: Concepts- Singular points – Classification of singular points.
Definition of stability- asymptotic stability and instability.
Construction of phase trajectories using Isocline method for linear and nonlinear systems.
Lyapunov stability analysis: Lyapunov function- Lyapunov methods to stability of nonlinear systems- Lyapunov methods to LTI continuous time systems.

Text Books:
1. Nagarath I. J. and Gopal M., Control System Engineering, 5/e, New Age Publishers, 2007
2. Gopal M, Modern Control System Theory, 2/e, New Age Publishers, 1984
3. Kuo B.C, Analysis and Synthesis of Sampled Data Systems, Prentice Hall Publications, 2012.

Course Outcomes: After the completion of the course the student will be able to:
CO 1 Develop the state variable representation of physical systems
CO 2 Analyse the performance of linear and nonlinear systems using state variable approach
CO 3 Design state feedback controller for a given system and characteristics of nonlinear systems
CO 4 Apply the tools like describing function approach or phase plane approach for assessing the performance of nonlinear systems
CO Apply Lyapunov method for the stability analysis of physical systems

Course code : EEE DE314
Course Title : DIGITAL CONTROL SYSTEMS
L-T-P/S=credits : 3-1-0=4
Course category :Department Elective

Detailed Syllabus

Module 1
Basics of Digital Control
Basic digital control system- Mathematical modelling - sampling and reconstruction - Zero order and First order hold circuits - realisation of digital filters. Relation between transfer function and pulse transfer function - Mapping between s-domain and z-domain.

Module 2
Response Computation
Pulse transfer function of different configurations of systems- Modified z-transform- Time Response of discrete time system. Order and Type of a system Steady state error and Static error constants.

Module 3
Design of controller/Compensator in frequency domain
Bilinear transformation and sketching of frequency response - Digital P/PI/PID controller design based on frequency response - Digital compensator based on frequency response. Introduction to design and simulation using MATLAB (for demo/ assignment only and not to be included for examination).

Module 4
Design of controller/Compensator based on time response
Design of lag, lead and lag-lead compensator using root locus - Design of controllers and compensators by the method of Ragazzini- Dead beat response and deadbeat controller design.

Module 5
Modern control approach to digital control
Introduction to state space - state space modelling of discrete time SISO system - Computation of solution of state equation and state transition matrix.
Controllability, observability and stabilizability of discrete time systems- Loss of controllability and observability due to sampling. Digital controller and observer design - state feedback – pole placement - full order observer - reduced order observer.

Text Book:
1. C. L. Philips, H. T. Nagle, Digital Control Systems, Prentice-Hall, Englewood Cliffs, New Jersey, 1995.
2. M. Gopal, Digital Control and State Variable Methods, Tata McGraw-Hill, 1997
3. Ogata K., Discrete-Time Control Systems, Pearson Education, Asia.
ELECTRICAL AND ELECTRONICS
References:
1. Benjamin C. Kuo, Digital Control Systems, 2/e, Saunders College Publishing, Philadelphia, 1992.
2. Constantine H. Houpis and Gary B. Lamont, Digital Control Systems Theory, Hardware Software, McGraw Hill Book Company, 1985.
3. Åström, Karl J., and Björn Wittenmark,. Computer-controlled systems: theory and design. Courier Corporation, 2013.

Course Outcomes : After the completion of the course the student will be able to:
CO 1 Describe the various control blocks and components of digital control systems.
CO 2 Analyse sampled data systems in z-domain.
CO 3 Design a digital controller/ compensator in frequency domain.
CO 4 Design a digital controller/ compensator in time domain.
CO 5 Apply state variable concepts to design controller for linear discrete time system

Course Code : EEP DC 206
Course Title : CONTROL SYSTEM Lab.
L-T-P/S=credits :0-0-2=1
Course category :DCC

Detailed Syllabus

List of Experiments:

Note: Minimum ten experiments are to be performed from following list:

1. To study the characteristics of DC Servo motor.

2. Determination of steady state error using Matlab.

3. To study step response of 2 nd order system.

4. To study the performance of various types of controllers used to control the temperature of an oven

5. To study the open loop system and its subsystems of a dc motor

6. To study the closed loop system and its subsystems of a dc motor

7. To study the bode plot of a plant

8. To study lag network design

9. To study lead network design

10. To study the effect of P, PD, PI , PID controller on a 2 nd order system.

11.To study AC position control system.

12.To study DC position control system.

Course code : EEE 5018
Course Title : Non Conventional Energy Resources
L-T-P/S=credits : 3-0-0=3
Course category : Department Elective

Detailed Syllabus

Module 1

Introduction to conventional energy sources,Limitations of conventional energy sources need & growth of alternate energy sources, basic schemes and applications of direct energy conversion.

Solar Energy: Photovoltaic effect, characteristics of photovoltaic cells, conversion efficiency, solar batteries and applications. Solar energy in India, solar collectors, solar furnaces & applications.

Module 2

MHD Generators: Basic Principles and Half effect, generator and motor effect, different types of MHD generators, conversion effectiveness. Practical MHD generators, applications and economic aspects

Module 3

Wind Energy: History of wind power, wind generators, theory of wind power, characteristics of suitable wind power sites, scope in India.

Module 4

Thermo-electric, Generators: Seeback effect, peltier effect, Thomson effect, thermoelectric convertors, brief description of the construction of thermoelectric generators, applications & economic aspects.

Fuel Cells: Principle of action, Gibbs free energy, general description of fuel cells, types, Construction, operational characteristics and applications.

Module 5

Miscellaneous Sources: Geothermal system, Characteristics of geomethermal resources, choice of generators, electric equipment and precautions. Low head hydro plants, definition of low head hydro power, choice of site and turbines. Tidal energy, idea of tidal energy, Tidal electric generator, limitations.

Text/Reference books:

1. Non conventional Energy Resources	D.S. Chauhan
2. Conventional energy sources	G.D. Rai
3. Non Conventional energy sources	B.H. Khan
4. Solar Energy Fundamentals and Applications	H.P. Garg and Jai Prakash

Course outcomes

1. Understand the different alternate energy sources and the process of direct energy conversion
2. Familiarize with solar energy technologies and their applications.
3. familiarize with wind energy technologies with their applications.
4. Understand other direct energy conversion systems like magneto hydrodynamic thermoelectric and fuel cells.
5. Familiarize with geothermal and tidal energy.

Course Code : **EEL DC205**
Course Title : **Electronic Devices & Circuits**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Department Core**
Pre-requisite Courses (if any) : **Engineering Physics, Mathematics, Electric Circuit Analysis**

Detailed Syllabus

Semiconductor Physics: Crystal structure and lattice vibrations, Energy bands and charge carriers in semiconductors, Semiconductor doping and carrier concentration, Carrier transport mechanisms: drift and diffusion.
Semiconductor Diodes: PN junction diode: operation and characteristics, Diode equivalent circuit models, Applications of diodes: rectifiers, clippers, and clamps, Zener diodes and voltage regulation.
Bipolar Junction Transistors (BJTs): BJT operation modes: active, cutoff, and saturation, BJT characteristics and parameters, BJT biasing techniques: fixed bias, emitter bias, and voltage-divider bias, Small-signal analysis and modeling of BJTs.
Field-Effect Transistors (FETs): MOSFET and JFET operation principles, MOSFET characteristics and parameters, MOSFET biasing and small-signal analysis, CMOS technology and digital logic circuits.
Amplifiers and Feedback: Single-stage and multistage amplifiers, Common emitter, common base, and common collector amplifier configurations, Amplifier frequency response and bandwidth, Feedback in electronic circuits: types and stability criteria.
Power Amplifiers and Oscillators: Class A, Class B, and Class AB power amplifier configurations, Power amplifier efficiency and distortion, Oscillator principles and feedback networks, Types of oscillators: LC, RC, and crystal oscillators.
Special Devices: Schottky barrier diodes, Varactor diodes, Power diodes, Tunnel diodes, Photodiodes, Solar cells, PNPN devices: Silicon Controlled Rectifier (SCR), Silicon Controlled Switch (SCS), Gate Turn-Off switch (GTO), Light Activated SCR, DIAC, TRIAC, Unijunction Transistor, Opto-isolators.
Advanced Topics in Electronic Devices and Circuits: Semiconductor memories: SRAM, DRAM, and flash memory, Introduction to electronic devices beyond silicon: MEMS, nanoelectronics, Emerging trends in electronic circuits: organic electronics, flexible electronics.

2 weeks for each of the above topics

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Prentice Hall	2006
2	2. Microelectronic Circuits, Adel S. Sedra and Kenneth C. Smith, Oxford University Press	2009
3	3. Fundamentals of Microelectronics, Behzad Razavi, Wiley	2017/2021
Reference Books		
1	Microelectric Circuits: Analysis and Design, Mohd Rashid, Cengage Learning	2011
2	4. Electronic Principles, Albert Malvino and David Bates, McGraw Hill	2015

Course Outcome

Sr	Course Outcome	CO
1	To provide students with a fundamental understanding of semiconductor physics and device characteristics.	CO1

2	To introduce students to various electronic components and their behavior in electronic circuits	CO2
3	2. To familiarize students with the analysis and design of electronic circuits using semiconductor devices.	CO3
4	3. To enable students to analyze, simulate, and troubleshoot electronic circuits.	CO4
5	4. To prepare students for advanced courses in electronics and related fields, as well as for careers in electronics engineering.	CO5

Course Code : **EEL DE316**
Course Title : **Digital Design with HDL**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Department Elective**
Pre-requisite Courses (if any) : **C programming, Electronic Devices & Circuits, Digital Electronics**

Detailed Syllabus

Introduction to Digital System Design: Overview of digital logic design principles, Number systems and codes, Introduction to Hardware Description Languages (HDL), Overview of digital system design flow.
Combinational Logic Design: Boolean algebra and logic gates, Combinational circuit analysis and synthesis, HDL modeling of combinational circuits, Synthesis and optimization techniques.
Sequential Logic Design: Flip-flops and registers, Sequential circuit analysis and synthesis, Finite State Machine (FSM) design using HDL, Timing constraints and synchronization techniques.
HDL Programming Basics: Introduction to VHDL and Verilog, Syntax and semantics of HDL, Behavioral, dataflow, and structural modeling in HDL, Writing testbenches for HDL simulation.
RTL Design and Synthesis: Register Transfer Level (RTL) design methodology, RTL coding guidelines and best practices, Synthesis of RTL designs using synthesis tools, Timing analysis and optimization.
Advance HDL Topics: Hierarchical design and modularization, Parameterized modules and generics in HDL, Designing reusable components and libraries, Introduction to SystemVerilog and advanced features.
Design Verification and FPGA Implementation: Verification methodologies: simulation, formal verification, and hardware emulation, Writing and running testbenches for HDL designs, Code coverage analysis and debugging techniques, Overview of Field-Programmable Gate Arrays (FPGAs), Synthesis and implementation of HDL designs on FPGAs, Design project using FPGA prototyping.

2 weeks for each of the above topics

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Digital Design with RTL Design, VHDL, and Verilog, Frank Vahid, Wiley	2010
2	2. Digital Design: Principles and Practices, John F. Wakerly, Pearson India	2018/2022
Reference Books		
1	3. FPGA Prototyping by VHDL Examples: Xilinx Spartan-6 Version, Pong P. Chu, Wiley	2007
2	4. Digital Systems Design Using VHDL, Charles H. Roth and Lizy Kurian John, Cengage Learning.	2012

Course Outcome

Sr	Course Outcome	CO
1	To provide students with a fundamental understanding of digital logic design principles.	CO1
2	2. To introduce students to Hardware Description Languages (HDL) for digital system modeling and synthesis.	CO2
3	3. To familiarize students with the design methodologies and tools used in digital	CO3

	system design.	
4	4. To enable students to design, simulate, and implement digital systems using HDL.	CO4
5	5. To prepare students for careers in digital system design, FPGA prototyping, and ASIC development.	CO5

Course Code : **EEL DE318**
Course Title : **Digital Signal Processing**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Department Elective**
Pre-requisite Courses (if any) : **Engineering Mathematics, Signal & Systems, MATLAB**

Detailed Syllabus

Introduction to Digital Signal Processing: Overview of digital signal processing and its applications, Discrete-time signals and systems: representation and classification, Sampling theorem and analog-to-digital conversion, Introduction to MATLAB/Python for signal processing.
Discrete Fourier Transform (DFT): Basics of Fourier analysis: continuous and discrete Fourier transforms, Properties of DFT and its relationship to the Fourier series, Fast Fourier Transform (FFT) algorithms and their implementations, Applications of DFT in signal analysis and spectral estimation.
Digital Filter Design: FIR (Finite Impulse Response) filter design techniques, Windowing methods: Hamming, Hanning, and Blackman windows, IIR (Infinite Impulse Response) filter design using Butterworth and Chebyshev methods, Filter design specifications and trade-offs.
Frequency Domain Analysis: Discrete-time Fourier transform (DTFT) and its properties, Relationship between DFT, DTFT, and Fourier transform, Spectral analysis of discrete-time signals, Power spectral density estimation.
Digital Signal Processing Applications: Speech and audio signal processing techniques, Image processing fundamentals: sampling, quantization, and filtering, Biomedical signal processing applications, Digital communication systems and signal processing.
Multirate Signal Processing: Downsampling and upsampling operations, Decimation and interpolation techniques, Polyphase representation of multirate systems, Applications of multirate signal processing in digital communication and audio systems.
Adaptive Signal Processing: Introduction to adaptive filtering, Least Mean Squares (LMS) adaptive filtering algorithm, Applications of adaptive filtering in noise cancellation and system identification, Performance analysis of adaptive filters.
Advanced Topics in Digital Signal Processing: Wavelet transform and its applications, Nonlinear signal processing techniques, Time-frequency analysis methods: Short-Time Fourier Transform (STFT), Wigner-Ville distribution, Emerging trends in DSP: machine learning for signal processing.

2 weeks for each of the above topics

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Digital Signal Processing: Principles, Algorithms, and Applications, John G. Proakis and Dimitris G. Manolakis, Pearson India	2007
2	2. Discrete-Time Signal Processing, Alan V. Oppenheim and Ronald W. Schafer, Pearson India	2009
Reference Books		
1	3. Digital Signal Processing: A Practical Approach, Emmanuel C. Ifeachor and Barrie W. Jervis, Pearson India	2001
2	4. Digital Signal Processing Using MATLAB, Vinay K. Ingle and John G. Proakis, Cengage Learning.	2011

Course Outcome

Sr	Course Outcome	CO
1	To introduce students to the fundamental principles of digital signal processing.	CO1
2	2. To familiarize students with discrete-time signals and systems analysis techniques.	CO2
3	3. To provide an understanding of digital filter design methods and their applications.	CO3
4	4. To enable students to analyze and process signals in both time and frequency domains.	CO4
5	5. To equip students with practical skills in implementing DSP algorithms using software tools and programming languages.	CO5

Course Code : **EEE DE320**
Course Title : **VLSI Technology**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Department Elective**
Pre-requisite Courses (if any) : **Electronic Devices & Circuits, Digital Electronics, Digital System Design with HDL**

Detailed Syllabus

Introduction to VLSI Design: Overview of VLSI technology and its applications, Evolution of integrated circuit technology, Moore's Law and scaling trends in VLSI, Introduction to the VLSI design flow and design automation tools.
Semiconductor Devices and Fabrication: Semiconductor physics fundamentals, CMOS technology and fabrication processes, MOS transistor operation and characteristics, Layout design rules and design for manufacturability (DFM) considerations.
Combinational Logic Design: Boolean algebra and logic gates, Combinational circuit design techniques, CMOS logic families: RTL, DTL, TTL, and CMOS, Power dissipation and delay analysis in combinational circuits.
Sequential Logic Design: Flip-flops and latches, Sequential circuit analysis and design, Finite State Machine (FSM) design using Mealy and Moore models, Timing constraints and clocking methodologies.
VLSI Design and Simulation: RTL design and behavioral synthesis, High-level synthesis (HLS) techniques, Design space exploration and optimization, Review of hardware description languages (HDLs) such as Verilog and VHD, SPICE simulation fundamentals, Transistor-level simulation techniques, Model parameter extraction for CMOS devices, Simulation of digital and analog circuits
VLSI Testing and Verification: Fault modeling and test pattern generation, Design for testability (DFT) techniques, Built-in self-test (BIST) and scan-based testing, Functional verification methodologies.
Advanced Topics in VLSI: Low-power design techniques, VLSI interconnect modeling and optimization, Emerging trends in VLSI technology (e.g., 3D integration, neuromorphic computing), Ethical considerations in VLSI design and intellectual property rights

2 weeks for each of the above topics

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	CMOS VLSI Design: A Circuits and Systems Perspective, Neil H. E. Weste and David Harris, Pearson	2010
2	Digital Integrated Circuits: A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolić, Prentice Hall	2003
Reference Books		
1	Introduction to VLSI Circuits and Systems, John P. Uyemura, Wiley	2002
2	VLSI Design, Deb. Das, Oxford University Press	2015

Course Outcome

Sr	Course Outcome	CO
1	To provide students with a fundamental understanding of VLSI design principles and	CO1

	methodologies	
2	To introduce students to the concepts of digital and analog integrated circuit design	CO2
3	To familiarize students with the various stages of the VLSI design flow, including design specification, synthesis, verification, and testing	CO3
4	To enable students to comprehend the challenges and constraints associated with VLSI design, such as power consumption, timing, and area optimization	CO4
5	To equip students with practical skills in using industry-standard VLSI design tools and simulation techniques	CO5

Course Code : **EEL DE411**
Course Title : **Embedded Systems**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Department Elective**
Pre-requisite Courses (if any) : **Electric Circuit Analysis, C programming, Microprocessors & Microcontrollers**

Detailed Syllabus

Introduction to Embedded Systems: Overview of embedded systems and their applications, Embedded system architecture and components, Embedded systems design challenges and constraints, Introduction to microcontrollers and development boards.
Embedded C Programming: Basics of C programming for embedded systems, Data types, operators, and control structures in C, Input/output (I/O) operations and memory management in embedded C, Interrupt handling and real-time programming concepts.
Microcontroller Architecture and Programming: Overview of microcontroller architecture, Programming microcontrollers using assembly language and embedded C, Peripheral interfacing techniques: GPIO, UART, SPI, I2C, Timers and counters for time-critical applications.
Real-Time Operating Systems (RTOS): Introduction to real-time operating systems, Characteristics and requirements of RTOS, Task scheduling algorithms: preemptive and non-preemptive scheduling, RTOS kernel architecture and services.
RTOS Programming and Applications: RTOS task creation, management, and synchronization, Inter-task communication mechanisms: queues, semaphores, mutexes, Case studies of RTOS-based embedded systems applications, Hands-on projects using RTOS on development boards.
Embedded System Design and Development: Embedded system design methodologies: top-down vs. bottom-up design, Hardware-software co-design considerations, Design constraints: power consumption, size, and cost optimization, Case studies of real-world embedded systems projects.
Embedded System Testing and Debugging: Techniques for testing embedded systems, Debugging tools and methodologies, Code optimization and performance tuning, Integration testing and system validation techniques.
Advanced Topics in Embedded Systems: Internet of Things (IoT) and embedded systems connectivity, Embedded systems security and reliability, Emerging trends in embedded systems technology.

2 weeks for each of the above topics

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Embedded Systems: Architecture, Programming, and Design, Raj Kamal, McGraw Hill	2003/2017
2	2. Embedded Systems: Real-Time Interfacing to the ARM Cortex-M Microcontroller, Jonathan W. Valvano, Createspace Publishing	2011
Reference Books		
1	3. Programming Embedded Systems: With C and GNU Development Tools, Michael Barr and Anthony Massa, O'Reilly publishing	2006

Course Outcome

Sr	Course Outcome	CO
1	To provide students with a comprehensive understanding of embedded systems architecture, components, and programming.	CO1
2	2. To introduce students to the design methodologies and development tools used in embedded systems development.	CO2
3	3. To familiarize students with real-time operating systems (RTOS) and their applications in embedded systems.	CO3
4	4. To enable students to design, implement, and test embedded systems projects using microcontrollers and development boards.	CO4
5	5. To prepare students for careers in embedded systems engineering and related fields through hands-on experience and practical projects.	CO5

Course Code : EEE DE423
Course Title : Electrical Energy Conservation and Auditing
L-T-P/S=Credits : 3-1-0 =4
Course Category : Department Elective

Detailed Syllabus

Unit I

Energy Scenario Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment: air pollution, climate change, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, Energy Conservation Act-2001 and its features.

Unit II

Basics of Energy and its various forms Electricity Basics, Electricity tariff, load management and maximum demand control, power factor, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Unit III

Energy Management & Audit Definition, energy audit, need, types of energy audit. Energy management (audit) approach- understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.

Unit IV

Energy Efficiency in Electrical Systems Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Unit V

Energy Efficiency in Industrial Systems Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types,

performance evaluation, efficient system operation, Cooling Tower: Types and performance evaluation, efficient system operation,

Energy Efficient Technologies in Electrical Systems Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Text/ Reference Books:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

Course Outcomes:

1. Understand the current energy scenario and importance of energy conservation.

2. Students are able to understand different terms related to energy.

3. Understand the concepts of energy management.

4. Understand the methods of improving energy efficiency in different electrical systems.

5. Understand the concepts of different energy efficient devices.

Course Code	**: EEE DE 305**
Course Title	**: Industrial Electrical Systems**
L-T-P/S=Credits	**: 3-1-0=4**
Course Category	**: DEC**
Pre-requisite Courses (if any)	**:Electricb system design, Electrical Machines**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Unit I: Illumination

Introduction, laws of illumination, polar curves, photometry. Artificial sources of light: Incandescent lamps, Arc lamps, discharge lamps. Basic principles of light control, Types and design of lighting, Street lighting, factory lighting and flood lighting.

Unit II: Industrial Systems

Industrial loads, different types of motors, starting of motors, Lightning Protection, methods of earthing, UPS System, Electrical Systems for the elevators, Battery banks, Selection of UPS and Battery Banks.

Unit III: Electric Heating and Welding

Electric Heating: Introduction, advantages, modes of heat transfer, different heating methods: resistance heating, arc heating, induction heating, dielectric heating, and infrared heating.

Electric Welding: Introduction, different welding processes: Electric arc welding, submerged arc welding, Tungsten-inert gas (TIG) welding, metal-inert gas (MIG) welding, electro-beam welding, ultrasonic welding, plasma arc welding, laser beam welding. Electrodes, welding of different metals.

Unit IV: Electric Drives

Introductions, types of drives, advantage and disadvantages, classifications of electric drives, types of loads, status of AC and DC drives, DC motor drives: starting, reversing, electric braking, speed control. AC motor drives: Three phase induction motor and synchronous motor, Electronic control of AC motor drives.

Unit V: Electric Traction Systems

Introduction, requirements of traction systems, Different traction System, Railway electrification process, comparison between AC and DC electrification system, Power supply in Electric traction systems, AC locomotive, tram-ways, trolley bus, Overhead equipments, Train movements and energy consumption.

Text/ Reference Books:

1. S.L. Uppal, "Electric Power", Khanna Publishers.
2. C.L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age International (P) Ltd.
3. E.O. Taylor, "Utilization of Electric Energy", Orient Longman (P) Ltd.
4. A.I. Starr, "Generation, Transmission and Utilization of Electric Power", ELBS. 5. R.K. Rajput, "Utilization of Electric Power", Laxmi Publication (P) Ltd.

Course Outcomes:

1. To understand the various methods of efficient utilization of electrical energy for different applications. 2. To understand the electrical lighting systems and their applications.

3. To get a comprehensive idea about the electrical supply systems for industrial customers. 4. To impart knowledge on effective utilization of electrical heating and welding processes. 5. To obtain a comprehensive idea about electrical drives and traction systems.

Course Code	**: EEE DE 413**
Course Title	**: HVDC Transmission Systems**
L-T-P/S=Credits	**: 3-1-0=**
Course Category	**: DEC**
Pre-requisite Courses (if any)	**:Power electronics and Power system**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

UNIT – I

Basic Concepts: Necessity of HVDC systems, Economics and Terminal equipment of HVDC transmission systems, Types of HVDC Links, Apparatus required for HVDC Systems, Comparison of AC and DC Transmission, Application of DC Transmission System, Planning and Modern trends in D.C. Transmission. Analysis of HVDC Converters: Choice of Converter Configuration, Analysis of Graetz circuit, Characteristics of 6 Pulse and 12 Pulse converters, Cases of two 3 phase converters in Y/Y mode – their performance.

UNIT – II

Converter and HVDC System Control: Principle of DC Link Control, Converters Control Characteristics, Firing angle control, Current and extinction angle control, Effect of source inductance on the system, Starting and stopping of DC link, Power Control. Reactive Power Control In HVDC: Introduction, Reactive Power Requirements in steady state, sources of reactive power- Static VAR Compensators, Reactive power control during transients.

UNIT – III

Power Flow Analysis in AC/DC Systems: Modelling of DC Links, DC Network, DC Converter, Controller Equations, Solution of DC load flow, P.U. System for DC quantities, solution of AC-DC Power flow-Simultaneous method-Sequential method.

UNIT - IV

Converter Faults and Protection: Converter faults, protection against over current and over voltage in converter station, surge arresters, smoothing reactors, DC breakers, Audible noise, space charge field, corona effects on DC lines, Radio interference.

UNIT – V

Harmonics: Generation of Harmonics, Characteristics harmonics, calculation of AC Harmonics, Non- Characteristics harmonics, adverse effects of harmonics, Calculation of voltage and Current harmonics, Effect of Pulse number on harmonics Filters: Types of AC filters, Design of Single tuned filters –Design of High pass filters.

TEXT BOOKS:

1. "K. R. Padiyar", HVDC Power Transmission Systems: Technology and system Interactions, New Age International (P) Limited, and Publishers, 1990.

2. "S K Kamakshaiah, V Kamaraju", HVDC Transmission, TMH Publishers, 2011

3. "S. Rao", EHVAC and HVDC Transmission Engineering and Practice, Khanna publications, 3

rd Edition 1999.

REFERENCE BOOKS:

1. "Jos Arrillaga", HVDC Transmission, The institution of electrical engineers, IEE power & energy series 29, 2nd edition 1998.

2. "E. W. Kimbark", Direct Current Transmission, John Wiley and Sons, volume 1, 1971.

3. "E. Uhlmann", Power Transmission by Direct Current, B. S. Publications, 2009

Course Outcomes: After completion of this course the student is able to

1.Compare EHV AC and HVDC system and to describe various types of DC links

2. Analyze Graetz circuit for rectifier and inverter mode of operation

3. Describe various methods for the control of HVDC systems and to perform power flow analysis in AC/DC systems

4. Describe various protection methods for HVDC systems and classify Harmonics and design different types of filters

Course Code	**:**
Course Title	**: MATLAB/Simulink**
L-T-P/S=Credits	**: 0-0-4=2**
Course Category	**: SEC-2**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

Lab experiments

1. MATLAB Environment & Built-in MATLAB Functions
2. Built-in MATLAB Functions
3. Using Built-in MATLAB Functions
4. Built-in MATLAB Functions
5. Manipulating MATLAB Matrices
6. Matrices
7. Plotting
8. Plotting & User Defined Functions
9. User Defined Functions & User Controlled Input and Outputs
10. User Controlled Input and Outputs Logical Functions
11. Functions
12. Repetition Structures & Matrix Algebra
13. Logical Functions
14. Matrix Algebra
15. Loops

Course Code	**:**
Course Title	**: Electric Wiring**
L-T-P/S=Credits	**: 2-0-0=2**
Course Category	**: SEC-2**
Pre-requisite Courses (if any)	**:**
Equal Course Code (if any)	**:**
Equivalent Course Code (if any)	**:**

UNIT 1

Types of wires, wiring system,Specifications of Different types of wiring materials, Accessories, Wiring tools, Wiring circuits, Domestic and industrial panel wiring,I.E. rules for wiring.

Layout for domestic Wiring, Load calculation, Cable selection, Earthing, Selection of switchgear, Overall Estimating and costing, Layout for domestic Wiring, Load calculation, Cable selection, Earthing, Selection of switchgear, Megger and earth tester.

UNIT 2

Transmission lines, Line supports, Factors governing height of pole, Conductor materials, size of conductor for overhead ,Transmission line: cross arms, pole brackets and clamps, guys and stays, conductors configuration spacing and clearances, span lengths, overhead line insulators, insulator materials lightning arrestors, erection of supports, setting of stays, Earthing of lines, Guarding of overhead lines, Clearances of conductor from ground, Spacing between supports conductors, I.E. rules pertaining to LV Transmission lines

UNIT 3

Describe Method of installation of service connection(1-phase and 3-phase), observing I.E. rules, Overhead distribution system, Materials and accessories required for the overhead distribution system,Types of service connections , Method of installation of service connection(1-phase and 3-phase), I.E. rules pertaining to overhead lines and service connection

UNIT 4

Underground distribution system.
Materials and accessories required for underground distribution system, Estimate for 440 V, 3-phase, 4 wires or 3 wires underground distribution system. I.E. rules pertaining to underground system and service.

Text Books:

1. Electrical wiring, Estimating and costing, by S.L. Uppal, 2011
2. Electrical wiring, Estimating and costing, by K.B. Bhatia.2008
3. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Edition, 2008.
4. Wadhwa, C.L.,"Electric Power Systems", 6th Edition, Wiley Eastern Limited,2018.

Course Outcomes

1. be well acquainted with the internal and external wiring estimates,
2. be well acquainted with the methods of designing of innovative wiring system,
3. be substantially prepared to learn about special techniques of estimations.

श्री माता वैष्णो देवी विश्वविद्यालय

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