Branch Specific Courses for Electrical and Electronics Engineering Department

Basic Electrical Engineering

EEEE 103 S1
ECEE 103 S1

	L	T	P	Credit
Scheme	3	0	2	04

MAGNETIC CIRCUIT AND ELECTROMAGNETIC INDUCTION (08 Hours)
Amperes circuital law, analogy between electric & magnetic circuits, fringing, leakage, series, parallel, series-parallel circuits, Faradays law, Lenz law, self-inductance, mutual inductance, coefficient of mutual inductance, coefficient of coupling, inductance in series, parallel, series-parallel, Analysis of coupled coils, dot rule, conductively coupled equivalent circuit.

SERIES AND PARALLEL AC CIRCUITS (06 Hours)
Complex algebra and its application to circuit analysis, R-L, R-C, R-L-C series and parallel circuits, series and parallel resonance.

ELECTRICAL NETWORKS ANALYSIS (10 Hours)
Kirchhoff's Voltage Law, Kirchhoff's Current Law, independent and dependent sources, Mesh current and Nodal Voltage analysis, Super position theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Maximum power transfer theorem

POLYPHASE CIRCUITS (06 Hours)
Balanced three phase systems, star and mesh connections, calculations for balanced and unbalanced three phase networks, polyphase vector diagram, and measurement of power in three phase circuits.

SINGLE PHASE TRANSFORMERS (04 Hours)
Principle of transformer, construction - shell type, core type, transformer on no-load, with load, phasor diagram for transformer under no-load and loaded condition (with unity, lagging power factor load) equivalent circuit, open circuit and short circuit test, losses in the transformer, efficiency, voltage regulation.

THREE-PHASE INDUCTION MOTORS (04 Hours)
Rotating magnetic field, types of induction motor, Principle of operation, slip, different power stages, efficiency of the induction motor.

ELECTRIC WIRING AND ILLUMINATION (04 Hours)
Circuits in domestic wiring, simple control circuit in domestic installation, Types of lamps, fixtures & reflectors, illumination schemes for domestic, industrial & commercial premises, Lumen requirements for different categories, working principle of tube light (fluorescent tube) , LED.

Total Lecture Hours: 42

List of Practical
1. Power measurement in single phase R-L series circuit.
2. Power measurement in single phase R-C series circuit.
3. To study the working principle of tube light and fan.
4. Hysteresis loop on CRO.
5. Study the different types of wiring in electrical engineering.
6. Determination of single phase transformer equivalent circuit parameters using open-circuit and short circuit test.
7. Load test on single phase transformer.
8. Three phase power measurement using two wattmeter method.
9. Star- delta connection of three phase circuit.

BOOKS RECOMMENDED:

1. V. N. Mittle and Arvind Mittal, "Basic Electrical Engineering", 2nd edition, Tata McGraw-Hill Education 2005.
2. Edminister Joseph A., "Electrical circuits", Schaum's outline series, McGraw hill, 2nd edition, 1983
3. B. L. Theraja and A. K. Theraja, "A text book of Electrical Technology: Volume I: Basic Electrical Engineering", S. Chand, 2013.
4. Kothari Nagrath, " Basic Electrical Engineering", 2nd edition, Tata McGraw-Hill Education 2007.
5. A. chakrabarti, M. L. Soni, P.V. Gupta, U. S. Bhatnagar, "Power System Engineering", Dhanpatrai & Co., Second edition, 2013.
6. A.Chakrabarti, " Circuit Theory", Dhanpat Rai & Co. , Sixth edition, 2012

Electronic Devices and Circuits

EEEC 114 S2
ECEC 114 S2

	L	T	P	Credit
Scheme	3	0	2	04

- **SEMICONDUCTOR DIODES AND APPLICATIONS** **(10 Hours)**
  Quantitative theory of pn diode, volt-ampere characteristics and its temperature dependence, narrow- base diode, transition and diffusion capacitance of p-n junction diodes, breakdown of junctions on reverse bias, small signal models of diode, PN diode Application as Rectifier, Half Wave Rectifier, Center Tap and Bridge Rectifier, Filter circuits, C, LC and pie filter with circuit Diagram and waveforms.
  Zener Diode theory, Construcion, Operation with forward and reverse VI characteristics, Zener Voltage Regulator, construction and application of Schottkey and Varactor Diodes.

- **BIPOLAR JUNCTION TRANSISTOR ANALYSIS AND DESIGN** **(08 Hours)**
  Introduction to BJT, IV characteristics, Analysis of CE Configuration: Current Amplification in the Transistor Circuits, Power Calculations, Bypass Capacitor, Coupling Capacitors, concept of AC and DC Load Lines, Different DC Biasing Methods, Fixed Bias, Emitter Stabilized Bias, Potential Divider Bias, DC Bias with voltage Feedback, Common Base Configuration Analysis, Emitter follower, Charge Storage and transient response, small signal models of BJT, Ebers-Moll Model of BJT.

- **FIELD EFFECT TRANSISTOR CIRCUITS** **(08 Hours)**
  Introduction to FET, Bias stability in FET, Different FET Configuration, Analysis of CS, CG and CD Configuration, Voltage Biasing Techniques, Common Source Amplifier, MOS capacitor, Depletion Mode and Inversion, MOSFET Operation and Enhancement Mode of MOSFET, Transfer Characteristics.

- **SMALL SIGNAL LOW FREQUENCY ANALYSIS AND DESIGN** **(08 Hours)**
  Hybrid Parameters, CE Configurations, CB Configurations, CS Configurations, CD Configuration, Impedance Reflections, Phase Splitter.

- **DEVICES USED FOR POWER ELECTRONICS** **(08 Hours)**
  Diac,UJT, SCR, Triac, Power MOSFET and IGBT,

(Total Lecture Hours: 42)

PRACTICALS

1. Diode Characteristic
2. Rectifiers and Filters
3. Zener as a voltage Regulator
4. BJT Characteristics
5. BJT Biasing Methods
6. FET Characteristics
7. FET Biasing Methods
8. MOSFET Inverter
9. Common Emitter Amplifier
10. Common Source Amplifier
11. SPICE Modeling of Diode, BJT and MOSFET
12. MINI - PROJECT

BOOKS RECOMMENDED

1. Schilling Donald L. and Belove E., "Electronics Circuits- Discrete and Integrated", McGraw-Hill, 3rd Ed., 1989, Reprint 2008
2. Boylestad Robert L. and Nashlesky Louis, "Electronics Device & Circuits Theory", PHI, 10th Ed., 2009
3. Millman Jacob, Halkias Christos C. and Parikh C., "Integrated Electronics", McGraw-Hill, 2nd Ed., 2009
4. D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, Chicago) 1997
5. J. Milman and A. Grabel, Microelectronics, McGraw Hill, International, 1987. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991

B. Tech. II year, Semester III

Electrical Circuits

L	T	P	Credit
4	1	0	05

EE 201 **Scheme**

1. Course Outcomes (Cos):

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

CO1	apply concept of graph theory for solution of AC and DC circuits.
CO2	develop a mathematical model (differential equations) of a given electric circuit and solve it using technique of domain transformation.
CO3	construct a given waveform by using set of standard functions.
CO4	calculate various parameters of two port network and inter relationship between them.
CO5	design filter circuits for given specifications.

2. Syllabus

- **GRAPH THEORY AND ITS APPLICATIONS** **(10 Hours)**
  Fundamental concepts, definitions of a graph and various related terms, cut sets and tie sets, matrices of oriented graphs, properties and inter relationships of incidence, tie set and cut set matrices, complete circuit analysis using tie set and cut set techniques
- **LAPLACE TRANSFORMATION** **(09 Hours)**
  Laplace transform properties and theorems, Laplace transform of standard functions, Laplace transforms for periodic functions, initial and final value theorems, Inverse Laplace transform using partial fraction expansion and convolution integral methods. Waveform synthesis.
- **NETWORK FUNCTIONS AND TWO PORT PARAMETERS** **(16Hours)**
  Poles and zeros of a function, physical and analytical concepts, terminals and terminal pairs, driving point immittances, transfer functions, restrictions on locations of poles and zeros in S-plane. time domain behavior from pole zero locations in the S plane, procedure for finding network functions for general two terminal pair network, transfer immittances, two port and N-port networks, Ladder, Lattice, Pie, and Tee networks. Definitions, calculations and interrelationships of impedance, admittance, hybrid, and transmission line parameters for two port networks and their interrelations
- **ONE TERMINAL PAIR NETWORKS** **(05 Hours)**
  Reactive networks and their properties, external and internal critical frequencies, separation property for reactive functions and its proof
- **TWO TERMINAL PAIR REACTIVE NETWORKS (FILTERS)** **(08Hours)**
  Ladder network and its decomposition into tee, pie, and L sections, image impedance, image transfer function and applications to LC networks, attenuation and phase shift in symmetrical Tee and Pie networks, constant K-filters, m-derived filters, composite filters, lattice filters, Bartlett's bisection theorem. Introduction to the active filters
- **AC AND DC TRANSIENTS** **(08 Hours)**
  Initial and final conditions of networks and their S-domain equivalent circuits , R-L, R-C and R-L-C DC transients, two mesh transients, R-L, R-C and R-L-C sinusoidal transient analysis using Laplace transform methods, two mesh AC transients, complete response of RL, RC and RLC circuits to step, sinusoidal, exponential, ramp, impulse and the combinations of these excitations.

Total Hours: 56

Tutorials will be conducted separately for 14 hours

3. Books Recommended:

1. W. H. Hayt, J. E. Kemmerly, and Durbin S. M., Engineering Circuit Analysis, Tata McGraw Hill, 6th Edition, 2006.
2. M.E. Van Valkenburg, Network Analysis, Prentice Hall, India, 3rd Edition, 2002.
3. A. Chakrabarti, Circuit Theory, Dhanpat Rai & Co., 6th Edition, 2012.
4. A. Edminister Joseph, Electrical circuits, Schaum's outline series, McGraw hill, 2nd Edition, 1983.
5. Charles K. Alaxander and Matthew N.O. Sadiku, Fundamentals of electric circuits, Tata McGraw Hill, 5th Edition, 2013.

B. Tech. II year, Semester III

L	T	P	Credit
3	1	2	05

Electrical Machines – I

EE203 **Scheme**

1. Course Outcomes (Cos):

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

CO1	explain the construction and principle of operation of the transformers and induction motors.
CO2	perform tests on the transformers and induction motors
CO3	analyze the performance of the transformers and induction motors
CO4	compare the performance of different types of transformers and induction motors
CO5	select the machines for different real world applications
CO6	communicate effectively through laboratory report writing, presentation and perform task as an efficient team member

2. Syllabus

- **TRANSFORMERS** **(06 Hours)**
  Review of equivalent circuits and vector diagram, circuit parameter determination, per unit impedance, regulation, losses, efficiency, magnetic inrush and effect of saturation, parallel operation.
- **POLYPHASE TRANSFORMERS** **(09 Hours)**
  Standard connections phase angle difference, harmonic analysis, open delta connection, Scott connections, three-phase to six-phase conversion, three winding transforms and parallel operation.
- **AUTO TRANSFORMERS** **(02 Hours)**
  Construction, voltage and current ratios, phasor diagram and equivalent circuit.
- **TESTS ON TRANSFORMERS** **(04 Hours)**
  OC- SC tests, Polarity test, Back to back Sumpner's test.
- **THREE-PHASE INDUCTION MOTORS** **(07 Hours)**
  Review of equivalent circuit and vector diagram, performance analysis, torque-speed characteristics, no load and blocked rotor tests, circle diagram.
- **STARTING, BRAKING AND SPEED CONTROL** **(07 Hours)**
  Double cage motors, starting problems, methods of starting, speed control methods, cascade connections, cogging and crawling, regenerative braking, plugging, ac and dc dynamic (rheostatic) braking.
- **INDUCTION GENERATORS AND REGULATOR** **(03 Hours)**
  Principle of operation, performance analysis, application.
- **SINGLE PHASE INDUCTION MOTORS** **(04 Hours)**
  Principle of operation, revolving field theory, cross field theory, equivalent circuit and performance analysis, determination of circuit parameters by no- load and blocked rotor test, starting methods, unbalanced operation of three phase induction motor.

Total Hours:42

Tutorials will be conducted separately for 14 hours

3. List of Experiments:

1. Determination of efficiency & regulation of single- phase transformer from Open circuit and short circuit test.
2. Determination of efficiency & regulation of single- phase transformer from Sumpner's test.
3. Scott connection of 1-phase transformers.
4. Open delta connection of three single-phase transformers.
5. Standard connections for three-phase transformer.
6. Load test on three-phase Induction Motor.
7. Load test on three-phase Induction Generator.
8. Determination of the equivalent circuit parameters from No-Load and Blocked rotor tests of three-phase Induction Motor.
9. Determination of the equivalent circuit parameters from No-Load and Blocked rotor tests of 1-phase Induction Motor.
10. Determination of the performance parameters of three-phase induction motor from circle diagram.
11. Induction regulator.
12. Unbalanced operation of three-phase Induction Motor.

4. Books Recommended:

1. I. J. Nagrath and D. P. Kothari, Electric Machines, Tata McGraw Hill, New Delhi, 2005.
2. M. G. Say, The performance and design of alternating current machines, CBS Publishers and Distributors, Delhi, 1983.
3. Fitzgerald, Kingsley and Umans, Electric Machinery, Tata McGraw Hill, New Delhi, 2003
4. S. K. Sen, Electrical Machinery, Khanna Pub., Delhi, 2012.
5. Mukherjee and Chakravorty, Electrical Machines, Dhanpat Rai Pub., New Delhi, 2005.

B. Tech. II year, Semester III

Digital Circuits

L	T	P	Credit
3	1	2	05

EC211 **Scheme**

1. Course Outcomes (Cos):

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

CO1	apply Boolean algebra to understand binary logic and logic circuits.
CO2	formulate combinational logic problems and solve using truth table. Optimize using K-map and other equivalent techniques
CO3	investigate and realize various options for implementing sequential synchronous logic
CO4	explain operation of synchronous sequential circuit, counters, registers and memory
CO5	formulate RTL (register transfer language) statements to describe complex digital hardware and derive or infer logic circuit from RTL Description
CO6	design and analyze circuits for ALU and Shifter. Design and investigate various Control unit architecture (Hardwired, Micro-program, PLA etc.) to control and sequence hardware operations

2. Syllabus:

- **BOOLEAN ALGEBRA AND SIMPLIFICATION** **(08 Hours)**
  Basic Logic Operation and Logic Gates, Truth Table, Basic Postulates and Fundamental Theorems of Boolean Algebra, Standard Representations of Logic Functions- SOP and POS Forms, Simplification of Switching Functions-K-Map and Quine-McCluskey Tabular Methods, Synthesis of Combinational Logic Circuits
- **COMBINATIONAL LOGIC CIRCUITS** **(08 Hours)**
  Binary Parallel Adder, BCD Adder, Encoder Priority Encoder, Decoder, Multiplexer and De-multiplexer Circuits, Implementation of Boolean Functions using Decoder and Multiplexer, Arithmetic and Logic Units, BCD-To-Segment Decoder, Common Anode and Common Cathode, 7-Segment Displays, Random Access Memory, Read Only Memory and Erasable Programmable ROMs, Programmable Logic Arrays(PLA) and Programmable Array Logic(PAL)
- **LATCHES AND FLIP-FLOPS** **(06 Hours)**
  Cross Coupled SR Flip-Flop Using NAND or NOR Gates, Clocked Flip-flops, D-Types and Toggle Flip-flops, Truth Tables and Excitation Tables for Flip-flop. Master Slave Configuration, Edge Triggered and Level Triggered Flip-flop, Flip-flop with Preset and Clear
- **SEQUENTIAL LOGIC CIRCUIT** **(06 Hours)**
  Introduction to State Machine, Mealy and Moore Model, State Machine Notation, State Diagram, State Table, Transition Table, Table Excitation, Table and Equation, Basic Concepts of Counters and Register, Shift Left and Right Register, Registers with Parallel Load, Serial-in-Parallel-Out(SIPO) and Parallel-In-Serial-Out(PISO), Register Using Different Types of Flip-flop, Binary Counters, BCD Counters, Up Down Counter, Johnson Counter, Module-N Counter, Design of Counter using State Diagrams and Tables, Sequence Generators
- **REGISTER TRANSFER LOGIC** **(04 Hours)**
  Arithmetic Logic and Shift Micro-Operation, Conditional Control Statements, Fixed-Point and Floating-Point Data, Arithmetic Shifts, Instruction code and Design of Simple Computer
- **PROCESSOR DATA PATH AND CONTROL UNIT** **(06 Hours)**
  Processor Organization, Design of Arithmetic Logic Unit (ALU), Design of Accumulator, Control Organization, Hard-Wired Control, Micro Program Control, Control of Processor Unit, PLA Control

- **INTRODUCTION TO VHDL** **(04 Hours)**
  Introduction, Gate-Level Modeling, Data Type, Operators, Operands, Process and Behavioral Modeling, Timing Controls, Structural modeling, Registers, Flip-flop, Counter, Multiplexer, Adder/Subtractors, Tri-State Buffers
- **TUTORIALS** **(14 Hours)**

Total Hours:42

Tutorials will be conducted separately for 14 hours

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3. List of Experiments:

(Following experiments are to be performed using discrete components)

1. Introduction to variety of logic gates and digital ICs
2. Flip-flops using NAND/ NOR Gate.
3. Half-Adder/ Half-subtarctor Circuits using a serial Input.
4. Full-Adder/ Full-subtarctor Circuits using a serial Input.
5. Parity checker and parity generator circuit
6. 4-Bit Gray to Binary, Binary to Gray Code convertor using Select input.

(Following experiments are to be performed on CPLD kit using VHDL)

7. Logic expression with the Help of MUX IC 74153.
8. (a) Modulo-7 Ripple Counter with synchronous reset.
   (b) 4-bit up/down ripper counter with asynchronous reset
9. 4-Bit Shift Left/Right Register.
10. Sequence Generator using LFSR method.
11. Excess-3 BCD Adder/ Subtractor with Select Input.

4. Books Recommended:

1. Mano Morris, Digital Logic and Computer Design, Pearson Education, 4th Edition, 2006.
2. Anand Kumar, Fundamentals of Digital Circuits, PHI, 4th Edition, 2016.
3. R. P. Jain and M. H. S. Anand, Digital Electronics Practices using Integrated Circuits, Tata McGraw Hill, 1st Edition, 2004.
4. Lee Samual, Digital Circuits and Logic Design, PHI, 1st Edition, 1998.
5. Floyed Thomas L. and R. P. Jain, Digital Fundamentals, Pearson Education, 8th Edition, 2006.
   Brown S. and Zvonko Vranesic, Fundamental of Logic with Verilog Design, Tata McGraw Hill, 1st Edition, 2003.

B. Tech. II year, Semester IV

Electrical Machines – II

L	T	P	Credit
3	1	2	05

EE204 **Scheme**

1. COURSE OUTCOMES (COs):

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

CO1	explain the construction and principle of operation of the DC machines and synchronous machines
CO2	perform tests on the DC machines and synchronous machines
CO3	analyze the performance of the DC machines and synchronous machines
CO4	compare the performance of different types of DC machines and synchronous machines
CO5	select the machines for different real world applications
CO6	communicate effectively through laboratory report writing, presentation and perform task as an efficient team member

2. SYLLABUS

- **DIRECT CURRENT MACHINES** **(09 Hours)**
  Construction, armature windings, simple lap and wave windings, armature reaction, demagnetizing and cross magnetizing ampere-turns, compensating winding, commutation, commutation time and type, reactance voltage, inter-poles, ampere-turns for inter-poles, self and separate excitations, shunt, series and compound motors and generators, magnetization characteristics, performance characteristics of DC generators and motors.

- **STARTING, SPEED CONTROL AND BRAKING OF DC MACHINES** **(06 Hours)**
  Starting problems, methods of starting, starters, methods of speed control, methods of braking.

- **TESTING OF DC MACHINES** **(05 Hours)**
  Swinburne's test, Hopkinson's test, separation of core losses, retardation test, series field test.

- **BRUSHLESS D.C. MACHINES** **(03 Hours)**
  Construction, equivalent circuit, performance analysis.

- **SYNCHRONOUS MACHINES**
  Construction, cylindrical and salient pole type, basic principles, armature windings, distributed winding, full pitched windings, chording, EMF equation, distribution and pitch factors, excitation system, **(04Hours)**
  armature reaction, synchronous machine impedance, SCR, equivalent circuit, phasor diagram, voltage regulations, synchronous impedance method, MMF method, ZPF method, operating characteristics **(05Hours)**
  'V' and inverted 'V' curves, power angle characteristics, power flow equation for salient and non-salient pole type synchronous machines, salient pole synchronous machine - two reaction model, phasor diagram, **(05 Hours)**
  power angle characteristic, hunting, damper winding, parallel operation of alternators, starting methods of synchronous motors, synchronous condenser, synduction machines **(05Hours)**

Total Hours: 42

Tutorials will be conducted separately for 14 hours

3. LIST OF EXPERIMENTS:

1. Speed control of dc shunt motor.
2. Swinburne's test
3. Speed torque characteristic of a D. C. Shunt motor.
4. D. C. Series motor, Speed -torque characteristic.
5. External & Internal characteristics of D. C. separately excited and Shunt generator.
6. Regulation of an alternator by synchronous impedance method
7. 'V' and 'inverted V' curves of a synchronous motor.
8. Regulation of an alternator by zero power factor method
9. Regulation of an alternator by MMF method.
10. Synchronization of an alternator with infinite bus bar.
11. Power factor improvement using synchronous motor.
12. Hopkinson's Test on DC machines.
13. Retardation Test on DC Shunt motor.
14. Separation of core losses of DC machines.

4. BOOKS RECOMMENDED:

1. Nagrath and Kothari, "Electric Machines", TMH, New Delhi, 2005.
2. M. G. Say, The performance and design of alternating current machines, CBS Publishers and Distributors, Delhi, 1983.
3. A. E. Clayton and N. M. Hancock, The Performance and Design of Direct Current Machines, CBS Publishers, 2004.
4. P. K. Mukherjee and S. Chakravorty, Electrical Machines, Dhanpat Rai Pub., New Delhi, 2005.
5. Fitzgerald, Kingsley and Umans, Electric Machinery, Tata McGraw Hill, New Delhi, 2003.

B. Tech. II year, Semester IV

Elements of Power Systems

L	T	P	Credit
3	1	2	05

EE206 **Scheme**

1. Course Outcomes (Cos):

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

CO1	classify and analyze the electrical power transmission and distribution.
CO2	compute the cost of power generation and the cost of electricity.
CO3	design the transmission line and analyze the performance of transmission lines.
CO4	analyze the performance of the underground cable.
CO5	Simulate/model the power system components in MATLAB/ETAP platforms and analyze the numerical results.

2. SYLLABUS:

- **SUPPLY SYSTEMS** **(04 Hours)**
  AC and DC power supply systems, comparison of ac and dc transmission, advantages of high transmission voltage, various systems of power supply, comparison of conductor materials in overhead system and underground cable system, economic choice of conductor size and economic choice of voltage.

- **D.C. AND A. C. DISTRIBUTION** **(06 Hours)**
  Types of dc distributors, dc distribution calculations, ac distributor, fed at one and fed at both the ends with concentrated loads and uniformly distributed loads, ring distributors with inter connectors, current distribution in three wire and four wire ac systems, overview of distribution automation.

- **ECONOMIC ASPECTS OF POWER SYSTEM** **(06 Hours)**
  Power factor improvement, Tariff structure, ABT, Economic aspects of power generation.

- **UNDERGROUND CABLES** **(05 Hours)**
  Underground cables, construction of cables, classification of cables, cables for three phase services, insulation resistance of a single core cable, capacitance of a single core cable, dielectric stresses in a single core cable, most economical conductor size in a cable, grading of cables, capacitance grading and inter-sheath grading, capacitance of three core cable and measurements of capacitances, dielectric loss and tan(δ) measurement.

- **CALCULATION OF LINE PARAMETERS** **(09 Hours)**
  Conductors, types of conductors in use, bundled conductor, spacing of conductors, symmetrical and unsymmetrical spacing, equivalent spacing, transposition, transmission line constants, calculation of resistance, inductance and capacitance for simple arrangements and multi-circuit lines, symmetrical and unsymmetrical spacing, concept of self GMD, mutual GMD and their uses in calculations of parameters of overhead lines, skin and proximity effects.

- **CHARACTERISTICS AND PERFORMANCE OF POWER TRANSMISSION LINES** **(12 Hours)**
  Short and medium transmission lines, Line performance, effect of capacitance, charging currents, short and medium lines, calculation by nominal-T, nominal-π and end-condenser method, regulation and efficiency, Concept of ABCD constants, the long transmission line- rigorous solution, evaluation of ABCD constants, interpretation of long line equation, surge impedance and surge impedance loading,

the equivalent circuit of a long transmission line, power flow through a transmission line, circle diagrams, Ferranti effect. Reactive power compensation, transmission line transients, concept of travelling waves, reflection and refraction coefficients.

Total hours: 42

Tutorials will be conducted separately for 14 hours

3. List of Experiments:

The experiments are based on the MATLAB/ETAP simulations of power system components and hardware experiments and a substation/power plant visit.

1. Demonstration visit of 66 kV/22 kV SVNIT sub-station.
2. Study of single line diagram of Power System.
3. Power factor improvement of load.
4. Performance calculation of short and medium transmission lines.
5. Performance calculation of long transmission lines.
6. String efficiency calculation of suspension type insulator.

4. Books Recommended:

1. W. D. Stevenson, Element of Power System Analysis, McGraw Hill, 4th Edition 1982.
2. I. J. Nagrath and D. P. Kothari, Power System Engineering, 4th edition, Tata McGraw Hill publishing Company Ltd, 2014.
3. A. Chakrabarti, M. L. Soni, P. V. Gupta and U. S. Bhatnagar, A Text Book on Power System Engineering, Dhanpat Rai & Co., 2nd Edition 2001.
4. Hadi Saadat, Power System Analysis. 5th reprint, TMH publishing Company Ltd, 2004.
5. Arthur R. Bergen, Vijay Vittal, Power Systems Analysis, Prentice-Hall, Inc., 2nd Edition 2000.

B. Tech. II year, Semester IV

Electromagnetic Field Theory

L	T	P	Credit
3	1	0	04

EE208 **Scheme**

Course Outcomes (Cos):

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

CO1	describe various theorems related to vector analysis
CO2	differentiate different types of coordinate systems and use them for solving the problems of electromagnetic field theory
CO3	explain concepts, theories and laws of electrostatics, magnetics, electromagnetics, electromagnetic wave propagation and transmission lines
CO4	analyze problems of electrostatics, magnetics, electromagnetics and electromagnetic wave propagation
CO5	apply theories and laws of electrostatics, magnetics and electromagnetics to solve electrical engineering problems
CO6	deduce the electromagnetic wave propagation from Maxwell's equations

1. Syllabus:

- **VECTOR ANALYSIS:** **(08 Hours)**
  General Treatment on Cartesian, cylindrical, spherical and general curvilinear co-ordinate systems with reference to vectors, operation of gradient, divergence, curl, Laplacian., Gauss's Divergence theorem, Stoke's theorem.

- **ELECTROSTATICS:** **(09 Hours)**
  Review of electric field quantities and their definitions. Gauss's flux theorem, Poisson's Equation and Laplace Equation, uniqueness theorem, Green's theorem, Coulomb's law, dipole moment. Electrostatic Field in Dielectric: Polarization, electric flux density, boundary conditions, capacitor and capacitance, electrostatic shielding, energy stored in electric fields.

- **MAGNETIC FIELDS AND ELECTROMAGNETIC INDUCTION:** **(10 Hours)**
  Magnetic flux and flux density, static currents in conducting media, Ampere's law, Biot-Savart law, boundary between magnetic media, forces between currents, magnetic potentials, magnetic torque and moment, Dipole, Energy stored in magnetic field. Faraday's law of induction (transformer and motion), Inductor and Inductances (self and mutual).

- **MAXWELL'S EQUATIONS & ELECTROMAGNETIC WAVES:** **(09 Hours)**
  Maxwell's equations - Equation of continuity - Displacement current - Maxwell's equation in point and integral forms ,Time-varying potentials, wave equations, plane waves in Losses Dielectrics, Free space & Good conductors, Poynting vector and Theorem.

- **TRANSMISSION LINES:** **(06 Hours)**
  Line equations, input impedance, SWR and power, smith chart, some applications of Transmission lines.

Total hours: 42

Tutorials will be conducted separately for 14 hours

2. Books Recommended:

1. W. H. Hayt, J. A. Buck, and M. Jaleel Akhtar, "Engineering Electromagnetics", 8th Edition, McGraw Hill Publication
2. David J. Griffiths, Introduction to Electrodynamics, 4th Edition, PHI, 2013.
3. S. P. Seth, Elements of Electromagnetic Fields, Dhanpat Rai & Co., 4th Edition, 2012.
4. C. L. Wadhwa, Engineering Electromagnetics, New Age International Publishers, 3rd Edition, 2012.
5. Fawwaz T. Ulaby, Electromagnetics for engineers, Pearson education, first Indian reprint,2005.

B. Tech. II year, Semester IV

Signal and Systems

L	T	P	Credit
3	1	0	04

EE212 **Scheme**

1. Course Outcomes (Cos):

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

CO1	classify various signals and their mathematical representation
CO2	develop insights into discrete-time systems and their realization
CO3	analyze the characteristics of LTI systems with the help of impulse response and convolution
CO4	design the system properties in frequency domain
CO5	analyze random signals and justify their usefulness in engineering systems

2. Syllabus:

- **SIGNALS AND THEIR PROPERTIES** **(08 Hours)**
  Classification of Signals, continuous-time and discrete-time signals, deterministic and random signals, periodic signals, even and odd signals, exponential and sinusoidal signals, unit step and unit impulse signals, systems with and without memory, time-varying, time-invariant, stationarity, causality, homogeneity, linearity, stability of systems
- **LINEAR TIME INVARIANT SYSTEMS** **(08 Hours)**
  Properties of linear time-variant systems, continuous-time LTI systems, relationship between linear differential equations with constant coefficients, transfer function, state space models, convolution integrals from transfer function and state space models, discrete-time LTI systems, relationship between linear difference equations with constant coefficients, pulse transfer function, discrete-time state space models, convolution sum from transfer function and state space models, connections between time-invariance, causality, stationarity.
- **FOURIER SERIES REPRESENTATION AND FOURIER TRANSFORM** **(05 Hours)**
  Fourier series representation of continuous-time periodic signals, Parseval formula for continuous-time periodic signals, continuous time Fourier transform, discrete-time Fourier transforms, connection between the Fourier transform and Laplace transform, connection between the z-transform and discrete-time Fourier transform.
- **THE LAPLACE TRANSFORMATION TECHNIQUE** **(06 Hours)**
  Definition of the Laplace transformation, the need of the Laplace transformation, region of the convergence of the Laplace transform of signals, properties of the Laplace transform, the Laplace transforms of test signals and practically useful signals, unilateral Laplace transform and bilateral Laplace transforms.
- **THE Z-TRANSFORMATION TECHNIQUE** **(06 Hours)**
  Definition of the z- transformation, the need of the z- transformation, region of the convergence of the z- transform of signals, pulse transfer function, stability of systems using the z-transform. The z-transforms of test signals and practically useful signals, unilateral z transform and bilateral z transforms
- **FEEDBACK CONCEPTS** **(09 Hours)**
  Physical representation of network, general restrictions on physical network characteristics Feedback, mathematical definition of feedback, stability and feedback realizability, contour integration and Nyquist criterion for stability, physical representation of network, general restrictions on physical network characteristics

Total Lectures: 42

Tutorials will be conducted separately for 14 hours

3. **Books Recommended**:

1. A. V. Oppenheim, A. S. Wilsky and S. H. Nawab, Signals and Systems, Pearson India Education Services Private limited India, 2nd Edition, 2016.
2. R. A. Gabel and R. A. Robert, Signals and Linear Systems, John Wiley and Sons, 3rd Edition, 1987.
3. B. P. Lathi, Principles of Linear Systems and Signals, Oxford University Press, 2nd Edition, 2009.
4. C. T. Chen, Systems and Signal Analysis - A Fresh Look, Oxford University Press India, 3rd Edition, 2004.
5. S. T. Alan, Introduction to Signals and Systems, Thomson India Edition, 1st Edition, 2007.

B. Tech. III year, Semester V

Power System Analysis

L	T	P	Credit
3	1	2	05

EE301 **Scheme**

1. Course Outcomes (Cos):

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

CO1	explain the concept of per unit system and its application in power
CO2	analyze symmetrical and unsymmetrical fault conditions in electrical power systems.
CO3	discuss, analyze and compare different methods of power flow analysis in power system and estimate economic load dispatch.
CO4	classify power system stability, and its importance in power system operation
CO5	illustrate using software tools (MATLAB, ETAP etc.) to examine system performance with reference to fault, load flow and stability and analyze the results

2. Syllabus:

- **REPRESENTATION OF POWER SYSTEM COMPONENTS** **(04 Hours)**
  Introduction, single phase solution of balanced three phase networks, the one line diagram and the impedance or reactance diagram, per-unit (pu) system, complex power, synchronous machine, representation of loads.

- **LOAD FLOW STUDIES** **(08 Hours)**
  Network model formulation, formation of Y bus, power flow problem, different types of buses, approximate power flow, Gauss Seidel method, Newton-Raphson method, Decoupled Power flow studies, Fast Decoupled power flow studies, comparison of power flow methods.

- **ECONOMIC LOAD DISPATCH** **(04 Hours)**
  Economic dispatch of thermal units and methods of solution, Transmission losses, B matrix loss formula, Composite generation production cost function-solution by gradient search techniques, Nonlinear function optimization

- **SYMMETRICAL FAULT ANALYSIS** **(08 Hours)**
  Introduction, transient on a transmission line, short circuit of a synchronous machine on no load, short circuit of a loaded synchronous machine, balanced three phase fault, short circuit capacity, fault analysis using bus impedance matrix, selection of protective equipment.

- **UNSYMMETRICAL FAULT ANALYSIS** **(08 Hours)**
  Symmetrical component analysis of unsymmetrical faults, single line to ground (LG) fault, line to line (LL) fault, double line to ground (LLG) fault, open conductor faults, bus impedance matrix method for analysis of unsymmetrical faults.

- **POWER SYSTEM STABILITY** **(10 Hours)**
  Importance of stability analysis in power system planning and operation - classification of power system stability - angle and voltage stability – simple treatment of angle stability into small-signal and large-signal (transient) stability Single Machine Infinite Bus (SMIB) system: Development of swing equation - equal area criterion - determination of critical clearing angle and time by using modified Euler method and Runge-Kutta second order method. Algorithm and flow chart.

Total Hours:42

Tutorials will be conducted separately for 14 hours

3. List of Experiments:

Simulations based on different types of faults, stability and transients using MATLAB and ETAP.

1. To study mathematical modeling of R-L, R-L-C and complex electrical circuit using MATLAB.
2. To study mathematical modeling of 3rd order differential equation.
3. To solve differential equations using Euler's and trapezoidal rule.
4. To observe variable of rotor angle and to find critical clearing time when fault occurs at:
   - (i) Sending end of the line
   - (ii) Mid-point of the line
   - (iii) When the fault at mid-point is cleared by removing the faulty line of SMIB system.
5. To study short circuit analysis of overhead transmission line using MATLAB.
6. To study and obtain sub-transient current for symmetrical fault using ETAP software.
7. To perform load flow analysis using ETAP software.
8. To study and determine fault current for short circuit analysis using ETAP software.

4. Books Recommended:

1. J. J. Grainger and W. D. Stevenson, Power System Analysis, McGraw Hill, New Delhi, 1st Edition, 1994.
2. Hadi Saadat, Power System Analysis, 5th reprint, Tata McGraw Hill publishing Company Ltd, New Delhi, 2004.
3. I. J. Nagrath and D. P. Kothari, Power System Engineering, Tata McGraw Hill publishing Company Ltd., New Delhi, 3rd Edition, 2014.
4. J. Duncan Glover, S. Mulkutla Sarma and Thomas Overby, Power System Analysis and Design, 5th Edition Cengage Learning 2012.
5. Arthur R. Bergen, Vijay Vittal, Power Systems Analysis, Prentice Hall of India, Inc., 2nd Edition, 2000.

B. Tech. III year, Semester V

L	T	P	Credit
3	1	2	05

Control Systems

EE303 **Scheme**

1. Course Outcomes (Cos):

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

CO1	classify various types of control systems and to develop mathematical modeling of physical systems
CO2	analyze the response of various control systems in the time domain
CO3	analyze the stability of control systems using a variety of methods
CO4	evaluate the response and stability of control systems using frequency domain techniques
CO5	design various control schemes for linear systems

2. Syllabus:

- **INTRODUCTION TO CONTROL SYSTEMS:** **(02 Hours)**
  Open loop control and close loop control; Illustrative examples of control systems.

- **MATHEMATICAL MODELS OF PHYSICAL SYSTEMS:** **(10 Hours)**
  Linear and non-linear systems; equations and transfer functions for linear mechanical translational systems and linear electrical network; Force-Voltage and Force-Current analogy; Block diagram representation of control systems; Block diagram reduction; Transfer functions of armature-controlled and field-controlled DC servomotors and 2-phase AC servomotors; Signal flow graph and Mason's gain formula.

- **TIME DOMAIN ANALYSIS OF CONTROL SYSTEMS:** **(06 Hours)**
  Typical test signals; Response of first-order systems; Transient response of a second order system due to step input; Time domain specifications of a second order system; Impulse and ramp response of second order system; Steady-state errors; Static error coefficients; Error series and dynamic error coefficients.

- **CONCEPTS OF STABILITY:** **(08 Hours)**
  Introduction to stability, definition through impulse response function, asymptotic stability and relative stability, Routh-Hurwitz stability criterion. Basic Properties of Root Loci, Construction of Root Loci, Effects of Adding Poles and Zeros.

- **FREQUENCY DOMAIN ANALYSIS OF CONTROL SYSTEMS:** **(08 Hours)**
  Steady state response of a system due to sinusoidal input; Frequency response; Logarithmic plots or Bode diagrams; Log-magnitude versus phase plots; Resonant peak and resonant frequency of a second order system; Polar plots; conformal mapping, principal of argument, Nyquist stability criterion, Stability analysis; Relative stability; Gain margin and phase margin; Closed loop frequency response.

- **DESIGN OF CONTROL SYSTEMS:** **(08 Hours)**
  Introduction to phase lag, phase lead and phase lag-lead networks and their applications. P, PI, PID Controllers.

Total Hours: 42

Tutorials will be conducted separately for 14 hours

3. List of Experiments:

1. To obtain open loop and close loop transfer function for an oven.
2. To control the speed of two-phase AC Servo motor using auto tunable PI controller.
3. To understand the practical Air blower control system and to control the speed Of Blower using Programmable Logic Controller (PLC) and VFD from SCADA.
4. a) To obtain no load speed Vs control voltage curve for the two phase servo motor
   b) To obtain speed –torque curves for the various control voltages of servo motor.
5. To obtain Close Loop Response of an OVEN.
6. To understand the about the transient behavior on practical Air blower control system.
7. To understand the PID controller tuning using MATLAB.
8. To obtain the frequency response of phase lead network
9. a) To obtain step response and to find transient time domain specification for Second order system using MATLAB.
   b) To obtain Bode plot and Root locus using MATLAB.

4. Books Recommended:

1. I. J. Nagrath and M. Gopal, Control system engineering, New Age International Publishers, 3rd Edition, 2001.
2. K. Ogata, Modern control system engineering, Pearson Education Asia, 4th Edition, 2002.
3. B. C. Kuo, Automatic control system, Prentice Hall of India, 7th Edition, 1995.
4. Richard C. Dorf and Robert H Bishop, Modern control system, Pearson Education Asia. 8th Edition, 2004.
5. N. S. Nise, Control System Engineering, John Wiley & sons, 4th Edition, 2004.

B. Tech. III year, Semester V

L	T	P	Credit
3	1	2	05

Power Electronic Converters

EE305 **Scheme**

1. Course Outcomes (Cos):

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

CO1	explain the basic principle of operation of semiconductor devices and list their applications.
CO2	analyze and compare the performance of various phase-controlled rectifier
CO3	analyze and design the various choppers.
CO4	design inverters and AC voltage controllers for various application.
CO5	develop laboratory prototype of power electronic systems.

2. Syllabus:

- **POWER SEMICONDUCTOR DEVICES** **(12 Hours)**
  Introduction to Power Electronics Scope and Applications, Interdisciplinary Nature of Power Electronics, Types of power electronics circuits, Thyristor Characteristics, Two transistor analogy, Gate Characteristics, Methods of triggering and commutation, series and parallel operation of thyristors, Ratings and protection of devices, Introduction to power electronic devices like Power BJT, MOSFET, GTO, IGBT, MCT etc.

- **PHASE CONTROLLED RECTIFIERS** **(12 Hours)**
  Principle of phase control, half wave controlled rectifiers, half wave controlled rectifiers with R, R-L, R-L-E load, single phase full wave controlled converters, 2-pulse mid-point converters, 2-pulse half and fully controlled bridge converters with R, R-L, R-L-E load, Three phase converter system with diodes, 3 phase half and fully controlled bridge converters, triggering scheme, Effect of source impedance on the performance or the converters, Dual converters.

- **CHOPPERS** **(06 Hours)**
  Basic principle of chopper operation, Control strategies – Duty Ration Control and Frequency Control, Types of idealized chopper circuits, Steady state time domain analysis of Type A choppers, Step up chopper.

- **INVERTERS** **(08 Hours)**
  Single phase voltage source inverters, half bridge inverters, full bridge inverters, Steady state analysis, Voltage control in single phase inverters, 3-phase bridge inverters, Pulse width modulated inverters, Reduction of harmonics in Inverter.

- **AC VOLTAGE CONTROLLERS** **(04 Hours)**
  Principle of AC Voltage Controllers – Integral Cycle Control and Phase Control, Types of AC voltage controllers, Analysis of 1-phase Integral Cycle Control AC controllers with R load, Analysis of 1-phase Phase Control AC controllers with R and R-L load, Thyristor controlled reactors (TCR).

Total Hours: 42

Tutorials will be conducted separately for 14 hours

3. List of Experiments:

1. Study of IGBT, MOSFET, SCR, Triac, Diac Characteristics.
2. Study of Different SCR Triggering Circuit Trainer – DC, R, R-C, UJT.
3. Study of Single Phase Half Controlled Bridge Converter with R, R-L Load.
4. Study of Single Phase Fully Controlled Bridge Converter with R, R-L Load.
5. Study of Single Phase SCR Full Bridge Inverter Circuit.
6. Study of High Voltage Thyristorised Chopper.
7. Study of Single Phase AC Voltage Controller Using SCR.
8. Study of Single Phase AC Voltage Controller Using Triac.
9. Study of Single Phase Dual Converter Circuit.
10. Study of SCR dc Circuit Breaker Circuit.
11. Study of Three Phase SCR Triggering Circuit Using Tca785 IC.
12. Study of Ac Solid State Relay Using IC 555, Opto Coupler & Triac.
13. Simulation of Power EC circuits in PSIM and SIMULINK.

4. Books Recommended:

1. P. S. Bimbhra, Power electronics, Khanna Publishers, New Delhi, 5th Edition, 2014.
2. M. H. Rashid, Power Electronics Circuits, Devices, and Applications, Prentice-Hall of India Pvt. Ltd., New Delhi, 2nd Edition, 1999.
3. M. D. Singh and K. B. Khanchandani, Power electronics, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2nd Edition, 2006.
4. Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics Converters, Applications, and Design, John Willey & Sons, Inc., 2nd Edition, 1995.
5. J. P. Agrawal, Power electronic systems: Theory and design, Addison Wesley Longman (Singapore) Pte. Ltd. New Delhi, 2nd Edition, 2001.

B. Tech. III year, Semester V

L	T	P	Credit
3	1	2	05

Electrical and Electronic Measurements

EE307 — Scheme

1. Course Outcomes (Cos):

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

CO1	identify different standards and explain measurement techniques of resistance, inductance and capacitance.
CO2	explain magnetic measurement techniques, discuss and analyze utilization of CT and PT.
CO3	classify different indicating instrument.
CO4	Operate electronic meters and oscilloscope
CO5	Illustrate calibration and traceability of test equipment

2. Syllabus:

- **STANDARDS** **(03 Hours)**
  Standards and their classification. Electrical Standards: EMF, current, resistance and capacitance standards
- **MEASUREMENT of RESISTANCE, INDUCTANCE AND CAPACITANCE** **(07 Hours)**
  Concept of four arm bridge network, Kelvin's double bridge, Anderson bridge, Schering bridge, Wagner earthling device, Localization of cable fault using loop methods
- **MAGNETIC MEASUREMENTS** **(05 Hours)**
  Measurement of flux: ballistic galvanometer, Grassot flux meter, Hall effect devices for measurement of flux, measurement of iron loss by wattmeter method, Hibbert magnetic standard.
- **INSTRUMENT TRANSFORMERS** **(06 Hours)**
  Theory of current and voltage transformer, ratio error and phase angle, burden, turns compensation performance characteristics, testing of CT and PT and applications of CT and PT in measurement of power.
- **INDICATING INSTRUMENTS** **(07 Hours)**
  Classification, operating principles, general construction details of indicating instruments, balancing, control and damping method, theory and construction of PMMC, moving iron and electrostatic instruments, electrodynamics wattmeter.
- **ELECTRONIC METERS AND OSCILLOSCOPE** **(08 Hours)**
  DC amplifier voltmeter, AC voltmeter using rectifiers, true RMS responding voltmeter, Oscilloscope block diagram, CRT and its circuits, vertical deflection systems, delay line, multiple trace, horizontal deflection system, oscilloscope probes, Function generator.
- **CALIBRATION AND MEASUREMENT** **(06 Hours)**
  calibration and traceability of instruments, Calibration of indicating instruments using DC potentiometer, High voltage oil testing equipment, H.V. breakdown tester, Insulation resistance measurement techniques, calibration of energy meter

Total hours:42

Tutorials will be conducted separately for 14 hours

3. List of Experiments:

1. To measure unknown resistance using Kelvin's Double Bridge.
2. To measure unknown inductance using Anderson Bridge
3. To calibrate voltmeter using Potentiometer.
4. To measure unknown capacitance using Schering Bridge
5. Calibration of single phase energy meter.
6. Testing of Current Transformer using Biffi's method.
7. To find out iron loss and flux density in a given sample of laminated steel core. (Lloyd fisher square)
8. To perform the operation of HV oil testing.
9. To study operation of oscilloscope and function generator.

4. Books Recommended:

1. Golding and Widdis, Electrical measurements and Measuring instruments, Wheeler books, 5th Edition.
2. A. K. Sawhney, Electrical and electronic Measurements and Instrumentation, Dhanpat Rai & Co., 17th Edition.
3. A. D. Helfrick and W. D. Cooper, Modern electronic Instrumentation and Measurement techniques, PHI, 2nd Edition, 2009.
4. D. A. Bell, Electronic Instrumentation and Measurement, Oxford Uni. Press, 3rd Edition, 2013.
5. P. Purkait, B. Biswas, S. Das and C. Koley Electrical and Electronics Measurement and Instrumentation, McGraw Hill Education, 1st Edition, 2013.

B. Tech. III year, Semester VI

Power Electronics Systems and Electric Drives

L	T	P	Credit
3	1	2	05

EE304 **Scheme**

1. Course Outcomes (Cos):

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

CO1	explain the basic concept of electric drives and list their applications for industrial use.
CO2	apply various power electronic converters to DC and AC drives
CO3	devise different control techniques for DC and AC drives
CO4	compare the performance of various methods of drive control
CO5	decide the suitability of electric drive for industrial needs

2. Syllabus:

- **ELECTRICAL DRIVES** **(07 Hours)**
  Review on dc drives, Fundamental torque equation, speed-torque convention and multi quadrant operation, dynamics of motor load combination, nature and classification of load torque, measurement of moment of inertia, calculation of acceleration time in transient operation, acceleration time for specific nature of motor and load torque, load equalization, stability of electrical drives, Selection of Motor Power Rating.

- **POWER ELECTRONICS CONTROL OF DC DRIVES** **(07 Hours)**
  Review of DC Motors and its performance, starting, braking, Speed control, Rectifier fed DC drives with continuous and discontinuous mode of operation, Design of controllers, Supply Harmonics, Power Factor and ripple in motor current, Chopper Controlled DC Drives, Sources current harmonics in chopper, Converter Ratings and closed loop control scheme.

- **THREE PHASE INDUCTION MOTOR DRIVES** **(12 Hours)**
  Review of Three phase Induction Motor and its performance, starting, braking, Static Voltage control, Variable Frequency Control based on VSI, CSI, cyclo-converter etc, static rotor resistance control and slip power recovery control schemes, vector control.

- **THREE PHASE SYNCHRONOUS MOTORS** **(12 Hours)**
  Review of Three phase Synchronous Motor and its performance, Self-controlled schemes, Variable frequency control of multiple synchronous motor, Permanent magnet AC motor drives, Control of Brushless DC Motor Drives and its applications,

- **INDUSTRIAL APPLICATIONS** **(04 Hours)**
  Steel mills, rolling mills, cement mills, tractions, machine tools and coal mining, Petro-chemical industry etc.

Total Hours: 42

Tutorials will be conducted separately for 14 hours

3. List of Experiments:

1. Study of Speed Control of DC Shunt Motor Using Single Phase Fully Controlled Converter.
2. Controlling of DC Motor with Single Phase Dual Converter.
3. Study of Speed Control of Three Phase AC Induction Motor (V/F Control).
4. Experimental investigation of a 5 HP Induction Motor Drive.
5. Study of DSP Controlled Induction Motor Drive.
6. Study of DSP Controlled BLDC Motor Drive.
7. Simulation of V/F control of 3 phase induction motor using MATLAB.
8. Simulation of speed control of three phase induction motor using stator voltage control (AC Voltage controller) in MATLAB.

4. Books Recommended:

1. B. K. Bose, Modern Power Electronics & AC Drives, Pearson, 1st Edition.
2. G. K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2nd Edition, 2001.
3. R. Krishnan Electric motor drives Modeling, Analysis and Control PHI-India, 1st Edition, 2015.
4. Hughes, Electric Motors & Drives, Newnes, 3rd Edition, 2005.
5. Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics Converters, Applications, and Design, John Willey & Sons, Inc., 2nd Edition, 1995.

B. Tech. III year, Semester VI

L	T	P	Credit
3	1	2	05

Microprocessor and Microcontrollers

EE306 **Scheme**

1. Course Outcomes (Cos):

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

CO 1	Illustrate with examples basic concepts of digital circuits.
CO 2	explain architecture of 8–bit Microprocessor (8085A), concept of memory and input-output interfacing with timing diagrams.
CO 3	Describe architecture of 8 bit microcontroller (8051) with special function registers (SFR), basic on chip peripherals like Timer0, Timer 1, UART, and External Interrupts and program execution timings (MIPS).
CO 4	Demonstrate interfacing of external peripheral like ADC, DAC, Key board, LCD and seven segment LED display with 8051 Microcontroller.
CO 5	develop assembly language and embedded 'C' programs with the exposure of Kiel µvision IDE.
CO 6	Design and develop using microcontroller, power electronics based electrical systems and provide solution to other real world problems.

2. Syllabus:

- **REVIEW OF DIGITAL LOGIC CONCEPTS** **(02 Hours)**
  Number systems, gates & De-Morgan's equivalents, 3-state logic gates, flip-flops, buffers, decoders, Encoders, multiplexers, de-multiplexers.

- **MICROPROCESSOR SYSTEM ARCHITECTURE** **(03 Hours)**
  Introduction, Registers, concept of address and data buses, system control signals, basic bus timing, memory (RAM, ROM), input output devices, Microcomputer systems

- **INTRODUCTION TO 8085A MICROPROCESSOR ARCHITECTURE** **(03 Hours)**
  Introduction to 8085A, pin diagram and pin description, bus timing and instruction timing, de-multiplexing of buses, generation of control signals, concept of interrupts.

- **MEMORY INTERFACING WITH 8085A** **(04 Hours)**
  Different types of memory, memory map, address decoding scheme for different memory, memory timings.

- **INPUT OUTPUT DEVICES INTERFACING WITH 8085A** **(04 Hours)**
  Basic interfacing concepts, peripheral I/O interfacing and memory mapped I/O interfacing

- **8051 MICROCONTROLLER ARCHITECTURE** **(06 Hours)**
  Introduction, 8051 family microcontrollers, hardware architecture, input/output pins, I/O ports and circuits, on chip ram ,general purpose registers ,special function registers, timers-counters, concepts of interrupts.

- **ASSEMBLY LANGUAGE PROGRAMMING OF 8051** **(10 Hours)**
  Concept of IDE (assembler, compiler, linker, de-bugger), addressing modes, data move instructions, arithmetic and logical instructions, jump, loop and call instructions, concepts of subroutines, interrupt service routine.

- **PERIPHERALS OF 8051 – HARDWARE CONCEPTS AND 'C' PROGRAMMING** **(10 Hours)**
  GPIO port architecture, timers, interfacing with push button keys, interfacing with seven segment LED display, interfacing with ADC

Total hours: 42

Tutorials will be conducted separately for 14 hours

3. List of Experiments:

(to write and execute assembly language programme for)

1. Arithmetic operations of Signed and Unsigned Numbers
2. Memory Block Movements (Forward, reverse, overlapping)
3. Ascending and descending arrangement of data string.
4. Code conversion. (Hexadecimal, BCD, Binary, ASCII etc.)

   (Embedded 'C' programming)
5. Toggling of port pin with time delay
6. Sensing of push button keys
7. Two digit second clock based on seven segment display
8. Interrupt driven clock
9. Programming of ADC and DAC

4. Books Recommended:

1. R. S. Gaonker, Microprocessor Architecture, programming and application, Wiley Eastern Limited, 6th Edition, 2013.
2. Kenneth J. Ayala, The 8051 Microcontroller, Penram International 3rd Edition, 1999.
3. M. Mazidi and others, The 8051 Microcontroller and Embedded Systems, Prentice Hall of India, 2nd Edition, 2007.
4. Michael Slater, Microprocessor based Design, Prentice Hall of India, 3rd Edition, 2016.
5. Badri Ram, Fundamentals of microprocessors and microcomputers, Dhanpat Rai & Sons, 4th Edition, 1993.

B. Tech. III year, Semester VI

L	T	P	Credit
3	1	2	05

Instrumentation

EE308 **Scheme**

1. Course Outcomes (Cos):

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

CO1	analyze performance characteristics of measurement systems.
CO2	demonstrate different types of transducers.
CO3	explain different types of recorders and data transmission techniques.
CO4	discuss operational amplifier and its applications.
CO5	Classify various digital displays and digital measuring instruments.

2. Syllabus:

- **PERFORMANCE CHARACTERISTICS OF MEASUREMENT SYSTEMS** **(06 Hours)**
  Input-output configuration of instruments and measurement systems, methods of correction for interfering and modifying inputs, static performance characteristics of instruments, noise, signal to noise ratio, errors in measurement
- **TRANSDUCERS** **(09 Hours)**
  Classification of transducers, passive transducers: resistive, inductive and capacitive transducers, active transducers: thermocouple, piezoelectric transducer, taco-generator, pH cell, basic signal conditioning circuits for transducers.
- **DATA TRANSMISSION ,RECORDERS and DATA LOGGERS** **(05 Hours)**
  Introduction to industrial data transmission techniques, Distinction between recorder and data loggers, strip chart recorder, X-Y recorders, data logger
- **OPERATIONAL AMPLIFIER FUNDAMENTALS** **(04 Hours)**
  Operational Amplifier, Basic Op-Amp Configuration, an Op-Amp with Negative Feedback, Voltage Series and Voltage Shunt Configurations, Difference Amplifiers,
  Specification of An Op-Amp, Offset Voltages and Currents, CMRR, Slew Rate
- **LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS** **(06 Hours)**
  Summing, Scaling and Averaging Amplifiers, Voltage to Current Converter with Floating and Grounded Load, Current to Voltage Converter, Integra tor and Differentiator, Instrumentation Amplifier, Isolation amplifier
- **NON-LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS** **(06 Hours)**
  Schmitt Trigger, Voltage Comparator, Voltage Limiters And Window Detector, Clippers And Clampers, Peak Detector, Precision Rectifiers, Analog Switches
- **BASICS of DIGITAL INSTRUMENTS** **(06 Hours)**
  Digital meter displays: LED and LCD, Quantization and digitization process, Quantization error, Specifications of digital instruments like digits, resolution and accuracy, Ramp type Digital voltmeter, Dual slope DVM, Digital multi-meter, LCRQ meter, Digital storage oscilloscope

Total hours: 42

Tutorials will be conducted separately for 14 hours

3. List of Experiments:

1. To study input and output characteristics of LVDT.
2. To study strain measurement using Strain Gauge and cantilever assembly.
3. Measurement of liquid level capacitive transducer.
4. To determine the breakdown voltage of transformer oil.
5. To determine the breakdown voltage of different types of paper.
6. To study the characteristics of RTD.
7. To study and perform Inverting & Non-Inverting Configuration Op-amp.
8. To study and perform Summing, Scaling & Averaging Circuits using Op-amp.
9. To study and perform Integrator & Differentiator using Op-amp.
10. To study Peak detector.

4. Books Recommended:

1. A. K. Sawhney, Electrical and electronic Measurements and Instrumentation, Dhanpat Rai & co., 17th Edition.
2. Gayakwad Ramakant, Op-Amps and Linear Integrated Circuits, PHI, 3rd Edition, 1993.
3. A. D. Helfrick and Cooper W. D., Modern electronic Instrumentation and Measurement techniques, Prentice Hall of India, 1997.
4. E. O. Doebelin, Measurement Systems - Application and Design, 4th Edition, McGraw-Hill, New York, 1992.
5. D. A. Bell, Electronic Instrumentation and Measurement, Oxford University press, 3rd Edition, 2013.

B. Tech. IV (Electrical), Semester – VII

L	T	P	Credit
3	0	2	04

Microcontroller and Embedded C Programming

EE401 **Scheme**

1. Course Outcomes (Cos):

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

CO 1	revise basic concepts of 8051 microcontroller and embedded 'C' programming.
CO 2	explain architecture of CIP 51 8 bit microcontroller with the advanced features of the controller.
CO 3	describe the functionality of Programmable internal and external peripherals of CIP 51.
CO 4	write embedded 'C' code for CIP51 with the exposure of SI Lab IDE.
CO 5	develop microcontroller based prototype for automation, power electronics based electrical systems and other real world problems.

2. Syllabus:

- **INTRODUCTION TO CIP-51 CONTROLLER ARCHITECTURE** **(04 Hours)**

  Memory Map, Instruction Pipeline, PLL & Clock System, On Chip Peripherals, concept of Cross-bar and Pin assignment

- **INTRODUCTION TO EMBEDDED 'C' PROGRAMMING** **(04 Hours)**

  Variables and constants, storage classes, enumerations and definitions, I/O operations, control statements, functions, pointers and arrays, structure and unions, interrupt service routines.

- **HARDWARE CONCEPT AND PROGRAMMING OF CIP-51 PERIPHERALS** **(14 Hours)**

  Timer/Counters, GPIO, ADC, DAC, UART, Interfacing of seven-segment LED and LCD display, interfacing of pushbutton keys, interfacing of Matrix key board

  ADVANCED PERIPHERAL OF CIP-51 **(12 Hours)**

  Comparator, SPI & I2C serial Communication interface, MAC unit on CIP-51, On-chip PLL and Its programming

- **CIP-51 BASED DESIGN OF EMBEDDED SYSTEMS** **(08 Hours)**

  Design and implementation of ZCD circuits, Thyristor and triac firing circuit, Non isolated buck and boost converters

Total Hours: 42

3. List of Experiments:

(to write and execute using 'C' programming to)

1. generate square wave of different frequency using timer T0
2. generate square wave of different frequency using timer T0
3. generate different duty cycle and different switching frequency waveform with timer T0 and T2.
4. interface LCD with cip-51
5. display digital clock on LCD
6. turn on and turn off led with key debounce
7. generate PWM signal using timer T2 and PCA timer

8. generate high frequency square wave using PCA Timer
9. generate sine wave and triangular wave using DAC
10. measure voltage and current using ADC
11. measure frequency of unknown signal using timer T2 and PCA timer
12. transmit following character data string at 9600 baud rate using uart0. Use timer 2 to generate required baud rate data string- _hello svnit"

4. Books Recommended:

1. Barnett, O'cull, Cox, Embedded C Programming and the Microchip PIC, Cengage Learning publication.
2. M. Mazidi, J. G. Mazidi and R. D. McKinlay, _The 8051 Microcontroller and Embedded Systems, Prentice Hall of India, 3rd edition, 2007.
3. Mark Siegesmund, Embedded C Programming: Techniques and Applications of C and PIC MCUS, Elsevier Science, 1st Edition 2014.
4. Datasheet of SILABS C8051F12X. (www.silabs.com)
5. Application notes from SILAB C8051F12X.

B. Tech. IV (Electrical), Semester – VII

Electrical Machine Design

L	T	P	Credit
3	1	0	04

EE403 **Scheme**

1. Course Outcomes (Cos):

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

CO1	demonstrate the basic steps involved in design of electrical machines
CO2	describe the basic equations related to the electric machine design
CO3	calculate the performance indices of electrical machines
CO4	estimate the design parameters as per performance requirements
CO5	analyze the effect of design parameters on the performance of electric machines
CO6	develop the design of transformers, induction machines, dc machines and synchronous machines

2. SYLLABUS:

- **GENERAL ASPECTS OF ELECTRICAL MACHINE DESIGN** **(04 Hours)**
  Electrical engineering materials, magnetic circuit design, thermal design.
- **TRANSFORMERS** **(09 Hours)**
  Output equation - single phase and three phase power transformers - main dimensions - choice of specific electric and magnetic loadings- design of core, LV winding, HV winding, tank and cooling tubes - prediction of no load current, forces on winding during short circuit, leakage reactance and equivalent circuit based on design data – computer aided design examples.
- **GENERAL CONCEPTS AND CONSTRAINTS IN DESIGN OF ROTATING MACHINES** **(03 Hours)**
  Specific loadings and output equations of AC and DC machines.
- **DC MACHINES** **(08 Hours)**
  Main dimensions - choice of speed and number of poles - design of armature conductors, slots and winding - design of air-gap, field system, commutator, interpoles, compensating winding and brushes – Carter's coefficient - real and apparent flux density – Computer aided design examples.
- **ALTERNATORS** **(08 Hours)**
  Salient pole and turbo alternators - main dimensions - choice of speed and number of poles - design of armature conductors, slots and winding - design of air-gap, field system and damper winding - prediction of open circuit characteristics and regulation of the alternator based on design data – computer aided design examples.
- **INDUCTION MACHINES** **(10 Hours)**
  Main dimensions - design of stator and rotor windings, stator and rotor slots and air-gap of slip ring and squirrel cage motors – calculation of rotor bar and end ring currents in cage rotor - calculation of equivalent circuit parameters and prediction of magnetizing current based on design data – computer aided design examples.

Total Hours:42

Tutorials will be conducted separately for 14 hours

3. **Books Recommended:**

1. A. K. Sawhney, Chakrabarti, A Course in Electrical Machine Design, Dhanpat Rai & Co., 2016.
2. Clayton & Hancock, Performance & Design of DC Machines, CBS, 3rd Edition, 2001.
3. M. G. Say, Performance & Design of AC Machines, Pitman, ELBS.3rd Edition, 1983.
4. S.K.Sen, Principles of Electrical Machine Design, Oxford & IBH Pub., 2nd Edition, 2006
5. R. K. Agarwal, Principles of Electrical Machine Design, S. K. Kataria & Co., 2nd Edition, 2012.