Scheme & Syllabus
(2009 - 2013)
CORE & CLUSTER ELECTIVES

DEPARTMENT OF ELECTRICAL AND
ELECTRONICS ENGINEERING

BMS COLLEGE OF ENGINEERING, BANGALORE
(Autonomous College under VTU)
Bull Temple Road, Bangalore - 560 019
### Program: Electrical & Electronics  
**Department / Cluster: Electrical Sciences**  
**Semester: III**

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**L**-Lecture Hours / week; **T**-Tutorial Lecture Hours / week; **P**-Practical Lecture Hours / week.  
**CIE**-Continuous Internal Evaluation; **SEE**-Semester End Examination (of 3 Hours duration)
### Program: Electrical & Electronics  
#### Semester: IV

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**L**-Lecture Hours / week; **T**-Tutorial Lecture Hours / week; **P**-Practical Lecture Hours / week.  
**CIE**-Continuous Internal Evaluation; **SEE**-Semester End Examination (of 3 Hours duration)
### BMS COLLEGE OF ENGINEERING, BANGALORE
(Autonomous College under VTU)

#### Department / Cluster: Electrical Sciences

**Program: Electrical & Electronics**

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**Total Credits** 25 29 650

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**CIE**-Continuous Internal Evaluation; **SEE**-Semester End Examination (of 3 Hours duration)
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**L**-Lecture Hours / week; **T**-Tutorial Lecture Hours / week; **P**-Practical Lecture Hours / week.

**CIE**-Continuous Internal Evaluation; **SEE**-Semester End Examination (of 3 Hours duration)
Program: Electrical & Electronics

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L - Lecture Hours / week; T - Tutorial Lecture Hours / week; P - Practical Lecture Hours / week.
CIE - Continuous Internal Evaluation; SEE - Semester End Examination (of 3 Hours duration)
# Intellectual Property Rights 2002

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**Total Credits**: 24

**Contact hours/week**

- **L**: Lecture Hours / week
- **T**: Tutorial Lecture Hours / week
- **P**: Practical Lecture Hours / week
- **CIE**: Continuous Internal Evaluation
- **SEE**: Semester End Examination (of 3 Hours duration)

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**Academic Year**: 2012-2013
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GE- Group Elective L - Lecture Hours / week; T- Tutorial Lecture Hours / week; P-Practical Lecture Hours / week.
CIE- Continuous Internal Evaluation; SEE- Semester End Examination (of 3 Hours duration)
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### BMS COLLEGE OF ENGINEERING, BANGALORE  
(Autonomous College under VTU)

**Group III Electrical Cluster Electives  (Programs: EC/TC/IT/EE/ML)  
Semester: VI**

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Group V Electrical Cluster Electives (Programs: EC/TC/IT/EE/ML)  Semester: VII

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### Summary Categorization of Courses Offered

**Department of Electrical & Electronics Engineering for Batch Admitted: 2009**

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**Autonomous College under VTU**

BMS COLLEGE OF ENGINEERING, BANGALORE
Objectives

The purpose of the course is to make the students well conversant with Fourier-Series, Fourier Transforms, formulate physical problems in terms of Partial Differential Equations, find insight into the physical behavior of systems from mathematical solution and develop computational skills using efficient numerical methods for problems in science and engineering.

UNIT I

Fourier Series:
Infinite series, convergence and divergence of infinite series of positive terms, power series, periodic function, Dirichlet’s conditions, statement of Fourier Theorem, Fourier series of periodic function of period \(2\pi\) and arbitrary period, half range Fourier series, complex form of Fourier series, practical harmonic analysis. (7L+2T)

UNIT II

Fourier Transforms:
Infinite Fourier transform, Fourier Sine and Cosine transforms, properties, Inverse transforms, Convolution theorem (statement only), Parseval’s identities for Fourier transform. Fourier transforms of the derivatives of a function. (7L+2T)

UNIT III

Partial Differential Equations:
Formation of Partial differential equations-elimination of arbitrary constants, elimination of arbitrary functions. Equations of first order- The linear equation \(P \frac{\partial p}{\partial x} + Q \frac{\partial q}{\partial y} = R\) (Lagrange’s partial differential equation). Method of separation of variables. (5L+2T)

Applications of Partial Differential Equations:
Derivation of one-dimensional heat equation, wave equation, various possible solutions of these by the method of separation of variables, D’Alembert’s solution of wave equation. (4L+1T)

UNIT IV

Numerical Methods:
Finite Differences and interpolation: Forward differences, backward differences. Interpolation: Newton-Gregory forward interpolation formula, Newton-Gregory backward interpolation formula, Newton’s general interpolation formula, Lagrange’s interpolation
formula, Lagrange’s inverse interpolation. Numerical differentiation: Numerical differentiation using Newton-Gregory forward and backward interpolation formula \( (4L+2T) \)


UNIT V

Z –Transforms :
Definition, Properties, Transforms of standard functions, Inverse transforms.

Applications of Z –Transforms:
Solution of difference equations using Z-transforms. \( (4L+2T) \)

Calculus of Variations:
Variation of function and functional, Euler’s equation, variational problems.

Applications of Calculus of Variations:
Geodesics, minimal surface of revolution, hanging chain, Brachistochrone problem. \( (4L+1T) \)

Text Books:

Reference Books:
Subject: NETWORK ANALYSIS
Sub. Code: 10ES3GCNAL
Credits: 04
L-T-P: 4-0-0

Objectives: This is a basic course which aims at absorbing the fundamental concept of circuit theory. It involves analysis of steady state and transient response of different networks excited by different sources. A strong background of this course will form a sort of a backbone to other related courses.

Loop Current, Node Voltage Techniques:
To review the fundamental concepts of circuit theory which are based on physical laws, develop network equations based on these laws and solve them by applying mathematical techniques.

Network Theorems:
To analyze networks for the evaluation of parameters and electrical quantities by applying theorems.

Laplace Transform:
To determine the steady state and transient response of electrical networks using the transform approach.

UNIT I [08 hours]
Basic Concepts:
Practical sources, Source transformations, Network reduction using Star-Delta transformation, Loop and node analysis With linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh

UNIT II [10 hours]
(a) Network Topology: Graph of a network, Concept of tree and co-tree, incidence matrix, tie-set, tie-set & cut-set schedules, Formulation of equilibrium equations, Principle of duality.
(b) Resonant Circuits: Series and parallel resonance, frequency response of series and Parallel circuits, Q-factor, Bandwidth

UNIT III [12 hours]
Network Theorems:
Superposition, Reciprocity, Millman’sThevinin’s and Norton’s theorems; Maximum Power transfer theorem.

UNIT IV [12 hours]
Transient behavior and initial conditions
Behavior of circuit elements under switching condition and their representation, evaluation of initial and final conditions in RL, RC and RLC circuits Laplace Transformation & Applications

UNIT V [10 hours]

Two port network parameters and State Variable analysis:
Definition of z, y, h and transmission parameters, modeling with these parameters, and relationship between parameters sets. Writing State equations and solution using Laplace transforms.

TEXT BOOKS:

REFERENCE BOOKS:
2. "Network analysis and Synthesis", Franklin F. Kuo, Wiley

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<th>Subject</th>
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Objectives:
- To understand basic semiconductor device physics and circuit analysis of the p-n junction diode and also getting into the design of practical applications of p-n diode.
- Get some practical knowledge about the design and analysis of basic analog circuits.
- Understanding of basic semiconductor device physics and circuit analysis of BJT transistor and MOSFET.
- Ability to perform both formal DC circuit analysis and small / large signal mid-band frequency AC circuit analysis by model representation.
- Ability to perform circuit design and analysis, operating at mid-band frequencies.
BMS COLLEGE OF ENGINEERING, BANGALORE
(Autonomous College under VTU)

- Ability to perform the detailed design and analysis of the discreet BJT Common Emitter Amplifier operating at mid-band frequencies.
- To Learn frequency response analysis and understand Bode Plots. Ability to perform the detailed design and analysis of the discreet BJT Common Emitter Amplifier operating at low and high frequency range.
- Analysis and Design of Feedback Amplifiers.
- Ability to analyze JFET and MOSFET analog devices including Common Source, Common Base and Common Collector Configurations.
- Ability to simulate electronic circuits using PSPICE.

UNIT I [10 hours]

Semiconductor Diodes – Semiconductor diode, ideal versus practical, resistance levels, diode equivalent circuits, transition and diffusion capacitance, reverse recovery time, diode specification sheets, semiconductor diode notation, diode testing.

Diode Applications – Introduction, load line analysis, series diode configurations, parallel and series –parallel configurations, AND/OR gates, clippers, clamps, voltage multipliers.

UNIT II [12 hours]

DC biasing of BJTS – Introduction, operating point, fixed bias circuit, emitter bias, voltage divider bias, dc bias with voltage feedback, miscellaneous bias configurations, design operations, transistor switching networks, troubleshooting techniques, PNP transistors, bias stabilization.

BJT AC Analysis – Introduction, amplification in the ac domain, BJT transistor modeling, r.e. transistor model, the hybrid equivalent model, CE fixed bias, voltage divider bias, CE emitter bias, Determining the current gain, Effect of R_L and R_S, two-port system approach, summary tables, complete hybrid equivalent model, problems on h parameters (only CE configuration)

UNIT III [10 hours]

Power amplifiers – Introduction – definitions and amplifier types, series fed class A amplifier, transformer coupled class A amplifier, class B amplifier operation, class B amplifier circuits. Amplifier distortion, Power transistor heat sink, class C and class D amplifiers. Cascaded systems, Darlington connections.

UNIT IV [10 hours]

Feedback and Oscillator Circuits (BJT version only) – Feedback concepts, feedback connection types, practical feedback circuits, feedback amplifier – phase and frequency considerations, oscillator operation, phase shift oscillator, Wein bridge oscillator, tuned oscillator circuit, crystal oscillator, unijunction oscillator.

UNIT V [10 hours]

BJT frequency response – Introduction, logarithms, decibels, general frequency considerations, low frequency analysis – bode plot, BJT low frequency response, miller effect capacitance, BJT high frequency response.
FETs – Introduction, construction and characteristics of JFETs, transfer characteristics, important relationships, Depletion and Enhancement type MOSFETS.

Lab Experiments:- Clipping, clamping, half wave and full wave rectifiers, RC coupled amplifiers, Darlington emitter follower, RC phase shift oscillator, crystal oscillator, Hartley and Colpitts oscillator, voltage series feedback amplifier, Simulation experiments using Multisim/P-Spice.

TEXT BOOK:

REFERENCE BOOKS:
1. Integrated Electronics - Jacob Millman and Christos C. Halkias - TMH
2. Electronic Devices and Circuits - David A. Bell - PHI 4th edition

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Objectives
- The Knowledge of Digital Electronics as a Cluster core subject is to provide material fundamental to the design and analysis of digital systems.
- To provide various methods and techniques suitable for a variety of digital system design applications.

Introduction
To introduce the generation of switching equations from map and tabulation methods for simplifying Boolean functions.

Combinational Logic Circuits:
To Introduce the systematic procedure for Design and analysis of combinational circuits such as adders, code converters, multiplexers etc.,

Flip-Flops and Simple Flip-Flops Applications:
To Introduce the concept of sequential logic circuits by presenting various types of flip flops (with different types of triggerings). Convenient tools to analyse the sequential circuits are presented

Sequential Logic Circuits:
To Introduce a variety of sequential circuits such as registers, shift registers, counters(synchronous/asynchronous), and their design.

Synchronous Sequential circuits:
To Present various types of Synchronous Sequential Circuits, their structure, and design
UNIT I [11 hours]

Introduction :
Review of Boolean algebra, logic gates. Simplification of Boolean functions: The Map Method, Two and Three Variable Maps, Four Variable Map, Five and Six variable Maps, Product of sums simplification, NAND and NOR implementation, Other Two level implementations, Don’t care conditions, The Tabulation Method, Determination of Prime Implicants, Selection of prime implicants, Concluding Remarks

UNIT II [11 hours]

Combinational Logic Circuits: Introduction, Design Procedure, Adders, Subtractors, Code conversion, Combinational Logic with MSI and LSI: Introduction, Binary Parallel Adder, Decimal Adder, Magnitude Comparator, Decoders, Multiplexers, Programmable Logic Devices, Programmable Read Only memories (PROMs), Programmable Logic Arrays (PLAs), Programmable array logic (PAL).

UNIT III [10 hours]


UNIT IV [09 hours]

Sequential Logic Circuits: Registers, Counters, Design of Synchronous Counters

UNIT V [11 hours]


LAB experiments: Verification of gates, implementation using basic gates and universal gates, Code conversion (Binary to gray, BCD to Excess 3), verify adders, subtracters, multiplexers, demultiplexers, comparators & code converter, verification of Flip flops, counters, shift registers

TEXT BOOKS:
1. Digital logic and computer design- Morris Mano, Prentice Hall
2. Digital Principles and Design- Donald Givone, Tata McGraw Hill

REFERENCE BOOKS:
1. Fundamental of Logic Design- Charles Roth Jr., Thomas Learning
2. Digital Logic Applications and principles- John Yarbrough, Pearson Education
Electromagnetic theory deals with the electric and magnetic fields produced by electric charges and currents, respectively, as well as the interaction forces between such objects. The demonstration that electric and magnetic forces are actually part of the same unified electromagnetic force led to the development of Maxwell’s equations and the realization that light is in fact an electromagnetic wave. The theory of electromagnetism is perhaps the most successful theory of all time, and remains essentially unchanged even with the advent of quantum physics. We will develop the fundamentals of electromagnetic theory by studying individually static electric fields, static magnetic fields and time varying filed.

The overall objectives of each topic are:

- **Coulomb’s Law, Electric Field Intensity (EFI) & Electric Flux Density (EFD):**
  - To review basic concepts of vector analysis
  - To discuss about the Coulomb’s Law
  - To derive equation for EFI, and EFI due to Line Charge, Surface and Volume Charge.
  - To explain the Gauss’ Law and Gauss’ Law applied to differential elements (Divergence theorem).
  - To derive expression for Electric Flux Density and also discuss the Gauss’ Law, Application.

- **Energy and Potential & Current and current density:**
  - To discuss about Energy spent in moving charge,
  - To derive expression for PD and PD due to Point Charge & System of Charge.
  - To develop equation forCurrent, Continuity of Current, Current Density, Energy Density and Boundary Conditions.
  - To explain the Properties of Conductor.

- **Dielectric and capacitance &Poisson’s and Laplace’s equations:**
  - To develop equation for capacitance of different configuration.
  - To derive the expression for Poisson’s and Laplace’s Equations &solution of Poisson’s & Laplace’s for Single Variables.

- **Steady Magnetic Field:**
  - To obtain expression for Biot-Savart Law and its application
  - To explain the Ampere’s circuital law and Ampere’s circuital Law applied to differential elements (Curl)
• To build the relation of Magnetic Flux and Flux Density,
• To recognize the significance of Scalar and Vector Magnetic Potentials.

• Magnetic forces and Inductance & Time varying fields and Maxwell’s equations:
  • To derive equation for Force on a moving charge and Force on different
    current element.
  • To develop equation for Inductance and Mutual Inductance and Magnetic
    Boundary Condition.
  • To derive the expression for Faraday’s Law and Displacement Current.
  • To develop equation for Maxwell’s Equations in Point and Integral Form.
  • To derive the Uniform plane waves, Wave equations and solution of wave
    equation.
  • To discuss the Wave propagation through good dielectric, good conductor,
    skin depth.
  • To obtain expression forPoynting Theorem.

UNIT I

Coulomb’s Law, Electric Field Intensity (EFI):-
Experimental Law, EFI due to Line Charge , Surface and Volume Charge.

Electric Flux Density (EFD), Gauss’ Law, Divergence:-
Electric Flux Density, Gauss’ Law, Application, Divergence and Divergence Theorem.

UNIT II

Energy and Potential:
- Energy spent in moving charge, Definition of Potential Difference (PD), PD due to Point Charge and System of Charge, Energy Density

Current and current density:
-Current and Current Density, Continuity of Current, Conductor, Properties, and Boundary Conditions.

UNIT III

Dielectric and capacitance:
-Dielectric materials, boundary conditions, capacitance of different configuration.

Poisson’s and Laplace’s equations:
-Derivations of Poisson’s and Laplace’s Equations, solution of Poisson’s and Laplace’s for Single Variables.

UNIT V

Steady Magnetic Field:
-Biot-Savart Law, Ampere’s circuitual law, curl, Magnetic Flux, Flux Density, Scalar and Vector Magnetic Potentials.

UNIT V

Magnetic forces and Inductance:
-Force on a moving charge, Force on different current element, Magnetic Boundary Condition, Inductance and Mutual Inductance.

Time varying fields and Maxwell’s equations:
-Faraday’s Law, Displacement Current, Maxwell’s Equations in Point and Integral Form, Uniform plane waves, Wave equations,
solution of wave equation, wave propagation through good dielectric, good conductor, skin depth, Poynting Theorem.

Text Book:


Reference books:


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Objectives

This Course aims at educating UG students about electronic measuring instruments & basic Principles of measurement, starting with an introduction to measurement errors, construction & Working of PMMC meter, range extension methods, followed by study of digital instruments. There is a discussion on measurement of resistance, inductance & capacitance using bridges. The course exhaustively deals with transducers. Recording & display devices were briefly discussed.

Fundamentals of measurement & Electrical measuring instruments

To study the performance characteristics of an instrument.
To classify the three major categories of error of an instrument.
To explain the construction & working of PMMC instrument.
To know how to convert a galvanometer into an ammeter or a voltmeter having desired range
How to use a universal shunt to extend current ranges

Electronic measuring instruments

To list the advantages of an electronic measuring instrument over an analog meter.
To appreciate the basic block diagram description of digital instruments.
To Design the instrument to measure some electrical properties of coils & capacitors using Q-meters.

Measurement of Resistance, Inductance & Capacitance

Measurement of resistance, inductance, capacitance using Bridge methods.

Transducers, Display devices & Recorders

To distinguish the functions of a transducer, principle & working of displacement transducers, temperature sensors, photo sensitive devices.
To recognize the usage of graphical recorders & display devices.
To Measure electrical quantities using C.R.O.
UNIT I [7 hours]
Fundamentals of Measurement

UNIT II [08 hours]
Electronic Measuring Instruments:
Need for electronic measuring instruments, True RMS responding voltmeter, Digital voltmeters- Ramp Type, Integrating Type, Successive Approximation Type, Q meter, Digital Multimeter - Block Diagram description.

UNIT III [08 hours]
Measurement of Resistance, Inductance & Capacitance:
Wheatstone’s Bridge- Sensitivity analysis, Limitations, Kelvin’s Double Bridge, Maxwell’s Bridge, Schering Bridge, sources & Detectors, Minimization of AC Bridge Errors, Problems.

UNIT IV [08 hours]
Transducers-I:
Classification & Selection, Principle of operation of Thermocouples, Resistance Temperature Detectors, Thermistors, LVDT, Capacitive Transducers, Piezoelectric Transducers.

UNIT V [08 hours]
Transducers -II:

TEXT BOOKS:

REFERENCE BOOKS:
2. Electronic Instrumentation & Measurement- by David A. Bell, 2/e, PHI Publications.
IV SEMESTER ELECTRICAL CLUSTER

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Objectives
To prepare students with adequate knowledge in mathematics to succeed in industry and provide necessary platform to pursue academics, keeping pace with global standards. Topics spanned are Probability and Statistics, Complex Analysis and series solution of Differential Equations. The thrust is to identify and clarify concepts of mathematics needed for the graduation program.

UNIT I

Statistics:
Curve fitting – Fitting a straight line, fitting of a parabola, fitting of curves of the form \( y = ae^{bx} \), \( y = ab^x \), \( y = ax^b \), Correlation and regression. (4L+1T)

Probability-1:
Probability of an event, axiomatic definition, addition theorem, conditional probability, multiplication theorem, Bayes’ theorem. (4L+2T)

UNIT II

Probability-2:
Probability distributions: Random variables, Discrete probability distributions, continuous probability distributions, Some standard distributions: Binomial distribution, Poisson distribution, exponential distribution, normal distribution. (7L+2T)

UNIT III

Complex Analysis-1:

Application To Flow Problems:
Complex potential, velocity potential, equipotential lines, stream functions, stream lines.

Transformations: \( w = z^2 \), \( w = e^z \) and \( w = \frac{q^2}{z} \) (\( z \neq 0 \)), Bilinear transformations. (8L+2T)
UNIT IV

Complex Analysis-2:
Complex integration-Cauchy’s theorem, Cauchy’s integral formula, Taylor’s and Laurent’s series, Singular points, poles, residues, the residue theorem. (5L+2T)

Series Solution Of Differential Equations:
Series solution-Frobenius method, series solution of Bessel’s differential equation leading to Bessel function of first kind, equations reducible to Bessel’s differential equation, series solution of Legendre’s differential equation leading to Legendre polynomials, Rodrigue’s formula. (4L+1T)

UNIT V

Optimization:
Linear programming, mathematical formulation of linear programming problem (LPP), graphical method, simplex method, artificial variable technique- M method, two phase method. (7L+3T)

Text Books:
1. Advanced Engineering Mathematics by Erwin Kreyszig, 8th Edn., John Wiley & Sons

Reference Books:
Subject: Op-amps and Linear ICs
Sub. Code: 09ES4GCLIC
Credits: 05
L-T-P: 4-0-1

Objectives:
The opamp has become an important building block of linear integrated circuits and applications. The objective of this course is to offer the student proficiency in the analysis and design of circuits using linear IC’s

Circuit configurations for linear ICs:
To understand the basic circuit configurations for linear IC’s such as current sources, voltage sources and differential amplifier using BJT.

Operational amplifier characteristics:
To discuss the characteristics of 741 opamp.

Applications of Opamps:
To analyze the working of different applications of opamps such as filters, instrumentation amplifiers, comparators, waveform generators etc.

555 timer:
To understand the working principle of the timer and the use of the same in different areas.

A/D and D/A converters:
To understand the fundamentals of conversion techniques and various conversion methodologies.

UNIT I
Operational Amplifier Fundamentals: Operational Amplifier Description, basic operational Amplifier circuit, input and output voltage, common mode and supply rejection, offset voltages and currents, input and output impedances, slew rate and Frequency limitations.

Opamps as DC Amplifiers: Biasing operational Amplifiers, Direct coupled voltage followers, Direct coupled non-inverting amplifiers, Direct coupled inverting amplifiers, summing amplifiers, Difference amplifiers

UNIT II

Signal Processing Circuits : Precision Half wave and Full wave Rectifiers, Limiting Circuits, Clamping circuits, peak Detectors, sample and hold circuit

UNIT III
Opamp Non Linear Circuits: opamp and switching circuits, crossing detectors, inverting and non-inverting Schmitt trigger circuits, Astable and MonostableMultivibrator.
Signal Generators: Triangular/rectangular wave generator, waveform Generator Design, phase shift oscillator, oscillator amplitude stabilization, wien bridge oscillator, Signal Generator output control.

UNIT IV
Active Filters: All pass phase shifting circuits, 1st order lowpass active filter, 2nd order low pass filter, 1st & 2nd order high pass filter

UNIT V

Lab Experiments:
Inverting amplifier, non-inverting amplifier, summing amplifier and voltage follower, precision halfwave and full wave rectifier, limiting circuits, clamping circuits, peak detectors, sample and hold circuits, differentiator and integrator, Schmitt trigger and zero crossing detector, Wien bridge oscillator, first order lowpass and high pass filter, IC 723 low voltage and high voltage regulator Simulation experiments using Labview/ P-Spice.

TEXT BOOKS:

REFERENCE BOOK:

<table>
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<tr>
<th>Subject</th>
<th>8086 MICROPROCESSOR</th>
<th>Sub. Code</th>
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<tr>
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<td>L-T-P</td>
<td>3-0-1</td>
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</tbody>
</table>

Objectives
This course focuses on microprocessor architecture, related hardware, introduces programming, interpolates hardware and software in interfacing microprocessor based products. It maintains a balance between basic concepts and skills needed for system design. The theoretical concepts and practical applications using 8086 microprocessor family gives a solid foundation for developing system architecture and embedded applications.
UNIT I [08 hours]
Introduction, Microprocessor based computer system, Architecture of 8086 Microprocessor, Pin functions, Clock generator, Minimum /Maximum mode of operation.

UNIT II [08 hours]
Read /Write Timing diagrams, Assembly level programming of 8086, 8086 instruction set, addressing modes. Assembler directives, Programming examples.

UNIT III [08 hours]
Stacks, Procedures and Interrupts. Interfacing 8086 with Memory devices.

UNIT IV [08 hours]

UNIT V [07 hours]
Programmable Interval Timer – modes of operation of 8253 and interfacing. 8087 Numeric data processor and interfacing, 8087 Data types.

LAB Experiments:
Data and address transfer operations, unsigned and signed arithmetic operations using instructions for add/sub/mul/div, logical operations, linear search and sorting, code conversion programs using procedures, interfacing I/O devices like DSC, stepper motors, Keyboard, 7 segment display to 8086 using 8255 PPI, realization of ALU, Counters and multiplexer using 8086.

TEXT BOOKS:

REFERENCE BOOKS:
1. Microprocessor and Interfacing, Programming & Hardware- Douglas V Hall, 2nd ed, TMH
2. Microprocessor Architecture, Programming and Applications with the 8085- Ramesh S Gaonkar, 4th ed, Penram International
BMS COLLEGE OF ENGINEERING, BANGALORE
(Autonomous College under VTU)

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<th>Subject</th>
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<tr>
<td>Credits</td>
<td>04</td>
<td>L-T-P</td>
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</table>

Objectives
Coverage of continuous and discrete-time signals and systems, their properties and representations and methods that is necessary for the analysis of continuous and discrete-time signals and systems. Knowledge of time-domain representation and analysis concepts as they relate to difference equations, impulse response and convolution, etc. Knowledge of frequency-domain representation and analysis concepts using Fourier analysis tools, Z-transform.

The overall objectives of each topic are:

- **Introduction:**
  - To determine whether a signal has the following properties: discrete time, continuous time, power, energy, periodic, a periodic, even, odd.
  - To perform the following operations on signals, alone or in combination: amplitude scaling, addition, multiplication, differentiation, integration time scaling, reflection, time shifting.
  - To determine whether an input/output description for a system has the following properties: stability, memory, memoryless, causality, inevitability (simple cases), time invariance, linearity.

- **Time-domain Representations For LTI Systems:**
  - To evaluate the convolution sum and integral given an input and the impulse response
  - To derive equation for characterize the natural response, forced response, and complete response for systems described by second order difference or differential equations
  - To discuss about Block diagram representations

- **Fourier Representation For Signals – 1:**
  - To drive an expression for properties of FS&DTFS.
  - To determine the FS &DTFS representation is appropriate for a give signal

- **Fourier Representation For Signals – 2:**
  - To drive an expression for properties of FT&DFTT.
  - To determine FT & DTFT representation is appropriate for a give signal.

- **Applications Of Fourier Representations:**
  - To study the Frequency response of LTI systems for Fourier transform representation of periodic signals.
  - To study the Frequency response of LTI systems for Fourier transform representation of discrete time signals.
Z-Transforms – 1:
- To discuss the Z – transform and to drive an expression for properties of Z – transform.
- To explain properties of ROC of Z – transforms and inversion of Z–transforms.

Z-Transforms – 2:
- To study of Transform analysis of LTI Systems, unilateral Z- Transform and its application to solve difference equations.
- To study of LTI discrete-time signals and systems in the frequency domain using z-transforms (transfer function) and the discrete-time Fourier transform (frequency response).

UNIT I [10 hours]
Introduction: Definitions of a signal and a system, classification of signals, basic Operations on signals, elementary signals, Systems viewed as Interconnections of operations, properties of systems.

UNIT II [12 hours]

UNIT III [12 hours]
Fourier Representation For Signals - 1 : Introduction, Discrete time and continuous time Fourier series (derivation of series excluded) and their properties.
Fourier Representation For Signals – 2: Discrete and continuous Fourier transforms(derivations of transforms are excluded) and their properties.

UNIT IV [08 hours]
Applications Of Fourier Representations: Introduction, Frequency response of LTI systems, Fourier transform representation of periodic signals, Fourier transform representation of discrete time signals

UNIT V [10 hours]

TEXT BOOK:
BMS COLLEGE OF ENGINEERING, BANGALORE
(Autonomous College under VTU)

REFERENCE BOOKS:

Subject  
CONTROL SYSTEMS  
Sub. Code  
09ES4G00ST  
Credits  
04  
L-T-P  
4-0-0

Objectives
This course aims at representation, performance analysis and stability analysis of linear time invariant control systems. This forms a background to the study of non-linear control systems.

Block Diagram, Signal Flow Graph:
To learn to represent Single Input and Single Output, Multiple Input and Multiple Output systems and evaluate their transfer functions.

Time response Of Systems:
To analyze control systems of first and second order with respect to their response to certain types of test inputs in the time domain.
To evaluate their performance through determination of various specifications in the time domain.

Stability Analysis:
To determine the stability of systems applying time-domain and frequency-domain analyses and using stability techniques such as BODE, ROOT LOCUS etc.

UNIT I  
[12 hours]

UNIT II  
[10 hours]
Time Response Analysis of Control Systems: Step response of first order, second order systems, response specification, steady state error and error constants

UNIT III  
[10 hours]
UNIT IV [10 hours]

**Root Locus Technique:** Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot

UNIT V [10 hours]

**Frequency Response Analysis:** Bode plots, Relative stability, Frequency domain specification.

TEXT BOOK:
1. Control Engineering by Nagrath & Gopal, New Age International Publishers

REFERENCE BOOKS:
1. Modern control Engineering - Ogata, Prentice Hall
2. Automatic Control Systems - B.C Kuo, John Wiley and Sons

<table>
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<th>Subject FUNDAMENTALS OF HDL</th>
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<td>Credits</td>
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</table>

Objectives

The objective of the course is to study the programming concepts of VHDL and verilog. The same is implemented using the simulation tools.

UNIT I [07 hours]

**Introduction:**
Why HDL? , A Brief History of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, simulation and synthesis, Brief comparison of VHDL and Verilog.

UNIT II [08 hours]

**Data-flow Descriptions:**
Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type – Vectors. Behavioral Descriptions: Behavioral Description highlights, structure of HDL behavioral Description, The VHDL variable –Assignment Statement, sequential statements.

UNIT III [08 hours]

**Structural Descriptions:**
Highlights of structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements.

UNIT IV [08 hours]

**Procedures and Functions:**
UNIT V [08 hours]

**Synthesis Basics:**
Highlights of Synthesis, Synthesis information from Entity and Module, Mapping Process and Always in the Hardware Domain.

**LAB Experiments:-**
Verification of combinational logic circuits, sequential circuits using data flow and sequential descriptions & structural descriptions. Interfacing experiments : stepper motor, dc motor, relay, waveform generation.

**TEXT BOOK:**

**REFERENCE BOOKS:**
1. Verilog HDL -Samir Palnitkar, Pearson Education
2. VHDL -Douglas Perry, TMH
4. Circuit Design with VHDL-VolneiA.Pedroni, PHI
**Objectives**

To understand the concepts of power transmission and distribution system to learn the usage of passive elements in various Power Transmission Systems. To understand the factors affecting Insulators and also in Under Ground cables. To calculate the various parameters in Distribution System. To study line parameters and performance of transmission of lines.

The overall objectives of each topic are:

- **Typical Transmission & Distribution Systems Scheme:**
  - To provide an overview of components of power systems and line parameters.
  - To discuss the Standard voltages for transmission and advantage of high voltage transmission.
  - To explain a Feeders, distributors& service mains.

- **Overhead Transmission Lines-:**
  - To model the affects of sag in over head lines under various conditions.

- **Insulators:**
  - To discuss the types of insulators and derive an expression for potential distribution over a string of suspension insulators.
  - To explain the String efficiency & methods of increasing strings efficiency.
  - To discuss about the testing of insulators.

- **Distribution:**
  - To explain the radial & ring main systems and the ac to dc distribution.
  - To derive the calculation for concentrated loads and uniform loading.

- **Underground Cables:**
  - To introduce the types of underground cables, material used, and derive an expression for various cable parameter.
  - To introduce method of cable testing.

- **Line Parameters:**
  - To develop equation for calculation of inductance of 1Ø, 3Ø lines with equilateral & unsymmetrical spacing.
  - To develop equation for calculation of Capacitance-calculation for two wires & 3Ø lines, capacitance calculation for two wires 3Ø line with equilateral & unsymmetrical spacing.

- **Performance Of Power Transmission Lines:**
  - To obtain mathematical models of over head transmission lines and to analyze the performance based on developed models.
UNIT I


B: Overhead Transmission Lines: Sag calculation in conductors a) suspended on level supports b) support at different levels. Effect of wind & ice tension & sag at erection. Stringing chart.

UNIT II

A: Insulators: Types, potential distribution over a string of suspension insulators. String efficiency & methods of increasing strings efficiency, testing of insulators.

B: Distribution: Radial & ring main systems, ac to dc distribution: calculation for concentrated loads and uniform loading

UNIT III

Underground Cables: Types, material used, insulation resistance, thermal rating of cables, charging current, grading of cables, capacitance grading & inter sheath grading, testing of cables.

UNIT IV

Line Parameters: Calculation of inductance of single phase, 3 phase lines with equilateral & unsymmetrical spacing. Capacitance calculation for two wires & three phase lines, capacitance calculation for two wire three-phase line with equilateral & unsymmetrical spacing.

UNIT V

Performance Of Power Transmission Lines: Short Transmission-lines, medium Transmission-lines, nominal T method, π method and long transmission lines, ABCD constants of Transmission lines.

TEXT BOOKS:

REFERENCE BOOKS:
Objectives
In this course, students belonging to the Electrical and Electronics discipline are introduced to the fundamental concepts of digital signal processing, starting from its evolution, to its predominant use in development of new technologies for different applications. They apply mathematical concepts in obtaining the frequency spectrum and their reconstruction from the samples of signals. They also use algorithms for computation of frequency spectrum. They obtain system outputs through simplified processes using the properties of transforms. They develop structural representations for systems (filters) and design them for given specifications.

Introduction:
- To illustrate the applications of digital signal processing.
- To highlight the contributions to development of technology through DSP.
- To appreciate the need for analyses of signals in the digital domain.
- To distinguish the distinctive features of analog signal processing and digital signal processing.
- To identify the problems associated with the sampling process.

Discrete Fourier Transform:
- To obtain the frequency spectrum of a signal from its sampled values (DFT) using mathematical techniques for its evaluation.
- To obtain the system response using the properties of DFT.

Block Convolution:
- To identify the need and to determine the system response for an input signal of different length of samples by different methods of block convolution.

Computation of Discrete Fourier Transform:
- To use the radix-2 algorithms for computation of the Discrete Fourier transform as well as reconstruction from sampled values of a signal.
- To list out the distinctive features, advantages, disadvantages, and computational efficiency of each.

Development of system structures:
- To classify digital systems based on the nature of their impulse response (IIR AND FIR).
- To realize system structures for both types with the help of block diagram
Design of Filters
- To design IIR (infinite impulse response) digital filters such as Butterworth and Chebyshev given their specifications in analog as well as digital domains using different methods of transformation from analog to digital domains.
- To design filters FIR (finite impulse response) by the windowing technique choosing the type of window based on the required specifications.
- To identify the drawback associated with windowing technique and know how it is overcome.

UNIT I
Introduction to DSP, Sampling and reconstruction of a discrete time signal in the frequency domain. Definition of Discrete Fourier Transform (DFT). Useful properties of DFT: linearity, circular shift, Multiplication by a complex exponential sequence, Properties of even and odd parts of x[n], Multiplication, Parseval's relation.

UNIT II
(A) Circular convolution in the time domain, use of tabular arrays and circular arrays. Use of DFT in linear filtering, linear convolution of two finite duration sequences, overlap add and save methods.
(B) Relation between DFT and other transforms. Direct computation of DFT. Necessity for efficient computation of DFT. Radix 2 Fast Fourier Transform (FFT) algorithm for DFT computation. Decimation in time algorithm, decimation in frequency algorithms.

UNIT III
(A) Computation of 2N point DFT of a real sequence using single N point DFT. Computation of N point DFT of a real sequence using N point DFT. Decomposition for 'N', a composite number. Number of computations, number of multiplications, computational efficiency, Radix 2 FFT algorithm for computation of Inverse Discrete Fourier Transform. (IDFT)
(B) Introduction to realization of digital systems, block diagrams, representation. Realization of Infinite Impulse Response (IIR) systems: direct form, parallel form, cascade form.
Realization of Finite Impulse Response (FIR) systems: Direct Form, Linear Phase Form.

UNIT IV
UNIT V

(A) Introduction to FIR filters, Frequency response of ideal digital low pass filter, high pass filter, frequency sampling technique of designing FIR filters.

(B) Windowing, Design of FIR filters using rectangular, triangular, Hamming, Hanning and Blackman window. Gibbs phenomenon (qualitative discussion only), comparison between IIR and FIR filters.

TEXT BOOKS:

REFERENCE BOOKS:

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<th>Subject</th>
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<th>Sub. Code</th>
<th>10EE5DCTIM</th>
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<tr>
<td>Credits</td>
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Objectives
This Course is the backbone of the power sector, the analysis of which is very important for practising Electrical engineers. This Course takes the student through various aspects of electrical machine performance & analysis. This Course is the prerequisite for the power system courses. The complementary laboratory course helps the student to understand the various control methods & testing methods of Electrical machines.

Transformers
To analyse the principle of operation & construction of single phase transformer. To develop the electrical equivalent circuit of a single phase transformer. To draw the phasor diagram of a practical transformer under no load & loaded conditions.
Testing the transformer for the measurement of losses.
To Evaluate the performance quantities like efficiency & voltage regulation.
To appreciate three phase transformer connections & their usage.

Induction Machines
To analyse the principle of operation & construction of three phase induction motors.
To develop the equivalent circuit of a three phase induction motor.
To obtain the performance evaluation of 3 phase induction motor thro’ equivalent circuit & circle diagram.
To analyse the performance of high starting torque cage motors.
To Distinguish the Starting methods & speed control methods of 3 phase induction motor.

UNIT I
(A) Basic Concepts: Principle of transformer action for voltage transformation. Constructional details of shell type and core type single-phase transformers.

UNIT II

UNIT III

UNIT IV
Basic Concepts of Induction Machines: Concept of rotating magnetic field. Operating principle, construction, classification and types — single-phase, three-phase, squirrel-cage, slip-ring, Three-phase Induction Motor: Phasor diagram of induction motor on
no-load and loaded conditions. Visualization of a three-phase induction motor as a
generalized transformer with a rotating secondary and obtaining its equivalent
evaluation — output power, torque, efficiency, current and power factor. 10 Hrs

UNIT V

(A) Torque-slip characteristics covering motoring, generating and braking regions of
operation. Induction generator. No-load and blocked rotor tests. Circle diagram and
therefrom performance evaluation of the motor. Cogging and crawling. Equivalent
circuit and performance of double-cage and deep-bar motors. —

(B) Starting and Control of Three-phase Induction Motor, Need for starter. DOL, Y-
Delta and auto-transformer starting. Rotor resistance starting. Speed control —
voltage, frequency, and rotor resistance variations.

(C) Single-phase Induction Motor: Double revolving field theory and principle of
operation. Types of single-phase induction motors: split-phase, capacitor start,
shaded pole motors.

12Hrs

Laboratory Experiments Test on single phase transformer: OC, SC test and pre-
determination of efficiency and regulation. Load test and performance evaluation,
Sumpner’s test, polarity test, Parallel operation. Three phase transformer connections
and scott connection. Tests on three phase induction motor. Load test, OC and
SC tests and development of equivalent circuit and performance evaluation through
Circle diagram, Speed control of 3-phase induction motor. Load test on single
phase induction motor, OC and SC test and development of equivalent circuit.

TEXT BOOKS:

   and sons –New Delhi.

2. Transformers and Induction Machines, Dr. A S Aravind Murthy, Pearson
   Publications.

REFERENCES:

   Education Pvt Ltd., New Delhi

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<th>Subject</th>
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Objectives:

1. To list sources of Electrical Power: Different types of energy avenues/methods/generation.
2. To identify the purpose of nuclear power as an alternative to fossil fuels, problems encountered with nuclear power stations.
3. To know the operation of Diesel Power plants: diesel and gas turbine power plants.
4. To contemplate over use of Water as a perpetual element for power generation and coal based power generation.
5. To distinguish and compare different types of cost structures and hence tariff for power generation power factor improvement to reduce load, plant capacity and cost of power.
6. To recognize bus bar arrangement of power transmission, different types and their placement. To list the limitations of current using reactors and MVA calculation during short circuit on power systems.

UNIT I
Sources Of Electrical Power: Conventional and nonconventional sources: Introduction, environmental impact, prospects, development, applications, recent advances in energy resources (block diagram approach only). Concept of co-generation. Combined heat and power distributed generation 8 Hrs

UNIT II
(B) Diesel electric plants. Gas turbine plants. Mini, micro, and bio generation. Concept of distributed generation. 8 Hrs

UNIT III
(A) Hydro Power Generation: Selection of site. Classification of hydro-electric plants. General arrangement and operation. Hydroelectric plant power station structure and control.
(B) Thermal Power Generation: Introduction. Main parts of a thermal power plant. Working Plant layout. 8 Hrs

UNIT IV
(B) Power factor improvement and tariffs. Energy-load curve 8 Hrs

UNIT V
(B) Current limiting reactors. Symmetric short circuit MVA calculations. 7 Hrs

TEXT BOOKS:

REFERENCES:

<table>
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<tr>
<th>Subject Microcontrollers</th>
<th>Sub. Code</th>
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Objective:
The objective of this course is to introduce the students to the fundamental concepts of 8051 Microcontrollers.

During the course, the students will be learning about the internal architecture of the 8051 Microcontroller and the instruction set. They will be learning to write assembly programming. Programming in Embedded C is also included in the syllabus. The course also includes lab sessions in order to strengthen the programming skills. The lab sessions include programming in Assembly language as well as programming using Embedded C code for interfacing experiments.

The overall objectives of different topics are:

8051 Architecture:
- To distinguish between Microcontrollers and Microprocessors
- To review different types of architectures
- To understand the architecture of the 8051 Microcontroller

Addressing modes and Instruction set:
- To learn the different types of addressing modes and instruction set.
- To apply these concepts to understand the operations like data transfer, arithmetic, logical and branching instructions.

Programming in C:
- To distinguish between Embedded C and 8051 Assembly Programming
- To develop programs using Embedded C language.

Timer / Counter, Interrupts Programming:
- To analyze the different operating modes of the Timers and different types of Interrupts.
- To program Timers in different modes to create delays, waveform generation, using both Embedded and Assembly code.
- To create and analyze interrupt driven programs using both Embedded and Assembly code.
8051 Serial Communication:
- To learn basics of serial communication, different modes and baud rate calculations
- To create programs to communicate to display unit/any other unit through serial port of 8051.

8051 Interfacing and Applications:
- To have an idea of the interfacing concepts of 8051
- To interface and analyze the behavior of various devices/machines like DAC, LCD display, Stepper motor, DC motor using 8051 Embedded C/Assembly language
- To enable the students to carry out project work using 8051 Microcontroller.

UNIT I
Introduction to Microcontrollers:
The 8051 Architecture: Introduction, 8051 Microcontroller Hardware, Input/Output Pins, Ports and Circuits, External Memory.

UNIT II
Assembly Language Programming in 8051
Addressing Modes and Instruction set: Introduction, Addressing modes, Data transfer instructions, Example programs, Arithmetic instructions, Logical instructions, Example programs, JUMP and CALL Program range, Jumps, calls and Subroutines, Returns, Example Programs.

UNIT III
Embedded 'C' Programming:
8051 programming in C: Data types and time delays in 8051 C, I/O programming, logic operations, data conversion programs, accessing code ROM space, data serialization.

UNIT IV
8051 Serial Communication: Basics of Serial Communication- Serial data input/output, 8051 connections to RS-232, 8051 Serial communication Programming.
Interrupts Programming: 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Interrupt programming in C.
UNIT V

8051 Interfacing and Applications:
Interfacing 8051 to LCD, Keyboard, DAC, ADC, Stepper motor, DC motor interfacing and PWM. 7hrs

Laboratory Experiments:
A. Data Transfer, Logical-Byte/Bit manipulations, Jump and Subroutine Calls using Assembly-Language Programming
B. Interfacing: Counters and generate delay using timers, LCD Display, Stepper motor control using interrupt, Serial transmission/Receiving of Number of characters using serial interrupt, Temperature Controller interface, Elevator interface and 7 segment interface.

The Experiments will be implemented using 'Keil' software with Embedded IDE. For interfacing programs 8051 target board is used.

TEXT BOOKS:

REFERENCE BOOKS:
1. "Programming and Customizing the 8051 Microcontroller", Predko ;, TMH

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<th>Electrical Measurements and Control Systems lab</th>
<th>Sub. Code</th>
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1. To measure (a) Medium resistance by Wheatstone bridge, (b) Low resistance by Kelvin's Double Bridge. (c) High Resistance by Megger.
3. Measurement of Inductance and Capacitance using A.C Bridges
4. Calibration of Single Phase Energymeter
5. To measure the variation in speed of a dc servomotor in terms of voltage and frequency using an optical sensor and a frequency to voltage converter.
6. Using MATLAB, to simulate a typical second order system and to determine the step response and to evaluate $\zeta$ (a) the time-domain specifications for different values of $\zeta$
   (b) the effect of change in $\zeta$ on pole location and stability

7. (a) Using MATLAB, to design a passive RC lead compensating network for the given specifications, viz., the maximum phase lead and the frequency at which it occurs and to obtain its frequency response.
   (b) Verify experimentally the frequency response of the above lead compensating network.

8. (a) Using MATLAB, to design a RC lag compensating network for the given specifications, viz., the maximum phase lag and the frequency at which it occurs, and to obtain its frequency response
   (b) Verify experimentally the frequency response of the above lag compensating network.

9. To study the effect of P, PI, PD and PID controller on the step response of a feedback control system. Verify the same by simulation using MATLAB/SIMULINK.

VI SEMESTER

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<td>POWER SYSTEM ANALYSIS</td>
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<td>04</td>
<td>3-1-0</td>
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Objectives

Representation of Different elements of Power systems and their interconnection, short circuit studies, symmetrical components, sequence impedance & networks, and unsymmetrical fault analysis using symmetrical components.

The overall objectives of each topic are:

- **Representation of power system components:**
  - To model the elements of power system
  - To review basic concepts of Circuit models of Transmission line.
  - To obtain the components of power systems and draw the one line diagram, impedance and reactance diagram.
  - To develop equation in per unit system.

- **Formation of Y-bus and Z-bus and Symmetrical 3 - Phase Faults:**
  - To develop the Formation of Y-bus and Z-bus & Matrix partitioning technique.
  - To study on Transients on a transmission line, Short-Circuit currents and the reactance of synchronous machines on load and on no load.

- **Symmetrical Components:**
  - To study Dr.Fortescue's theorem of symmetrical components.
  - To discuss the sequence components for voltage and current.
  - To develop equation for impedance offered to Positive, Negative and Zero sequence currents in symmetrical circuits.
  - To discuss Phase shift of symmetrical components in star-delta/delta-star transformer bank.
  - Derive an expression for power in terms of symmetrical components.

- **Sequence Impedances and Networks of Power System Elements:**
  - To develop relation of Analysis of balanced and unbalanced loads against unbalanced 3 phase supply.
  - Sequence impedances and networks of power system elements (alternator, transformer and transmission line) Sequence networks of power systems.

- **Unsymmetrical faults:**
  - Analysis of L-G, L-L, L-L-G faults on an unbalanced alternator with and without fault impedance.
  - Concept of Open conductor faults in power system.
UNIT I [7L+3T]

**Representation Of Power System Components:** Circuit models of Transmission line, Synchronous machines, Transformer and load. One line diagram, impedance and reactance diagram. Per unit system, per unit impedance. Single line diagram of power system.

UNIT II [8L+2T]

Formation of Y-bus and Z-bus, Matrix partitioning technique, Symmetrical 3 - Phase Faults: Transients on a transmission line, Short-Circuit currents and the reactance of synchronous machines on load and on no load.

UNIT III [7L]

**Symmetrical Components:** Analysis of unbalanced load against balanced Three-phase supply, neutral shift, Resolution of unbalanced phasors into their symmetrical components, Phase shift of symmetrical components in star-delta transformer bank, Power in terms of symmetrical components.

UNIT IV [7L+4T]

Analysis of balanced and unbalanced loads against unbalanced 3 phase supply, Sequence impedances and networks of power system elements (alternator, transformer and transmission line) Sequence networks of power systems.

UNIT V [10L+4T]

**Unsymmetrical Faults:**
L-G, L-L, L-L-G faults on an unbalanced alternator with and without fault impedance. Unsymmetrical faults on a power system with and without fault impedance. Open conductor faults in power system.

**TEXT BOOKS:**
1. Elements of Power System Analysis- W.D.Stevenson, -TMH,

**REFERENCE BOOKS:**
1. Power System Analysis- Hadi Sadat- TMH
4. Power System Analysis- W.D.Stevenson& Grainger- TMH
Objectives

The course mainly aims at the detailed concepts of electrical machines such as dc motors, synchronous generators, synchronous motors. Students learn the various types of these machines, their control, analysis and applications. This course gives a solid base to understand various courses in future such as Power system analysis, Industrial Drives & Applications etc.,

The dc machine is the first to be dealt with, and gives an insight into various concepts like distinctive characteristics, types of dc generators and motors, speed control, important phenomenon such as armature reaction, commutation, testing of dc motors, and applications.

Under the synchronous machines, firstly the course introduces to the concepts of Synchronous generators (alternators), factors affecting the emf generated, various methods to evaluate the important performance parameter such as voltage regulation. It also gives an important practical aspect i.e synchronization of alternators and their operation under various conditions such as variable excitation, variable frequency.

The objectives of the contents under Synchronous Motor is the principle of operation, starting methods, phenomenon of hunting etc.,

DC Generator

To Expose various concepts such as armature reaction, commutation, use of interpoles and compensating winding. Analysis of the behavior of generators through load characteristics.

DC Motors

To discuss elementary treatment of types of dc motors and their characteristics, Detailed analysis of various methods of Speed Control. Losses in dc machines

Testing of DC Machines and Applications

To evaluate the performance parameters such as efficiency by analyzing the behaviour of dc machines by various testing methods.

Synchronous Machines

To focus on the basic principles, constructional features.

To Evaluate of performance parameter such as voltage regulation of alternators using various methods.

Synchronisation

To discuss the concept, necessity conditions of synchronization. Parallel operation of alternators.

To analyse the behavior of alternators in synchronism
To analyse the behavior of synchronous machines using equations, capability curves of synchronous generators.
To discuss the methods of starting.

UNIT I

A) DC Generator - Review:
Classification of DC generator, types of armature winding, EMF equation, armature reaction, commutation, No load & load characteristics, use of interpoles & compensating winding (only qualitative analysis).

B) DC Motors - Review:
Classification, Back EMF equation, Torque equation, Characteristics of shunt, series & compound motors, Speed control of shunt, series & compound motors, losses in DC machines (both generator and motor)

UNIT II

Testing of DC Machines and Applications,
Power flow diagrams, direct & indirect methods of testing of DC machines, Swinburne's test, Hopkinson's test, Retardation test, applications of DC motors,

UNIT III

Synchronous Machines - Basic principle of operation, construction of salient & non-salient pole synchronous machines, generated EMF, effect of distribution of winding and use of chorded coils.

Voltage Regulation:
Voltage regulation by EMF, MMF, Potier Triangle method, voltage regulation of salient machines.

UNIT IV

Synchronisation:
Concept, necessity, conditions, Synchronizing to infinite bus bars, parallel operation of alternators. Operating characteristics, power angle characteristics excluding armature resistance, operation for fixed power input and variable excitation and vice-versa for both generating and motoring modes

UNIT V

V curves of synchronous machines, power flow equations including armature resistance, capability curves of synchronous generators, hunting in synchronous machines, damper winding, starting methods.

Lab Experiments:
TEXT BOOKS:
2. DC and Synchronous Machines, Dr. A S Aravind Murthy, Pearson Publications.

REFERENCES:

<table>
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Objectives
The scope and objective of the course is to develop an understanding of state of the art in power electronic devices and circuits: their operations, performance, protection and applications.

The overall objectives of each topic are,
- Introduction, power Semiconductor Devices:
  - To impart knowledge on different applications of power electronics.
  - To understand the concept of power semiconductor devices used as a switch.
  - To learn the Control characteristics of power semiconductor devices.
  - To study the switching characteristics of power transistor, MOSFET.

- Thyristors:
  - To learn the characteristics of thyristor.
  - To study the concept of two transistor model turn-on, turn-off.
  - To understand different classification of thyristors.

- Control Rectifiers:
  - To study the principle of phase controlled converter and
  - To expose students to the concepts of different types of 1φ & 3φ converters such as semi-converter, full converter

- Inverters:
  - To impart knowledge on principle of operation of inverter, the performance parameters.
  - To study different types of inverters both 1φ & 3φ.

- Choppers:
  - To study the concept dc-dc converter& its principle & performance parameters.
  - Classification of choppers & also to study the concept of AC voltage controllers
UNIT I


UNIT II


UNIT III


UNIT IV


UNIT V


Laboratory Experiments
1. Static characteristics of SCR, MOSFET and IGBT.
2. SCR turn-on circuit using synchronized UJT relaxation oscillator.
3. SCR Digital triggering circuit for a single-phase controlled rectifier OR A.C. voltage controller.
5. A.C. voltage controller using TRIAC and DIAC combination connected to R and R-L loads.
6. Speed control of a separately excited D.C. motor using an IGBT or MOSFET based chopper.
7. Simulation Study of Power Electronic Circuits (Controlled Rectifiers or Choppers)
8. MOSFET OR IGBT based single-phase full-bridge inverter connected to R load.

TEXT BOOK:

REFERENCES

<table>
<thead>
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<th>MODERN CONTROL THEORY</th>
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Objective
The objective of this course is to introduce the state space approach for modeling and control of linear systems using state space approach. It is also intended to give an introduction to the non linear systems. This course is intended to make students develop the ability to do the following:

1) Modeling:
   To create state models using physical variables, mathematical variables and to solve the state equation.

2) Check Controllability and observability:
   To check the system for its Controllability and observability which is helpful in the design of controller.

3) Design controllers:
   To develop ability to design of controllers using state feedback with state observers.

4) Nonlinear systems analysis:
   To develop ability to classify nonlinear systems and apply the phase plane method for the analysis of some simple nonlinear systems.
BMS COLLEGE OF ENGINEERING, BANGALORE
(Autonomous College under VTU)

UNIT I
State Variable Analysis and Design:
Introduction, concept of state, state variables and state model, state modeling of linear systems, linearization of state equations. State space representation using physical variables, phase variables & canonical variables. 8 Hrs

UNIT II
Derivation of transfer function from state model, Eigen values, Eigen vectors, generalized Eigen vectors. Solution of state equation, state transition matrix and its properties, computation using Laplace transformation, power series method, Cayley-Hamilton method. 8 Hrs

UNIT III
Concept of controllability & observability, methods of determining the same, Effect of Pole-Zero Cancellation. Duality. 7 Hrs

UNIT IV
Pole Placement Techniques:
Stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole placement, state regulator design, and design of state observer. 8 Hrs

UNIT V
Non-linear systems:
Introduction, behavior of non-linear system, common physical non linearity-saturation, friction, backlash, dead zone, relay, multi variable non-linearity. Phase plane method, singular points, stability of nonlinear system, limit cycles, construction of phase trajectories. 8 Hrs

TEXT BOOKS:

REFERENCE BOOKS:
1. State Space Analysis of Control Systems- Katsuhiko Ogata -Prentice Hall Inc
3. Modern Control Engineering- Katsuhiko Ogata- PHI 2003
OBJECTIVES
Over the years, the power system has grown in size and is highly interconnected due to operational reasons. The power utilities need to carry out a number of studies in order to ensure proper planning, operation and control of modern day power systems. The aim of the course is to equip the student with the knowledge required to carry out the various studies on practical power systems. The course is designed to fulfill the following objectives.

1. To acquaint the student with the mathematical background for carrying out a load flow study. The formulation of the load flow problem and different iterative methods to solve the problem are introduced.
2. To introduce the student to the topic of optimal operation of power systems. The application of mathematical optimization techniques in order to solve the economic dispatch problem is introduced.
3. To introduce the concept of power system stability. The student learns numerical methods for solving non-linear differential equations used for transient stability analysis.
4. For the different problems identified above, the student learns to carry out simulation studies by developing a computer program or by means of a standard software package.

UNIT I [10 hours]
Network Formulation, representation of transmission lines and transformers with off nominal turns ratio, Formation of Y_bus by inspection, Bus incidence matrix, Primitive network - impedance form and admittance form, Y_bus by singular transformation, Z_bus building algorithm (without mutuals).

UNIT II [10 hours]
Power flow equations, Classification of buses, Operating constraints, Data for load flow; Gauss-Seidel Method - Algorithm and flow chart for PQ and PV buses (numerical problem for one iteration only), Acceleration of convergence.

UNIT III [10 hours]
Newton-Raphson Method - Algorithm and flow chart for NR method in polar coordinates (numerical problem for one iteration only), Algorithm for Fast Decoupled load flow method, Comparison of Load Flow Methods.

UNIT IV [12 hours]
scheduling including generator limits and neglecting losses; Economic Dispatch including transmission losses; Derivation of transmission loss formula, iterative technique for solution of economic dispatch with losses.

UNIT V [10 hours]


Lab Experiments
1. $Y_{bus}$ formation for power systems with and without mutual coupling, by singular transformation and inspection method.
2. Determination of bus currents, bus power and line flow for a specified system bus voltage Profile
3. Formation of $Z_{bus}$ using $Z_{bus}$ building Algorithm without mutual coupling.
4. ABCD parameters:
   (i) Formation for symmetric $\pi$ and $T$ configuration.
   (ii) Verification of AD-BC=1
   (iii) Determination of efficiency and regulation
5. To determine (i) Swing curve (ii) critical clearing time, for a single m/c infinite bus system with a double circuit line, for a 3-phase fault on one of the lines. Simulation for the above to be conducted with variations in inertia constant/line parameters /fault location/clearing time/pre-fault electrical output.
7. To perform load flow using Gauss-Seidel method (only PQ bus)
8. Load flow analysis using Gauss Siedel method, NR method, Fast decoupled flow method for both PQ and PV buses.
9. Optimal Generator Scheduling for Thermal power plants.
10. To determine fault currents and voltages in a single transmission line system with star-delta transformers at a specified location for SLGF, DLGF.

Note: Write programs for Experiments 1-7, use Simulation Package for Experiments 8-10.

TEXT BOOKS:
4. **Power System Analysis**, W.D Stevenson, TMH

**REFERENCE BOOKS:**


<table>
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<th>SWITCHGEAR AND PROTECTION</th>
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**Objectives**

**Fuses and Protective Relays:**

To have knowledge of various switchgear components. The students being able to list and identify the types of fuses. The ability to know the applications of the main components used in power system protection. To develop an understanding of switch sizes, ratings and requirements. Students being knowledgeable in selecting the qualities and having a choice in designing the required type of relay for a particular abnormal condition.

**Electromechanical Relays:**

Students are knowledgeable in the field of relays. Students will demonstrate and ability to design the relevant protection systems for the main elements of a power system. The ability to design over current protection relay, which can operate on the permissible conditions by setting the over current value. The ability to test unwanted conditions (over current) and when such conditions arise to isolate the fault condition in the shortest time possible. To investigate IDMT curve characteristic. To develop the skills of practical system design.

**Circuit Breakers:**

To identify the types of circuit breakers. To establish an understanding of circuit breaker operation, figures of merit, design, ratings and their effect on reliability. To provide an appreciation of the need for different ratings, and to develop skills in applying appropriate correction techniques under various supply and load conditions. Examine the causes and effects of transients at the distribution level and the application of various protection schemes.

**Static Relays:**

An ability to differentiate the static relays operation from the conventional relays. To understand the knowledge of basic operation of static relays. An ability to design various components involved in static relays operation. The student shaving necessary foundation for functioning of sensors involved and design of individual subcomponents and their coordination.
Comparators:
To have a knowledge of classification of comparators and their importance. An ability to apply knowledge of mathematics and engineering. An ability to design and conduct experiments, as well as to analyze and interpret data. An ability to design a system, component, or process to meet desired needs within constraints such as economic, environmental, safety, manufacturability, and sustainability.

UNIT I [10 hours]
Switches And Fuses: Isolating switch, load breaking switch, Fuse law, cut-off characteristics, Time current characteristics, fuse material, HRC fuse, liquid fuse, Application of fuse.
Protective Relaying: Requirement of Protective Relaying, Zones of protection, primary and backup protection, Essential qualities of Protective Relaying, Classification of Protective Relays.

UNIT II [10 hours]
Induction Type Relay: Non-directional and directional over current relays, IDMT and Directional characteristics. Differential relay - Principle of operation, percentage differential relay, bias characteristics, distance relay, Impedance relay, Reactance relay, Mho relay, Buchholz relay, Negative Sequence relay.

UNIT III [10 hours]
Circuits Breakers: Air Circuit breakers - Air break and Air blast Circuit breakers, SF6 breakers, Vacuum Circuit breakers, Construction, principle of operation, Advantages and disadvantages of different types of Circuit breakers.

UNIT IV [10 hours]
Static Relays: Introduction, Basic construction, Classification, Basic Circuits, Smoothing Circuits, Voltage regulation, square wave Generator, Time delay Circuits, Level Detectors, Summation device, Sampling Circuits, Zero crossing detector, output devices

UNIT V [12 hours]
Comparators: Replica impedance, Mixing Transformers, General equation of phase and Amplitude, Comparators, Realization of ohm, mho, Impedance and offset impedance characteristics, Duality principle, Static amplifier comparator - Rectifier bridge circulations current type, sampling comparator, static phase comparator coincidence circuits type Rectifier phase comparator.
Lab Experiments
1. Fuses
2. Overcurrent protection using Electromagnetic relays
3. Over-Voltage protection using Electromagnetic relays
4. Under-Voltage protection using Electromagnetic relays
5. Over-Voltage protection using Static relays
6. Under-Voltage protection using Static relays
7. Motor Protection relay
8. Operation of Circuit Breaker using PSCAD
9. Capacitive Switching using PSCAD
10. Detection of various types of faults in a simple AC system using PSCAD

TEXT BOOKS:
2. Power System Protection & Switchgear - Badriram&ViswaKharma -TMH.

REFERENCE BOOKS:
Objective

- ability to work in multiple teams to understand Patents, Rights conferred on a Patentee, Copyright, and Trademarks leading to improvement in team work and leadership qualities.
- ability to identify, formulate and solve problems on Patent law, the legislative provisions regulating patents, principles and procedure for obtaining patent.
- ability to apply technical concepts of IP related technology to give an insight into IP management, Licensing, Valuation, Audit and other aspects of IP.

Unit I [5 hours]

**Basic principles of IP laws:** Introduction, Concept of property, Need for a holistic approach, Constitutional aspects of IP, Evolution of the patent system in UK, US and India, Basis for protection, Invention, Criteria for patentability, Non-patentable inventions.

Unit II [5 hours]

**Patents:** Introduction, Origin and meaning of the term patent, Objective of a patent law, the legislative provisions regulating patents, principles underlying the patent law in India, patentable invention. Procedure for obtaining patent: Submission of application, Filing provisional and complete specification, Examination of the application, advertisement of the acceptance, opposition, Grant and sealing of patent, Term of the patent, compulsory license.

Provisional and complete specification: Definition of Specification, Kinds of specification, provisional specification, complete specification, Claims, Conditions for amendment.

Unit III [5 hours]

**Rights conferred on a patentee:** Patent rights, Exception and limitations, Duties of a Patentee.

**Transfer of patent:** Forms of transfer of Patent rights, Assignment, kinds of assignment, License, kinds of license, Rights conferred on a licensee, Transmission of patent by operation of law.

**Infringement of patents:** Construction of claims and infringement, patents held to be infringed, patents held to be not infringed.

**Action for Infringement:** Where a suit is to be instituted, procedure followed in the suit, Onus of establishment infringement, Defence by the defendant, The Relief’s, Injunction, Damages or account of profits, patent agents, patent drafting, database searching, and Case studies.
Unit IV [06 hours]

Copy Right: Meaning and characteristics of copy right, Indian copy right law, requirement of copy right, Illustrations copy right in literary work, Musical work, Artistic work, work of architecture, Cinematograph film, sound recording.

Author and Ownership of copy right: Ownership of copy right, Contract of service, Contract for service, rights conferred by copy right, terms of copy right, license of copy right.

Infringement of copy right: Acts which constitute infringement, general principle, direct and indirect evidence of copying, Acts not constituting infringements, Infringements in literary, dramatic and musical works, Remedies against infringement of copy right, Case studies.

Unit V [04 hours]

Trade Marks: Introduction, Statutory authorities, procedure of registration of trade marks, rights conferred by registration of trade marks, licensing in trade mark, infringement of trade mark and action against infringement.

Text Books:

References:
Subject: PROJECT MANAGEMENT

Sub. Code: 11HS8GCPRM

Credits: 02

Objectives:
- Ability to design, conduct and analyze projects, track costs and time expenditures, manage quality and risk, evaluate human resources requirements and overcome potential obstacles.
- Ability to work in multiple teams to perform one common characteristic – the projection of ideas and activities into new endeavors.
- Ability to identify, control and coordinate the complex and diverse activities of modern industrial and commercial projects.

UNIT I (06 Hours)
Introduction – Definitions – classifications – project risk – scope

UNIT II (05 Hours)
Project planning – scope – problem statement – project goals – objectives

UNIT III (05 Hours)
Project implementation – project resource requirements – types of resources – men – materials – finance

UNIT IV (05 Hours)

UNIT V (05 Hours)
Project team management – recruitment – organizing – human resources – team operating rules – project organization – various forms of project organizations.

TEXT BOOKS:
2. Project Management – Denislok

REFERENCE BOOKS:
2. Project Management – Gopalakrishnan – Mcmillan India Ltd.
3. Project Management-Harry-Maylor-Peason Publication