B. E. SYLLABUS

ELECTRICAL & ELECTRONICS ENGINEERING

III & IV SEMESTER

With

Scheme of Teaching

& Examination

DEPARTMENT: ELECTRICAL & ELECTRONICS ENGINEERING

Sl. No	Name of Faculty	Qualification	Designation
1	Dr. Nagesh Prabhu	PhD	Professor & HOD
2	Dr. Sathyendra Kumar	Ph.D	Professor
3	Dr. Pius Pinto	Ph.D	Professor
4	K. Vasudeva Shettigar	M.Tech	Associate Professor
5	Suryanarayana K	M.Tech (on PhD)	Associate Professor
6	Nayana P Shetty	M.Tech (PhD)	Associate Professor
7	Naveen J	M.Tech	Asst. Prof Gd III
8	Pradeep Kumar	M.Tech (PhD)	Asst. Prof Gd III
9	Latha Shenoy	M.Tech (PhD)	Asst. Prof Gd III
10	Anitha Marina Colaco	M.Tech (on PhD)	Asst. Prof Gd II
11	Mahabaleshwara Sharma K	M.Tech	Asst. Prof Gd II
12	Raksha Adappa	M.Tech	Asst. Prof Gd II
13	Dinesh Shetty	M.Tech (PhD)	Asst. Prof Gd II
14	Raghavendra Prabhu	M.Tech	Asst. Prof Gd II
15	Girisha Joshi	M.Tech (PhD)	Asst. Prof Gd II
16	Soumya Rani Mestha	M.Tech (PhD)	Asst. Prof Gd I
17	Md. Abdul Raheman	M.E	Asst. Prof Gd I
18	Gururaj K	M.Tech	Asst. Prof Gd I
19	Ravikiran Rao	M.Tech	Asst. Prof Gd I
20	Swathi Hatwar H	M.Tech	Asst. Prof Gd I

DEPARTMENT: ELECTRICAL & ELECTRONICS ENGINEERING

Vision:

Pursuing excellence in Electrical & Electronics Engineering, creating a research environment to promote innovation and address global challenges.

Mission:

To equip students to face global challenges by excelling in professional career and higher education.

To offer high quality graduate and post graduate programs in electrical & electronics engineering.

To promote excellence in research, collaborative activities and contribute to social development with ethical values.

Programme Educational Objectives (PEOs):

Excel in professional career and / or higher education by acquiring knowledge in mathematical, electrical, electronics and computer engineering principles.

Analyze real life problems, design electrical and electronics & multidisciplinary engineering systems and solutions that are socially acceptable

Inculcate and exhibit ethical values, communication skills and provide supportive and leadership roles in their profession to emerge as excellent professionals and adapt to current trends by engaging in lifelong learning to promote research.

Programme Outcomes (PO)

At the end of B.E (E&E) program the students will have an ability to

1 **Engineering knowledge**: Apply the knowledge of mathematics, science and engineering fundamentals while practicing Electrical & Electronics Engineering.

2 **Problem analysis**: Identify, formulate, review research literature, analyze complex Electrical & Electronics Engineering problems and draw substantiated conclusions by applying the principles of mathematics, basic science and engineering sciences.

3 **Design/development of solutions**: Design solutions for electrical and electronics engineering problems to meet the specified needs, taking into consideration the public health, safety, cultural, societal, and environmental issues.

4 **Conduct investigations of complex problems**: Investigate Electrical & Electronics Engineering problems using design of experiments, analysis & interpretation of data, to provide valid conclusions.

5 **Modern tool usage**: Create, select, use and apply emerging technologies, skills, and modern engineering and IT tools necessary for practicing Electrical & Electronics Engineering with an understanding of the limitations.

6 **The engineer and society**: Apply the contextual knowledge to assess societal, health, safety, legal, cultural issues and the consequent responsibilities while practicing electrical and electronics engineering profession.

7 **Environment and sustainability**: Understand the impact of the professional engineering solutions on society and environment, and demonstrate the need for sustainable development.

8 **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9 **Individual and team work**: Function effectively as an individual/ member or as a leader in diverse teams and contribute to multidisciplinary project.

10 **Communication**: Communicate effectively by comprehending, writing effective reports/design documentation, making effective presentations, and giving & receiving clear instructions.

11 **Project management and finance**: Manage the multidisciplinary projects and finance economically, utilizing the gained knowledge of engineering and management principles.

12 **Life-long learning**: Update and strengthen the knowledge by engaging in lifelong learning to keep pace with technological change.

Program Specific Outcomes (PSO)

PSO1 An ability to demonstrate the electrical engineering concepts by developing working models.

PSO2 An ability to apply embedded system concepts to address electrical engineering problems.

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF TEACHING AND EXAMINATION

III Semester **31 Hours/week**

Sl.No.	Code	Course Title	Theory/Tuto. /Prac./ Self study/ Project	Total Hrs./Week	CIE	SEE	Credits
1	16EE301	Vector Calculus and Transform Techniques	4+0+0+0+0	4	50	50	4
2	16EE302/ 16EE405	Signals and Systems / Network Analysis	3+2+0+0+0	5	50	50	4
3	16EE303	DC and Synchronous Machines	4+0+0+0+0	4	50	50	4
4	16EE304	Analog Electronic Circuits	3+2+0+0+J	5	50	50	4
5	16EE305	Logic Design	4+0+0+0+0	4	50	50	4
6	16EE306	Instrumentation and Measurements	3+0+0+S+0	3	50	50	3
7	16EE307	Analog Electronic Circuits Laboratory	0+0+3+0+0	3	50	50	2
8	16EE308	Logic Design and HDL Laboratory	0+0+3+0+0	3	50	50	2
		TOTAL	**31**	**31**	**400**	**400**	**27**

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF TEACHING AND EXAMINATION

IV Semester **33 Hours/week**

Sl. No.	Code	Course Title	Theory/Tuto. /Prac./ Self study/ Project	Total Hrs. /Week	CIE	SEE	Credits
1	16EE401	Probability Theory and Numerical Methods	4+0+0+0+0	4	50	50	4
2	16EE402	Transformers and Induction Machines	4+0+0+S+0	4	50	50	4
3	16EE403	Microcontrollers	4+0+0+0+J	4	50	50	4
4	16EE404	Electromagnetic Fields	3+2+0+0+0	5	50	50	4
5	16EE405 16EE302	Network Analysis/ Signals and Systems	3+2+0+0+0	5	50	50	4
6	16EE406	Microcontrollers Laboratory	0+0+3+0+0	3	50	50	2
7	16EE407	DC and Synchronous Machines Laboratory	0+0+3+0+0	3	50	50	2
8	16EE408	Circuit Simulation Laboratory	0+0+2+0+0	2	50	50	1
9	16HU411	Enhancing Self Competence	1+0+2+0+0	3	50	50	2
		TOTAL	**33**	**33**	**450**	**450**	**27**

VECTOR CALCULUS AND TRANSFORM TECHNIQUES

Sub Code	**: 16EE301**	**Credits**	**: 04**
Hrs/Week	**: 4+0+0+0**	**Total Hours**	**: 52**

Teaching Department: Mathematics

Prerequisites
This subject requires the students to know about Vector algebra, infinite series, differentiation and integration, knowledge of complex numbers.

Course Learning Objectives:

1. To apply operators like gradient, divergence and curl to both scalar as well as vector functions.
2. To evaluate surface and volume integrals in terms of line integrals using various integral theorems.
3. To apply theory of complex variables in life related problems.
4. To perform Fourier analysis on non-sinusoidal periodic signals.
5. To introduce Z- transform and its applications to solve difference equation.

UNIT – I

Vector Calculus: Vector algebra, Vector differentiation- gradient, divergence, curl, Laplacian, solenoidal and rotational vectors, Curvilinear, Spherical and Cylindrical Co-ordinates.
10 Hours

UNIT – II

Vector integration- Line, Surface & Volume integrals.Green's, Gauss divergence &Stoke's theorems.Applications. **8 Hours**

UNIT – III

Theory of complex variables: Functions of complex variables, Cauchy Riemann equations. Properties of analytic functions, conformal mapping.Bilinear transformations.
Line integrals in complex plane, Cauchy's theorem, Power series, Residues, Cauchy's residue theorem, Evaluation of standard real integrals using contour integration. **12 Hours**

UNIT – IV

Fourier Analysis: Periodic functions, Euler's formulae, Fourier series of odd and even functions, functions with arbitrary period, half range series. Harmonic Analysis.
Fourier integral theorem, Fourier Transforms, Inverse Fourier transform, Convolution theorem and Parseval's identity. Fourier sine and Fourier cosine transforms, Inverse Fourier sine and Inverse Fourier cosine transforms (simple problems) **12 Hours**

UNIT – V

Z transforms: Z-transform, standard forms, linearity property, damping rule, shifting rule. Inverse Z-transform, Finite differences and difference equations, Solving Difference equations using Z-transforms. **10 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Solve the vector functions and their derivatives for engineering applications
2. Demonstrate the applications of Gauss divergence and Stoke's theorem.
3. Illustrate the concept of complex variables and line integrals in complex plane.
4. Apply Fourier analysis to solve engineering problems.
5. Apply the concepts of Z- transforms to solve engineering problems.

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√	√										
CO2	√	√										
CO3	√											
CO4	√	√										
CO5	√	√										

TEXT BOOKS:

1. Kreyszig: "Advanced Engineering Mathematics", John Wiley and Sons VI-Edition
2. B.S.Grewal : "Higher Engineering Mathematics" – 36th Edition.

REFERENCE BOOKS :

1. Wylie Ray ., Advanced Engineering Mathematics, 6thedn., McGraw Hill.Inc
2. Murray R. Spiegel: Vector Analysis, Schuam publishing Co.

E Books / MOOCs/ NPTEL

1. http://nptel.ac.in/courses/111105035/
2. http://nptel.ac.in/courses/111103021/
3. http://nptel.ac.in/downloads/122101003/
4. http://nptel.ac.in/courses/117101056/17
5. http://nptel.ac.in/courses/108106075/
6. https://www.coursera.org/learn/calculus1
7. https://www.coursera.org/learn/advanced-calculus

****

SIGNALS AND SYSTEMS

Sub Code : 16EE302 **Credits : 04**
Hrs/Week : 3*+2+0+0+0 **Total Hours : 39*+26**

***Note:** Lecture hours indicated are for teaching theoretical concepts. Illustrative examples and numerical problems are to be worked out in tutorial classes.

Prerequisites:
BEE (16EE105),

Course Learning Objectives:

1. To introduce the time domain analysis of various signals
2. To perform convolution and other operation on signals.
3. To represent the CT and DT periodic signals in its Fourier form.
4. To solve the differential equations of the signals
5. To perform the discrete time Fourier Transform on various signals
6. To introduce the concept of Z transform technique to find ROC and other parameters.

UNIT – I

Introduction: Definitions of CT and DT signals and system, classification of signals, basic operations on signals. Elementary signals viewed as interconnections of operations, properties of system. Time-domain representations for LTI CT systems.
Convolution: impulse response representation, properties of impulse response representation, differential equation **8*+5 Hours**

UNIT – II

Fourier Representation of Periodic Signals: Introduction, Fourier representation of continuous-time periodic signals (FS), properties of continuous-time Fourier series,
The Continuous-Time Fourier Transform: Representation of a periodic signals: continuous-time Fourier transform (FT), Properties of continuous-time Fourier transform. Application; frequency response of LTI systems, Solutions of differential equations.
9*+5 Hours

UNIT – III

Time-domain representations for LTI DT systems, **Convolution**: impulse response representation, properties of impulse response representation, difference equation.
Fourier representation of discrete-time signals, properties of discrete-time Fourier series (DTFS). **7*+5 Hours**

UNIT – IV

The Discrete-Time Fourier Transform: Representations of periodic signals: The discrete time Fourier transform (DTFT), Properties of DTFT. Application; frequency response of LTI systems, Solutions of differential equations. **7*+6 Hours**

UNIT – V

Z- Transforms: Introduction, Z-transform, properties of ROC, properties of Z-transforms, inversion of Z-transform methods - power series and partial expansion, Transforms analysis of LTI systems, transfer function, stability and causality, unilateral Z-transform and its application to solve difference equations. **8*+5 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Comprehend the various mathematical operations on signals and systems and analyse LTI continuous time system
2. Discuss Fourier representations, Fourier transforms and their properties
3. Analysis of Linear time invariant Discrete time system and use of Discrete time Fourier series.
4. Perform the discrete time Fourier Transform on various signals
5. Use z transform to analyze the LTI systems

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	H	M										
CO2	M	M										
CO3	H	M	L									
CO4	M	H	L									
CO5	H	M		L		L						

TEXT BOOKS:

1. Signals and Systems- Simon Haykin and Barry Van Veen, Wiley India Pvt Ltd, 2nd Edition 2008.
2. Fundamentals of Signals and Systems - Michel J Roberts, McGraw Hill Education (India) Private Limited; 2nd edition, 2010.
3. Signals and systems- S.Narayan Iyer, Cengage Learning,India,2011

REFERENCE BOOKS :

1. Signals and Systems, Alan V Oppenheim, Alan S. Willsky and S. Hamid Nawab, PHI, 2nd edition, 2009.
2. Signals and Systems, H P Hsu and others, Schaums Outline Series, TMH,2nd Edition, 2008.

E Books /MOOC /NPTEL

1. http://nptel.ac.in/courses/117101055/
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/
3. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/
4. https://www.edx.org/course/signals-systems-part-1-iitbombayx-ee210-1x-2
5. http://nptel.ac.in/courses/117104074/

****

DC AND SYNCHRONOUS MACHINES

Sub Code : 16EE303 **Credits : 04**
Hrs/Week : 4+0+0+0+0 **Total Hours : 52**

Prerequisites
Basic Electric Engineering (16EE105)

Course Learning Objectives:

1. To understand the working principle and operating characteristics of DC machine
2. To understand testing methods of DC Machine
3. To study the working principle and operating characteristics of Synchronous machine
4. To get acquainted with methods to predetermine voltage regulation of synchronous generator.
5. To understand the process of synchronization of alternator to infinite bus.
6. To get familiarized with the working principle, characteristics, testing and applications of Synchronous motor.

UNIT – I

DC Motors: Review of operating principle,
Armature reaction, commutation, use of inter poles & pole face compensating winding Characteristics, Speed control of shunt & series motors, losses & efficiency
Special Motors: Principle of operation of Brushless DC motor, Servo motor and Stepper motors. **11 Hours**

UNIT – II

DC Motor Starter: 3 -point, 4-point starter, illustration on design (qualitative).
Testing of DC motors – direct & indirect methods of testing of shunt and series machines.
Permanent magnet DC motors. **10 Hours**

UNIT – III

Synchronous machines-Review of principle of operation, construction of salient & non Salient pole synchronous machines.
Generated EMF in a concentrated winding, effect of distribution of winding & use of chorded coils, Regulation by EMF, MMF, ZPF Methods. **10 Hours**

UNIT – IV

Synchronizing of Alternators to infinite bus bars, parallel operation of alternator.
Operating characteristics, power angle characteristics, operation at constant load with variable excitation and vice versa for generating mode & motoring mode. **11 Hours**

UNIT – V

Salient pole synchronous machines, two reaction theory, power angle diagram, reluctance power, slip test. **4 Hours**

Synchronous Motors: Principle of operation, starting methods. Motor at load, Constant load variable excitation. V and inverted V curves, power flow equations, hunting in synchronous machines, synchronous condenser and Applications **6 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Distinguish different types of DC machines along with their characteristics and testing methods.
2. Illustrate the effect of the armature reaction and justify the use of interpole and compensating winding.
3. Predetermine the voltage regulation of Synchronous machine.
4. Illustrate synchronization of alternators to infinite bus and understand the performance characteristics for various operating conditions.
5. Depict the V and inverted V curves of synchronous machines and their applications.

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√	√		√								
CO2	√	√		√								
CO3	√	√		√								
CO4	√	√		√								
CO5	√	√		√								

TEXT BOOKS:

1. Bhimbra, Electric machinery, Khanna publishers , 7th Edition, 2011
2. B. Gupta, AC and DC Machines, S K Kataria and Sons publications, 2012 edition

REFERENCE BOOKS :

1. AE Clayton & Hancock, Performance & design of DC machine ELBS Publication, 1st edition,2004
2. Alexander Langsdorf, Theory of alternating current machines, TMH, 2nd Edition , 2004
3. AshfaqHussain, Electrical Machines, DhanpatRai Publications, 2012..

E Books /MOOC /NPTEL

1. http://nptel.ac.in/courses/108106072/
2. http://nptel.ac.in/syllabus/108105018/
3. http://nptel.ac.in/courses/108105017/
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-685-electric-machines-fall-2013/course-notes/

****

ANALOG ELECTRONIC CIRCUITS

Sub Code : 16EE304 **Credits : 04**
Hrs/Week : 3*+2+0+0+J# **Total Hours: 39*+26**

***Note:** Lecture hours indicated are for teaching theoretical concepts. Illustrative examples and numerical problems are to be worked out in tutorial classes.
J Refers to Project Based Learning – The evaluation of the projects carried out during semester can be considered as task.

Prerequisites
Basic Electronics (16EC112), Engineering Physics

Course Learning Objectives:

1. To introduce the frequency dependence parameters of Diode and its switching characteristics.
2. To analyse the structural properties, characteristics and operation of MOSFET /JFET
3. To analyse the MOSFET parameters when used as an amplifier and as a switch.
4. To use MOSFET single stage amplifier and analyse its behaviours at various frequencies
5. To introduce the feedback concept and analyse the oscillator circuits using FET
6. To analyse the differential and multistage amplifiers and various parameters associated with them

UNIT – I

DIODE CIRCUITS: Diode Specifications, Transition Capacitance, Diffusion Capacitance, Diode Switching Time, Clippers, Clampers. **3*+2 Hours**
MOSFET: Device structure and Physical operation, I-V Characteristics, Depletion type MOSFET, Enhancement Type MOSFET, Junction Field- Effect Transistor (JFET)
5*+3 Hours

UNIT – II

MOSFET circuits at DC.
MOSFET as an Amplifier and as a switch: Large signal operation, Graphical derivation of the transfer characteristics, operation as a switch, operations as a linear amplifier, Analytical expressions, Biasing in MOS Amplifier circuits: Biasing by Fixing V_{GS}, Biasing by fixing V_{GS} and connecting a resistances in the source, Biasing using a Drain-to-gate feedback amplifier, Biasing using a constant current source. **5*+4 Hours**
Small-signal operation and models: DC bias point, signal current in the drain terminal, voltage gain, DC analysis and signal analysis, small signal equivalent, Transconductance, T equivalent circuit model **3*+1 Hours**

UNIT – III

Single Stage MOS Amplifiers: Basic Structure, characterizing amplifiers, Common source amplifier, CS amplifier with a source resistance, Common gate amplifier, Common drain amplifier. **4*+2 Hours**

MOSFET Internal Capacitances and high frequency model: Gate capacitive effect, junction capacitances, high frequency MOSFET model, UNIT - y- Gain frequency, Frequency response of the CS Amplifier, Circuit operation of CMOS Logic Inverter.

4*+3 Hours

UNIT – IV

Frequency Response of MOS Amplifiers: CS amplifier with active load, Miller's Theorem, High frequency response of CS amplifier, MOS cascade amplifier, Source Follower, Cacode MOS current Mirror. **4*+3 Hours**

Feedback Amplifiers: General Feedback structure, Properties of negative feedback, Feedback topologies, Practical feedback amplifier.

Oscillators : FET based RC phase shift oscillator, FET crystal oscillator. **4*+3 Hours**

UNIT – V

Differential and Multistage FET Amplifiers: MOS Differential pair with common mode and differential input voltage, Small-signal operation of MOS Differential pair, Common-mode Gain and CMRR , Non ideal characteristics, Differential Amplifier with Active Load, Differential Amplifier Frequency Response of the differential amplifier, Multistage Amplifier, Two-stage CMOS Op Amp. **7*+5 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Explain the frequency dependence parameters of Diode and its switching characteristics and analyze the structural properties, characteristics and operation of MOSFET /JFET
2. Analyze the MOSFET parameters when used as an amplifier and as a switch.
3. Use MOSFET single stage amplifier and analyse its behaviours at various frequencies
4. Illustrate various the feedback concepts and analyze the oscillator circuits using FET
5. Analyze the differential and multistage amplifiers and various parameters associated with them.

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√	√										
CO2	√	√		√					√			
CO3	√	√		√					√			
CO4	√	√							√			
CO5	√	√		√	√				√		√	

TEXT BOOKS :

1. Sedra /Smith, "Microelectronic Circuits" 6th Edition, OXFORD UNIVERSITY PRESS-NEW DELHI,2013.

2. Jacob Millman & Christos C. Halkias, "Integrated Electronics", McGraw Hill Publications, 2nd Edition, 2011..

REFERENCE BOOKS :

1. Behzad Razavi, "Fundamentals of Microelectronics", Wiley 2013.
2. Nashelesky & Boylestead, "Electronic Devices & Circuit Theory", PHI, 11TH Edition.2015.
3. Jacob Millman & Arvin Grabel, "Microelectronics" 2nd Edition, McGraw Hill Publications,1987
4. Muhammad H. Rashid, "Microelectronic Circuits Analysis and Design", 2nd Edition, Cengage Learning, 2011

E-Books / MOOC

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2005/lecture-notes/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2009/lecture-notes/
3. https://www.edx.org/course/circuits-electronics-1-basic-circuit-mitx-6-002-1x-0
4. http://freevideolectures.com/Course/2952/Microelectronic-Devices-and-Circuits-Fall-2011

****

LOGIC DESIGN

Sub Code : 16EE305 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours: 52**

Prerequisites
Basic Electronics (16EC112)

Course Learning Objectives:

1. To impart the knowledge of combinational circuit design.
2. To impart the knowledge of Sequential circuit design.
3. To provide the basic knowledge about HDL programming & its application

UNIT – I

Review: Basic Gates and Universal Logic Gates, AND-OR-Invert Gates, Positive and Negative Logic, Boolean Laws and Theorems

Combinational Logic Circuits: Sum of Product, Product-of sum forms, Truth Table to Karnaugh Map, Pairs, Quads, and Octets, Karnaugh simplifications, Don't Care Conditions, Simplification by Quine- McClusky Method & Table reduction, Map entered variables.

9 Hours

HDL: Introduction, A brief history of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, Simulation and synthesis.

HDL Implementation Models of Basic Gates. **3 Hours**

UNIT – II

Analysis and design of combinational logic - I: General approach for combinational design, Decoders, BCD decoders, Encoders, Priority Encoder. HDL Implementation.

5 Hours

Analysis and design of combinational logic - II: Digital multiplexers- Using multiplexers as Boolean function generators, Demultiplexers, Adders and subtractors, Cascading full adders- Ripple Carry, Carry Look ahead, Binary comparators. HDL Implementation.

5 Hours

UNIT – III

Sequential Circuits – 1: Basic Bi-stable Element, Latches, S'R' Latch, Application of SR Latch, A Switch Debouncer, The SR Latch, The gated SR Latch, The gated D Latch, JK Latch-Race around condition, The Master-Slave Flip-Flop (Pulse-Triggered Flip -Flops):The Master-Slave SR Flip-Flop, The Master-Slave JK Flip-Flop, Edge Triggered Flip Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip -Flop. HDL implementation of Flip Flops. **10 Hours**

UNIT – IV

Sequential Circuits – 2: Characteristic Equations, Registers-Shift registers, Bidirectional shift registers, Universal shift registers, Counters- Binary Ripple Counters, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters, Design of a Synchronous Mod-6 Counter using clocked JK Flip-Flops Design of a Synchronous Mod-6 Counter using clocked D, T, or SR Flip-Flops, Design of synchronous UP/DOWN counter, Decade counter. HDL implementation of Registers and Counters

10 Hours

UNIT – V

Sequential Design - I: Introduction to Mealy and Moore Models, State Machine Notation, Synchronous Sequential Circuit Analysis. HDL Implementation. **5 Hours**

Digital Integrated circuits: Introduction, RTL, DTL circuits, ECL, TTL, MOS, CMOS, I2L

5 Hours

Course Outcomes:

At the end of the course student will be able to

1. Recall basic gates, Boolean algebra and Simplify Boolean expressions using different methods and to introduce HDL.
2. Analyze and design of combinational logic circuits and its HDL implementation
3. Analyze and design of sequential logic circuits and its HDL implementation
4. Analyze and design the working of Flip Flops, shift registers and counters and their HDL implementation.
5. Familiarize the Digital Integrated Circuits.

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M	L		L	L				L			
CO2	H	H		L	M				M			
CO3	H	H		M	M				M			
CO4	H	H		M	M				M			
CO5	H	M		M	M				M		L	

TEXT BOOKS :

1. Donald P Leach, Albert Paul Malvino & Gautham Saha, Digital Principles and Applications, 7th Edition, McGraw Hill Education (India) Private Limited, 2010.
2. Digital Principles and Design Donald D Givone McGraw Hill Education 1st Edition 2002
3. Digital Logic Applications and Design John M Yarbrough Cengage Learning 2011.

REFERENCE BOOKS :

1. Charles H. Roth, Jr., Fundamentals of Logic Design, 6th Edition, Thomson Learning, 2009.
2. Ronald J Tocci, Neal S. Widmer, Gregory L Moss, Digital Systems Principles and Applications, 10th Edition, PHI/Pearson Education, 2007.
3. A VHDL Primer, J. Bhaskar, Pearson Education; 3rd edition 2015
4. HDL Programming (VHDL and Verilog) Nazeih M. BotrosCengage Learning 1st Edition 2011
5. Logic and computer design Fundamentals M. Morries Mano and Charles Kime Pearson Learning 4th Edition 2014
6. Fundamentals of logic design Charles H Roth, JR and Larry L. Kinney Cengage Learning 6th Edition 2013.

E Books /MOOC /NPTEL

1. https://www.coursera.org/learn/digital-systems
2. http://nptel.ac.in/courses/117105080/
3. http://nptel.ac.in/courses/117106086/

****

INSTRUMENTATION AND MEASUREMENTS

Sub Code : 16EE306 **Credits : 03**
Hrs/Week : 3+0+0+S* **Total Hours : 39**

*** Self Study to be exercised under the supervision of course instructor and to be restricted to not more than 10% of the total teaching hours.**

Prerequisites: BEE (15EE105)

Course Learning Objectives :

1. To measure resistance, inductance, capacitance by use of different bridges.
2. To study the construction and working of various meters used for measurement of electrical quantities.
3. To introduce various sensors and transducers, their working and applications
4. To introduce various electronic instruments and display devices and their applications.

UNIT – I

Instruments: Introduction, Characteristic of instruments, errors
Measurement of R, L, and C: Measurement of Resistance, Inductance, and Capacitance: Wheatstone's bridge, KDB, Measurement of High resistance, Maxwell's bridge, Schering bridge, Anderson's Bridge Shielding of bridges and problems, Murray Loop Test, Measurement of earth resistance by fall of potential method, LCR Meters
Extension of Instrument Ranges: Principles of Shunts and multipliers used to extend instrument range, examples, Construction and theory of instrument transformers, Equations for ratio and phase angle errors of C.T. and Illustrative examples.
Energy Meter: Errors, adjustments and calibration of Induction type energy meter. Introduction to Digital Energy Meter
SS Topic: Megger. Turns compensation **15 Hours**

UNIT – II

Sensors: Roll of sensors in engineering, classification of transducers
Frequency and Phase: Principle of measurement of frequency and phase angle, Weston frequency meter, power factor meter and phase sequence indicator.
Linear Displacement: Resistive Potentiometers, strain gauge, LVDT, Capacitive Piezoelectric, Hall Effect sensors, Optical displacement sensor, fiber optic sensor, Ultrasonic distance Sensor, Linear encoder,
Rotational Displacement: Optical tachometer, Rotary encoder, gyroscope
Temperature measurement: Classification of temperature sensors Resistance Temperature Detectors, Thermistor
Recorder: Magnetic recording, digital recording, optical recording
SS Topic: Proximity sensors, Thermocouple **14 Hours**

UNIT – III

Display devices: 7 segment display, dot matrix displays, LCD and LED display. Photo conductive, photo-voltaic cells

Electronic Instruments: Introduction, True RMS responding voltmeter, Electronic multimeters, ADC (Flash, SAR), DAC, Digital voltmeters, Working of a digital storage oscilloscope, Method of measuring amplitude, period, phase, frequency, Use of Lissajous patterns, broken ring and modulated ring method, Sampling Oscilloscope.

SS Topic: Q meter **10 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Analyze and study the methods of measurement of resistance, capacitance and inductance.
2. Expound the concepts of extension of instruments for the measurement of voltages and currents and calibration of errors in energy meter.
3. Explicate the principle of measuring frequency, phase and temperature.
4. Select and Use various sensors for measurement of different electrical quantities
5. Illustrate the use of different electronic instruments and signal conditioning equipment to be used with modern controllers.

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	H	H										
CO2	H	H										
CO3	H	M			√							
CO4	H	M			√						√	
CO5	H	L			√						√	

TEXT BOOKS:

1. A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpatrai and Sons, New Delhi.
2. David A. Bell, "Electronic Instrumentation and Measurement", 2nd Edition, P.H.I, 2006.

REFERENCE BOOKS :

1. Cooper D. and A.D. Heifrick, "Modern Electronic Instrumentation and Measuring Techniques", P.H.I.
2. H.S. Kalsi, Electronic Instrumentation-second edition, Tata McGraw hill publications, 2004
3. Golding and Widdies, "Electrical Measurements and Measuring Instruments", Pitman.

E Books /MOOC /NPTEL

1. http://nptel.iitg.ernet.in/courses/Elec_Engg/IIT%20Madras/Electrical%20and%20Electronic%20Measurements%20(Video).htm
2. http://nptel.iitg.ernet.in/courses/Elec_Engg/IIT%20Bombay/Electrical%20and%20Electronic%20Measurements.htm
3. http://nptel.ac.in/courses/108105064/

****

ANALOG ELECTRONICS CIRCUITS LABORATORY

Sub Code : 16EE307 **Credits : 02**
Hrs/Week : 0+0+3+0 **Total Hours : 39**

Course Learning Objectives:

1. To conduct experiments on diode circuit and study their applications
2. To study the FET /MOSFET characteristics
3. To use FET as an amplifier and study its behaviour
4. To use FET as an signal generator

List of Experiments

1. Testing of Bridge Rectifier circuits with Capacitor filter, with and without Zener voltage regulator. Determination of ripple factor, regulation and efficiency.
2. Testing of Diode clipping (Single/Double ended) circuits for peak clipping.
3. Testing of Clamping circuits: positive clamping /negative clamping
4. Study of FET / MOSFET characteristics
5. Wiring and Testing of Common Source MOSFET amplifier and determination of the gain-frequency response, input and output impedances.
6. Wiring and Testing of FET Source follower
7. Wiring and Testing for the performance of FET RC Phase Shift Oscillator.
8. Testing for the performance of FET Crystal Oscillator for f_0> 100 KHz.
9. Multistage FET amplifier circuits to determine frequency response, input impedance output impedance.
10. FET differential amplifier to determine differential and common mode gains.

Course Outcomes:

At the end of the course student will be able to

1. Design and test diode based Bridge Rectifier, clipping and clamping circuits
2. Design and test FET / MOSFET common source amplifier and determine the gain-frequency response, input and output impedances.
3. Design and test FET / MOSFET source follower and determine the gain-frequency response, input and output impedances.
4. Design and test FET / MOSFET based RC Phase Shift Oscillator and Crystal Oscillators
5. Design and test FET based Multistage and differential amplifiers.

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√	√	√						√			
CO2	√	√	√						√			
CO3	√	√	√						√			
CO4	√	√	√						√			
CO5	√	√	√						√			

****

LOGIC DESIGN AND HDL LABORATORY

Sub Code : 16EE308 **Credits : 02**
Hrs/Week : 0+0+3+0 **Total Hours : 39**

Course Learning Objectives:

1. To Simplify and verify combination logic circuit
2. To Simplify and verify sequential logic circuit
3. To verify the combinational and sequential logic circuits using HDL software.

List of Experiments

1. Simplification, realization of Boolean expressions using logic gates/Universal gates.
2. Realization of Half/ Full adder and Half/Full subtractor using logic gates.
    a. BCD to Excess-3 code conversion and vice versa using IC 7483.
    b. Realization of Binary to Gray code conversion and vice versa using 7483.
    c. Realization of parallel adder/subtractor using IC 7483.
3. MUX/DEMUX – use of IC 74153, IC 74149 for arithmetic circuits and code converter.
4. Realization of one/two bit comparator using logic gates and using 7485 IC (magnitude comparator).
5. Use of
    a. Decoder chip to drive LED display.
    b. Priority encoder.
6. Truth table verification of Flip flops
    a. JK Master slave
    b. T type
    c. D type
7. Realization of 3 bit counters as a sequential circuit and MOD-N counter design using IC 7476, IC 7490, IC 74192, IC 74193.
8. Shift left, shift right, SIPO, SISO, PISO, PIPO operations using IC 74S95.
9. Wiring and testing of Ring counter and Johnson counter using IC 7474 and IC 74S95.

Simulation Programs using HDL

10. Code and simulate Basic gates
11. Simulation of Multiplexer and Demultiplexer
12. Simulation of full adder.
13. Simulation of Ring counter and Johnson counter

Course Outcomes:

At the end of the course student will be able to

1. Simplify and realize Boolean expressions and perform code conversion operation using various digital IC and very the same using HDL coding.
2. Design and test MUX/DEMUX using of IC 74153, IC 74139 for arithmetic circuits and verify the same using HDL.
3. Design and test one/two bit comparator using logic gates and using 7485 IC
4. Design and test Decoder chip to drive LED display and Priority encoder.
5. Verification of the operation of JK Master slave, T type, D type flip flops and design counters and shift registers and verify their operation using HDL.

Mapping of POs & COs:

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√	√	√		√				√			
CO2	√	√	√		√				√			
CO3	√	√	√		√				√			
CO4	√	√	√		√				√			
CO5	√	√	√		√				√			

****

PROBABILITY THEORY AND NUMERICAL METHODS

Sub Code : 16EE401 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Teaching Department: Mathematics

Course Learning Objectives :

1. To introduce the concept of probabilistic models for situations involving chance effect.
2. To study two and higher dimensional random variables and different types of distributions for engineering problems.
3. To study numerical methods to solve engineering problems where the analytical solutions for some functions are not possible.
4. To introduce numerical methods to solve partial differential equations.
5. To study the application of ordinary differential Equations and Special Functions.

UNIT – I

Introduction to probability, finite sample space, conditional probability and independence. Baye's theorem (Overview) One dimensional random variable: discrete and continuous random variable, probability functions, cumulative distribution function. Mean and variance. **10 Hours**

UNIT – II

Two and higher dimensional random variables, joint probability distributions, marginal distributions. Expectation, covariance and correlation coefficient. Distributions: Binomial, Poisson, Normal, Exponential, Gamma and Chisquare distributions. **10 Hours**

UNIT – III

Numerical methods: Roots of algebraic and transcendental equations: Regula falsie & Newton Raphson method. Finite differences, Newton-Gregory forward and backward

difference interpolation formulae, Lagrange's interpolation formula, Lagrange's Inverse interpolation formula.
Numerical differentiation using Newton's forward & backward formulae.
Numerical integration: General quadrature formula, Trapezoidal rule, Simpson's one third rule, Simpson's three eight rule. **12 Hours**

UNIT – IV

Numerical solution of first order ordinary differential equations: Taylor's series Method, Modified Euler's method, 4^{th} order Runge –Kutta Method.
Numerical solution Partial differential equations: Laplace and Poisson equations by standard five point formulae, heat and wave equations by explicit method.

10 Hours

UNIT – V

Series Solution of Ordinary Differential Equations and Special Functions: Series solution-Fresenius method, Series solution of Bessel's D.E leading to Bessel function of first kind. Equations reducible to Bessel D.E The generating function for $J_n(x)$.Orthogonality of Bessel functions. Series solution of Legendre's D.E. leading to Legendre polynomials. Rodrigue's formula. **10 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Demonstrate and appreciate probabilistic models for situations involving chance effect.
2. Illustrate the applications of two and higher dimensional random variables and different types of distributions for engineering problems.
3. Apply numerical methods to solve engineering problems where the analytical solutions for some functions are not possible.
4. Apply numerical methods to solve partial differential equations.
5. Illustrate the application of ordinary differential Equations and Special Functions.

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√											
CO2	√	√			√							
CO3	√	√			√							
CO4	√	√										
CO5	√	√										

TEXT BOOKS:

1. P.L. Meyer : Introduction of probability and Statistical applications, second Edn. 1975, American Publishing Co.

2. B. S. Grewal: "Higher Engineering Mathematics" – 36th Edition..

REFERENCE BOOKS :

1. Kreysizg: "Advanced Engineering Mathematics", John Wiley and Sons VI-Edition
2. S. S. Sastry: Introductory methods of Numerical Analysis-2nd edn.1990; Prentice Hall.
3. Wylie Ray., Advanced Engineering Mathematics, 6thedn., McGraw Hill.Inc.

E Books / MOOCs/ NPTEL:

1. http://nptel.ac.in/courses/111105041/
2. http://nptel.ac.in/courses/111101004/
3. http://nptel.ac.in/courses/111105035/
4. http://nptel.ac.in/courses/111103021/
5. http://nptel.ac.in/downloads/122101003/
6. http://nptel.ac.in/courses/117101056/17
7. https://ocw.mit.edu/courses/mathematics/

****

TRANSFORMERS AND INDUCTION MACHINES

Sub Code : 16EE402 **Credits : 04**
Hrs/Week : 4+0+0+S* **Total Hours : 52**

* Self Study to be exercised under the supervision of course instructor and to be restricted to not more than 10% of the total teaching hours.

Prerequisites : Basic Electrical Engineering (16EE105)

Course Learning Objectives:

1. To study the principle, types and analysis of the performance of single phase transformer
2. To introduce the concept of testing the transformer for its efficiency and regulation.
3. To explain the construction, types, and analysis of the three phase induction machine.
4. To study various tests performed on an induction machine.
5. To know various staring and speed control methods of a three phase induction machine.
6. To introduce the theory and types of single phase induction machine.

UNIT – I

Transformers: Review of construction and principle of single phase transformer.
Construction of three phase transformers, Types of transformers -power, distribution, instrument, welding, tap changing. **4 Hours**

Single phase transformers, analysis & performance: Ideal & practical transformers on no load, EMF equation, transformer on load vector diagrams, equivalent circuit, Losses, power & all day efficiency, Regulation, parallel operation, load sharing

SS Topic: Methods of cooling of transformer. **6 Hours**

UNIT – II

Testing: Polarity test, SC, OC test, Sumpner's test
Autotransformers: Calculation of Saving of copper, Advantages/disadvantages **5 Hours**
3 Phase transformers: operational aspects, 3 phase transformer connection including open delta, bank of 1 phase transformer for 3 phase operation, phase conversion, Scott connection for 3 phase -2phase, Specification of commercial transformer.
3 winding transformer: Tertiary winding and its importance, equivalent circuit analysis of a two winding transformer as a magnetically coupled circuit.
SS Topic: Principle of Autotransformers **7 Hours**

UNIT – III

Induction Machines: Operating principle, Classification & types-1 phase,3phase, squirrel cage, slip ring **5 Hours**

Analysis & performance of 3 phase induction motor: Induction motor on no load & load, efficiency and losses, vector diagram, equivalent circuit
SS Topic: Concept of rotating magnetic field **5 Hours**

UNIT – IV

Performance of Induction Machine HP, Torque, efficiency, current & power factor evaluation, Induction generator
SS Topics – slip torque characteristics covering regions of motoring generating & Braking. **5 Hours**

No load & BR tests, circle diagram & performance evaluation, cogging & crawling, equivalent and performance of double cage & deep bar motors **5 Hours**

UNIT – V

Starting & control: Need for starter, DOL, Y-Δ autotransformer starting, speed control-voltage, frequency & rotor resistance variations (conventional) **6 Hours**
Single phase induction motor:
SS Topics- double field revolving theory
Principal of operation Types of I phase IM split phase, capacitor start **4 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Explain the principle, types and analyze the performance of single phase transformer
2. Test the transformer for its efficiency and regulation and understand the operation of autotransformers, and possible three phase connections of a transformer.
3. Expound the construction, types, and analyze the three phase induction machine on no load and full load.

4. Summarize various tests and know the torque slip characteristics of an induction machine.
5. Illustrate the principles of starting and speed control methods of a three phase induction machine. Also explicate the theory and types of single phase induction machine.

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M	M										
CO2	H	H	L									
CO3	H	H										
CO4	H	H	L									
CO5	H	H	H	M		L						

TEXT BOOKS:

1. P. S. Bimbhra, Electrical Machinery, Khanna Publishers,7th edition,2011
2. A. Langsdortf, Theory of alternating current machine, TMH,2nd edition,2004..

REFERENCE BOOKS :

1. M.G Say, Performance & design of AC machines, CBS publishers,3rd edition,2002.
2. Nagarath and Kothari, Electrical Machine, TMH,4th edition,2010
3. Kosow, Electrical Machines and Transformers, 2/e, PHI,1990
4. Ashfaq Husain, Electrical Machines, Dhanapathrai& co,2nd edition,2014
5. Transformers, BHEL, Tata McGraw Hill ,2nd edition,2003

E Books /MOOCs /NPTEL

1. http://nptel.ac.in/courses/108106072/
2. http://nptel.ac.in/syllabus/108105018/
3. http://nptel.ac.in/courses/108105017/
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-685-electric-machines-fall-2013/course-notes/

****

MICROCONTROLLERS

Sub Code : 16EE403 **Credits : 04**
Hrs/Week : 4+0+0+0+J[#] **Total Hours : 52**

[#] J Refers to Project Based Learning – The evaluation of the projects carried out during semester can be considered as task.

Course Learning Objectives:

1. To introduce the 8051 microcontroller architectural features and programming techniques.
2. To study various applications of 8051 connected to peripheral devices.

UNIT – I

Microprocessors and microcontroller. Introduction, Microprocessors and Microcontrollers, RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture, Computer software. **2 Hours**

The 8051 Architecture: Introduction, Architecture of 8051, Pin diagram of 8051, Memory organization, External Memory interfacing, Stacks. **3 Hours**

Addressing Modes: Introduction, Instruction syntax, Data types, Subroutines, Addressing modes: Immediate addressing , Register addressing, Direct addressing, Indirect addressing, relative addressing, Absolute addressing, Long addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. **5 Hours**

UNIT – II

Instruction set: Instruction timings, 8051 instructions: Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. **4 Hours**

8051 programming: Assembler directives, Assembly language programs, C Programming, Time delay calculations. **6 Hours**

UNIT – III

8051 Interrupts and Timers/counters: Basics of interrupts, 8051 interrupt structure, Timers and Counters, 8051 timers/counters, programming 8051 timers in assembly and C . **6 Hours**

8051 Serial Communication: Data communication, Basics of Serial Data Communication, 8051 Serial Communication, connections to RS-232 (DB-9 only), Serial communication Programming in assembly and C. **6 Hours**

UNIT – IV

8051 Interfacing and Applications: Interfacing 8051 to LCD, Keyboard, parallel and serial ADC, DAC, Stepper motor interfacing, DC motor interfacing and PWM. **7 Hours**

Interfacing LED, LCD, External memory. Seven segment LED modules interfacing. Example – Real-time clock. **4 Hours**

UNIT – V

Case Studies: Home Automation System, Security System, Temperature monitoring and Control, Speed Measurement and Control, Automatic Irrigation System, Measurement of Voltage and Current. **9 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Know the basics of microcontrollers and understand the architecture, Pin diagram, Memory organization, different addressing modes of 8051 microcontroller
2. Analyze different types of instruction set and Illustrate Assembly language and C Programs.
3. Develop programming skills using timer/counter and demonstrate the use of serial communication for data transfer.
4. Develop the programming skills to interface various hardware with 8051.
5. Demonstrate some case study examples of applications of 8051using the knowledge gained.

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√	√							√			
CO2	√	√							√			
CO3	√	√			√				√			
CO4	√	√		√	√		√		√		√	
CO5	√	√		√	√		√		√		√	

TEXT BOOKS :

1. "The 8051 Microcontroller and Embedded Systems – using assembly and C "-, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006
2. "The 8051 Microcontroller", V.Udayashankar and Malikarjuna Swamy, TMH, 2009
3. Micro-LABlet Hardware and Software Design Documents, Version_0D, Department of E&E, NMAMIT, Nitte, 2016

REFERENCE BOOKS :

1. "The 8051 Microcontroller Architecture, Programming & Applications", 2e Kenneth J. Ayala, Penram International, 1996 / Thomson Learning 2005.
2. Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, "Pearson Education, 2005

E Books /MOOC/NPTEL

1. http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/micro/ui/TOC.htm
2. http://nptel.ac.in/courses/106108100/
3. http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/New_index1.html
4. http://nptel.ac.in/courses/117104072/

****

ELECTROMAGNETIC FIELDS

Sub Code	**: 16EE404**	**Credits**	**: 04**
Hrs/Week	**: 3*+2+0+0**	**Total Hours**	**: 39*+26**

***Note:** Lecture hours indicated are for teaching theoretical concepts. Illustrative examples and numerical problems are to be worked out in tutorial classes.

Prerequisites

Basic Electrical Engineering (16EE105)

Course Learning Objectives:

1. To study different coordinate systems for understanding the concept of gradient, divergence and curl of a vector.
2. To study the application of Coulomb's Law and Gauss Law for electric fields produced by different charge configurations.
3. To evaluate the energy and potential due to a system of charges.
4. To study the behavior of electric field across a boundary between a conductor and dielectric and between two different dielectrics.
5. To study the magnetic fields and magnetic materials.
6. To study the time varying fields and propagation of waves in different media.

UNIT – I

Coulomb's Law and Electric field intensity: Experimental law of coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge. **4*+3 Hours**

Electric flux density, Gauss's law and Divergence: Electric flux density, Gauss's law and Divergence , Vector operator ▼ and Divergence theorem. **4*+3 Hours**

UNIT – II

Energy and Potential: Energy expanded in moving a point charge in an electric field, the line integral, Definition of Potential difference and Potential, the potential field of a point charge and system of charges, Potential gradient, Energy density in an Electrostatic field.

4*+3 Hours

Conductors, dielectrics and capacitance: Current and current density, Continuity of current, Metallic Conductors, Conductor properties and boundary conditions, Boundary conditions for perfect dielectrics, capacitance and examples. **4*+2 Hours**

UNIT – III

Poisson's and Laplace's equations: Derivation of Poisson's and Laplace's equations. Examples of the solutions of Laplace's and Poisson's equation. **4*+3 Hours**

The steady magnetic field: Biot – Savarat's law, Ampere's circuital law, curl, Stokes theorem, Magnetic flux and Magnetic flux density, Scalar and vector magnetic potentials.

4*+3 Hours

UNIT – IV

Magnetic forces, Magnetic Materials and Inductance: Force on a moving charge, Magnetic boundary conditions, Inductance. **4*+3 Hours**

Time varying fields and Maxwell's equations: Faraday's law, Displacement current, Maxwell's equation in point and integral form. **4*+2 Hours**

UNIT – V

Transmission Lines: Physical description of Transmission line propagation, Transmission line equations, Lossless propagation, Lossless propagation of sinusoidal voltages, voltage standing wave ratio. **4*+3 Hours**

Uniform plane wave: Wave propagation in free space and dielectrics, Poynting's theorem and wave power, propagation in good conductors – skin effect. **4*+2 Hours**

Course Outcomes:

At the end of the course student will be able to

1. State and apply the Coulombs, Gauss Law to determine the electric field intensity and flux density resulting from various configurations of charge distributions.
2. Determine the electric potential and its relation to electric field intensity and analyze the properties of conductor, semiconductor, and dielectrics
3. Evaluate capacitance of various geometrics and apply Poisson's and Laplace's equations for the calculation of Capacitances
4. Comprehend Biot- Savart's, Ampere's Law for steady magnetic field and use Maxwell's equations, Faraday's law for time varying fields and Analyze magnetic forces, magnetic material, and calculation of inductance.
5. Analyze plane wave reflection and transmission at the boundaries and solve basic transmission line and Wave propagation problems and problems on skin effect..

Mapping of POs & COs:

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	H	H	L	M					L			
CO2	H	H	L	M					L			
CO3	H	H	L	M					L			
CO4	H	H	L	M					L			
CO5	H	H	L	M					L		L	

TEXT BOOKS :

1. "Engineering Electromagnetics" William H. Hayt Jr. and John A. Buck, Tata McGraw-Hill, 7th edition, 2006
2. "Electromagnetics with Applications" John Krauss and Daniel A. Fleisch, McGraw-Hill, 5th edition, 1999

REFERENCE BOOKS :

1. "Electromagnetic Waves and Radiating Systems" Edward C. Jorden and Keith G Balmain, Prentice – Hall of India / Pearson Education, 2nd edition, 1968.
2. "Field and Waves Electromagnetics", David K. Cheng, Pearson Education Asia,2nd edition - 1989

E Book /MOOC / NPTEL

1. https://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/
2. https://ocw.mit.edu/resources/res-6-002-electromagnetic-field-theory-a-problem-solving-approach-spring-2008/
3. http://nptel.ac.in/courses/117103065/
4. http://nptel.ac.in/courses/108106073/
5. http://nptel.ac.in/courses/108104087/

****

NETWORK ANALYSIS

Sub Code : 16EE405 **Credits : 04**
Hrs/Week : 3*+2+0+0 **Total Hours : 39*+26**

***Note:** Lecture hours indicated are for teaching theoretical concepts. Illustrative examples and numerical problems are to be worked out in tutorial classes.

Prerequisites : Basic Electrical Engineering (16EE105)

Course Learning Objectives:

1. To familiarize the basic laws, theorems and the methods of analysing electrical circuits.
2. To explain the concept of resonance and coupling in electric circuits.
3. To familiarize the analysis of three-phase circuits
4. To analyze the transient response of circuits with dc and sinusoidal ac input
5. To impart basic knowledge on network analysis using Laplace transforms

UNIT – I

Independent and dependent sources, source transformation, DC and AC multi-loop circuit analysis- mesh, node and mixed mesh and node analysis for electric circuit with linearly dependent and independent sources. **7*+5 Hours**

UNIT – II

Coupled circuits- coefficient of coupling, dot convention for coupled coils and analysis of simple coupled circuits.Series and parallel resonance, Q factor, band width.
Unbalanced Three phase systems: Analysis of three phase unbalanced systems, neutral shift, calculation of real and reactive powers. **8*+5 Hours**

UNIT – III

Network theorems- superposition, reciprocity, Thevenin's and Norton's theorem, Maximum power transfer theorem, Telligens theorem, Millman theorem as to AC and DC circuits.
8*+5 Hours

UNIT – IV

Transient behaviour and initial conditions-Behaviour of circuit elements under switching. Conditions and their representations, evaluation of initial and final conditions in RL, RC and RLC circuits with AC and DC excitations, Solution of network equations including coupled circuits **8*+5 Hours**

UNIT – V

Transform method of analysis:Review of Laplace transformation, Laplace Transform of network and time domain solution for RL, RC and RLC networks for ac and dc excitations.
Two port networks -Short circuit admittance parameters, Open circuit impedance parameters, T-, H- parameters, Relationship between parameter sets. **8*+6 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Analyze and solve problems pertaining to DC and AC circuits.
2. Illustrate the coupled circuits, series, parallel resonance and unbalanced three phase system.
3. Solve problems pertaining to electrical network using various network theorems.
4. Analyze the transient behaviour of various electrical network.
5. Perform the Laplace transform on electrical network and analyse the two port network.

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√	√		√								
CO2	√	√		√								
CO3	√	√		√								
CO4	√	√		√								
CO5	√	√		√								

TEXT BOOKS:

1. Engineering Circuit Analysis, William H Hayt et al, McGraw Hill, 8th Edition, 2014
2. Engineering Circuit Analysis, J David Irwin et al, Wiley India, 10th Edition 2014.

REFERENCE BOOKS:

1. Fundamentals of Electric Circuits, Charles K Alexander, Matthew N O Sadiku, McGraw Hill, 5th Edition, 2013
2. Network Analysis, M.E Van Valkenberg, 3rd Edition, Series Volume: 7, Prentice-Hall Publishers. 2014
3. Electric Circuits, MahmoodNahvi, McGraw Hill, 5th Edition, 2009
4. Electric circuits, A chakrabarthi, DhanpathRai and company, 6th Edition.2014

E Book /MOOC / NPTEL

1. http://nptel.ac.in/courses/108102042/
2. http://nptel.ac.in/courses/108106075/
3. http://nptel.ac.in/courses/108105065/
4. https://www.coursera.org/learn/linear-circuits-dcanalysis

****

MICROCONTROLLERS LABORATORY

Sub Code	**: 16EE406**	**Credits**	**: 02**
Hrs/Week	**: 0+0+3+0**	**Total Hours**	**: 39**

Course Learning Objectives:

1. To introduce the assembly language program using various addressing modes and data transfer process
2. To write the assembly language program for data processing applications using arithmetic, logical and jump instruction.
3. To write the assembly language program to display application output through LCD display.
4. To write C language program for interfacing stepper motor control, ADC,DAC

List of Experiments

1. Data Transfer - Block move, Exchange, Sorting, Finding largest element in an array.
2. Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube – (16 bits Arithmetic operations – bit addressable).
3. Counters.
4. Boolean & Logical Instructions (Bit manipulations).
5. Conditional CALL & RETURN.
6. Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII; HEX - Decimal and Decimal - HEX .
7. Programs to generate delay, Programs using serial port and on-Chip timer / counter.

II. INTERFACING:

Write C programs to interface 8051 chip to Interfacing modules to develop single chip solutions.

1. Simple Calculator using 6 digit seven segment displays and Hex Keyboard interface to 8051.
2. Alphanumeric LCD panel and Hex keypad input interface to 8051.
3. External ADC and Temperature control interface to 8051.
4. Generate different waveforms Sine, Square, Triangular, Ramp etc. using DAC interface to 8051; change the frequency and amplitude.
5. Stepper and DC motor control interface to 8051.
6. Elevator interface to 8051.

Course Outcomes:

At the end of the course student will be able to

1. Develop assembly language program for various addressing modes and data transfer process
2. Develop assembly language program for data processing applications using arithmetic, logical and jump instruction.
3. Develop assembly language program to display application output through LCD display.
4. Develop C language program for interfacing stepper motor control
5. Develop C language program for interfacing ADC,DAC.

Mapping of POs & COs:

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√	√	√		√				√			
CO2	√	√	√		√				√			
CO3	√	√	√		√				√			
CO4	√	√	√		√				√			
CO5	√	√	√		√				√			

****

DC AND SYNCHRONOUS MACHINES LABORATORY

Sub Code : 16EE407 **Credits : 02**
Hrs/Week : 0+0+3+0 **Total Hours : 39**

Course Learning Objectives:

1. To perform test on DC Machine to determine the speed torque characteristics, BHP, efficiency.
2. To perform the Speed control experiments on DC Machines
3. To perform various tests on DC and synchronous machines.
4. To test the alternator for its voltage regulation.
5. To test the synchronous machines to draw V and inverted V curves.

List of Experiments

1. Load characteristics of DC Generator
2. Load test on DC Motor-Determination of speed torque and BHP efficiency characteristics
3. Speed control of DC motors by Armature Voltage and Flux control methods.
4. Speed control of DC motors by Ward Leonard method.
5. Swinburnes Test
6. Hopkinson's Test
7. Field test on series motors
8. Retardation test-Electrical braking method
9. Voltage Regulation of Alternator by EMF and MMF method
10. Voltage regulation of alternator by ZPF method
11. Slip test
12. V and inverted V curves of a synchronous motor

Course Outcomes:

At the end of the course student will be able to

1. Determine speed torque characteristics, BHP, efficiency of DC Machine.
2. Control the Speed of DC Machines
3. Perform various tests on DC and synchronous machines.
4. Determine voltage regulation of Alternators

5. Draw V and inverted V curves of synchronous machines.

Mapping of POs & COs:

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√	√	√									
CO2	√	√	√									
CO3	√	√	√									
CO4	√	√	√									
CO5	√	√	√									

****

CIRCUIT SIMULATION LABORATORY

Sub Code : 16EE408 **Credits : 01**
Hrs/Week : 0+0+2+0 **Total Hours : 26**

Course Learning Objectives:

1. Verify network theorem and solve various electrical networks using simulation tools
2. Design, simulate and verify diode based circuits
3. To simulate and verify op-amp based circuit using simulation package
4. To simulate and verify transistor based circuit using simulation package
5. To introduce the concept of PCB layout for the desired circuit using layout software.

List of Experiments

Note: Exposure should be given to simulate using schematics as well along with PSpice programming and should be verified using Multisim Load characteristics of DC Generator

1. Verification of KCL and KVL for multiloop electrical circuits with DC and AC controlled independent sources.
2. Series and parallel resonance plot of current, impedance, admittance, power factor Vs frequency and determination of Q factor and bandwidth.
3. Verification of Thevenin's, Norton's theorem for AC and DC circuits
4. Verification of Maximum power transfer theorem.
5. Diode clipping , clamping , rectifier circuits (both half and full wave, bridge rectifier) (2 Experiments)
6. Inverting non-inverting circuits using OPAMP
7. RC phase shift oscillator using OPAMP.
8. Performance of BJT RC phase shift oscillator.
9. Simulation of 2-stage RC coupled amplifier and determination of gain, frequency response, bandwidth, half power frequencies.
10. Introduction to PCB Layout, creating a PCB Layout for any two of the above applications (2 Experiments)

Course Outcomes:

At the end of the course student will be able to

1. Verify network theorem and solve various electrical networks using simulation tools
2. Design, simulate and verify diode based circuits
3. Design simulate and verify op-amp based circuit using simulation package
4. Design simulate and verify transistor based circuit using simulation package
5. Create PCB layout for the desired circuit using layout software.

Mapping of POs & COs:

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√	√	√		√							
CO2	√	√	√		√							
CO3	√	√	√		√							
CO4	√	√	√		√							
CO5	√		√		√	√	√				√	√

TEXT BOOKS:

1. Rashid, Introduction of PSPICE using ORCAD for circuits and electronics 3/e, Pearson education.
2. LabVIEW Reference Manual.
3. OrCADPSpice Reference Manual.

****

ENHANCING SELF COMPETENCE

Sub Code : 16HU411 **Credits : 02**
Hrs/Week : 1+2+0+0 **Total Hours : 26**

Course Learning Objectives:

This Course will enable students to

1. Introspect and learn more about oneself
2. Learn social behaviour and etiquette
3. Develop positive attitude and values in life
4. Learn to be effective in communication and interactive skills
5. Educate on writing and presentation skills and also to educate onself on legal and ethical aspects

UNIT – I

Self Awareness and Emotional Quotient:
SWOT Analysis; Johari Window

4 Hours

UNIT – II

Grooming and Etiquette:
Personal grooming, hygiene, dressing for different occasions, making small talk, showing respect to women, eye contact, being appreciative, dos and don'ts in a conversation; Time Management.

4 Hours

UNIT – III

Attitude Development:
Building self worth, confidence, developing empathy; Goal Setting; Motivation.

5 Hours

UNIT – IV

Interactive Behavior:
Active listening, verbal & non-verbal communication, interview skills, group discussions, dealing with people in an organization, handling feed back and criticism.

7 Hours

UNIT - V

Writing and Presentation:
Formal and informal e-mails, framing requests, accepting or rejecting proposals, greetings, salutations, Close. Plagiarism, Presentation Skills.

6 Hours

Course Outcomes:

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

1. Develop awareness of his or her strengths and weaknesses and handle emotions.
2. Ensure a refined behaviour.
3. Become an asset to the society.
4. Become a good communicator.
5. Present to a group, on a one to one basis and create an impact.

REFERENCE BOOKS :

1. "Communicating at work – Principles and Practices for Business and the Professions" - Ronald B Adler & Jeanne Marquardt Elmhorst; McGraw-Hill College; Sixth Edition.
2. "Organizational Behaviour", - Stephen P Robbins; Prentice Hall, India.
3. "Organizational Behaviour", - Fred Luthans; McGraw Hill International Edition.

****