B. E. SYLLABUS

ELECTRONICS & COMMUNICATION ENGINEERING

III & IV SEMESTER

With

Scheme of Teaching

& Examination

DEPARTMENT: ELECTRONICS & COMMUNICATION ENGINEERING

1.	Dr. Rekha Bhandarkar	Ph.D	Professor & HoD
2.	Dr. M.K. Parasuram	Ph.D	Director
3.	Dr. Krishna Shenai	Ph.D	Director R&D
4.	Dr. K. Rajesh Shetty	Ph.D	Professor/Dean (Admissions & Alumni Affairs)
5.	Dr. K. V. S. S. S. S. Sairam	Ph.D	Professor
6.	Dr. Veena Devi Shastrimath V.	Ph.D	Professor
7.	Dr. Ananth A. G.	Ph.D	Professor
8.	Dr. K. S. Shivaprakasha	Ph.D	Assoc. Professor
9.	Dr. Krishnananda Shet	Ph.D	Assoc. Professor
10.	Dr. Usha Desai	Ph.D	Assoc. Professor
11.	Mr. Durga Prasad	M.Tech(Ph.D)	Assoc. Professor
12.	Mrs. Sushma P.S.	M.Tech(Ph.D)	Assoc. Professor
13.	Mrs. Shrividya G.	M.Tech(Ph.D)	Assoc. Professor
14.	Mrs. Padmavathi K.	M.Tech(Ph.D)	Assoc. Professor
15.	Mrs. Prabha Niranjan	M.Tech(Ph.D)	Assoc. Professor
16.	Mr. Sukesh Rao M.	M.Tech(Ph.D)	Assoc. Professor
17.	Mr. Subrahmanya Bhat	M.Tech(Ph.D)	Assoc. Professor
18.	Mr. Mahaveera K.	M.Tech(Ph.D)	Asst. Prof Gd III
19.	Mrs. Sunitha Lasrado	M.Tech(Ph.D)	Asst. Prof Gd III
20.	Mrs. Vidya Kudva	M.Tech(Ph.D)	Asst. Prof Gd III
21.	Mr. Satheesh Rao	M.Tech	Asst. Prof Gd III
22.	Dr. Ashish Singh	Ph.D	Asst. Prof Gd III
23.	Dr. Ansal V.	Ph.D	Asst. Prof Gd III
24.	Dr. Jagadeesh V. K.	Ph.D	Asst. Prof Gd III
25.	Mr. Ravindra K.S.	M.Tech	Asst. Prof Gd II
26.	Mr. Pradyumna G.R.	M.Tech	Asst. Prof Gd II
27.	Mrs. Roopa B. Hegde	M.Tech(Ph.D)	Asst. Prof Gd II

28.	Mrs. Charishma	M.Tech	Asst. Prof Gd II
29.	Mrs. Niju Rajan	M.Tech	Asst. Prof Gd II
30.	Mrs. Shubha B.	M.Tech	Asst. Prof Gd II
31.	Mr. Anil Kumar Bhat	M.Tech	Asst. Prof Gd II
32.	Mr. Shivakumar B. R.	M.Tech(Ph.D)	Asst. Prof Gd II
33.	Ms. Amrutha D. Pai	M.Tech	Asst. Prof Gd I
34.	Mrs. Deepa K.	M.Tech	Asst. Prof Gd I
35.	Mr. Bomme Gowda	M.Tech(Ph.D)	Asst. Prof Gd I
36.	Mr. Dileep Kumar M.J.	M.Tech(Ph.D)	Asst. Prof Gd I
37.	Mr. Sudharshana	M.Tech	Asst. Prof Gd I
38.	Mrs. Nagapriya Kamath K.	M.Tech	Asst. Prof Gd I
39.	Mrs. Ramya Shetty	M.Tech	Asst. Prof Gd I
40.	Mr. Prajwal Hegde N.	M.Tech(Ph.D)	Asst. Prof Gd I
41.	Mr. Karthik	M.Tech	Asst. Prof Gd I
42.	Mrs. Anupama B.	M.Tech	Asst. Prof Gd I
43.	Ms. Anusha R.	M.Tech(Ph.D)	Asst. Prof Gd I
44.	Mrs. Ashwini K.	M.Tech	Asst. Prof Gd I
45.	Mrs. Shankari N.	M.Tech	Asst. Prof Gd I
46.	Ms. Harshitha Bhat	M.Tech	Asst. Prof Gd I
47.	Mrs. Vaishali Y Suvarna	M.Tech(Ph.D)	Asst. Prof Gd I
48.	Ms. Lavanya B. L.	M.Tech	Asst. Prof Gd I
49.	Ms. Kavitha S.	M.Tech	Asst. Prof Gd I

DEPARTMENT: ELECTRONICS & COMMUNICATION ENGINEERING

Vision:

Empowering people, Partnering in Community Development by achieving expertise requiring the knowledge of state of the art technology in the field of Electronics and Communication.

Mission:

To impart specialized education in the field of Electronics & Communication that contributes to the socio-economic development of the region and to generate technical manpower with high degree of credibility, integrity and ethical standards by providing vibrant learning environment.

Program Educational Objectives (PEOs):

PEO1: The graduate should have effective foundation in mathematics, science as well as other relevant disciplines and a strong foundation in Electronics and Communication Engineering.

PEO2: The graduate will inculcate effective communication skills, teamwork, lifelong learning and leadership in preparation for a successful career in industry and academia with credibility, integrity and ethics.

PEO3: The graduate will be able to design and develop innovative system that contribute to socio-economic development.

Program Specific Outcomes (PSOs):

PSO1: Understand the concepts and applications in the field of communication, signal processing, VLSI, embedded systems, power electronics and control systems.

PSO2: Effectively apply the domain knowledge to arrive at optimum solutions to real time applications.

PSO3: Apply acquired skills in project management and execution to Electronics and Communication systems.

Program Outcomes (POs):

Engineering Graduates will be able to:

PO1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Graduate Attributes :

Sl. No.	**Graduate Attributes**
a	Engineering Knowledge
b	Problem Analysis
c	Design / development of solutions
d	Conduct investigations of complex problems
e	Modern tool usage
f	The engineer and society
g	Environment and sustainability
h	Ethics
i	Individual and team work
j	Communication
k	Project management and finance
l	Life-long learning

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF TEACHING AND EXAMINATION

III SEMESTER B.E. **28 Hours/week**

Sl. No.	CODE	COURSE	Theory/Tuto./Prac./ Self Study	Total Hrs. / Week	C.I.E.	S.E.E.	CREDITS
1.	16EC301	Vector Calculus and Transform Techniques	4+0+0+0	4	50	50	4
2.	16EC302	Analog Electronic Circuits	4+0+0+0	4	50	50	4
3.	16EC303	Network Analysis	4+0+0+0	4	50	50	4
4.	16EC304	Digital Electronic Circuits	4+0+0+0	4	50	50	4
5.	16EC305	Signals & Systems	4+0+0+0	4	50	50	4
6.	16EC306	Analog Electronic Circuits Lab	0+0+3+0	3	50	50	2
7.	16EC307	Digital Electronic Circuits Lab	0+0+3+0	3	50	50*	2
8.	16HU311	Enhancing Self Competence	2+0+0+0	2	50	50	2
		Total	**28**	**28**	**400**	**400**	**26**

*** Project is evaluated**

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF TEACHING AND EXAMINATION

IV SEMESTER B.E. **30 Hours/week**

Sl. No.	CODE	COURSE	Theory/Tuto./Prac./ Self Study	Total Hrs. / Week	C.I.E.	S.E.E.	CREDITS
1.	16EC401	Probability Theory and Numerical Methods	4+0+0+0	4	50	50	4
2.	16EC402	Digital Signal Processing	4+0+0+0	4	50	50	4
3.	16EC403	Control Systems	4+0+0+0	4	50	50	4
4.	16EC404	Electromagnetic Theory	4+0+0+0	4	50	50	4
5.	16EC405	Analog Communication	4+0+0+0	4	50	50	4
6.	16EC406	Digital System Design Using Verilog	4+0+0+0	4	50	50	4
7.	16EC407	Digital Signal Processing Lab	0+0+3+0	3	50	50	2
8.	16EC408	Digital System Design Lab	0+0+3+0	3	50	50*	2
		TOTAL	**30**	**30**	**400**	**400**	**28**

*** Project is evaluated**

VECTOR CALCULUS AND TRANSFORM TECHNIQUES

Sub Code : 16EC301 **Credit : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Prerequisites:

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

Course Learning Objectives:

At the end of the course the successful student is expected to:

1. Know the areas in which vector functions and their derivatives can be used. Apply operators like curl, gradient, divergence and find directional derivatives.
2. Define and compute line, surface and volume integrals over general regions. Apply Green's, Stoke's and Divergence theorem in relevant fields.
3. Determine analyticity of a function and find the derivative of a function, evaluate integral using Cauchy's integral formula. Compute the residue of a function and use the residue theory to evaluate a contour integral or an integral over the real line.
4. Find Fourier series of a function; obtain the half range series, harmonics, find the Fourier transform and the inverse Fourier transform of a function.
5. Find the Z-transform and the inverse Z-transforms of function. Apply this to obtain the solutions of difference equations.

UNIT – I

Vector Calculus: Vector algebra, vector differentiation-gradient, divergence, curl, Laplacian, solenoidal and irrotational 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 the student should be able to

1. Explain the concepts of gradient of a function, the divergence and curl of a vector field and prove identities involving these. Also able to recognise irrotational and solenoidal vector fields.
2. Evaluate line and surface integrals and understand the various integral theorems relating line, surface and volume integrals.
3. Recognize analytic functions, differentiate and integrate complex functions, compute the residue of a function and use the residue theorem to evaluate a contour integral over the real line.
4. Find the Fourier transform and the inverse Fourier transform of a function and will be able to apply this concept in his technical subjects.
5. Find the Z-transform and the inverse Z-transforms of function. Apply this to obtain the solutions of difference equations and will come to know its application in his field of engineering.

Mapping of PO's & CO's:

CO \ PO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	M										
2	H	M										
3	H											
4	M	L										
5	H	M										

L: Low **M: Medium** **H: High**

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",** 6th edition, McGraw Hill.Inc.
2. Murray R. Spiegel, **"Vector Analysis"**, Schuam publishing Co.

ANALOG ELECTRONIC CIRCUITS

Sub Code : 16EC302 **Credit : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives :

Upon Completing this course, the students will be able to

1. Understand the structure and operation of MOSFET
2. Derive the Models for Diode, BJT and MOSFETs
3. Differentiate between the MOSFET and BJT
4. Perform DC and AC analysis on Transistor circuits
5. Understand the working of Differential amplifiers
6. Understand the behaviour of transistor amplifiers for high-frequency signals
7. Understand the need and effect of feedback
8. Understand the operation of Oscillators
9. Understand the need and operation of Output stage circuits

UNIT - I

DIODE CIRCUITS AND BJT MODELS: Piecewise Linear Equivalent circuit, Transition and Diffusion Capacitance, Light Emitting Diodes [T1-1], Clippers, Clampers [T1-2], Bipolar Transistor Models and characteristics [T2-4] **8 Hours**

UNIT – II

PHYSICS OF MOS TRANSISTORS: Device Structure and Operation, Current–Voltage Characteristics, Channel Length Modulation, Trans-conductance, Other 2nd order effects, MOS device Models, PMOS transistor, Comparison of BJT and MOS devices [T2-6]

10 Hours

UNIT – III

TRANSISTOR AMPLIFIERS: Bipolar Amplifiers**:** Operating Point Analysis and Design, Common Emitter Topology, Emitter Follower [T2-5], MOS Amplifiers: Common Source Stage, Source Follower [T2-7] **10 Hours**

UNIT – IV

DIFFERENTIAL AMPLIFIERS: Bipolar Current Mirror, MOS Current Mirror [T2-9], Bipolar Differential Pair, MOS Differential Pair, Common Mode Rejection, Differential pair with Active Load [T2-10] **12 Hours**

UNIT – V

FREQUENCY RESPONSE, FEEDBACK CONCEPTS AND POWER AMPLIFIERS: High-Frequency Model of the MOSFET and the BJT, Transit Frequency [T2-11], Feedback concepts, Feedback connection types, Practical feedback circuits, Oscillator operation, Phase shift oscillator, Tuned oscillator circuit [T1-14], Classification of Output Stages; Class A Output Stage; Class B Output Stage; Class AB Output Stage; [T3-13] **12 Hours**

Course Outcomes:

CO1. Analyse and Design Clipper and Clamper circuits using Diodes; Design Circuits using Photodiodes and LEDs, Derive the small signal model for BJT

CO2. Explain the structure of a MOSFET and its operation; Derive the Current-Voltage characteristics; Define body effect and other non-ideal behaviour in MOSFET

CO3. Analyse or Design a discrete transistor amplifier for given specifications

CO4. Analyse or Design a Current Mirror Circuit; Explain the operation of Differential amplifiers; Analyse Multistage Amplifiers

CO5. Derive the high frequency model for a transistor; Explain the frequency response of CS and CE amplifiers; Explain the effects of negative feedback; Compare the types of Feedback topologies; Design RC and LC Oscillators; Classify and analyse the Output stage amplifier circuits

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1.	H	H	M	M	H	-	-	-	-	-	-	-
2.	H	-	-	M	H	-	-	-	-	-	-	L
3.	H	H	M	M	H	-	-	-	L	-	-	-
4.	H	H	L	M	H	-	-	-	-	-	-	-
5.	H	H	H	M	H	-	-	-	L	-	-	-

L: Low M: Medium H: High

TEXT BOOKS:

1. Robert L. Boylestad, Louis Nashelsky, "**Electronic Devices and Circuit Theory",** Pearson, 10^{th} Edition
2. Behzad Razavi, "**Fundamentals of Microelectronics**", PHI, 1999
3. A.S. Sedra, K.C Smith, "**Microelectronic circuits**", Oxford University Press, 6^{th} Edition 2004

REFERENCE BOOK:

1. David. A. Bell, **"Electronic Devices and Circuits**", PHI, 4th Edition, 2004

NPTEL/ MOOC Link:

1. http://www.nptel.ac.in/courses/117101106/
2. https://www.edx.org/course/circuits-electronics-1-basic-circuit-mitx-6-002-1x-0
3. https://www.edx.org/course/circuits-electronics-2-amplification-mitx-6-002-2x-0
4. https://www.edx.org/course/electronic-materials-devices-mitx-3-15-1x-0

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NETWORK ANALYSIS

Sub Code : 16EC303 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Note: 16EC303 IS A FLIP COURSE

Course Learning Objectives:
This course will enable students to

1. Understand about analysis of complex circuits using Source transformations, Star-Delta transformations, mesh current & nodal voltage method and use the concepts of graph theory to solve the electrical networks.
2. Apply and analyze various network theorems in solving the problems related to Electrical Circuits.
3. Describe behavior of circuit elements under switching condition and their representations, evaluate initial and final condition for RL, RC and RLC circuits for DC and AC excitations.
4. Understand the use of Laplace transform to solve Electrical Circuits.
5. Describe and Analyze two-port networks.

UNIT – I

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. **10 Hours**

UNIT – II

Network Theorems-I: Superposition, Reciprocity and Millman's theorems.
Network Theorems-II: Thevenin's and Norton's theorems, Maximum power transfer theorem **10 Hours**

UNIT – III

Network Topology: Graph of a network, Concept of tree and co-tree, Incidence matrix, Tie-set and Cut-set schedules, Formulation of equilibrium equations in matrix form, Solution of resistive networks, Principle of duality.
Resonant Circuits: Series and parallel resonance, Frequency response of series and parallel circuits, Q- factor, Bandwidth. **12 Hours**

UNIT – IV

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 for AC and DC excitations.
Laplace Transformation and Applications: Properties: Linearity, Initial &final value theorem, Periodicity and Convolution theorem. Solution of networks:Step, Ramp and Impulse responses.Waveform synthesis. **12 Hours**

UNIT – V

Two Port Network Parameters: Definition of z, y, h and transmission parameters, Modeling with these parameters and relationship between parameters sets. **8 Hours**

Course Outcomes:

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

1. Understand the basic concepts of source transformations, star- delta transformations, mesh current and node voltage methods to analyze electrical networks.
2. Appreciate and apply different network theorems to solve complex electrical circuits.
3. Understand and apply the concepts of graph theory in solving electrical networks.
4. Evaluate initial and final condition for RL, RC and RLC circuits for DC and AC excitations and to understand the need for transformations.
5. Relate and evaluate different two-port parameters in electrical networks**.**

Mapping of PO's and CO's

CO \ PO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H			L							
2	H	H	M	M	L						M	
3	H		M		L						M	
4	H	M										
5	H	M										

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. M. E. VanValkenburg, **"Network Analysis",** PHI/ Pearson Education, 3rd Edition.
2. Roy Choudhury, **"Networks and Systems",** 2nd Edition, 2006 reprint, New Age International publications.

REFERENCE BOOKS:

1. Hayt, Kemmerly and Durbin, **"Engineering Circuit Analysis**", TMH 6th Edition, 2002
2. Franklin F. Kuo, **"Network Analysis and Synthesis",** Wiley International Edition, 2nd Edition, Reprint 2009
3. David K Cheng, **"Analysis of Linear Systems",**Narosa Publishing House, 11th Reprint,2002
4. Bruce Carlson, **"Circuits: Engineering Concepts and Analysis of Linear Electric Circuits",** Thomson Learning, 2000, 1st Edition, Reprint 2002

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/117106116/
2. http://nptel.ac.in/courses/117106108/64
3. http://www.nptel.ac.in/courses/108102042/9
4. https://www.edx.org/course/circuits-electronics-1-basic-circuit-mitx-6-002-1x-0

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DIGITAL ELECTRONIC CIRCUITS

Sub Code : 16EC304 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives:

This course will enable students to:

1. Understand the functions of different logic gates and simplify the Algebraic Equations using Karnaugh Maps, Quine McClusky Techniques and Map Entered Variable method.
2. Describe and Analyze Combinational Logic circuits - Decoders, Encoders, Digital multiplexers, Adders and Subtractors, Binary comparators and Code Converters.
3. Describe and Analyze operation of Latches / Flip Flops, Master-Slave Flip-Flops, Edge-Triggered flip-flops and Flip-Flop Conversions.
4. Describe and Design of Registers, Synchronous/Asynchronous Counters and Sequence Generators.
5. Analyze and Design of Mealy and Moore Models, Synchronous Sequential Circuits and State Diagrams.

UNIT - I

Digital Concepts and Optimizations:

Basic logic operation of Logic Gates, Truth Table and Fundamental Theorems of Boolean Algebra, Canonical Representations of Logic Functions - SOP and POS Forms. Truth Table from Problem Statement, Deriving Switching Equations from Truth Table and Logic Circuit. NAND and NOR Implementation.
Digital IC Parameters: Fan-in, Fan-out, I_{OL}, I_{OH}, I_{IL}, I_{IH}, V_{OL}, V_{OH}, V_{IL}, V_{IH}, t_{pHL}, t_{pLH}, V_{CC}, I_{CC} and Dissipated Power.

Gate Level Minimization:

The Map Method (2, 3 & 4 Variable) - SOP and POS Simplification, Don't care Conditions.
Q-M Method and MEV Method.

12 Hours

UNIT – II

Combinational Logic Circuits:

Introduction, Combinational Circuits - Analysis and Design Procedure, Binary Adder-Subtractor, Parallel Adder, Look Ahead Carry Adder, Decimal Adder, Binary Multiplier, Comparators, Decoder/Encoders and Multiplexers.

Binary Codes:

BCD, Self-Complementing Code [Excess-3], Unit distance Code [Gray] and Code conversions.

10 Hours

UNIT – III

Introduction to Sequential Circuits:

Introduction, Basic Bistable Element, Latches: SR Latch (using NOR/NAND), gated SR Latch/Flip Flop, gated D Latch/Flip Flop, JK Flip-Flop, T Flip-Flop, Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR/JK/T/D Flip-Flops, 0's and 1's catching problem in JK Master-Slave Flip Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop, Characteristic Equations and Flip-Flop Conversions.

10 Hours

UNIT - IV

Sequential Circuit Design:

Registers: Introduction, Shift Register – SISO, SIPO, PISO, PIPO, Universal Shift Register, Ring Counter, Johnson Counter and Sequence Generators.

Counters: Ripple Counters (Asynchronous Counters) – Up/Down Counters. Synchronous Counters – Modulus-N Synchronous Counters and Counter Design.

10 Hours

UNIT – V

State Machine Concepts:

Basic state machine concepts- Moore and Mealy Models, Analysis of Clocked Sequential Circuits, Excitation and Output Expressions, Transition Equations, Transition Tables, Excitation Tables, State Tables, and State Diagrams.

Serial Adder as Mealy and Moore model.

10 Hours

<u>Course Outcomes:</u>

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

1. Employ different circuit minimization techniques for simplifying Boolean functions and design circuits composed of NAND and NOR gates.
2. Design and Analyze Combinational Logic Circuits.
3. Analyze sequential devices such as Latches and Flip-Flops.
4. Design Registers, Counters and Sequence Generators.
5. Analyze and Design Synchronous Sequential Circuits.

Mapping of PO’s & CO’s:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M	L	M		L							
2	M	M	H	L	L					L	L	
3	L	H	L	L	M							
4	L	H	M	M	L	L				L		
5	L	H	H	H	L					L		

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. John M Yarbrough, “**Digital Logic: Applications and Design**”, Thomson Learning, 2001.
2. Donald D Givone, “**Digital Principles and Design**”, Tata McGraw Hill, Edition, 2000.
3. M. Morris Mano and Michael D. Ciletti, “**Digital Design: With and Introduction to the Verilog HDL**”, Pearson Prentice Hall, 5th Edition, 2013.
4. S. Salivahanan and S. Arivazhagan, **“Digital Circuits and Design”**, 3rd Edition., Vikas Publishing House Pvt. Ltd, New Delhi, 2006

REFERENCE BOOKS:

1. Charles H Roth Jr. and Larry L. Kinney, “**Fundamentals of Logic Design**”, Cengage Learning, 6th Edition, 2010.
2. Mano and Kime, “**Logic and Computer Design Fundamentals**”, Pearson Prentice Hall, 3rd Edition, 2004.

NPTEL/ MOOC Link

1. http://nptel.ac.in/courses/117105080/3
2. http://nptel.ac.in/courses/117106086/1
3. http://nptel.ac.in/courses/117106114/5

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SIGNALS & SYSTEMS

Sub Code : 16EC305 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives :

This course will enable students to

1. Understand different types of signals, systems.
2. Study properties of impulse response representation, differential/ difference & block diagram representation for LTI system
3. Fourier series representation for periodic signals
4. Understand Fourier transform representation for non periodic signals & the applications of Fourier representation in analyzing LTI systems
5. Understand the Z transform representation for discrete time signals & its applications in analyzing discrete time systems

UNIT – I

Elements of Signal Space Theory: 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. **10 Hours**

UNIT – II

Time-Domain Representations for LTI Systems: Convolution, impulse response representation, convolution sum and convolution integral, properties of impulse response representation, differential equation representation (solution not included), difference equation representation and its solution, Block diagram representations. **12 Hours**

UNIT – III

Fourier Representation for Periodic Signals: Introduction, Continuous time & discrete time Fourier series (derivation of series excluded) and their properties. **08 Hours**

UNIT – IV

Fourier Representation for Signals – 2: Continuous time & discrete time Fourier transforms and their properties. (derivations & **proofs are excluded**).
Applications of Fourier Representations: Introduction, Frequency response of LTI systems, Fourier transform representation of periodic signals, Fourier transform representation of discrete time signals, Sampling. **12 Hours**

UNIT – V

Z -TRANSFORMS: Introduction, Z – transform, properties of ROC, Properties of Z – transforms, inversion of Z – transforms, Transform analysis of LTI Systems, unilateral Z-Transform. **10 Hours**

Course Outcomes:

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

1. Classify different types of signals and systems, perform the basic operations on signals
2. Determine the output of an LTI system, check for system stability, causality, linearity etc., represent system using block diagram, solve difference equation.
3. Represent periodic signals in frequency domain.
4. Represent the non periodic signals in frequency domain and use Fourier representation for analyzing signals & systems.
5. Represent discrete time signals in Z domain and analyze discrete time systems.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	**H**	**L**	**L**	**L**		**L**					**L**	**L**
2	**H**	**L**	**M**	**L**		**L**					**L**	**L**
3	**H**	**M**	**M**	**L**		**L**					**L**	**L**
4	**H**	**M**	**M**	**L**		**L**					**L**	**L**
5	**H**	**M**	**M**	**L**		**L**					**L**	**L**

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. Simon Haykin and Barry Van Veen**, "Signals and Systems",** 2nd edition**,** John Wiley & Sons, 2002.

REFERENCE BOOKS:

1. Alan V Oppenheim, Alan S. Willsky and A. Hamid Nawab, **"Signals and Systems",** Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002
2. H. P. Hsu, R. Ranjan, **"Signals and Systems",**Schaum's outlines, TMH, 2006
3. B. P. Lathi, **"Linear Systems and Signals",**Oxford University Press, 2005
4. C. L. Phillips, J.M. Parr and E. A. Riskin, **"Signals, Systems and Transforms",** PHI, 2008

NPTEL/ MOOC Link:

1. http://www.nptelvideos.in/2012/12/signals-and-system.html?m=1

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ANALOG ELECTRONIC CIRCUITS LAB

Sub Code : 16EC306 **Credits : 02**
Hrs/Week : 0+0+3+0 **Total Hours : 39**

Course Learning Objectives:

To Design and Test the following circuits for the given specifications by performing experiments or simulation:

1. Diode rectifiers , zener regulator, power supply design.
2. Clipping and clamping circuits.
3. BJT RC coupled amplifier, Emitter follower
4. Oscillators using BJT.
5. MOSFET Common Source amplifier, Source follower.

Introduction:

1. Study of CRO, DMM & Function Generator, Identification of Active & Passive Components
2. Soldering

LIST OF EXPERIMENTS

Hardware experiments:

1. Diode Rectifiers: Half wave, Centre tapped Full wave
2. Zener voltage regulator
3. DC regulated power supply using bridge rectifier and Zener diode
4. Diode Clipping circuits
5. Diode Clamping circuits
6. Single stage RC Coupled BJT Amplifier
7. RC Phase shift Oscillator
8. Emitter Follower
9. MOSFET Common Source Amplifier
10. MOSFET Source Follower

Simulation experiments:

1. Series and parallel resonant circuits
2. Verification of Thevenin's and Maximum Power Transfer Theorem
3. Enhancement MOSFET Characteristics
4. Hartley and Colpitt's oscillator using BJT
5. Frequency Response of the CS and CE Amplifiers
6. Current mirrors

Course Outcomes:

After completing this course students are able to design and test the following circuits for the given specifications by performing experiments or simulation:

1. Diode rectifiers , zener regulator, power supply design.

2. Clipping and clamping circuits using diodes
3. BJT RC coupled amplifier, Emitter follower
4. Oscillators using BJT.
5. MOSFET Common source amplifier, Source follower.

Mapping of PO's to CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	L	M	M	H	H							
2	L	M	M	H	H							
3	L	M	M	H	H							
4	L	M	M	H	H							
5	L	M	M	H	H							

L: Low **M: Medium** **H: High**

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DIGITAL ELECTRONIC CIRCUITS LAB

Sub Code : 16EC307 **Credits : 02**
Hrs/Week : 0+0+3+0 **Total Hours : 39**

***This course is a project based learning subject associated, which will be evaluated based on project work carried out during semester (50 marks) and the CIE for the lab (50 marks).**

Course Learning Objectives:

This laboratory course enables students to get practical experience in design, realization and verification of:

1. Boolean expressions using universal gates.
2. Half/Full/Parallel Adders and Subtractors.
3. Code converters and Comparators.
4. Multiplexers, Demultiplexers, Encoders and Decoders.
5. Flip-Flops, Shift registers, Counters and Sequence generators.

LIST OF EXPERIMENTS

Experiment No.	Title
1.	Realization of Boolean functions
2.	Adder/Subtractor using logic gates
3.	Adder/Subtractor- using IC7483
4.	Code converters using logic gates
5.	Comparators
6.	Encoder/Decoder
7.	Multiplexer and Demultiplexer
8.	Flip-Flops
9.	Shift Registers
10.	Ring counter/Johnson counter
11.	Counters
12.	Sequence Generators using IC 7495

NOTE: 1. Use discrete components to conduct the above experiments.

2. Some of the logic circuits in all experiments are to be simulated using simulation tool. Simulations can be done using Logisim simulation tool**.**

Course Outcomes:

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

1. Realize Boolean expressions using logic gates and Design of digital Combinational Logic Circuits like Decoders, Encoders, Code Converters, Comparators, Multiplexers and De-Multiplexers including Arithmetic Circuits (Adders and Subtractors) using logic gates/ICs.
2. Analyze and Design of digital Sequential Logic Circuits like Flip-Flops, Registers, Counters and Sequence Generators using logic gates/ICs.

Mapping of PO’s and CO’s:

PO CO	1	2	3	4	5	6	7	8	9	10	11	12
1	**M**	**L**	**H**	**M**	**M**							
2	**M**	**M**	**H**	**M**	**M**	**M**				**L**		

L: Low **M: Medium** **H: High**

ENHANCING SELF COMPETENCE

Sub Code : 16HU311 **Credits : 02**
Hrs/Week : 2+0+0+0 **Total Hours : 26**

Course Learning Objectives:

This Course will enable students to

- Introspect and learn more about oneself,
- Learn social behaviour and etiquette,
- Develop positive attitude and values in life,
- Learn to be effective in communication and interactive skills; and
- To educate on writing and presentation skills and also to educate onself on legal and ethical aspects.

UNIT – I

Self Awareness and Emotional Quotient **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:
Inculcate 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:
How to write formal and informal e mails, how to frame requests, accept or reject proposals, greetings, salutations, ending. Plagiarism, Presentation Skills. **6 Hours**

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

1. He or she is aware of his or her strengths and weaknesses and is able to handle emotions.
2. Ensuring a refined behavior.
3. Ensure a student who is an asset to the society.
4. A person who is well adjusted and a good communicator.
5. Will be able to 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.

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PROBABILITY THEORY AND NUMERICAL METHODS

Sub Code : 16EC401	**Credits : 04**
Hrs/Week : 4+0+0+0	**Total Hours : 52**

Course Learning Objectives:

At the end of the course the successful student is expected to:

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: Introduction to probability, finite sample space, conditional probability and independence. Bayes' theorem(overview). One dimensional random variable: discrete and continuous random variable, probability functions, cumulative distribution function, expectation 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 Chi square distributions. **10 Hours**

UNIT - III

NUMERICAL METHODS: Roots of algebraic and transcendental equations: Regula falsi & Newton Raphson methods. Finite differences, Newton-Gregory forward and backward difference interpolation formulae, Lagrange’s interpolation formula and 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 and Simpson's three eigth rule. **12 Hours**

UNIT - IV

NUMERICAL SOLUTION OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS

Taylor's series method, Modified Euler's method, 4th 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-Frobenius method, series solution of Bessel's differential equation leading to Bessel function of first kind and equations reducible to Bessel's differential equation. The generating function for $J_n(x)$. Orthogonality of Bessel functions. Series solution of Legendre's differential equation leading to Legendre polynomials and Rodrigue's formula. **10 Hours**

Course Outcomes:

At the end of the course the student should 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 PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1.	H										L	
2.	H	M										
3.	H	H										
4.	H	M										
5.	M	L										

L: Low **M: Medium** **H: High**

TEXT BOOKS

1. P.L. Meyer, **"Introduction of probability and Statistical applications",** second edition, 1975,
American Publishing Co.
2. B.S.Grewal**,"Higher Engineering Mathematics"**,42nd edition, Khanna publishers,2012.

REFERENCE BOOKS

1. Kreysizg, **"Advanced Engineering Mathematics",** John Wiley and Sons VI th edition.
2. S.S.Sastry, **"Introductory methods of Numerical Analysis"**, 5th edition, 2013, Prentice Hall.
3. Wylie Ray, **"Advanced Engineering Mathematics"**, 6th edition, McGraw Hill.Inc,1995.

DIGITAL SIGNAL PROCESSING

Sub Code : 16EC402 **Credit : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives :

This course will enable students to

1. Understand the concept of Frequency Domain Sampling, Computation of DFT and properties of DFT.
2. Understand Linear Filtering methods using Overlap Add and Overlap Save Algorithms.
3. Understand the Fast Fourier Transform (FFT) using Radix 2 DITFFT and DIFFFT Algorithms.
4. Design and Analyze the characteristics of Analog filters using Butterworth & Chebyshev approximation techniques.
5. Design IIR filter using Impulse Invariance Technique and Bilinear transformation and FIR filter using windowing techniques.
6. Design Linear Phase FIR filters using frequency sampling technique.
7. Design Differentiator and Hilbert Transformer.
8. Implement Digital filters using various structures.

UNIT – I

Discrete Fourier Transform: Its Properties and Applications: Frequency Domain sampling and reconstruction of Discrete-Time signals, Discrete Fourier Transform (DFT), The DFT as a linear Transformation, Relationship of the DFT to Z- Transforms, Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of two DFTs and Circular Convolution, Additional DFT Properties. **11 Hours**

UNIT – II

Efficient Computation of DFT: Direct Computation of the DFT, Radix – 2 Fast Fourier Transform (FFT) algorithms, Decimation in Time FFT (DITFFT) algorithm and In-place computations, Decimation in Frequency FFT (DIFFFT) algorithm, N-point DFT computation of two real sequences using single N-point DFT, 2N-point DFT computation of two real sequences using single N-point DFT. **10 Hours**

UNIT - III

Design of Analog Filters and Frequency Transformations: Characteristics of commonly used Analog filters and Design of Butterworth and Chebyshev analog filters. Frequency Transformations in the Analog Domain. **10 Hours**

UNIT – IV

Design of IIR Digital Filters and IIR filter structures: Bilinear, Impulse Invariance Transformations, IIR Butterworth and Chebyshev Filter Design by Impulse Invariance, IIR Filter Design by Bilinear Transformation.

Basic IIR Filter structures: Direct forms (I & II), Cascade and parallel realizations, signal flow graph, Transposed structure. **10 Hours**

UNIT – V

Design of FIR Digital Filters and FIR Filter Structures: Linear phase FIR digital filters, Different types of windows: Rectangular, Bartlett, Hanning, Hamming and Blackman windows, Design of FIR filters using windows, Design of FIR filters using frequency sampling method, Design of Differentiator, Design of Hilbert Transformer.
Basic FIR Filter Structures: Direct form structure, Frequency sampling structure, Lattice structure, Linear phase FIR structure. **11 Hours**

Course Outcomes:
At the end of the course the student will be able to
1. Analyze and appreciate the properties of Discrete Fourier Transform (DFT)
2. Deduce and compute DFT using FFT algorithms
3. Design analog filters using Butterworth and Chebyshev approximations
4. Realize IIR filter from analog filters and to realize IIR filter structures
5. Realize FIR filters using windowing and frequency sampling approach and to realize FIR filter structures

Mapping of CO's and PO's

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H			M							
2	H	H	M		M							
3	H	M	L		H							
4	H	M	L	L	H	L					L	L
5	H	M	L	L	H	L					L	L

TEXT BOOK:
1. Proakis, Manolakis, "**Digital Signal Processing – Principles Algorithms & Applications**", PHI, 4th Edition, New Delhi, 2007. (3rd edition can also be referred)

REFERENCE BOOKS:
1. Oppenheim & Schaffer, "**Discrete Time Signal Processing**", PHI, 2003.
2. S. K. Mitra, "**Digital Signal Processing**", Tata McGraw Hill, 2nd Edition, 2004.

NPTEL/ MOOC Link
1. http://nptel.ac.in/courses/117104070/
2. http://nptel.ac.in/courses/117102060/
3. http://nptel.ac.in/courses/108105055/
4. https://www.mooc-list.com/course/digital-signal-processing-coursera
5. https://www.mooc-list.com/tags/dsp
6. https://www.mooc-list.com/tags/digital-signal-processing

CONTROL SYSTEMS

Sub Code : 16EC403 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Note: 16EC403 IS A FLIP COURSE

Course Learning Objectives:

This course will enable students to

1. Develop the theoretical aspects of Control systems and feedbacks, to find the mathematical models of physical systems and Analysis of Control Systems using Block Diagram Reduction and Signal Flow Graph Techniques.
2. Analyse steady state and transient behaviour of Control systems.
3. Study the concepts of RH-Criteria, Root Locus and to perform stability analysis in time domain.
4. Study the concepts of Bode Plot, to understand the correlation between time and frequency response analysis.
5. Study the concepts of Nyquist Plot.

UNIT – I

Introduction to Control Systems: Introduction, Definitions, Open Loop Control Systems, Closed Loop(Feedback) Control Systems, Merits and Demerits of feedback, Transfer Function Concept, Properties of Transfer Function, Unity Feedback Systems.
Mathematical Modeling of Systems: Translational Systems, Rotational Systems, Electrical Analogous of Mechanical Systems (Force voltage and Force current).
Block diagrams and Signal Flow Graphs: Block Diagram Reduction, Signal Flow Graph, and Mason's Gain Formula. **12 Hours**

UNIT – II

Time Response of Feedback Control Systems: Standard test signals, Unit step response of first and second order systems, Time response specifications of second order systems, steady–state errors and error constants. **8 Hours**

UNIT – III

Routh Stability: Introduction, Stability, Necessary Conditions for Stability, Routh Array, Special Cases, Application of Routh-Hurwitz Stability Criterion, Relative Stability.
Root-Locus Technique: Basic Conditions of Root-Loci, Rules for the Construction of Root-Loci. **12 Hours**

UNIT – IV

Frequency Domain Analysis: Introduction, Correlation between time and frequency response, Bode plots (construction and analysis of Bode plots for simple systems),Determination of transfer function from Bode Magnitude Plot. **10 Hours**

UNIT – V

Stability in the Frequency Domain: Mathematical preliminaries, Nyquist stability criterion, (Inverse polar plots excluded), Assessment of relative stability using Nyquist criterion, (Systems with transportation lag excluded) **10 Hours**

Course Outcomes:

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

1 Model the system in the different analogues form, Describe Open and Closed Loop Control Systems, Analyze the Control Systems using Block Diagram Reduction and Signal Flow Graph Techniques.

2 Determine the time domain response of first and second order systems to various types of Inputs.

3 Describe stability in control systems, Analysis of stability using Routh Hurwitz Criterion and Evaluate stability of systems using Root Locus technique.

4 Correlate between time and frequency response analysis, analyze the stability of the system using Bode plot.

5 Determine stability of the system using Nyquist criterion.

Mapping of PO's and CO's

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M	H	H	L	M	M	L				M	
2	M	M	H	L	M	M	L				L	
3	M	H	M	M	M	L					M	
4	M	M	M	M	M	L					M	
5	M	M	M	M	M	L					M	

TEXT BOOK:

1. J. Nagarath and M. Gopal,**"Control Systems Engineering",** New Age International (P) Limited Publishers, 4th Edition—2005.

REFERENCE BOOKS:

1. KuoB.C.,**"Automatic Control Systems",** John Wiley India Pvt. Ltd., 8th Edition, 2008.
2. Ogata, **"Modern Control Engineering"**, Pearson Education Asia/PHI, 4th Edition, 2002.

NPTEL/ MOOC Link

1. http://nptel.ac.in/courses/108101037/3
2. https://www.edx.org/course/dynamics-control-upvalenciax-dc201x-2

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ELECTROMAGNETIC THEORY

Sub Code : 16EC404 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives:

This course will enable students to

1. Understand the behavior of static electric field and magnetic fields.
2. Understand the basic laws that govern static electric field and magnetic fields.
3. Understand the concept of time varying fields.
4. Analyze wave propagation in different medium.

UNIT – I

Coulomb's Law and electric field Intensity: Introduction to Vector Calculus, Experimental Law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge.
Electric flux density, Gauss' law and divergence: Electric flux density, Gauss' law, Divergence, Maxwell's first equation (Electrostatics), Vector operator and divergence theorem. **10 Hours**

UNIT – II

Energy and Potential: Energy expended 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
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. **12 Hours**

UNIT – III

Poisson's and Laplace's equations: Derivations of Poisson's and Laplace's Equations, Uniqueness theorem, Examples of the solutions of Laplace's and Poisson's equations.
The steady magnetic field: Biot-Savart law, Ampere's circuital law, Curl, Stokes' theorem, magnetic flux and flux density, scalar and vector magnetic potentials. **10 Hours**

UNIT – IV

Magnetic forces: Forces on a moving charge and differential current element, Force between differential current elements, Force and torque on a closed circuit.
Magnetic materials and inductance: Magnetization and permeability, Potential energy and forces on magnetic materials, Magnetic boundary conditions. **9 Hours**

UNIT – V

Time varying fields and Maxwell's equations: Faraday's law, displacement current, Maxwell's equation in point and integral form, retarded potentials.
Uniform plane wave: Wave propagation in free space, Poynting's theorem and wave power, propagation in good conductors – (skin effect). **11 Hours**

Course Outcomes:

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

1. Apply vector calculus to understand the behavior of static electric fields.
2. Apply the basic laws that govern electrostatics to the system of charges.
3. Apply vector calculus to understand the behavior of static magnetic fields.
4. Apply the basic laws that govern magneto statics to the system of current carrying conductors.
5. Understand concepts of time varying fields and laws that govern time varying fields and analyze electromagnetic wave propagation in free space.

Mapping of PO's & CO's:

PO \ CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	H	H		M								
2	H	M	M		L							
3	H	H		M								
4	H	M	M		L							
5	H	H				M						

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. William H., Hayt Jr. and John A Buck, **"Engineering Electromagnetic",** Tata McGraw- Hill, 7th Edition, 2006.

REFERENCE BOOKS:

1 John Krauss and Daniel A. Fleish, **"Electromagnetic with Applications",** McGraw-Hill, 5th Edition, 1999
2. Edward C. Jordan and Keith G. Balman, **"Electromagnetic Waves and Radiating System",** Prentice-Hall of India /Pearson Education, 2nd Edition, 1968, Reprint 2002
3. David K. Cheng, **"Field and Wave Electromagnetic",** Pearson Education Asia, 2nd edition,-1989 Indian Reprint 2001

NPTEL/ MOOC Link

1. http://nptel.ac.in/courses/117103065/
2. http://nptel.ac.in/courses/108106073/

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ANALOG COMMUNICATION

Sub Code : 16EC405 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives :

This course will enable students to

1. Apply statistical parameters on various processes.
2. Understand different Amplitude modulation and demodulation schemes & their applications.
3. Understand different angle modulation and demodulation schemes.
4. Analyze different types of noise in communication system.
5. Analyze different receivers in presence of noise.

UNIT – I

Random Process: Introduction, probability theory, conditional probability, random variables, statistical averages, Random process: stationarity, mean, correlation and covariance functions, power spectral density, Gaussian process. **10 Hours**

UNIT – II

Amplitude Modulation: Introduction, Time Domain and Frequency domain description, Generation and Detection of AM, Various types of AM, Generation and Detection of different types of AM (SSB, DSB-SC), VSB(qualitative analysis), Applications of AM. **12 Hours**

UNIT – III

Angle Modulation: Basic Definitions , frequency modulation, narrow band and wide band frequency modulation, Transmission bandwidth of FM, Generation and detection of FM, FM stereo multiplexing, PLL, Nonlinear effects of FM, applications. **12 Hours**

UNIT – IV

Noise: Introduction, Shot noise, Thermal noise, White noise, Noise equivalent bandwidth, Narrow band noise, Noise figure, Equivalent noise temperature, Signal to noise Ratio, Cascade connection of two port networks Noise factor. **8 Hours**

UNIT – V

Noise in Continuous Wave Modulation Systems: Introduction, receiver model, Noise in DSB-SC receivers, Noise in SSB receivers, Noise in AM receivers, Noise in FM receivers, Threshold Effect, pre-emphasis and de-emphasis in FM. **10 Hours**

Course Outcomes:

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

1. Apply the knowledge of probability theory & random process in analyzing noise behavior in communication systems.
2. Analyze various types of Amplitude modulation and demodulation techniques.

3. Analyze direct and indirect techniques of Frequency modulation and demodulation schemes.
4. Model the system in the presence of noise.
5. Analyze the receiver performance in presence of noise.

Mapping of PO's & CO's:

CO \ PO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	L	L	L							L	L
2	H	L	L	L		L					L	L
3	H	L	L	L		L					L	L
4	H	L	M	M		L					L	L
5	H	H	M	L		L					L	L

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. Simon Haykin, Michael Moher ,**"Communication Systems",** 5th Edition, John Wiley, 2009.

REFERENCE BOOKS:

1. Simon Haykin, **"An Introduction to Analog & Digital Communication",** 2nd Edition, John Wiley, 2006.
2. John G. Proakis, Masoud Salehi, **"Communication Systems Engineering",** Pearson Education, 2002.
3. Herbert Taub, Donald L. Schilling, Goutam Saha, **"Principles of Communication Systems",** 3rd Edition, Tata McGraw Hill, 2008.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/117102059/2

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DIGITAL SYSTEM DESIGN USING VERILOG

Sub Code : 16EC406 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives:

This course will enable students to

1. Write programs for any digital circuits with this hardware programming language.
2. Execute digital module designs from written functional and systems specifications.
3. Complete a significant design project using VERILOG coding Language having a set of objective criteria & design constraints.

UNIT – I

Introduction to VLSI Design and Verilog: Introduction, conventional approach to Digital design, VLSI design, ASIC design flow, Role of HDL. Conventional Data flow, ASIC data flow, Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Module, Simulation and Synthesis Tools. **6 Hours**

UNIT – II

Modules and Ports: Modules, Ports, Rules for connection of ports, connecting port to external signals

Language Constructs and Conventions: Lexical conventions- Introduction, Keywords and Identifiers, White Space Characters, Comments, Operators, Numbers, Strings. Data types-Logic Values, Registers, Strengths, Nets, Scalars and Vectors, Parameters.

Modeling at Data Flow Level: Introduction, Continuous Assignment Structures, Assignment to Vectors, Operator types, Examples. **14 Hours**

UNIT – III

Gate Level Modeling: Introduction, Gate Primitives, Illustrative Examples, Array of Instances of Primitives, Additional Examples, Net Types, Design of Basic Circuits, Exercises. **10 Hours**

UNIT – IV

Behavioral Modeling: Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Examples, Multiple Always Blocks, Designs at Behavioral Level, The case statement, Simulation Flow, i*f* and i*f*-else constructs, repeat construct, for loop, the disable construct, while loop, forever loop. **12 Hours**

UNIT – V

Switch Level Modeling:. Introduction, Basic Transistor Switches, CMOS Switch, Bi-directional Gates,

Functions, Tasks and User Defined Primitives: Introduction, Function, Tasks, User-Defined Primitives (UDP).

Basics of System Tasks, Functions, and Compiler Directives: Introduction, Parameters, Module Parameters, System Tasks and Functions, Compiler Directives. **10 Hours**

Course Outcomes:

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

1. Aquire knowledge of the basics of VLSI Design and Verilog.
2. Learn the basics of Verilog coding and apply this to model basic Digital circuits using Data flow Coding.
3. Analyze and Model Complex digital systems using Gate level style.
4. Analyze and Model complex digital systems at several levels of abstractions using behavioral style.
5. Learn basics of Switch level, Functions, Tasks, UDP's and Compiler Directives.

Mapping of PO's & CO's:

CO \ PO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	M	M	M	M	-	-	-	-	-	-
2	H	H	M	M	M	M	H	L	-	-	-	-
3	M	M	H	H	H	M	-	-	-	-	M	-
4	M	H	H	H	H	M	-	-	-	-	M	-
5	L	H	-	H	M	M	-	-	-	-	-	-

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. R. Padmanabhan, B. Bala Tripura Sundari, **Design through Verilog HDL**, Wiley & Sons Education, IEEE Press, USA, 2004.
2. Samir Palnitkar, **VERILOG HDL A guide to Digital Design and Synthesis IEEE1364-2001Complaint**,Pearson Education, Second Edition, 2011
3. J. Bhaskar, **A Verilog Primier**, 2nd edition, BS Publications, India, 2003.

REFERENCE BOOKS:

1. Stephen. Brown, ZvonkoVranesic, **Fundamentals of Logic Design with Verilog,** Tata McGraw Hill, India, 2005.
2. Charles H. Roth, **Digital Systems Design using VHDL**, Jr. Thomson Publications, India, 2004.
3. Michael D. Ciletti, **Advanced Digital Design with Verilog HDL**, Prentice Hall of India, New Delhi, 2005.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/106105083/2
2. https://onlinecourses.nptel.ac.in/noc17_cs21

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DIGITAL SIGNAL PROCESSING LAB

Sub Code : 16EC407 **Credit : 02**
Hrs/Week : 0+0+3+0 **Total Hours : 39**

Course Learning Objectives :

This course will enable students to:

1. Explain and apply sampling theorem on analog signals
2. Study the impulse response of a given LTI system by using deconvolution operation and verify the result using convolution operation
3. Study, analyze and implement linear convolution of –one sided and two sided aperiodic sequences
4. Study and implement circular convolution of two periodic sequences
5. Analyze autocorrelation and cross correlation of a given sequence and verify symmetry and energy properties
6. Study and obtain impulse response, step response and steady state response of a system described by a difference equation
7. Analyze and understand N-point DFT computation using 'fft' command on a given discrete time signal and plot its magnitude and phase spectrum
8. Perform linear and circular convolution of two given sequences using DFT-IDFT method
9. Study and implement FIR and IIR filters for the given specifications
10. Implement linear convolution, circular convolution, impulse response of an LTI system and FIR filter design on DSP processor using Code Composer Studio platform.

LIST OF EXPERIMENTS USING MATLAB

Experiment No.	Title
	i) Familiarization with MATLAB software and general functions ii) Generation of Elementary signals • Sinusoidal • Square • Complex waveform • Unit Step • Unit Ramp • Exponential • Noise
2	Verification of Sampling theorem 1. Under Sampling 2. Sampling at Nyquist rate 3. Over Sampling
3	Finite and Infinite Response of an LTI System i) Impulse Response ii) Frequency Response

4 Linear Convolution of two given sequences.
   i) One sided sequences
   ii) Two sided sequences

5 Circular Convolution of two given sequences.
   i) Equal length sequences
   ii) Unequal length sequences

6 Auto Correlation of a given sequence and verification of its properties.
   i) Symmetry (Even)
   ii) Energy
   iii) Periodicity

7 Cross Correlation of a given sequence and verification of its properties.
   i) Conjugate Symmetry

8 Response of a system described by given difference equation.
   i) Impulse Response
   ii) Step Response
   iii) Steady state Response
   iv) Complete Response with a given initial condition

9 Computation of N point DFT of a given sequence and plot high density, high resolution Magnitude and Phase Spectrum.
   i) Using FFT command
   ii) Without using FFT command

10 Convolution of two given sequences using DFT and IDFT.
   i) Linear Convolution
   ii) Circular Convolution

11 Design and implementation of FIR filter to meet the given specifications using Rectangular /Bartlett /Hanning /Hamming /Blackman window for the following types of filters,
   i) LPF
   ii) HPF
   iii) BPF
   iv) BSF

12 Design and Implementation of Analog and Digital IIR filter to meet the given specifications for the following types of filters,
   i) LPF
   ii) HPF
   iii) BPF
   iv) BSF

LIST OF EXPERIMENTS USING DSP PROCESSOR

Experiment No.	Title
1	Linear convolution of two given sequences.
2	Circular convolution of two given sequences.
3	Computation of N point DFT of a given sequence.
4	Impulse response of a given system of a given system of first and second order.

<u>Course Outcomes:</u>

Upon successful completion of this lab, students will be able to:

1. Simulate sampling theorem, convolution, correlation, impulse response, DFT-IDFT of a given sequence, IIR and FIR filters using MATLAB.
2. Implement DSP algorithms using C programming with TMS320C6713 floating point DSP processor with CC Studio Platform.

<u>Mapping of PO's & Cos':</u>

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	M	H	M						H	
2	H	H	H	M	M						M	

L: Low M: Medium H: High

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DIGITAL SYSTEM DESIGN LAB

Sub Code : 16EC408 * **Credits : 02**
Hrs/Week : 0+0+3+0 **Total Hours : 39**

***This course is a project based learning subject associated which will be evaluated based on project work carried out during semester (50 marks) and the CIE for the lab (50 marks).**

This course will enable students to

1. Understand the basics of Verilog Language and write programs using it.
2. Analyze and Synthesize design Interfaces between two or more digital circuits.
3. Synthesize the designs and implement on the given FPGA.

LIST OF EXPERIMENTS

1. Write Verilog code to realize all logic gates.
2. Write Verilog program for combinational designs.
3. Develop Verilog code for flip-flops.
4. Design and testing of binary and BCD counters (Synchronous reset and Asynchronous reset) for any given sequence.

INTERFACING

1. Write Verilog code to display messages on the given seven segment display.
2. Write Verilog code to control speed, direction of DC and Stepper motor.
3. Write Verilog code to generate different waveforms using DAC module.
4. Write Verilog code to control external lights using relays.

Course Outcomes:

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

1. Design the given digital block and develop Verilog HDL in suitable modeling style.
2. Implement the design using available FPGA and EDA tool to interface it with the given hardware module.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	L	H	H		H	L						L
2	L	H	H		H	L						L

L: Low **M: Medium** **H: High**

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