B. TECH ELECTRONICS & COMMUNICATION ENGINEERING 2016-17

1ST SEMESTER						
S. No.	**Subject Code**	**Name of the Subjects**	**Contact Hours**			**Credits**
			L	**T**	**P**	
1	10B11PD111	Presentation & Communication Skill	3	0	0	3
2	10B11MA111	Mathematics-I	3	1	0	4
3	10B11PH111	Physics-I	3	1	0	4
4	10B11EC111	Electrical Circuit Analysis	3	1	0	4
5	10B11CI111	Introduction to Computer and Programming	3	1	0	4
6	10B17PH171	Physics Lab-I	0	0	2	1
7	10B17EC171	Electrical Circuits Lab	0	0	2	1
8	10B17CI171	Computer Programming Lab	0	0	4	2
9	10B19GE199	Institutional Orientation	0	0	0	0
					Total	**23**
2ND SEMESTER						
S. No.	**Subject Code**	**Subject Names**	**Contact Hours**			**Credits**
			L	**T**	**P**	
1	10B11EC211	Basic Electronics & Device Circuits	3	1	0	4
2	10B11PD211	Group and Cooperative Processes	3	0	0	3
3	10B11MA211	Discrete Mathematics	3	1	0	4
4	10B11PH211	Physics-II	3	1	0	4
5	10B11CI211	Data Structures	3	1	0	4
6	10B17EC271	Basic Electronics Lab	0	0	2	1
7	10B17PH271	Physics Lab-II	0	0	2	1
8	10B17CI271	Data Structures and Computer Prog. Lab	0	0	4	2
9	10B19EC299	Departmental Orientation	0	0	0	0
					Total	**23**
3RD SEMESTER						
S. No.	**Subject Code**	**Name of the Subjects**	**Contact Hours**			**Credits**
			L	**T**	**P**	
1	10B11PD311	Managerial Economics	3	0	0	3
2	10B11MA201	Mathematics-II	3	1	0	4
3	10B11EC311	Electrical Machines and Instruments	3	1	0	4
4	10B11EC301	Signals & Systems	3	1	0	4
5	10B11EC312	Analogue Electronics	3	1	0	4
6	10B17EC371	Electrical Machines and Instruments Lab	0	0	2	1
7	10B17EC307	Signals and Systems Lab	0	0	2	1
8	10B17EC372	Analogues Electronics Lab	0	0	2	1
9	10B28CI408	Multimedia Development Lab-I	0	0	2	1
					Total	**23**

4TH SEMESTER						
S. No.	**Subject Code**	**Subject Names**	**Contact Hours**			**Credits**
			L	**T**	**P**	
1	10B11PD411	Financial Management	3	0	0	3
2	10B11MA411	Probability Theory and Random Processes	3	1	0	4
3	17B11EC411	Electromagnetic Engineering	3	1	0	4
4	10B11EC401	Digital Electronics	3	1	0	4
5	17B11EC412	Analogue and Digital Communications	3	1	0	4
6	10B11GE411	Environmental Studies	3	0	0	3
7	10B17EC471	Devices and Circuit simulation Lab	0	0	2	1
8	10B17EC407	Digital Electronics Lab	0	0	2	1
9	17B11EC471	Analogue and Digital Communications Lab	0	0	2	1
10	10B17CI307	Unix Programming Lab	0	0	2	1
					Total	**26**
5TH SEMESTER						
S. No.	**Subject Code**	**Name of the Subjects**	**Contact Hours**			**Credits**
			L	**T**	**P**	
1	10B11PD511	Social and Legal Issues	3	0	0	3
2	17B11EC511	Linear Integrated Circuits	3	1	0	4
3	10B11EC512	Digital Signal Processing	3	1	0	4
4	10B11CI401	Microprocessor and Controllers	3	1	0	4
5	17B11EC512	Microwave Devices & Antenna Design	3	1	0	4
6	17B17EC571	Linear Integrated Circuits Lab	0	0	2	1
7	10B17EC572	Digital Signal Processing Lab	0	0	2	1
8	10B17CI407	Microprocessor and Controllers Lab	0	0	2	1
9	17B17EC572	Microwave Devices & Antenna Design Lab	0	0	2	1
10	10B1WEC515	Theory and Applications of Control System	3	1	0	4
11	10B1WEC575	Theory and App. Of Control Systems Lab	0	0	2	1
					Total	**28**
6TH SEMESTER						
S. No.	**Subject Code**	**Subject Names**	**Contact Hours**			**Credits**
			L	**T**	**P**	
1	10B11PD611	Project Management	3	0	0	3
2	10B11EC611	Telecommunication Networks	3	1	0	4
3	10B11EC612	VLSI Technology and Applications	3	1	0	4
4	10B11PH611	Material Sciences	3	1	0	4
5	10B11CI614	Object Oriented Systems and Programming	3	1	0	4
6	11B1WEC611	Power Electronics	3	1	0	4
7	10B17EC671	Telecommunication Networks Lab	0	0	2	1
8	10B17EC672	VLSI Lab	0	0	2	1
9	10B17CI674	Object Oriented Systems and Programming Lab	0	0	4	2

10	11B1WEC671	Power Electronics Lab	0	0	2	1
11	10B19GE698	Industrial Training	0	0	0	0
					Total	**28**
7TH SEMESTER						
S. No.	**Subject Code**	**Name of the Subjects**	**Contact Hours**			**Credits**
			L	**T**	**P**	
1		HSS Elective-I	3	0	0	3
2	10B19EC791	Project Part-I	0	0	10	10
3	E1	DE-I [Choose Any one]	3	0	0	3
4	E2	DE-II [Choose Any one]	3	0	0	3
5	E3	DE-VI [Choose Any one/ Open departmental]	3	0	0	3
					Total	**22**
8TH SEMESTER						
S.No.	**Subject Code**	**Subject Names**	**Contact Hours**			**Credits**
			L	**T**	**P**	
1		HSS Elective-II	3	0	0	3
2	E1	DE-IV [Choose Any one]	3	0	0	3
3	E2	DE-V [Choose Any one]	3	0	0	3
4	E3	DE-VI [Choose Any one/ Open departmental]	3	0	0	3
5	10B19EC891	Project Part II	0	0	10	10
					Total	**22**

LIST OF ELECTIVES

7TH SEMESTER

1.	10B1WEC731	Mobile Communication
2.	10B1WEC734	Fundamentals of Digital Image Processing
3.	12B1WEC732	Digital System Design
4.	13B1WEC731	CMOS Analog Circuit Design
5.	14B1WEC731	Sound Processing and its Applications
6.	14B1WEC733	Cognitive Radio Networks
7.	14B1WEC734	Non-linear and digital conrol systems
8.	14B1WEC735	Fundamentals of embedded systems
9.	18B1WEC732	Design of Dependable Systems

10.	15B1WEC732	RF and Microwave
11.	17B1WEC731	Time Frequency analysis and its applications
12.	18B1WEC735	Embedded system design
13.	17B1WEC733	Robotic Systems and Control
14.	18B1WEC734	Medical Image Processing
15.	10M11EC111	Advanced Communication System
16.	10M11EC112	Advanced Satellite and Fiber Optic Communication
17.	10M11EC113	Advanced Telecommunication Network
18.	10M11EC114	VLSI Circuits and System Design
19.	18B1WEC733	Machine Learning and Data Analytics-1
8TH SEMESTER		
1.	11B1WEC832	Digital Signal Processing for VLSI
2.	11B1WEC834	Optical Comm. Systems
3.	13B1WEC831	Soft Computing Techniques
4.	13B1WEC832	Modern Antennas
5.	13B1WEC833	Bio-Electronic Sensors
6.	13B1WEC834	Qunatum Effects in Semiconductor Physics
7.	16B1WEC831	Antenna and Wave Propagation
8.	10M11EC211	Advanced Digital Signal Processing
9.	10M11EC212	Advance Wireless & Mobile Communication
10.	10M11EC213	Information & Coding Theory
11.	14M1WEC231	Advanced CMOS Digital Design Techniques
12.	12M1WEC232	Real Time Embedded System
13.	16M1WEC231	Advanced Digital Image processing
14.	13M1WEC231	Advanced Neural Networks
15.	16B1WEC832	Spectral Analysis for Signal Processing

ELECTRICAL CIRCUIT ANALYSIS

(Core Subject)

Course Code:	**10B11EC111**	**Semester:**	1st Semester, B. Tech (ECE/CSE/IT/CE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

The objective of this course is to provide insight into the circuits and the study of different techniques in different domains to use them in the analysis of circuits. Become familiar with electrical quantities such as current, voltage, resistance, power, and frequency in simple DC and AC resistive circuits. Become familiar with multiport network.

Course Outcomes

After studying this course the students would gain enough knowledge:

1. To have a crystal clear understanding of fundamentals of Ohm's law, Kirchhoff's current and voltage laws
2. To develop mathematical equations for a given circuit (using matrices and simultaneous equations, integration and differentiation) for analysis
3. To analyze a given circuit depending on types of elements, DC analysis, Transient analysis and Frequency analysis.
4. To design circuits (at least proto type models) for a given set of specifications whether in time domain or in frequency domain.
5. Perform analysis using the fundamental electrical theorems and model simple electrical systems.
6. Derive the natural, forced and complete response of simple networks

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1	Introduction: Charge, Current, voltage and power, Voltage and Current sources, Ohm's law.	Hayt: Chapter 2	2
2	Circuit Concepts: Electromotive Force (EMF), Terminal Voltage; Open-circuit and Short-circuit; Circuit Elements – Active and Passive; Voltage Divider, Current Divider; Star-Delta Transformation.	Hayt: Chapter 3, 7	4

3	Network Analysis : Voltage Source and Current Source, Source Transformation, Combination of Sources; Kichhoff's Circuit Laws; Loop-Current Analysis, Supermesh; Mesh Analysis; Node-Voltage Analysis, Supernode; Choices of Method of Analysis.	Hayt: Chapter 4	8
4	Network Theorems (DC Circuits) : Superposition Theorem; Thevenin's Theorem; Norton's Theorem; Maximum Power Transfer Theorem	Hayt: Chapter 5	8
5	DC Transients : Simple RL Circuit, Time Constant, Decay and Growth of Current; Simple RC Circuit, Discharging of a Capacitor, Charging of a Capacitor; Initial and Final Value.	Hayt: Chapter 8, 9	4
6	Alternating Voltage and Current : Physical Model for a Sinusoid, Phase and Phase Difference; Average Value, Effective Value, Form Factor and Peak Factor; Nonsinusoidal Waveforms; Power and Power Factor	Hayt: Chapter 11	2
7	AC Circuits : Concept of Phasors, Addition of Phasors Using Complex Numbers; Behaviour of R, L and C in AC Circuits. Series RL Circuit, Complex Impedance; Series RC Circuit, Complex Power; Parallel RL Circuit; Parallel RC Circuit; Series RLC Circuit and its Phasor Diagram; Parallel RLC Circuit and its Phasor Diagram, Network Theorems (AC Circuits)	Hayt: Chapter 10	8
8	Resonance in AC Circuits : Series Resonance Circuit, Effect of Variation of Frequency, Quality Factor, Voltage Magnification; Resonance Curve, Selectivity, Relationship between f1, f2, f0 and BW; Parallel Resonant Circuit; Ideal Parallel Resonant Circuit, Current at Resonance; Quality Factor.	Hayt: Chapter 16	4
9	Two-Port Networks : Impedance, Admittance, Hybrid, Transmission Parameters; Equivalent Networks, Determination of Different Parameters.	Hayt: Chapter 17	2
Total Number of Lectures			42

Evaluation Scheme

1. Test 1: 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. Internal Assessment : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. W.H. Hayt, J. E. Kemerlay & S.M. Durbin, "Engineering Circuit Analysis (Sixth Edition)", McGraw Hill, 2006

Reference Books

1. D.C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill Education, 2011
2. Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, "Basic Electrical Engineering", Tata McGraw Hill Publishing Co, 2008.
3. Van Valkenburg, "Network Analysis", Prentice-Hall India Ltd., 2001.

Web Resources

1. http://www.tina.com/course/course
2. http://nptel.ac.in/courses/108105053/
3. http://nptel.ac.in/syllabus/syllabus.php?subjectId=108102042

ELECTRICAL CIRCUITS LAB

(Core Subject)

Course Code:	10B17EC171	Semester:	1st Semester, B. Tech (ECE/CSE/IT/CE)
Credits:	1	Contact Hours:	L-0, T-0,P-2

Course Objectives

The objectives are to study:

1. Fundamentals of Ohm's law, Kirchhoff's current and voltage laws and its practical implementation
2. Measurement of voltage, current, power and impedance of any circuit
3. Analysis of a given circuit depending on types of elements - DC analysis, Transient analysis and Frequency analysis
4. Measurement of frequency and amplitude of any signal using CRO
5. Designing of circuits (at least proto type models) for a given set of specifications weather in time domain or in frequency domain

Course Outcomes

After studying this course the students would gain enough knowledge on:

1. Practical implications of the fundamentals of Ohm's law, Kirchhoff's current and voltage laws
2. Accurate measurement of voltage, current, power and impedance of any circuit
3. DC analysis, Transient analysis and Frequency analysis of a given circuit depending on types of elements
4. Using DSO to measure the frequency, and amplitude of any signal
5. Practical implementation of the fundamental electrical theorems and modeling of simple electrical systems
6. Teamwork skills for working effectively in groups and develop analytical skills to compare experimental results with theoretical concepts

List of Experiments

1. Introduction to Power supply & Multimeter.
2. To determine the equivalent resistance of a circuit using color code and to verify it using a multimeter
3. To verify Voltage dividing rule and Kirchoff's Voltage Law (KVL)
4. To verify Current dividing rule and Kirchoff's Current Law (KCL)
5. To verify Superposition Theorem
6. To verify Thevenin's Theorem
7. To verify Norton's Theorem
8. To verify Maximum Power Transfer Theorem
9. To verify reciprocity theorem
10. Introduction to CRO & Function Generator
11. To study the transient response of series RC circuits using different values of R and C

Evaluation Scheme

1.	Mid Sem Evaluation	20 Marks
2.	End Sem Evaluation	20 Marks
3.	Attendance	15 Marks
4.	Class response	30 Marks
5.	File	15 Marks
Total Marks		**100 Marks**

Text Books

1. W.H. Hayt, J. E. Kemerlay & S.M. Durbin, "Engineering Circuit Analysis", Eighth Edition, McGraw Hill, 2012
2. Van Valkenburg, "Network Analysis", Prentice-Hall India, 2001.

BASIC ELECTRONICS AND DEVICE CIRCUITS

(Core Subject)

Course Code:	10B11EC211	**Semester:**	2nd Semester, B. Tech (ECE, CSE & IT)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

The objectives are to study

1. To understand and acquire knowledge about various semiconductor devices.
2. To prepare the students to design simple electronic circuits to meet a practical requirement.

Course Outcomes

Upon successful completion of this course the students would have:

1. Acquire knowledge about the different semiconductor materials and their behavior.
2. Able to understand the construction, working and characteristic of diode, BJT and FET.
3. Develop an ability to design different biasing arrangements of BJT and FET for stabilizing the operating point.
4. Able to understand the working of basic electronic circuits.
5. Able to design complex electronic circuits using basic semiconductor devices.

Course Content

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1	**Semiconductors** Intrinsic semiconductors, Charge carriers (electrons and holes), Energy-band diagrams, Extrinsic semiconductors (N-type and P-type and their representation), Effect of temperature on conductivity	**Chap- 1** **R L Boylestad**	**5**
2	**Semiconductor Diodes** Unidirectional property, Formation of depletion layer, Drift current, Diffusion current, *PN*-junction with no bias, with forward bias and with reverse bias, Transition and diffusion capacitances, *V-I* characteristics, Comparison of Si and Ge diodes, Temperature effects, Diode resistance (static and dynamic), Diode equation, Ideal diode, Circuit model of a diode.	**Chap-1** **R L Boylestad**	**8**

3	**Diode Applications** Block diagram of dc power supply, Half-wave and full-wave (centre tap and bridge) rectifiers, PIV rating of diode, Performance of half-wave and full-wave rectifiers, Shunt capacitor filter and its ripple factor, Clippers: Series and Parallel, Limiters; Clampers, SMPS. Breakdown Diodes : Zener and avalanche breakdown mechanism, Zener diode, Analysis of Zener voltage regulator	**Chap-2** **R L Boylestad**	**8**
4	**Bipolar Junction Transistors (BJTs)** BJT Structure, Working of a transistor, Transistor current equation, Collector reverse saturation current, three configurations, CB and CE input and output characteristics, Comparison between three configurations, Basic CE amplifier, DC load line, Biasing of a transistor.	**Chap-3,4** **R L Boylestad**	**8**
5	**Transistor Amplifiers** Amplification, A practical CE amplifier, Need of DC analysis, AC analysis, Role of capacitors.	**Chap-3,5** **R L Boylestad**	**5**
6	**Field-Effect Transistors (FETs)** Junction Field-Effect Transistor (JFET): Basic construction, Pinch-off voltage, Drain saturation current, Output and transfer characteristics, Voltage controlled resistor, JFET parameters, JFET small-signal amplifier, Its AC analysis. Metal Oxide Semiconductor Field Effect Transistors (MOSFETs): *Depletion MOSFET* : Structure, Working principle, Output characteristics; *Enhancement MOSFET* : Structure, Formation of channel, Output characteristics; *CMOS.*	**Chap-6,7** **R L Boylestad**	**8**

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. R L Boylestad and Nachelsky: Electronic Devices & circuit Theory, 10th Ed.Pearson.
2. Thomas L Floyd: Electronic Devices, Pearson Education (US), 1995.

Reference Books

1. B.G. Streetman: Solid State Electronic Devices, 5th Ed., Prentice Hall, 2000
2. Adel S. Sedra, Kenneth C. Smith : Microelectronics Circuits, 5th Ed., Oxford University Press, 2004

BASIC ELCTRONICS LAB

(Core Subject)

Course Code:	10B17EC271	Semester:	2nd Semester, B. Tech (ECE, CSE & IT)
Credits:	1	Contact Hours:	L-0, T-0,P-2

Course Objectives

The objectives are to study

1. To provide students basic experimental experiences in analyzing Diodes, BJTs, FETs, and OP-AMPS.
2. To develop skills to design various circuits using electronics devices.

Course Outcomes

After studying this course the students would gain enough knowledge

1. Acquire knowledge of the characteristic curves of normal diodes and of Zener diodes.
2. Acquire ability to design and analyze Clipper and Clamper Circuits.
3. Acquire ability to design and analyze Half and Full Wave Rectifiers.
4. Acquire knowledge of the input and output characteristics of a BJT in different configurations.
5. Acquire knowledge of the drain and transfer characteristics of a FET.
6. Acquire ability to design and analyze basic OP-AMP circuits.

List of Experiments

1. To plot the characteristics of a diode in forward and reverse biased conditions.
2. (a) To plot the zener diode characteristics and find the zener voltage.
   (b) To plot its transfer characteristics for a given load.
3. To implement a Half-Wave Rectifier circuit with and without a capacitive filter and to calculate its ripple factor.
4. To implement a full-Wave Rectifier circuit with and without a capacitive filter and to calculate its ripple factor.
5. To implement diode clipper circuits and observe the output waveforms on the CRO
6. To implement diode clampers circuits and observe the output waveforms on the CRO.
7. To plot input and output characteristics of a transistor in Common-Base configuration.
8. To plot input and output characteristics of a transistor in Common-Emitter configuration.
9. To compare the performance of fixed bias, emitter stabilized bias and voltage divider bias circuit.
10. To plot the drain and transfer characteristics of a JFET in common-source configuration.
11. To implement and verify the operation OP-AMP based adder and subtractor circuit using 741 IC.

12. To implement and verify the operation OP-AMP based Integrator and Differentiator circuit using 741 IC.

Evaluation Scheme

1.	Mid Sem Evaluation	20 Marks
2.	End Sem Evaluation	20 Marks
3.	Attendance	20 Marks
4.	Class response	20 Marks
5.	File	20 Marks
Total Marks		**100 Marks**

Text Books

1. Boylstad and Nashelsky, “Electronic Devices and Circuit Theory”, PHI, 8e, 2001.
2. N N Bhargava, “Basic Electronics and Linear Circuits” McGraw Hill Education, 2nd Editon, 2013.

ELECTRICAL MACHINES AND INSTRUMENTS

(Core Subject)

Course Code:	10B11EC311	**Semester:**	**3rd Semester, B. Tech (ECE, CE)**
Credits:	4	**Contact Hours:**	L-3, T-1,P-0

Course Objectives

The objectives are to study

1. T o prepare students to perform the analysis of any electromechanical system.
2. T o empower students to understand the working of electrical equipment used in everyday life.
3. T o prepare the students for advanced courses in robotics.

Course Outcomes

1. The ability to formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions.
2. The skill to analyze the response of any electrical machine.
3. The ability to troubleshoot the operation of an electrical machine.
4. The ability to select a suitable measuring instrument for a given application.
5. The ability to estimate and correct deviations in measurements due to the influence of the instrument and due to the accuracy of the instrument.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	**Magnetic Circuits** Magnetomotive Force (MMF); Magnetic Field Strength; Permeability, Reluctance, Permeance; Analogy between Electric and Magnetic Circuits.	Text Book # 1 Chapter No.6 Page No.164	**2**
2.	**Transformers** • Principle of Operation, EMF Equation; Ideal Transformer, Conditions for Ideal Transformer, Transformation Ratio, Volt-Amperes, Impedance Transformation. • Practical Transformer at No Load, Effect of Magnetization, Effect of Core Losses: (i) HysteresisLoss, (ii) Eddy-Current Loss; Construction of Transformer, Core of Transformer: (ii) Core Type Transformer; (ii) Shell Type Transformer. • Ideal Transformer on Load; Practical Transformer on Load : Effect of Winding Resistance, Effect of Flux Leakage; Equivalent Circuit of a Transformer, Phasor Diagram, Simplified Equivalent Circuit, Approximate Equivalent Circuit	Text Book # 1 Chapter No.13 Page No. 372	**8**

	• Voltage Regulation of a Transformer, Approximate Voltage Drop, Exact Voltage Drop; Condition for Zero Regulation, Condition for Maximum Regulation. • Efficiency of a Transformer; Condition for Maximum Efficiency; All-day Efficiency.		
3	**Electrical Instruments** • Essentials of an Instrument : (1) Deflecting Torque; (2) Controlling Torque : (i) *Spring Control*, (ii) *Gravity Control*); (3) Damping Torque, Methods of Obtaining Damping Torques (1) *Air Friction Damping*, (2) *Fluid Friction Damping*, (3) *Eddy-Current Damping.* • Permanent Magnet Moving Coil (PMMC) Instruments; Ammeters; (*Multi-Range Ammeter*); Universal Shunt for Extending Current Ranges; Voltmeters; (*Multi-Range Voltmeter*, *AC Voltage Measurement*). • The Series-Type Ohmmeter; Meter Sensitivity(Ohms-Per-Volt rating); Loading Effect; Multimeter; Dynamometer Wattmeter; Single- Phase Induction Type Energy Meter.	Text Book # 1 Chapter No.18 Page No. 589	**4**
4	**Synchronous Machines** • Electro-Mechanical Energy-Conversion Machines : Power Considerations for a Generator; Power Considerations for a Motor; How a Generator Differs from a Motor; How Mechanical Force is Developed in a Machine; Type of Rotary Machines. • General Characteristics of the Synchronous Machine; Synchronous Speed; Rotating Magnetic Flux due to Three-Phase Currents; EMF Equation • Synchronous Motors; Phasor Diagrams for Generator and Motor; Constant Speed Operation; Operation of a Synchronous Motor : Effect of Change in Mechanical Load, Effect of Change in Excitation, Synchronous Condenser.	Text Book # 1 Chapter No.14 Page No. 425	**8**
5	**Induction Motor** • Principle of Working; Slip of Induction Motor; (*Frequency of Rotor Currents*, *Speed of Rotation of* *Rotor-Field*); Construction of Induction Motor (*Squirrel Cage Rotor*, *Wire- or Phase-Wound Rotor*). Rotor EMF, Current and Power Factor **(***Rotor Impedance*, *Rotor current*, *Power*	Text Book # 1 Chapter No.15 Page No. 476	**6**

	Factor). • Torque-Slip Characteristics: Starting Torque; Torque-Slip Characteristic Curve; Three Modes of Operation : (1) Motor Action, (2) Brake Action, (3) Generator Action; Condition for Maximum Torque; Maximum Torque; Effect of Rotor Resistance on the Starting Torque.		
6	**Electronic Instruments** • Cathode Ray Oscilloscope: Construction, Working and Applications. • Digital meters; Function Generators.	Text Book # 2 Chapter No.14 Page No. 446	**2**
7	**DC Machines** • Construction of a DC Machine; Armature Winding : (1) *Lap Winding*, **(2)** *Wave Winding*; EMF Equation for a DC Generator • Types of DC Machines; A DC Machine as Generator or Motor; Types of DC Generators (*permanent magnet generators*, *separately excited generators*, *self-excited generators*); Losses in a DC Machine : (1) Copper Losses (*Armature Copper Loss*, *Field Copper Loss*, *Brush Contact Loss*); (2) Magnetic (or Iron) Losses (*Hysteresis Loss*, *Eddy- Current Loss*); (3) Mechanical Losses (*Air Friction* (*or Windage*) *Loss*, *Bearing Friction Loss*); Efficiency of a DC Generator, Condition for Maximum Efficiency. • Characteristics of DC Generators; Open-Circuit Characteristic (OCC) (*The Field Resistance Line*, *Building Up of Voltage*, *Critical Field Resistance*, *Critical Speed*). • DC Motors; Equivalent Circuit of a DC Motor; Speed Regulation of a DC Motor; Torque Developed by a DC Motor; Torque and Speed Characteristics of a DC Motor.	Text Book # 1 Chapter No.16 Page No. 513	**8**
8	**Fractional Horse Power Motors** • Introduction; Single-Phase Motors; Problem With Single-Phase Motor; What Can be Done to Run the Single-Phase Induction Motor; Double-Field Revolving Theory**;** The Remedy (*Two-Phase Motor*); Types of Single-Phase Motors. • **Stepper Motors:** Types of Stepper Motors; Variable Reactance (VR) Stepper Motors : (1) One-Phase on Mode, Full-Step Operation; Step Angle; Resolution; Speed; (2) Two-Phase on Mode, Full- Step Operation; (3) Alternate **One**-Phase on Mode & Two-Phase on Mode, Half-Step Operation; (4) Microstepping.	Text Book # 1 Chapter No.17 Page No. 561	**4**
		Total Number of Lectures	**42**

Evaluation Scheme

1. Mid Sem Exam : 30 Marks
2. End Marks Exam : 45 Marks
3. Teacher's Assessment : 25 Marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. D C Kulshreshtha: Basic Electrical Engineering: McGraw Hill Education, 2011.

Reference Books

1. V.N. Mittle and Arvind Mittal: Basic Electrical Engineering, Tata McGraw Hill Publishing Co.
2. Helfrick and Cooper: Modern Electronic Instrumentation and Measurement Techniques, PHI

SIGNALS AND SYSTEMS

(Core Subject)

Course Code:	10B11EC301	**Semester:**	3rd Semester, B. Tech (ECE) 4th Semester, B. Tech (CSE/IT)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

1. To study the properties and representation of discrete and continuous signals.
2. To study the analysis and synthesis of discrete time systems.
3. To study the sampling process and analysis of discrete systems using z-transforms.
4. To represent periodic signals using Fourier series
5. To find the spectral components of signals using Fourier transform
6. To analyze continuous signals using Laplace transform
7. To analyze discrete signals using z- transform.

Course Outcomes

Students will be able to

1. Classify signals and systems based on their properties and determine the mathematical representations of signals and systems.
2. Explain the role of convolution in the analysis of LTI systems and also able to formulate and solve differential /difference equations describing LTI systems.
3. Analyze the spectral characteristics of signals using Fourier analysis and analyze system properties based on impulse response and Fourier analysis.
4. Apply the Laplace transform and Z- transform for analysis of continuous-time and discrete-time signals and systems.
5. Understand the process of sampling and the effects of under sampling.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	Continuous-time and discrete-time signals, signal energy and power, periodic signals, even-odd signals, exponential and sinusoidal signals, Unit impulse and step functions, continuous and discrete time systems, System classifications, system properties.	A.V. Oppenheim: Chapter 1 B.P. Lathi: Chapter 1 & 8	8
2.	Convolution integral and convolution sum, properties of LTI systems, LTI systems described by differential and difference equation, response of LTI systems.	A.V. Oppenheim: Chapter 2 B.P. Lathi: Chapter 2 & 9	5
3	Fourier series representation of continuous and discrete time signals, properties, Fourier	A.V. Oppenheim : Chapter 3-5 B.P. Lathi: Chapter 3, 4	13

	Transform representation of continuous-time and discrete time signals, properties, system characterization by linear constant coefficient difference equation.	& 10	
4	The Laplace Transform, ROC, properties of Laplace-transform, analysis and characterization of LTI systems using Laplace Transform.	A.V. Oppenheim : Chapter 9 B.P. Lathi: Chapter 6	6
5	The z-transform, ROC and pole-zero-plot, properties of z-transform, analysis and characterization of LTI systems using z-transform. Stability criterion.	A.V. Oppenheim : Chapter 10 B.P. Lathi: Chapter 11	7
6	Sampling, types of sampling, Analog to digital conversion, Signal reconstruction.	A.V. Oppenheim : Chapter 7 B.P. Lathi: Chapter 5	3
		Total Number of Lectures	**42**

Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. A.V. Oppenheim & A.S. Willsky & S.H. Nawab, "Signals & Systems", 2nd Ed., Prentice Hall.

Reference Books

1. B.P. Lathi, "Signal Processing and Linear Systems", 2nd Ed., Oxford University Press.
2. Simon Haykin, Barry Van Veen, "Signal & Systems", 2nd Ed., John Willey and Sons.

ANALOGUE ELECTRONICS

(Core Subject)

Course Code:	10B11EC312	**Semester:**	3rd Semester, B. Tech (ECE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

The objectives are to study

1. To give the idea about fundamental properties of semiconductors.
2. To prepare students to perform the analysis of any Analog electronics circuit.
3. To empower students to understand the design and working of BJT / FET amplifiers, oscillators and Operational Amplifier.
4. To prepare the students for advanced courses in Communication system Circuit Design.

Course Outcomes

1. Acquire basic knowledge of physical and electrical conducting properties of semiconductors.
2. Develop the Ability to understand the design and working of BJT / FET amplifiers.
3. Able to design amplifier circuits using BJT s And FET's. and observe the amplitude and frequency responses of common amplifier circuits
4. Observe the effect of negative feedback on different parameters of an Amplifier and different types of negative feedback topologies.
5. Observe the effect of positive feedback and able to design and working of different Oscillators using BJTS.
6. Develop the skill to build, and troubleshoot Analog circuits.

Course Content

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1	**Review of Semiconductors** Intrinsic and extrinsic semiconductors, Effect of temperature and doping on carrier mobility, PN junction under thermal equilibrium, Contact potential and Formation of depletion layer, Effect of bias on PN junction, Calculation of electric field and potential distribution, Diode resistances, Junction capacitance, Diffusion equations and Einstein relation, Carrier injection and diffusion process, Low and high level injection,Electron and hole diffusion coefficient and diffusion current, Diffusion length	**Chap- 1,3,4,5** **B.G. Streetman**	**10**

2	**AC Analysis of BJT Amplifies** BJT small signal model, Transistor r_e model, Fixed bias, Self bias, Collector feedback, voltage divider bias, common base, Emitter follower, Effect of R_L and R_s , Cascade, Cascode, Darlington pair, Feedback pair, Hybrid equivalent model, relationship between h-parameter and r_e model of CE, CB and CC configuration Low frequency response of BJT amplifier Multistage frequency response.	**Chap-7,8,9,11,12** **R L Boylestad**	**10**
3	**AC Analysis of FET Amplifiers** JFET small signal model, Fixed bias, Self bias, voltage divider bias, common gate, source follower, MOSFETs, effect of R_L and R_{sig} , Cascade configuration	**Chap-10** **R L Boylestad**	**6**
4	**Feedback Amplifier** Feedback concept, negative & positive feedback, voltage/ current, series/shunt feedback, Practical feedback circuits, Design Procedure for the feedback amplifiers.	**Chap-17** **R L Boylestad**	**5**
5	**Oscillators** Berkhausen criterion, Colpitts, Hartley's, Phase shift, Wein bridge and crystal oscillators.	**Chap-17** **R L Boylestad**	**5**
6	**Power Amplifiers** Class A, B, AB, C and D amplifiers, Conversion efficiency, and Design of Tuned amplifier using BJT.	**Chap-15** **R L Boylestad**	**5**

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. B.G. Streetman: Solid State Electronic Devices, 5th Ed., Prentice Hall, 2000
2. R L Boylestad and Nachelsky: Electronic Devices & circuit Theory, 10th Ed.Pearson.

Reference Books

1. S.M.Sze: Semiconductor Devices: Physics & Technology, John Wiley, 2002.
2. Adel S. Sedra, Kenneth C. Smith : Microelectronics Circuits, 5th Ed., Oxford University Press, 2004

ELECTRICAL MACHINES AND INSTRUMENTS LAB

(Core Subject)

Course Code:	10B17EC371	**Semester:**	3rd Semester, B. Tech (ECE, CE)
Credits:	**1**	**Contact Hours:**	**L-0, T-0,P-2**

Course Objectives

The objectives are to study

1. To enable, train and evaluate the ability of the students to perform the analysis of any electromechanical system.
2. To empower students to determine the parameters of AC, DC machines and transformers by performing experiments on these machines.
3. To enable students to identify and solve AC, DC machine and Transformer related problems.
4. The ability to select a suitable measuring instrument for a given application.

Course Outcomes

After studying this course the students would gain enough knowledge

1. The ability to formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions.
2. The ability to troubleshoot the operation of an electrical machine.
3. The ability to conduct testing and experimental procedures on different types of electrical machines.
4. The ability to select a suitable measuring instrument for measuring electrical and non electrical quantities for a given application.

List of Experiments

1. To perform Ratio, Polarity and Load test on a single phase transformer.
2. To perform open circuit and Short circuit test on a single phase transformer and hence determine its equivalent circuit parameters.
3. To perform parallel operation on two single phase transformers.
4. To perform Sumpner's test on two single-phase transformers
5. To connect three single-phase transformers in different configurations (star-delta, delta–star etc.) to form a three-phase transformer and to determine its transformation ratio.
6. To perform No load and blocked rotor test on a three-phase Induction Motor, and hence determine its equivalent circuit parameters.
7. To perform the load test on a three phase Induction motor, and hence obtain the following characteristics –
   (i) Torque vs Slip
   (ii) Stator Current vs Power Output
   (iii) Efficiency vs Power Output
   (iv) Power factor vs Power Output
8. To plot "V" curves of a three phase Synchronous machine.
9. To find the relation between open circuit voltage and field current of –

a. Separately excited DC generator.
b. Self excited DC shunt generator.

10. To plot the load characteristic of –
    a. DC shunt generator.
    b. DC cumulative compound generator.
11. Speed control of DC shunt motor –
    a. By varying field current with armature voltage constant.
    b. By varying armature voltage with field current kept constant.
12. To perform No Load and Blocked Rotor Test on a Single-phase induction motor, and hence determine its equivalent circuit parameters.
13. To measure 3-phase power using two wattmeter method.
14. Study of bridges: (i) Hay's bridge, (ii) Maxwell bridge, (iii) Wein bridge

Evaluation Scheme

1.	Mid Sem Evaluation	20 Marks
2.	End Sem Evaluation	20 Marks
3.	Attendance	15 Marks
4.	Class response	30 Marks
5.	File	15 Marks
Total Marks		**100 Marks**

Text Books

1. D. C. Kulshrestha, Basic Electrical Engineering.
2. V. N. Mittle & Arvind Mittal, Basic Electrical Engineering.

SIGNALS AND SYSTEMS LAB

(Core Subject)

Course Code:	**10B17EC307**	**Semester:**	**3rd Semester, B. Tech (ECE)** **4th Semester, B. Tech (CSE/IT)**
Credits:	**1**	**Contact Hours:**	**L-0, T-0,P-2**

Course Objectives

The primary objective of this course is to provide a thorough understanding and analysis of signals and systems using MATLAB.

Course Outcomes

Upon successful completion of this course the students will be able to:

1. Understand basics of MATLAB syntax, functions and programming.
2. Generate and characterize various continuous and discrete time signals.
3. Perform the basic operations on the signals.
4. Design and analyze linear time-invariant (LTI) systems and compute its response.
5. Analyze the spectral characteristics of signals using Fourier analysis.
6. Analyze the systems using Laplace transform and Z-transform.

List of Experiments

1. Introduction to MATLAB
2. To create user defined functions for generating sinusoidal signal, delta function, unit step function and periodic signal.
3. To create user defined functions for signal operation: signal addition, time shifting, time scaling and time inversion.
4. To compute convolution of two signals and verify its properties.
5. To compute auto-correlation and cross-correlation of two signals and verify its properties.
6. To obtain the response of LTI system defined by linear constant coefficient difference equations.
7. To synthesize the periodic signal using Fourier series.
8. To analyze the spectrum of the signal using Fourier transform and verify its properties.
9. To compute and plot the impulse response and pole-zero diagram of transfer function using Laplace transform.

10. To compute and plot the impulse response and pole-zero diagram of transfer function using Z-transform.

Evaluation Scheme

1. Mid Sem. Evaluation	20 Marks
2. End Sem. Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

- B.P. lathi, Linear Systems and Signals, 2nd Edition, Oxford University Press, India.
- Barry Van Veen & Simon Haykin "Signals and Systems, 2nd Edition" Willey Publishers
- Oppenheim, Alan S. Willsky, S. Hamid Nawab, "Signals and Systems". 2nd Edition, PHI, India.

ANALOGUE ELECTRONICS LAB

(Core Subject)

Course Code:	10B17EC372	**Semester:**	3rd Semester, B. Tech (ECE)
Credits:	1	**Contact Hours:**	L-0, T-0,P-2

Course Objectives

1. To provide students basic experimental experiences in constructing Analog circuits, measuring the experimental data and analysis of the results.
2. To develop skills to design various Amplifier and Oscillator Circuits using BJTs, and FETs circuits.

CourseLearning Outcomes

After studying this course the students shall be able to:

1. To acquire knowledge about electronic components and hardware devices required for designing analog electronics circuits.
2. Demonstrate basic skills on using analog electronic devices and on applying them oncomplex engineering problems.
3. Develop skills to build, and troubleshoot Analog circuits
4. Foster ability to identify, analyze and design of Amplifier circuits.
5. Design, construct, and take readings of various analog circuits to compare experimental results in the laboratory with theoretical analysis.

List of Experiments

1. To compare the performance of fixed bias circuit, emitter stabilized bias circuit and Voltagedivider bias circuit.
2. To investigate the effect of R_2 and R_E on the stability ofoperating point for voltage divider bias circuit.
3. To plot the drain and transfer characteristics of a JFET in common source configuration.
4. To design single stage CE amplifier using BJT and calculate the *h*-parameter model.
5. To design a RC coupled amplifier and observe frequency response.
6. To plot the frequency response of RC Coupled amplifier for different values of$R_{E.}$
7. To plot the frequency response of RC Coupled amplifier for different values of$C_{E.}$
8. Design two stage RC coupled amplifier.
9. To study the performance of Darlington Pair Circuit.

10. To observe the effect of negative feedback on the performance of the amplifier.
11. To verify the operation of RC phase shift oscillator. Find the value of R for sustained oscillations. Also find out the frequency of oscillations.

Evaluation Scheme

1.	Mid Sem Evaluation	20 Marks
2.	End Sem Evaluation	20 Marks
3.	Attendance	15 Marks
4.	Class response	30 Marks
5.	File	15 Marks
Total Marks		**100 Marks**

Text Books

1. R L Boylestad and Nachelsky: Electronic Devices & circuit Theory, 10th Ed.Pearson.
2. Adel S. Sedra, Kenneth C. Smith : Microelectronics Circuits, 5th Ed., Oxford University Press, 2004

ELECTROMAGNETIC ENGINEERING

(Core Subject)

Course Code:	17B11EC411	**Semester:**	4th Semester, B. Tech (ECE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-1

Course Objectives

1. To provide the basic skills required to understand, develop, and design various engineering applications involving electromagnetic fields.
2. To lay the foundations of electromagnetism and its practice in modern communications such as wireless, guided wave principles such as fiber optics and electronic electromagnetic structures.

Course Outcomes

After study through lectures and assignments, students will be able to:

1. Apply vector calculus to static electric-magnetic fields in different engineering situations.
2. Analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems.
3. Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering.
4. Analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Vector Calculus and Co-ordinate systems: Scalar and Vector product, Line, surface and volume integral, Gradient, Curl and Divergence, Rectangular, Cylindrical and Spherical co-ordinate systems.	Dr. Sunil Bhooshan	5
2.	Electrostatics: Coulomb's law, Electric field, electric field due to point charges, dipole, infinite line charge and infinite sheet charge, Electric displacement and electric flux density, electric potential, equipotential surfaces, potential energy, current density, continuity equation, Capacitance, boundary conditions, Laplace and Poisson's equations.	William H.Hayat	10
3	Magnetostatics: Bio-Savart law, Ampere's law, Magnetic field, Magnetic scalar potential ,Magnetic vector potential, Magnetic flux density, Lorentz force, Electron moving in a steady magnetic field, A straight wire carrying a	William H.Hayat	7

	current in a magnetic field, Force between two current elements, Inductance and mutual inductance.		
4	Time dependent fields and Electromagnetic waves: Time dependent Maxwell's equations (Differential and Integral form), Time and Frequency domain wave equations, wave polarization (Circular and Elliptical), Boundary conditions, Reflection and Refraction of waves, Pointing vector and Poynting theorem.	William H.Hayat	11
5	Transmission Lines and Wave guides: Time domain and Frequency Domain transmission line equations, Solution of transmission line equation, Standing wave ratio, λ/8, λ/4, λ/2 transmission line, transmission line charts, Parallel Plate waveguide, Rectangular and Circular waveguides.	David M. Pozar	9
		Total Number of Lectures	**42**

Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. Prof. Dr. Sunil Bhooshan, 'Fundamentals of Engineering Electromagnetics', Oxford University press, 2012.
2. William H.Hayat and J. A.Buck, 'Engineering Electromagnetics',7thed, Tata McGraw Hill.
3. David M. Pozar, 'Microwave Engineering', 4thed, John Wiley & Sons.
4. C.A.Balanis, 'Antenna Theory',3rded, John Wiley & Sons.

Reference Books

1. Jordan Balmin, 'Electromagnetic waves and Radiating Systems'.
   M. Sadiku, 'Elements of Electromagnetics'.

Digital Electronics

(Core Subject)

Course Code:	10B11EC401	**Semester:**	3rd Semester B.Tech. (CSE and IT) 4th Semester, B. Tech. (ECE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

The objectives are to study

1. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
2. To prepare students to perform the analysis and design of various digital electronic circuits.

Course Outcomes

After studying this course the students would gain enough knowledge

1. Have a thorough understanding of the fundamental concepts and techniques used in digital electronics.
2. To understand and examine the structure of various number systems and its application in digital design.
3. The ability to understand, analyze and design various combinational and sequential circuits.
4. Ability to identify basic requirements for a design application and propose a cost effective solution.
5. The ability to identify and prevent various hazards and timing problems in a digital design.
6. To develop skill to build, and troubleshoot digital circuits.

Course Contents

Unit	Topics	References (chapter number, page no.	Lectures
1.	**Number System, Binary Codes and Boolean Algebra** : Conversion of bases, Representation of negative numbers, 1's complement, 2's complement, arithmetic using 2's complement Hexadecimal code, weighted codes - BCD, Excess-3 code, Gray Code. Logic gates and Boolean Algebra.	1,2	6
2.	**Boolean function representation and minimization techniques**: Standard and canonical representation and minimization of Boolean expressions using Karnaugh map.	3,4	7

3	**Combinational Logic Circuits** : Half Adder, Full Adder, Half Subtractor, Full Subtractor, Full adder using half adder, BDC Adder. Carry Look ahead, Multipliers. Multiplexer/de- multiplexers, Encoders and Decoders.	5,6	8
4	**Waveform and wave shaping generator using IC-555 based**: 555 Timer, Astable and monostable multivibrator and bistable multivibrator.	8	2
5	**Sequential Logic Circuits**: Latches, Edge Triggered Flip Flops: SR, D, JK, Master slave JK,. Excitation tables, conversion of Flip Flops. State Diagrams	8	4
6	**Counters:** Synchronous and Asynchronous counters, Up/Down Counters, Design of Synchronous counters, Cascaded Counters, Counter Decoding, Counter applications	9	8
7	**Shift registers:** Shift register functions, Serial in/serial out shift registers, serial in parallel out/shift registers, Parallel In/ Parallel out shift registers, bidirectional Shift registers, Shift register counters, Shift register Applications.	10	5
8	**Analog to Digital & Digital to Analog Converters**: Design of various A to D and D to A Converters.	14	2
9	**Digital Logic Families:** Parameters of Logic Families. Introduction to logic Families: DTL, RTL, TTL, CMOS.	15	2
Total Number of Lectures			**44**

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. T h o m a s L F l o y d " D i g i t a l F u n d a m e n t a l s "

Reference Books

1. M. Morris Mano. "Digital Logic and Computer Design",
2. M . Morris Mano, "Digital Design", Pearson Education Asia,.

ANALOGUE AND DIGITAL COMMUNICATIONS

(Core Subject)

Course Code:	17B11EC412	**Semester:**	4th Semester, B. Tech (ECE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

The objectives are to study

1. To introduce the basic concepts of analogue and digital communication systems, and to equip students with various modulation techniques used for communication.

Course Outcomes

After studying this course the students would gain enough knowledge

1. The students will have the knowledge of components of analogue communication system.
2. The students will have the ability to analyze the concept of various methods used for baseband/band pass analogue transmission and detection.
3. The students will be able to evaluate the performance of analogue communications in the presence of noise.
4. The students will have the knowledge how we can covert analog signal to digital signal with the help of sampling and PCM.
5. The students will have the knowledge of components of digital communication system.
6. The students will have the ability to analyze various modulation methods for transmission of digital information.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Elements of an electrical communication system; Characteristics of communication channel and their mathematical modeling; Signal models: deterministic and random; signal classification; Convolution Integral and response of LTI system; Fourier series representation, Parseval's theorem; Fourier transform; Probability theory, Random Process: mean, correlation and covariance; stationary and ergodic processes; power spectral density; Gaussian Process.	Simon Haykin : Chapter 2	4
2.	Concept of modulation and demodulation, Continuous wave (CW) modulation: amplitude modulation (AM) - double sideband (DSB); double sideband suppressed carrier (DSBSC); single sideband suppressed carrier (SSBSC) and vestigial sideband (VSB) modulation, angle modulation - phase modulation (PM) &	B.P.Lathi : Chapter 2 ,3 & 12	13

	frequency modulation (FM); narrow and wideband FM. Representation of narrowband noise; receiver model, signal to noise ratio (SNR), noise figure, noise temperature, noise in DSB-SC, SSB, AM & FM receivers, pre-emphasis and de-emphasis		
3	Sampling process, sampling theorem for band limited signals; pulse amplitude modulation (PAM); pulse width modulation (PWM); pulse position modulation (PPM) ; pulse code modulation (PCM); line coding; differential pulse code modulation; delta modulation and adaptive delta modulation, Basics of time division multiplexing, noise consideration in PAM and PCM systems.	B.P.Lathi : Chapter 6 Simon Haykin : Chapter 5	10
4	Overview of geometric representation of signals, Gram-Schmidt Orthogonalization procedure; Basic digital modulations schemes: Phase shift keying (PSK), amplitude shift keying (ASK), frequency shift keying (FSK) and Quadrature amplitude modulation (QAM); coherent demodulation and detection; probability of error. Basics of equivalent complex baseband representation of digitally modulated signals.	Simon Haykin : Chapter 7	10
5	Measure of information, Source encoding, Error free communication over noisy channel, Channel capacity of discrete memory less channel, Channel capacity of continuous memory less channel, Frequency selective channel capacity, MIMO communication system. Introduction, Redundancy for error correction, Linear block codes, Cyclic codes, Effect of error correction, Convolution codes, Trellis diagram of block codes	Robert G. Gallager :	7
		Total Number of Lectures	44

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Haykin, Simon : An introduction to analog and digital communications. John Wiley & Sons.
2. Lathi, B.P. : Modern Analog and Digital Communication Systems. Oxford.
3. Taub, Schilling. : Principles of Communication Systems, McGrawHill.
4. Carlson, Crilly : Communication Systems, McGrawHill.
5. Information theory and Reliable communication, Robert G. Gallager, Wiley.

Reference Books

1. Haykin, Simon : An introduction to analog and digital communications. John Wiley & Sons.
2. Lathi, B.P. : Modern Analog and Digital Communication Systems. Oxford.
3. Taub, Schilling. : Principles of Communication Systems, McGrawHill.
4. Carlson, Crilly : Communication Systems, McGrawHill.

DEVICES AND CIRCUIT SIMULATIONS LAB

(Core Subject)

Course Code:	10B17EC471	Semester:	4th Semester, B. Tech (ECE)
Credits:	1	Contact Hours:	L-0, T-0,P-2

Course Objectives

The objectives are to make the student familiar with the basics of PSPICE and CAPTURE and to know the steps involved in the analysis and synthesis of analogue circuits.

Course Outcomes

After studying this course the students would gain enough knowledge After the successful completion of the course, student should be able to:

1. Draw various analogue circuits in PSPICE Capture and write the code for the same and verify them.
2. To synthesize different analogue circuits and observe different types of outputs depending on the analysis type.
3. To use the knowledge acquired in this lab in the project related works in future.
4. To use the knowledge acquired through this lab to design blocks that are used in communications systems and integrated circuits.

List of Experiments

1. Introduction to PSPICE and Capture. To verify the KCL and the KVL on a given circuit.
2. To perform the Nodal and Mesh analysis on a circuit containing independent and dependent sources.
3. To obtain the Thevenin's and Norton's equivalent circuits for a given circuit.
4. To perform transient analysis on RC, RL and RLC circuits. To design the series resonant and shunt resonator circuits.
5. To design a half-wave and a full wave rectifier circuits.
6. To design and obtain the voltage transfer characteristics of a positive, negative and double sided clippers and observe the time domain signals.
7. To design different transistor biasing circuits.
8. To obtain series and shunt feedback amplifiers-Frequency response, Input and output impedances.
9. To measure the common mode rejection ratio of a differential amplifier.

10. To design inverting, non-inverting amplifiers using an op-amp. To obtain the transfer characteristic of an op-amp in open loop and design a voltage reference circuit. To design active LPF and HPF using op-amp.
11. To design a Schmitt trigger circuit and to design Wien bridge, oscillators using op-amp.
12. To design astable and mono stable multi vibrator circuits using IC555 timer.
13. To design LC filters and compare their magnitude and phase responses.
14. To design bi-stable and mono-stable and astable multi-vibrators using transistors.

Evaluation Scheme

1. Mid Sem Evaluation	20 Marks
2. End Sem Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

1. Rashid, Muhamad H. "Introduction to PSpice Using OrCAD." *Prentice Hall of India* (2010).
2. Tobin, Paul. "PSpice for circuit theory and electronic devices." *Synthesis Lectures On Digital Circuits and Systems* 2.1 (2007): 1-159.

DIGITAL ELECTRONICS LAB

(Core Subject)

Course Code:	10B17EC407	Semester:	3rd Semester B.Tech. (CSE and IT) 4th Semester, B. Tech. (ECE)
Credits:	1	Contact Hours:	L-0, T-0, P-2

Course Objectives

The objectives are to study

1. To provide students basic experimental experiences in constructing digital circuits, measuring the experimental data and analysis of the results.
2. To develop skills to design various combinational and sequential circuits using electronics devices.

Course Outcomes

After studying this course the students would gain enough knowledge.

1. To acquire knowledge about electronic components and hardware devices required for designing digital electronics circuits.
2. Foster ability to identify, analyze and design combinational circuits.
3. Foster ability to design various synchronous and asynchronous sequential circuits.
4. To acquire knowledge about internal circuitry and logic behind any digital system.
5. To develop skill to build, and troubleshoot digital circuits.

List of Experiments

Introduction (About Bread Board)

1. To implement Logic gates using TTL ICs (7400, 7402, 7404, 7408, 7410, 7411, 7420, 7427, 7432, 7486).
2. Implementation of Combinational Circuits.
3. To verify NAND and NOR gates are universal gates.
4. Implementation of Combinational Logic Design using 74** ICs.
5. Simplification of Boolean expression using Karnaugh Map Method.
6. To design a 4 bit Binary to Gray code Converter, bit Gray to Binary code Converter, 3 bit Binary to Excess-3 code Converter.
7. To implement Adder and Subtractor circuits:- (Half and Full using simple gates and universal gates).
8. Implement multiplexer using gates and TTL IC's.
9. To verify the truth table of Binary (2 bit) to decimal decoder and octal to decimal decoder.

10. To verify the truth table of one bit and two bit Comparators using logic Gates.
11. To verify the truth tables for each (a) DDL OR gate (b) DDL AND gate (c) TTL OR gate (d) TTL AND gate (e) TTL NAND gate (f) TTL NOR gate.
12. Functional table verification of Latches:-

(i) SR-Latch with NOR Gates

(ii) SR-Latch with NAND Gates

(iii) SR-Latch with control input using NAND Gates

(iv) D Latch

(v) T Latch

Evaluation Scheme

1. Mid Sem Evaluation	20 Marks
2. End Sem Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

1. Thomas L Floyd "Digital Fundamentals"

ANALOGUE AND DIGITAL COMMUNICATIONS LAB

(Core Subject)

Course Code:	17B11EC471	**Semester:**	4th Semester, B. Tech (ECE)
Credits:	1	**Contact Hours:**	L-0, T-0,P-2

Course Objectives

1. Familiarize the students with basic analog communication systems.
2. Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course, e.g., amplitude and frequency modulation.
3. Familiarize the student digital communication techniques which are widely used these days.
4. At the conclusion of the course, the student should have a far greater capacity to design, any communication system

Course Learning Outcomes

After studying this course the students shall be able to:

1. Able to design analog modulation circuits as amplitude and frequency modulation.
2. Design various line coding techniques.
3. Design the circuit to convert analog signals to digital signals.
4. Design different digital modulation circuits

List of Experiments

1. To design and implement Amplitude modulator and Demodulator.
2. To design and implement Frequency Modulator and Demodulator.
3. To design and implement Pulse Amplitude Modulator (PAM), Pulse Width Modulator (PWM), Pulse Position Modulator (PPM).
4. To design and implement sample and hold circuit.
5. Design and Generation of random binary signals.
6. Generation Unipolar NRZ, Polar NRZ, Unipolar RZ and Polar RZ line codes.
7. Design and implementation of Delta Modulator for analogue signals
8. Design, implementation and study of BASK Modulator and demodulator
9. Design, implementation and study of BPSK Modulator and demodulator.
10. Design, implementation and study of BFSK Modulator and demodulator

Evaluation Scheme

1. Mid Sem Evaluation 20 Marks
2. End Sem Evaluation 20 Marks

3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

1. Haykin, Simon : An introduction to analog and digital communications. John Wiley & Sons.
2. Lathi, B.P. : Modern Analog and Digital Communication Systems. Oxford.

Basic Electronics

(Core Subject)

Course Code:	15B11EC411	**Semester:**	4th Semester, B. Tech (BI& BT)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

1. To have understanding of Ohm's law, Kirchhoff's current and voltage laws.
2. To develop mathematical equations for circuit using node voltage and loop analysis.
3. Introduce the working, the characteristics and the applications of electronic devices.
4. To have basic understanding of digital electronics.
5. To analyze digital circuits with logic gates and the different number systems.

Course Outcomes

After successful completion of the course, student should be able to:

1. Design simple electric circuits to meet a practical requirement.
2. Provide an understanding of working of basic electronic circuits and find the expected outcome of the circuit.
3. Have understanding of the fundamental concepts and techniques used in digital electronics.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	**Circuit Concepts:** Terminal voltage; Open-circuit and Short-circuit; Circuit elements active and passive components ; Voltage divider, Current divider; Voltage source and Current source, Kirchhoff's circuit laws, Loop-current analysis, Node-voltage analysis. Concept of phasors, Behavior of *R*, *L* and *C* in AC circuits.	Basic Electrical Engineering D C Kulshreshtha Chapter 1, 2 and 3	12
2.	**Semiconductor Diode** *PN*-junction; Junction theory; *V-I c*haracteristics; Ideal diode; Static and dynamic resistance,	Electronic Devices and circuit theory : Boylestad and Nashelsky	5

	rectifiers; Shunt capacitor filter.	Chapter 1 and 2	
3	**Bipolar Junction Transistors (BJTs):** Structure; Working of transistor; Input and output characteristics of common-base (CB) and common-emitter (CE) configurations; Relations between alpha and beta of a BJT; Definition of Voltage gain, Current gain, Input impedance, Output impedance of Amplifier; Comparison between three configurations; Basic CE amplifier circuit; DC load line.	Electronic Devices and circuit theory : Boylestad and Nashelsky Chapter 3	5
4	**Transistor Biasing** Need of biasing a transistor, Choice of operating point, Selection of operating point, Need for bias stabilization; Fixed bias circuit, Saturation point, Collector- to- base bias circuit, Voltage divider bias circuit	Electronic Devices and circuit theory : Boylestad and Nashelsky Chapter 4	5
5	**Transistors (FETs)** Junction Field-Effect Transistor (JFET) : Basic construction, Pinch-off Voltage, Drain saturation current, Output characteristics, Voltage controlled resistor, JFET parameters**.** Metal Oxide Semiconductor Field Effect Transistor (MOSFET) :Depletion *MOSFET* : Structure, Working principle, Circuit symbol, Output characteristics. Enhancement *MOSFET* : Structure, Formation of channel, Working principle, Circuit Symbol, Output characteristics; Comparison between JFET, MOSFET and BJT. .	Electronic Devices and circuit theory : Boylestad and Nashelsky Chapter 6	6
6	**Digital Circuits:** Analog and digital signals; Binary, octal and hexadecimal numbers; Logic gates – OR, AND, NOT, NOR, NAND, XOR. Karnaugh Maps, Realization of logic gates using nMOS, pMOS and CMOS; Function of analog- to-digital circuit (ADC) and Digital-to-analog circuit (DAC). Sensors, Meters, Oscilloscope, Biosensors, ECG EEG	Digital Fundamentals: Floyd Chapter 1,2 and 3	11

Total Number of Lectures	44

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Basic Electrical Engineering D C Kulshreshtha tata Mc Graw Hill
2. Electronic Devices and circuit theory : Boylestad and Nashelsky PHI
3. Digital Fundamentals Floyd

Reference Books

1. Adel S. Sedra, Kenneth C. Smith : Microelectronics Circuits, 5th Ed., Oxford University Press, 2004

Basic Electronics LAB

(Core Subject)

Course Code:	15B11EC471	Semester:	4th Semester, B. Tech (BI& BT)
Credits:	1	Contact Hours:	L-0, T-0,P-2

Course Objectives

1. To have understanding of Ohm's law, Kirchhoff's current and voltage laws.
2. Introduce the working, the characteristics and the applications of electronic devices.
3. To have basic understanding of digital electronics.
5. To analyze digital circuits with logic gates.

Course Outcomes

1) After studying this course the students would gain enough knowledge analyze and design various electrical circuits
2) To implement various electronic circuits using discrete components and to understand their applications.
3) To implement Boolean expressions using logic gates and understand their application in logic design.

List of Experiments

1. Introduction to power supply, Multimeter, CRO & Function Generator.

2. To determine the equivalent resistance of a circuit using colour code and to verify it using a multimeter.

3. To verify Kirchoff's Voltage Law(KVL).

4. To verify Kirchoff's Current Law(KCL).

5. To plot the characteristics of a diode in forward and reverse biased conditions.

6. To plot input and output characteristics of a transistor in common-base configuration

7. To plot the drain and transfer characteristics of a JFET in common - source configuration

8. To implement Logic gates using TTL ICs.

9. Implementation of combinational circuits using MSI Logic.

10. To verify NAND and NOR gates as a universal gates.

Evaluation Scheme

1. Mid Sem Evaluation	20 Marks
2. End Sem Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

1. Basic Electrical Engineering D C Kulshreshtha tata Mc Graw Hill
2. Electronic Devices and circuit theory : Boylestad and Nashelsky PHI
3. Digital Fundamentals Floyd

LINEAR INTEGRATED CIRCUITS
(Core Subject)

Course Code:	17B11EC511	**Semester:**	Semester 5th, B. Tech (ECE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objective

1. Acquire knowledge about basic building blocks of an operational amplifier and its terminal characteristics.
2. Acquire knowledge about linear and nonlinear circuits and their applications.
3. Foster ability to identify basic requirements for designing any application using linear integrated circuits.
4. Foster ability to understand the use of linear integrated circuits in commercial and industrial applications.

Course Outcomes

1. Ability to understand the terminal characteristics of op-amps and design /analyze fundamental circuits based on op-amps.
2. Understanding of various parameters and interpretation of data sheets for Op-Amp.
3. Ability to analyze and design various applications like amplifiers, active filters, wave generators, wave shaping circuits, A/D and D/A convertors using Op-Amp.
4. Design and analysis of various applications using 555 timer.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	**Introduction to Op-Amp and its characteristics.** Linear Integrated Circuits Differential Amplifiers Basic of Differential Amplifier, Transistorized differential Amplifier, Configurations of Differential Amplifier, Analysis of Dual Input Balanced Output Differential Amplifier, Constant Current Bias, Current Mirror Circuit, Cascading of Differential Amplifiers.	Chapter 1, 2 & 3: OP-AMPS & Linear Integrated Circuits. Fourth Edition R A Gayakwad	7
2.	**Op-Amp characteristics and frequency response** Op –Amp packaging type, pin configuration, Op-Amp basics, Op-Amp specifications, DC offset parameters, Frequency parameters, Unit	Chapter 4 & 5: OP-AMPS & Linear Integrated Circuits. Fourth Edition R A Gayakwad	5

	specifications, offset voltages and currents, virtual Ground, slew rate, CMRR, PSRR, Gain bandwidth product etc.		
3.	**General linear applications.** DC & AC Amplifiers, Peaking Amplifier, Summing, Scaling and Averaging amplifier, Instrumentation Amplifier, Voltage-to-Current Converter, Current to-Voltage Converter, The Integrator, The Differentiator, Log and Antilog Amplifier, Peak Detector, Precision Rectifiers, Comparator, Zero Crossing Detector, Schmitt Trigger, Sample and Hold Circuit, Clippers and Clampers, A/D and D/A Converters.	Chapter 6 OP-AMPS & Linear Integrated Circuits. Fourth Edition R A Gayakwad	8
4.	**Active Filters** Butterworth Filters, Band-Pass Filters, Band Reject Filters, All Pass Filters, Universal Active Filter.	Chapter 7 OP-AMPS & Linear Integrated Circuits. Fourth Edition R A Gayakwad	6
5.	**Wave Shaping Circuits** Multi-vibrators (Astable, Mono-stable, Bi-Stable), High pass and low pass filters using R-C Circuits and R-L, R-L-C Circuits & their response to step input, Pulse input, Square input and Ramp Input, Attenuators, Clamping Circuit theorem, Clipping and Clamping circuits, Schmitt Trigger, Comparator.	Chapter 8 OP-AMPS & Linear Integrated Circuits. Fourth Edition R A Gayakwad	8
6.	**Specialized IC Applications** Voltage-Controlled Oscillator (VCO), Square Wave Generator, Triangular Wave Generator, Saw-tooth Wave Generator, The 555 Timer, Monostable and Astable Multivibrator using IC 555, Phase-Locked Loop (PLL), Voltage Regulators.	Chapter 9 OP-AMPS & Linear Integrated Circuits. Fourth Edition R A Gayakwad	8
Total number of Lectures			42

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes

- 5 marks : Attendance

Text Books

1. R.A. Gayakwad, Op Amp and Linear Integrated Circuits, Fourth edition, earson Education .
2. Robert F. Coughlin & Frederick F. Driscoll, Operational Amplifiers and Linear Integrated Circuits, 6th edition, Pearson, 2000.

Reference Books

1. Adel S. Sedra, Kenneth C. Smith : Microelectronics Circuits, 5th Ed., Oxford University Press, 2004

DIGITAL SIGNAL PROCESSING

(Core Subject)

Course Code:	**10B11EC512**	**Semester:**	**5th Semester, B. Tech (ECE)**
Credits:	**4**	**Contact Hours:**	**L-3, T-1,P-0**

Pre-requisites: Signal and System and Mathematics

Course Objectives:

The primary objective of this course is to provide a thorough understanding and working knowledge of design, implementation and analysis DSP systems.

Course Outcomes

Upon successful completion of this course the students will have developed following skills/abilities:

1. Interpret, represent and process discrete/digital signals and sytems
2. Thorough understanding of frequency domain analysis of discrete time signals.
3. Ability to design & analyze DSP systems like FIR and IIR Filter etc.
4. Practical implementation issues such as computational complexity, hardware resource limitations as well as cost of DSP systems or DSP Processors.
5. Understanding of spectral analysis of the signals

Course Contents :

Unit	Topics	Text book	Lectures
1.	**Introduction** DSP Applications, Concepts of Frequency and Filtering, Commonly used signals in DSP, characterization of LTI systems.	[2] & [1]	2
2.	**Review of Z-transform** a) Z-transform, Concepts of zeros and poles of a system, region of convergence (ROC) of z- transform[2L], b) Inverse z-transform and Properties of Z- transform[1L]	[1] & [2]	3
3.	**Frequency Domain Representation of Signals** a) Concept of spectrum [1L] b) Sampling theorem; decimation and interpolation of discrete signals. [2L] c) Frequency representation of discrete time signals: i. Discrete time Fourier transform (DTFT) [2L] ii. Discrete Fourier transform (DFT) [2L] iii. Fast Fourier transform (DIT and DIF)[2L] iv. Concepts of circular shift and convolution, [1L]	[1], &[2]	11

	b) Filtering of long data sequence[1L]		
4.	**Linear Time Invariant (LTI) Systems in Transform Domain** a) Concept of filtering – revisited, lowpass, bandpass and highpass filters [1L] b) Transfer function and the frequency response of a system [1L] c) Types of transfer functions i. FIR filters, ideal filters, linear phase filters, zero locations of linear phase FIR filters, [2L] ii. IIR filters, pole and zero locations of IIR filters, all pass filters, comb filters, stability issues for IIR filters [2L]	[1]	6
5.	**Filter Structures** a) IIR system- direct cascade and parallel form; Transposed form [2L] b) FIR system – direct and cascade form, and structure for linear phase FIR systems [2L]	[1]	4
6.	**Filter Design Techniques** a) Digital filter specifications, selection of filter type, and filter order [2L] b) FIR filter design using windowing Techniques[3L] c) FIR filter design using frequency sampling method[2L] d) IIR filter design using Impulse Invariance [1L] e) IIR filter design using bilinear transformation [1L] f) Spectral transformations for designing a filter with new characteristics based on a previously designed filter [1L] g) Finite precision: Quantization and round-off error, Finite word length effects in digital filter[2L]	[1],[2] &[4]	12
7.	**Random Signal Analysis & Spectral Estimation** a) Autocorrelation and cross correlation with examples [2L] b) power spectral density and Spectral estimation [2L]	[1] & [4]	4
8	Introduction to Digital Signal Processors		1
	Total Lectures		**43**

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Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    1. 10 Marks : Class performance, Tutorials & Assignments
    2. 10 Marks : Quizzes
    3. 5 marks : Attendance

Text Books

1. Oppenheim, Alan V., Ronald W. Schafer, and John R. Buck. Discrete-time signal processing, 2nd edition, Pearson Education.
2. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing: a computer- based approach, 2nd edition, Tata McGraw-Hill.
3. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing, 3rd edition, Tata McGraw-Hill.

REFERENCE BOOKS

1. Proakis, John G. Digital signal processing: principles algorithms and applications. Pearson Education India.
2. Hayes, Monson H. Digital signal processing Tata McGraw-Hill edition 2004

MICROPROCESSOR AND CONTROLLERS

(Core Subject)

Course Code:	10B11CI401	**Semester:**	4th Semester, B. Tech (CSE) 5th Semester, B. Tech (ECE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

The objectives are:

1. To study the Standard Intel Architectures.
2. To gain proficiency in Assembler language.
3. To gain experience in programming peripheral and I/O devices.
4. To acquire the background for understanding next-generation CPUs.
5. To learn concepts associated with interfacing a microprocessor to memory and to I/O devices.
6. To learn how to control components of a microprocessor based system though the use of interrupts.
7. To learn about Embedded Systems and micro controller architecture, I/O interfacing and programming.

Course Outcomes

After studying this course the students would gain enough knowledge on:

1. The Standard Architecture of Intel Microprocessors
2. Instruction set of Intel 80x86 processors and proficiency in assembly language programming
3. Concepts associated with interfacing a microprocessor to memory and to I/O devices and to learn the programming of peripheral I/O devices
4. Control components of a microprocessor based system though the use of interrupts
5. Background knowledge for understanding next-generation CPUs
6. Embedded system programming through 8051 architecture, I/O interfacing, programing and testing

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1	Introduction to Microprocessor. Overview of the Intel Family of the Microprocessors, The 8086 microprocessor architecture	Berry Brey: Chapter 2	4
2	Addressing Modes; Register Addressing; Immediate Addressing; Direct Data Addressing; Register Indirect Addressing; Base-Plus-Index Addressing; Register Relative Addressing; Base Relative-Plus-Index Addressing	Berry Brey: Chapter 3	2

3	8086 Instruction Set: Data movement Instructions, Arithmetic and Logic Instructions, Program control instruction	Berry Brey: Chapters 4,5,6	4
4	Using assembly language with C/C++; Using Assembly Language with C++ for 16-bit DOS Applications, Mixed Assembly and C++ Objects	Berry Brey: Chapter 7	2
5	Programming the 8086 microprocessor; Modular Programming, Using the Keyboard and Video Display, Disk Files	Berry Brey: Chapter 8	2
6	8086 Hardware specifications; Pin-Outs and the Pin Functions, Clock Generator (8284A), Bus Buffering and Latching, The 8288 Bus Controller	Berry Brey: Chapter 9	4
7	8086 Memory Interface; Memory Devices, Address Decoding, Memory Interface, Dynamic RAM	Berry Brey: Chapter 10	4
8	Basic I/O Interface; I/O Port Address Decoding, Programmable Peripheral Interface (8255), Programmable Interval Timer (8254), Programmable Communications Interface (16550), ADC(ADC804) and DAC (DAC830)	Berry Brey: Chapter 11	5
9	Interrupts; 8259A Interrupt controller	Berry Brey: Chapter 12	2
10	Direct memory access and DMA-controlled I/O; 8237 DMA controller	Berry Brey: Chapter 13	2
11	The arithmetic coprocessor; MMX, and SIMD technologies, 8087 arithmetic coprocessor	Berry Brey: Chapter 14	2
12	Bus interface; ISA Bus, PCI Bus, Parallel Printer Interface, Serial COM Ports, Universal Serial Bus (USB), Accelerated Graphics Port (AGP)	Berry Brey: Chapter 15	2
13	Intel Pentium and Core2 Processors	Berry Brey: Chapter 18	4
14	Embedded Systems and 8051 Architecture, Hardware specifications, Memory System, I/O interfacing, Programming	Kenneth Ayala: Chapters 3,5,6,7,8	5
		Total Number of Lectures	44

Evaluation Scheme

1. Test 1: 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. Internal Assessment : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. Berry B.Brey, “The Intel Microprocessors : Architecture, Programming, and Interfacing,” Eighth Edition, Prentice Hall, 2009
2. Kenneth Ayala, “The 8051 microcontroller,” Third Edition, Thomson, 2005

Reference Books

1. Douglas V Hall, “Microprocessors & Interfacing, Programming & Hardware,” Second Edition, Tata McGraw Hill
2. Yu-Cheng Liu,Glenn A. Gibson , “The 8086/8088 Family Architecture, Programming & design”, Second Edition, PHI.
3. Kenneth Ayala “The 8086 microprocessor programming and Interfacing the PC,” Cengage Learning
4. Tom Shanley, “Protected Mode Software Architecture,” Addison-Wesley, 1996

MICROWAVE DEVICES AND ANTENNA DESIGN

(Core Subject)

Course Code:	17B11EC512	**Semester:**	5th Semester, B. Tech (ECE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-2

Course Objectives

At the completion of this course, the student should have knowledge of the applications of Electromagnetics in microwave devices, basic antenna systems and antenna arrays.

Course Outcomes

After the successful completion of the course student should be able to:

1. Learn the applications of Electromagnetics applied to variety of Microwave Devices and Antenna Systems and their properties.
2. Analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications.
3. Know the operating principles of microwave devices and their characteristics measurements.
4. Integrate various disciplines in electromagnetic so that the student appreciates microwave devices and antennas from a system standpoint.
5. Familiarize the student with the procedure of designing simple antennas and array design.
6. At the conclusion of the course, the student should have a far greater capacity to read and understand technical articles such as those seen in the IEEE Transactions Microwave theory and techniques and also on IEEE Transaction on Antennas and Propagation to use them in real time applications.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	Introduction to Microwaves: Frequency allocations, Microwave waveguide, Rectangular waveguide and its analysis, circular waveguide, modes of propagation, dominant modes, cut off wavelength, mode excitation.	Pozar	5
2.	Microwave Generators And Amplifiers: Reflex klystron, two cavity and multi cavity klystron amplifiers and oscillators, basics of Magnetrons and traveling wave tubes and their applications.	Liao	8
3	Microwave Devices: Scattering matrix of microwave waveguide junction, properties of S-	Pozar	8

	matrix, E-plane tee, H-plane tee, magic tee, attenuators, directional couplers, ferrite devices, Faraday rotation, gyrator, isolator, circulators and cavity resonators, Gunn diode and its modes of operation.		
4	Antenna Basics: Directional properties of antennas, Radiation patterns, antenna gain and aperture, antenna terminal impedance, self and mutual impedance, front to back ratio, antenna beam width and bandwidth, antenna efficiency, antenna beam area, polarization, antenna temperature and reciprocity properties of antennas.	R.S.Elliot	6
5	Antenna Arrays: Classification of arrays, linear arrays of two point sources, linear arrays of n-point sources, pattern multiplication, array factor, linear arrays of equal amplitude and spacing (Broadside and end fire arrays), directivity and beam width Chebyshev arrays, Introduction to planar arrays.	R.S.Elliot	6
6	Special Antennas: VLF and LF antennas (Hertz and Marconi antennas), receiving antenna and radio direction finders. Folded dipole antennas, Yagi-uda antenna, horn antennas, microwave dish, helical antennas, microstrip antennas.	Ballanis	9
		Total Number of Lectures	42

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Pozar, David M. *Microwave engineering*, John Wiley & Sons, 2009.
2. Liao, Samuel Y. *Microwave solid-state devices*. Prentice Hall, 1985.

3. Elliot, Robert S. *Antenna theory and design*. John Wiley & Sons, 2006.
4. Ballanis, Constantine A. "Antenna theory analysis and design." *John Willey and Son's Inc., New York* (1997).

Reference Books

1. Jordan, E. C., and K. G. Balmain. *Electromagnetic Waves and Radiating Systems*, Prentice Hall." *Englewood Cliffs, New Jersey* (1968).
2. Robert E.Colin. *Foundations for Microwave Engineering*, McGraw Hill, 2nd Edition, 2001.
3. John D. Kraus & R.J Marhefka, *Antennas for all appl*ications, The McGraw-Hill Companies, 2nd/3rd edition, 2006
4. C.A. Balanis*, Antenna Theory, Analysis and Design*. NY: John Wiley and Sons, 2nd edition, 2002
5. WL Stutzman & GA Thiele, Antenna Theory and Design , John Wiley and Sons, 2nd edition,1997

LINEAR INTEGRATED CIRCUITS LAB

(Core Subject)

Course Code:	17B17EC571	Semester:	5th Semester, B. Tech (ECE)
Credits:	1	Contact Hours:	L-0, T-0,P-2

Course Objectives

1. Familiarize the students with linear integrated circuits (IC 741, IC555).
2. In depth knowledge of applying theoretical concepts on circuit design applications.
3. To provide experience in handling integrated circuits and design hardware applications using linear ICs on bread board.
4. To introduce the students to software (PSPICE) using which they can simulate various circuits based on linear ICs.
5. Impart ability to handle the apparatus and trouble shoot various linear circuit applications.

Course Outcomes

1. Ability to use Op- amp IC 741 to design various applications like amplifiers, comparator, active filters and waveform generator etc.
2. Ability to simulate various circuits using IC741 and IC 555 in PSPICE for DC bias point and AC sweep settings.
3. Experience to identify problems and troubleshoot various linear and nonlinear circuits.
4. Ability to handle the apparatus required to design linear circuit applications.

List of Experiments

1. Design of Inverting and Non-Inverting Amplifiers using OPAMP.
2. Design of Adder and Subtractor circuits using OPAMP.
3. Design of Integrator and Differentiator using OPAMP.
4. Design and simulate triangular/square waveform generator using IC 741.
5. Design and simulate voltage regulator using op-amp.
6. Design and simulate Frequency response of 1st order HPF and LPF filter.
7. Design and simulate Schmitt trigger using IC 741 for given values of UTP and LTP.
8. Design and simulate monostable multivibrator for required pulse width using IC 741.
9. Design and simulate astable multivibrator for required frequency and duty cycle using IC 741.
10. Design and simulate of RC oscillators for required frequency.

Evaluation Scheme

1. Mid Sem Evaluation 20 Marks
2. End Sem Evaluation 20 Marks
3. Attendance 20 Marks

4. Class response	20 Marks
5. File	20 Marks
Total Marks	**100 Marks**

Text Books

1. Op-Amps And Linear Integrated Circuitsby R. A. Gayakwad

DIGITAL SIGNAL PROCESSING LAB
(Core Subject)

Course Code:	**10B17EC572**	**Semester:**	**5th Semester, B. Tech (ECE)**
Credits:	**1**	**Contact Hours:**	**L-0, T-0,P-2**

Course Objectives

The objective of the course to practical implementation of the convolution, correlation, DFT, IDFT, Block convolution, Signal smoothing, filtering of long duration signals, and Spectral analysis of signals

Course Outcomes

After studying this course the students would be able to-

1. Understand the handling of discrete/digital signals using MATLAB
2. Understand the basic operations of Signal processing
3. Analyse the spectral parameter of window functions
4. Design IIR, and FIR filters for band pass, band stop, low pass and high pass filters.
5. Design the signal processing algorithm using MATLAB & VLAB.

List of Experiments

1: Introduction to MATLAB

2: Signal Generation and Manipulation

3: To perform the convolution and correlation operations

4: To perform the Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform(IDFT)

5: To perform the long data filtering using Overlap save and overlap add method

6: To analyze the spectral parameters of the fixed window functions.

7: To design the low pass and high pass FIR filters using the window functions

8: To design the band pass and band stop FIR filters using the window functions

9: To Study of the Infinite Impulse Response (IIR) filter using VLAB

10: To study the FIR filter design with window function using VLab: low pass and high pass filter

11: Lab assignment 1

12: Lab assignment 2

Evaluation Scheme

1. Mid Sem. Evaluation	20 Marks
2. End Sem. Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

- John G. Proakis, "Digital signal processing: principles algorithms and applications Uisng Matlab". Pearson Education India.
- Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing: a computer-based approach, 2nd edition, Tata McGraw-Hill.
- Alan V, Oppenheim, Ronald W., Schafer A. "Digital Signal Processing" PHI Publishers

MICROPROCESSOR AND CONTROLLERS LAB

(Core Subject)

Course Code:	**10B17CI407**	**Semester:**	**4th Semester, B. Tech (CSE)** **5th semester, B.Tech (ECE)**
Credits:	**1**	**Contact Hours:**	**L-0, T-0, P-2**

Course Objectives

At the conclusion of the course, following learning objectives are expected to be achieved. The lab work and homework portions of the course are intended to help you apply your understanding,

1. To develop, implement, and debug 8086 assembly language programs that meet stated specifications.
2. To understand and be able to explain bus transactions, memory organization and address decoding, basic I/O interfaces and port addressing.
3. To get familiarize with interfacing of various peripheral devices with the microprocessor
4. To control the components of a microprocessor based system through the use of interrupts.
5. To develop, implement, and debug 8051 assembly language programs and I/O interfaces that meet stated specifications.
6. to lay a foundation for pursuing some additional career options

Course Outcomes

After studying this course the students would gain enough knowledge

1. To increase proficiency in using assembly language to develop microprocessor based applications
2. To learn to control components of a microprocessor based system though the use of interrupts.
3. Gain practical experience in programming memory and peripheral devices like timers/counters, parallel peripheral devices, serial communication interfaces and I/O devices
4. To gain practical experience in programming with coprocessor and DMA controller
5. To work with 8051 microcontroller and interfaces like digital to analogue converters and analogue to digital converters etc.
6. To develop a microprocessor/microcontroller based system, using assembly language programming concepts, for handling a real life task

List of Experiments

Exp. 1 To get familiar with ET-8086LCD kit and its commands

Activity 1: Basic introduction of ET-8086LCD kit's component.

Activity 2: To get familiar with common monitor commands:

(i) S: Substitute Memory, I/O, Register
(ii) E: Expand Monitor (Assembler)
(iii) G: Execute Machine Code (Go To)
(iv) M: Move a block of data from one memory location to other
(v) C: Compare a block of data on a memory location

Exp.2 Data transfer and Arithmetic operations

Activity 1. Write a programme starting from the memory location 1000:1000H to move a 16bit data to AX register and then move the data to the memory location 1000:0000H

Activity 2. Write a programme to add, subtract, multiply and divide two 16bit nos. stored at locations 1000:0000H and 1000:0002H**.** Store the result starting from 1000:0004H

Note: Find out the total memory used and machine cycles requited for the programs.

Exp.3 Branch/Loop instructions and string instructions

Activity 1. Write memory efficient and time efficient programs to find the largest and smallest nos. in a string of 10 bytes, stored at location starting from 1000:0100H. Store the result at 1000:0200H and 1000:0201H

Activity 2. Write memory efficient and time efficient programs to sort a string of 10 bytes stored at location starting from 1000:0300H in ascending and descending order.

Exp. 4 Interrupts

Activity 1. Write a program to display the current time on the LCD in 24Hr format

Activity 2. Write a program to display three names successively on the LCD with a delay

Exp. 5 Keyboard and LCD display interfacing

Activity 1. Convert Fahrenheit to Celsius and display on the LCD

Activity 2. To check for palindrome in the given string

Exp. 6 On-board interfaces 8255, 8253, 8259

Write a program to output 55H and AAH repeatedly with a delay of 1sec at a port of 8255 using 8253 for delay and 8259 for interrupt.

Exp. 7 Serial communication interface 8251

Communicate between two microprocessor kits using serial communication interface 8251 and estimate the minimum time to transmit 10 characters.

Exp.8 Coprocessor 8087

Find the logarithm of a number using Math coprocessor 8087 and compare its execution time with 8086.

Exp. 9 DMA controller 8089 for high speed data transfer.

Write a program to transfer data from peripheral to Memory through DMA controller 8089

Exp. 10 Woking with BIOS and DOS interrupts

Write a program to create a file 'myfile.txt' and write your bio-data in it. Save the file into the sub directory MYDIR. Read and display the contents of the file.

Exp.11 8051 programming

Activity 1. Familiarize with the 8051 kit

Activity 2. Acquire analog voltage signal from ADC and process it by removing noise using average filter. Output the filtered signal in analogue form using DAC.

Exp. 12 Mini project

Select any project of your choice

Evaluation Scheme

1. Mid Sem Evaluation	20 Marks
2. End Sem Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

1. "The Intel Microprocessor 80x86, Pentium, Pentium Pro processor, Pentium II Pentium III, Pentium IV Architecture, Programming, and Interfacing " by **Berry B.Brey,** Eighth Edition, Prentice Hall, 2003
2. "The 8051 microcontroller" by Kenneth Ayala is recommended for 8051 only
3. "Microprocessors & Interfacing, Programming & Hardware", by Douglas Hall, 2nd Edn. Tata McGraw Hill.

MICROWAVE DEVICES AND ANTENNA DESIGN LAB

(Core Subject)

Course Code:	17B17EC572	Semester:	5th Semester, B. Tech (ECE)
Credits:	1	Contact Hours:	L-0, T-0,P-2

Course Objectives

The main objective of the lab is to be familiar with unique equipments used in microwave devices and antenna systems. And gaining hands on experience of some unique microwave circuits and antenna units.

Course Outcomes

After the successful completion of the course, student should be able to:

1. Know about the different types of devices and their usage in microwave frequencies.
2. Familiarize the students with handling, working and tuning of various equipment pertinent to the hardware experiments in the field of Microwave and antennas.
3. Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course, e.g., microwave devices and antennas, and applied in practice.
4. Familiarize the students with some antenna hardware and help them to connect and visualize the properties of the same.
5. At the conclusion of the course, the student should have a far greater capacity to design, measure, and understand novel microwave and antenna prototypes.

List of Experiments

1. Getting familiar with handling, working and tuning of various equipment to be used in this lab.
2. To measure the frequency and wavelength of TE10 mode in a rectangular waveguide
3. To measure the VSWR for different loads. Low VSWR (Matched load), Medium VSWR, High VSWR.
4. To measure the unknown load impedance using the Smith chart in a rectangular wave guide setup.
5. To match unknown impedance to characteristic impedance using stubs (with the help of slide-screw tuner).
6. To derive the fundamental and derived (secondary) parameters of a coaxial transmission line. Finding R, L, G and C using LCR meter. Finding the attenuation constant as a function of frequency.
7. To find the reflection coefficient on a co-axial transmission line with different terminations. Matched load, Open circuit, Short Circuit. Determining the dielectric constant of the coaxial cable used.
8. To measure coupling coefficient, Insertion loss and Directivity of a Directional coupler.

9. Study the characteristics of a Gunn diode oscillator, and make power and frequency measurements.
10. To determine the half power beam width, radiation pattern, gain and directivity of horn antenna in E – plane and H – plane.
11. Performance evaluation and study of Yagi-Uda antenna.

Evaluation Scheme

1. Mid Sem Evaluation	20 Marks
2. End Sem Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

1. Pozar, David M. *Microwave engineering*, John Wiley & Sons, 2009.
2. Liao, Samuel Y. *Microwave solid-state devices*. Prentice Hall, 1985.
3. Elliot, Robert S. *Antenna theory and design*. John Wiley & Sons, 2006.
4. Ballanis, Constantine A. "Antenna theory analysis and design." *John Willey and Son's Inc., New York* (1997).

THEROY AND APPLICATIONS OF CONTROL SYSTEM

(Core Subject)

Course Code:	10B1WEC515	**Semester:**	5th Semester, B. Tech (ECE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

The objectives are to study

1. To understand procedures for developing mathematical models of physical systems, and related analytical and numerical methods for predicting their behavior.
2. To develop the skill of designing compensating networks according to the desired design specifications.
3. Use computational tools in the modelling, simulation and analysis of linear control systems.
4. Understanding of stability of state space models and their controllability and observability in modern automation and control.
5. Ability to understand and design advance control schemes for industrial applications.

Course Outcomes

After studying this course the students would gain enough knowledge

1. The ability to analyze any physical system using mathematical model.
2. The ability to formulate reduced models for complex systems.
3. The skill to analyze the response of any LTI system.
4. The ability to design any system with desired specifications both in time and frequency domain.
5. The ability to derive, interpret and solve problems using modern state space control methods for continuous time and discrete time systems.
6. The skill to apply advance control schemes for various applications.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Introduction to Systems and Control: Open loop and closed loop control systems, components of control system: sensors, actuators, controllers, process, modeling principles of physical systems: electrical, mechanical, thermal and pneumatic systems, effect of feedback on gain, stability, sensitivity and noise, characteristics of transfer function models: poles, zeros, stability and minimal realization, block diagram algebra, signal flow graphs, Mason's gain formula, conversion between block diagram and signal	BC. Kuo : Chapter 1, 3, 4 M. Gopal: Chapter 4	6

	flow graph.		
2.	Response Analysis: Standard test input signals, transient and steady state response: first, second and higher order systems, system design specifications, error analysis: static and dynamic error coefficients, Effect of adding poles and zeroes, Correlation-ship between time and frequency domain specifications.	BC. Kuo : Chapter 7, 9 M. Gopal: Chapter 5	8
3	Stability Analysis: Absolute stability, relative stability, routh-hurwitz, root locus, bode plot, polar plot and Nyquist plot techniques, gain margin and phase margin, constant magnitude loci: M-circles, constant phase Loci: N-circles, nichol's chart. system identification: inverse bode plots. Effect of adding zero to the forward path, effect of adding pole to the forward path.	BC. Kuo : Chapter 6, 8, 9	10
4	Compensator Design: System design specifications, design of compensating networks (Lead, Lag, Lag-Lead) for specified control system performance using root locus and bode plot, concepts and applications of P, PD, PI and PID controllers.	BC. Kuo : Chapter 10	6
5	Linear State Variable Models: Concept of state, state space modeling: SISO and MIMO systems, useful transformations in state–space analysis and design, various forms: physical variable form, phase variable form, Jordan canonical form, solution of state equations, computation of state transition matrix: Laplace method, power series method and Cayley Hamilton method, derivation of transfer function from State variable model, decomposition of transfer function: direct decomposition, cascade decomposition, parallel decomposition, characteristics of linear state variable models, natural and forced responses, determination of controllability and observability of a control system using Kalman and Gilbert tests.	BC. Kuo : Chapter 5 M. Gopal: Chapter 12	8
6	Advanced Control Schemes: Control systems with multiple loops- cascade control, selective control systems: override control, split range	Stephanopoulos- Chapter 20, 21, 22	6

	control, feed-forward and ratio control, adaptive and inferential control systems.		
		Total Number of Lectures	44

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Benjamin C. Kuo, "Automatic Control Systems", Prentice Hall of India.
2. Nagrath & Gopal, "Control System Engineering", New age International.
3. Stephanopoulos, G., Chemical Process Control, Prentice Hall of India.

Reference Books

1. K. Ogata, "Modern Control Engineering", Prentice Hall of India.
2. Norman S. Mise, "Control System Engineering", Wiley Publishing Co.
3. Richard C Dorf, Robert H Bishop, "Modern Control Systems", Pearson Edu.

Web Resources: http://nptel.ac.in/courses/108102043/

THEORY AND APP OF CONTROL SYSTEMS LAB

(Core Subject)

Course Code:	10B1WEC575	Semester:	5th Semester, B. Tech (ECE)
Credits:	1	Contact Hours:	L-0, T-0,P-2

Course Objectives

The objectives are to study

1. Use computational tools in the modelling, simulation and analysis of linear control systems.
2. To understand procedures for modelling of physical systems, and related analytical and numerical methods for predicting their behavior.

Course Outcomes

After studying this course the students would gain enough knowledge

1. Mathematical modelling of physical systems and performing their analysis.
2. The skill to analyze the response of any LTI system using software tools.
3. The ability to design any system with desired specifications both in time and frequency domain and analyze systems using different techniques.
4. Be able to design the suitable controller and improve the performance of the system.

List of Experiments

1. To define a transfer function and draw its pole-zero plot for a (a) mechanical system (b) electrical system.

   Tasks:

   - Define a polynomial using (*a*) its roots and (*b*) its coefficients.
   - To obtain the roots of a given polynomial.
   - Define a polynomial using syslin.
   - To obtain the location of poles and zeros for a given transfer function.
   - To draw the pole-zero plot.

2. To obtain the overall transmittance of a given complex system represented in either the block diagram representation or signal flow graph representation by using masons gain formula.

   Tasks:

   - To convert the given block diagram to signal flow graph.
   - Define gains between different nodes as symbolic variables.
   - To obtain overall transmittance between the input and output node by using masons gain formula.

3. To obtain the time response of a given system and obtain the steady state error for different inputs.

   Tasks:

   - Define symbolic variables.

- To express the given system in terms of its partial fractions.
- To determine the Laplace inverse.
- To obtain the value of steady state error for (a) different inputs and for (b) different types of the system.

4. To obtain the time response specifications of a given systems for various inputs.

   Tasks:
   - To obtain the transient response specifications for a given system with various inputs.
   - To design a system for given transient response specifications.

5. To determine the stability of a given LTI system using locations of poles.

   Tasks:
   - To obtain the characteristic equation for a given closed loop systems.
   - To identify the locations of poles for the given systems.
   - To draw the pole-zero plot for the given systems.
   - To analyze the relative stability of the systems.

6. To determine the range of the forward path gain for the system to be stable using root locus technique.

   Tasks:
   - To obtain the transfer function for a given system.
   - To plot the root locus of the system by varying the forward path gain from k=0 to k=infinity.
   - To analyze the effect of adding pole and zero.

7. To design, simulate and analyze the stability and frequency domain specifications of LTI systems using Bode plot and Nyquist criteria.

   Tasks:
   - To define the system using transfer function.
   - To obtain the bode plot of the system.
   - To determine the gain margin and phase margin.
   - To obtain the range of K for which the system is stable.
   - To analyze the effect of adding a pole and zero.
   - Repeat above steps for Nyquist Plot.

8. To design, compensated systems to achieve the desired time domain and frequency domain specifications using (a) root locus and (b) bode plots.

   Tasks:
   - To define the system using transfer function.
   - To obtain the bode plot of the uncompensated system.
   - To design the compensator using desired time domain specifications.
   - To obtain the bode plot of the compensated system.
   - Repeat above steps for desired frequency response specifications using Bode plots.

9. To design and analyze the state space model of given LTI systems.

   Tasks:
   - To obtain the state model of the given transfer function.
   - To obtain the time response of the state model.

- To determine the controllability and observability of the developed state model.

10. To simulate a state space model for given LTI systems and analyze their (*a*) Response (*b*) Controllability and (*c*) Observability.

11. To determine the transfer function of electrical systems of first order and second order and observe its magnitude response and time response on CRO for different excitations.

12. To analyze the effect of variation in forward and feedback path parameters on the frequency response of the system.

13. To obtain proportional, derivate and integral constants of an analog PID controller using simulated systems.

Evaluation Scheme

1. Mid Sem Evaluation	20 Marks
2. End Sem Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

1. K. Ogata, “Modern Control Engineering”, Prentice Hall of India.
2. Norman S. Mise, “Control System Engineering”, Wiley Publishing Co.

COMMUNICATION SYSTEMS

(Core Subject)

Course Code:	10B11EC514	**Semester:**	5th Semester, B. Tech (CSE/IT)
Credits:	4	**Contact Hours:**	L-3, T-1, P-2

Course Objectives

1. To introduce the concept of communication system.
2. To make the students to know the constituents of the communication systems such as transmitter, receiver and channel with their features.
3. To enhance the understanding of communication system and device.

Course Outcomes

This course provides the knowledge of analog and digital communication system analysis and design. After study through lectures and assignments, students will be able to

1. Formulate and interpret the presentation and processing of signals in communication systems.
2. Assess and evaluate different analog and digital modulation and demodulation techniques.
3. Develop an ability to compare and contrast the strengths and weaknesses of various communication systems.
4. Evaluate the influence of noise on communications signals.
5. Understand the state-of-art of the communication systems.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	Introduction: Review of Signals and Systems, Review of Fourier Analysis, Elements of a communication system, Introduction to Modulation, Need of Modulation in Communication Systems, band-limited signals and systems, bandwidth, time-limited and frequency-limited signals.	B.P. Lathi: Chapter 1 W. Tomasi: Chapter 1	3
2.	Amplitude Modulation: DSBSC, AM, SSBSC, VSB modulation, Generation and detection of AM signals: Coherent detection, Envelope detection, Generation and detection of DSBSC, SSBSC signals.	B.P. Lathi: Chapter 4 W. Tomasi: Chapter 4-5	12
3	Angle Modulation: Concepts of FM and PM, Narrowband and Wideband FM, Carson's rule, Generation and detection of FM signals.	B.P. Lathi: Chapter 5 W. Tomasi: Chapter 7	10
4	Analog Communication Systems: Homo/Hetro/ Super-hetrodyne Receivers, Multiplexing, TDM,	W. Tomasi: Chapter 8	3

	FDM, QCM, PLL.		
5	Noise: Performance of modulation systems in presence of noise, Study of channel noise performance for various modulation schemes.	B.P. Lathi: Chapter 9 &12	3
6	Sampling and Pulse Modulation Techniques: Sampling theorem, time and frequency domain analysis of sampling , aliasing effect, under sampling and oversampling, practical sampling, Reconstruction of signals, PAM, PPM, PWM generation & demodulation methods, Overview of Digital Communication Systems (DCS) - Merits and Demerits.	B.P. Lathi: Chapter 6 W. Tomasi: Chapter 10	6
7	Analog to Digital Conversion: Quantization, Quantization Noise, Pulse code Modulation– PCM generation and reconstruction- Differential PCM, DM and ADM.	B.P. Lathi: Chapter 6	4
8	Digital Modulation Techniques: ASK, FSK, PSK, QPSK Modulation, Demodulation, Constellation diagrams, Comparison of digital modulation systems.	B.P. Lathi: Chapter 7 W. Tomasi: Chapter 9	4
		Total Number of Lectures	**45**

Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. a i, Zhi Ding, “Modern Digi al and Analog Communica ion”, 4th Ed., Oxford University Press.
2. W. Tomasi , “Electronic Communications Systems : Fundamentals Through Advanced”, 5th Ed., Pearson.

Reference Books

1. Simon S. Haykin, Michael Moher, “Communication Systems”, 4th Ed., John Wiley.
2. Bruce Carlson, “Communication Systems”, McGrawHill.

COMMUNICATION SYSTEMS LAB

(Core Subject)

Course Code:	10B17EC574	Semester:	5th Semester, B. Tech (CSE & IT)
Credits:	1	Contact Hours:	L-0, T-0,P-2

Course Objectives

The objectives are to enhance the understanding of students of communication systems and devices.

Course Outcomes

After studying this course the students would gain enough knowledge to

- Design different analog and digital modulation and demodulation techniques.
- Design various pulse modulation schemes.

List of Experiments

1. To study Amplitude modulation and demodulation
2. To study Frequency modulation and demodulation.
3. To study Pulse Amplitude modulation and demodulation.
4. To study Pulse Width modulation.
5. To study Pulse Position modulation.
6. To study Delta Modulation.
7. To study Amplitude Shift Keying.
8. To study Frequency Shift Keying.
9. To study Phase Shift Keying.
10. To study various Line Coding techniques.
11. To study a Phase Locked Loop (PLL) circuit.

Evaluation Scheme

1. Mid Sem. Evaluation	20 Marks
2. End Sem. Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

- B P Lathi: "Modern Digital and Analog Communication", Oxford University Press.
- R P Singh and S D Sapre: "Communication Systems: Analog and Digital" Tata McGraw-Hill Publishing Company Ltd.

TELECOMMUNICATION NETWROKS

(Core Subject)

Course Code:	10B11EC611	**Semester:**	6th Semester, B. Tech (ECE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

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

1. Build an understanding of the fundamental concepts of telecommunication networking.
2. Describe communication protocols and layered network architectures.
3. Understand the system design principles of data communication systems.
4. Understand, define, and explain data communication networks concepts.

Course Outcomes

This course provides the knowledge of data communication and networking. After study through lectures and assignments, students will be able to:

1. Identify the different types of network topologies. And to enumerate the layers of OSI model and TCP/IP model.
2. Utilize the available bandwidth in an efficient way.
3. Understand the basics of circuit switching and the multi-stage switching technologies and apply the same for the analysis and design of optimized switches.
4. Learn the different protocols working at various layers of TCP/IP model and apply the knowledge of same to design a given network.
5. Identify the key metrics required for the performance assessment of IP based networks and then to apply this knowledge to optimize a given network operation based on some specific metrics.
6. Understand various routing algorithms and apply this knowledge to design a network based on given constraints.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	Data Communication: Introduction: Networks – Protocols and standards – Line configurations – Topology – Transmission mode – Categories of networks – Inter networks. OSI & TCP/IP models: Functions of the layers. Bandwidth Utilization: Multiplexing & Spreading. Transmission media: Guided media &Unguided media Switching: Circuit Switching and Packet	Forouzan: Chapters 1,2,6,7,8,9	14

	Switching, Structure of switches Telephone Network and Cable network for Data Transmission		
2.	Error Control and Data Link Protocols: Error detection and correction: Types of errors, Detection, Linear Block Codes, Cyclic Codes, Checksum Data link Control: Framing, Noiseless and Noisy Channel Protocols, HDLC, point-to-point Protocol Multiple Access: ALOHA, CSMA, CSMA/CD, CSMA/CA, Controlled Access Methods	Forouzan: Chapters 10,11,12	11
3	Wired and Wireless LANs: Wired LAN: Ethernet, Standard Ethernet, Fast Ethernet, Gigabit Ethernet Wireless LAN: Bluetooth Connecting LANs: Repeaters, Hubs, Switches, Virtual LANs	Forouzan: Chapters 13,14	4
4	Logical Addressing, Internet Protocol & Routing: IPv4 addresses, IPv6 addresses, transition from IPv4 to IPv6. Network protocols: ARP, RARP, BOOTP, DHCP, ICMP, IGMP, Unicast Routing Protocols: Distance Vector Routing, Link State Routing, Path Vector Routing	Forouzan: Chapters 19,20,21,22	11
5	Transport layer protocols: UDP, TCP, SCTP Congestion control and Quality of Service	Forouzan: Chapters 23,24	4
		Total Number of Lectures	44

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks

4. **Internal Assessment** : 25 marks
    - 5 Marks : Class performance, Tutorial presentations
    - 15 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. B. A. Forouzan: “Data Communications and Networking”, Tata McGraw-Hill 4th Edition 2010.

2. A. Tanenbaum: “Computer Networks”, Pearson Education, 4th Edition.

Reference Books

1. William Stallings: “Data Communications and Networking”, Pearson Education.

VLSI TECHNOLOGY AND APPLICATIONS

(Core Subject)

Course Code:	10B11EC612	**Semester:**	6th Semester, B. Tech (ECE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

The objectives are to study

1. To bring both Circuits and System views on design together.
2. It offers a profound understanding of the design of complex digital VLSI circuits, computer aided simulation and synthesis tool for hardware design.

Course Outcomes

After studying this course the students would gain enough knowledge

1. Understand the static and dynamic behavior of MOSFETs (Metal Oxide Semiconductor Field Effect Transistors) and the secondary effects of the MOS transistor model.
2. To be aware about the trends in semiconductor technology, and how it impacts scaling and its effect on device density, speed and power consumption.
3. To understand MOS transistor as a switch and its capacitance.
4. Student will be able to design digital systems using MOS circuits (Static and Switching characteristics of inverters)
5. Able to learn Layout, Stick diagrams, Fabrication steps.
6. Understand the concept behind ASIC (Application Specific Integrated Circuits) design and the different implementation approaches used in industry.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Introduction to VLSI technology, VLSI design flow, Digital Design Cycle, Physical Design Cycle.	Kang : Chapter 1	3
2.	MOS fundamentals, Device Structure and Physical Operation, Current-Voltage Characteristics, channel length modulation, body effect, biasing of MOSFETs, capacitances in MOS, VLSI circuit and system representation.	Kang : Chapter 3	12
3	Logic gate characteristics, Design of MOS inverter with different loads, Determination of pull up and pull down ratio for an nMOS inverter driven by another n MOS inverter, Design of W/L, power dissipation, propagation delay, and noise margin analysis.	Kang : Chapter 5 Pucknell : Chapter 2	12

4	CMOS inverter, static and dynamic characteristics of CMOS inverter, DC Characteristics: NAND and NOR Gates, NAND and NOR transient response, System design using HDL.	Kang : Chapter 7 Uymera : Chapter 10	11
5	Stick diagram, Layout, Fabrication.	Pucknell : Chapter 3 Kang : Chapter 2 (Fabricarion)	6
		Total Number of Lectures	44

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Sung-Mo Kang, Yusuf Leblebici : CMOS Digital Integrated Circuits Analysis and Design",Tata McGraw-Hill Edition 2003
2. Adel S. Sedra, Kenneth C. Smith : Microelectronics Circuits, 5th Ed., Oxford University Press, 2004
3. John P. Uyemura : Introduction to VLSI Circuits and Systems, John Wiley & Sons, , Inc, 2002

Reference Books

1. Neil Weste and David Harris, "CMOS VLSI Design", 4th Ed., Addison Wesley, 2011.
2. Douglas A Pucknell et al, "Basic VLSI Design", 3rd Ed., Prenctice Hall, 2004

POWER ELECTRONICS

(Core Subject)

Course Code:	11B1WEC611	**Semester:**	6th Semester, B. Tech (ECE)
Credits:	4	**Contact Hours:**	L-3, T-1, P-0

Course Objectives

The objectives are to study

1. To understand and acquire knowledge about various power semiconductor devices.
2. To prepare the students to analyze and design different power converter circuits.

Course Outcomes

After studying this course the students would gain enough knowledge

1. Acquire knowledge about fundamental concepts and techniques used in power electronics.
2. Ability to analyze various single phase and three phase power converter circuits and understand their applications.
3. Foster ability to identify basic requirements for power electronics based design application.
4. To develop skills to build, and troubleshoot power electronics circuits.
5. Foster ability to understand the use of power converters in commercial and industrial applications.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Introduction: Concept of Power Electronics, Applications of power electronics, Advantages and disadvantages of power-electronic converters, Power electronic systems, Power semiconductor devices, Types of power electronic converters, Power electronic modules.	Bimbhra : Chapter 1	2
2.	Power semiconductors: The p-n junction, Basic structure of power diodes, Characteristics of power diodes, Power transistors, Power MOSFETS, Insulated gate bipolar transistor, Static induction transistor, MOS controlled thyristor.	Bimbhra : Chapter 2	5
3	Thyristors: Terminal characteristics of thyristors, thyristor turn on methods, Switching characteristics of thyristors, Thyristor gate characteristics, Two-transistor model of a thyristor, Thyristor ratings, Thyristor protection, Improvement of thyristor characteristics, Series and parallel operation of thyristors, Other members of the thyristor family, Gate turn off	Bimbhra : Chapter 4	8

	thyristor, Firing circuits for thyristors, Pulse transformer in firing circuits, Triac firing circuit, Gating circuits for single phase converters, Cosine firing scheme.		
4	Thyristor Commutation: Class A commutation: Load commutation, Class B commutation: Resonant commutation, Class C commutation: Complementary commutation, Class D commutation: Impulse commutation, Class E&F commutation.	Bimbhra : Chapter 5	5
5	Phase Controlled Rectifiers: Principle of phase control, Full wave controlled converters, Single phase full wave converters, Single phase symmetrical and asymmetrical semi converters, Three phase rectifiers and thyristor converters, Performance parameters of three phase full converters, Effect of source impedance on the performance of converters.	Bimbhra : Chapter 6	6
6	Choppers: Principle of chopper operation, Control strategies, Step up choppers, Types of chopper circuits, Steady state time domain analysis of Type A choppers, Thyristor chopper circuits.	Bimbhra : Chapter 7	5
7	Inverters: Single phase voltage source inverters: Operating principle, Force commutated thyristor inverters, Voltage control in single phase inverters, Current Source inverters, Series Inverters, Parallel Inverters.	Bimbhra : Chapter 8	7
8	AC Voltage Controllers: Principle of phase control, Principle of integral cycle control, single phase ac voltage controller with R load and RL load.	Bimbhra : Chapter 9	3
9	Cycloconverters: Principle of cycloconverter operation, step up and step down cycloconverters, Three phase half wave converters, Output voltage equation for a cycloconverter, Load commutated cycloconverter.	Bimbhra : Chapter 10	3
		Total Number of Lectures	44

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. P S Bimbhra : Power Electronics, Khanna Publishers.

Reference Books

1. M. H. Rashid. : Power Electronics – circuits, devices & applications, Pearson Education.

TELECOMMUNICATION NETWORKS LAB

(Core Subject)

Course Code:	10B17EC671	Semester:	6th Semester, B. Tech (ECE)
Credits:	1	Contact Hours:	L-0, T-0,P-2

Course Objectives

The objectives are to make students familiar with fundamentals of networking at the data link layer and especially MAC layer.

Course Outcomes

After studying this course the students would gain enough knowledge to

1. Calculate the network throughput for various different multiple access protocols like ALOHA, CSMA, CSMA/CD etc.
2. Understand the basic concepts of token bus, token ring LAN.

List of Experiments

1. To calculate throughput of ALOHA protocol using LAN trainer and to compare with the theoretical results. Plot throughput vs. load.
2. To calculate throughput of CSMA protocol using LAN trainers and to compare with the theoretical results. Plot throughput vs. load.
3. To calculate throughput of CSMA/CD protocol using LAN trainers and to compare with the theoretical results. Plot throughput vs. load.
4. To calculate the throughput of token bus LAN with the variation of token holding time, delay, BER etc. Plot throughput vs. load.
5. To calculate the throughput of token ring LAN with the variation of token holding time, delay, error etc. Plot throughput vs. load.
6. To calculate the throughput of stop and wait protocol with the variation of delay, packet size etc at zero BER. Plot throughput vs. load.
7. To calculate the throughput of stop and wait protocol with the variation of delay, packet size etc at nonzero BER. Plot throughput vs. load.
8. To calculate the throughput of sliding window protocol with the variation of delay, packet size etc at zero BER. Plot throughput vs. load.
9. To calculate the throughput of sliding window protocol with the variation of delay, packet size etc at nonzero BER. Plot throughput vs. load.

10. Implementation of packet transmission.

Evaluation Scheme

1. Mid Sem. Evaluation	20 Marks
2. End Sem. Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

- B. A. Forouzan: "Data Communications and Networking", Tata McGraw-Hill 4th Edition 2010.
- A. Tanenbaum: "Computer Networks", Pearson Education, 4th Edition.

VLSI LAB

(Core Subject)

Course Code:	10B17EC672	**Semester:**	6th Semester, B. Tech (ECE)
Credits:	1	**Contact Hours:**	L-0, T-0,P-2

Course Objectives

1. To study the constructs, conventions and design capabilities of the Verilog HDL
2. To study gate level , dataflow (RTL), behavioral, and switch level modeling, describes leading logic synthesis methodologies
3. To use the xilinx platform to write test benches and simulate the digital system designs
4. To learn to implement a given algorithm into an FPGA breaking it into modules and sub modules

Course Learning Outcomes

After studying this course the students shall be able to:

1. Apply the techniques of design, simulation and synthesis of digital circuits to design FPGA based systems or/and ASICs using Xilinx design tools
2. Explain and design the test benches for verification of the given IP core or HDL based design.
3. Able to explain the System Modeling with Tasks and Functions
4. Design digital circuits for implementing a signal processing algorithm using different verilog modelling styles.

List of Experiments

1. Learn how to use of XILINX ISE simulator by writing the Verilog code to simulate a half adder; where a, b are 1-bit input
2. Write data flow Verilog HDL model for Half Adder using different modelling technique
3. Write data flow Verilog HDL model for Full Adder
4. Using strutural modeling of Verilog HDL perform the following:
   - Half adder with proper test stimulus.
   - Full adder (using half adder module of part 1) with proper test stimulus
5. Write down Verilog HDL code of the following
   - Data flow model of 2x1 Multiplexer with proper test stimulus.
   - Structural model of 2x1 Multiplexer with proper test stimulus.
6. Write the hardware description of a 4:1 multiplexer
   - Using behavioural modelling
   - Using structural modelling
   - Using 2:1 multiplexer

7. Write down Verilog HDL code of 2x1 Multiplexer and 4x1 Multiplexer using **if-else** statement, **case** statement and **ternary** operator.
8. Write the hardware description of a 2:1 multiplexer and 4:1 multiplexer , each input and output of this multiplexer is of 4-bit.

```
module mux (a,b,sel,result);
input [3:0] a,b;
input sel;
output [3:0] result;
.....
endmodule
```

9. Write the hardware description of a 4-bit adder/Subtractor
10. Write data flow Verilog HDL model for Encoder/ Decoder using any modelling technique
11. Simulate the Verilog HDL code for the following
    - D-Latch using proper test stimulus.
    - D-flip flop using proper test stimulus.
12. Write the Verilog HDL code for a JK Flip flop, and its test-bench.
13. Write the hardware description of a 8-bit register with shift left and shift right modes of operation
14. Write the Verilog HDL code of a 4-bit PRBS (pseudo-random Binary sequene) generator using a linear feed-back shift register and test it. Choose your own polynomial for the generator.

Evaluation Scheme

1. Mid Sem Evaluation	20 Marks
2. End Sem Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

1. John P. Uyemura: Introduction to VLSI Circuits and Systems, John Wiley & Sons, , Inc, 2002
2. Samir Palnitkar, “Verilog HDL”, Pearson Education (2nd edition)

POWER ELECTRONICS LAB

(Core Subject)

Course Code:	11B1WEC671	Semester:	6th Semester, B. Tech (ECE)
Credits:	1	Contact Hours:	L-0, T-0,P-2

Course Objectives

1. To know the behavior of Power semiconductor devices and compare their performances.
2. To know how to synthesize a power converter using power electronics equipment.

Course Outcomes

After the successful completion of the course, student should be able to:

1. Analyze and test the power semiconductor devices and their applications.
2. Compare and contrast various power semiconductor devices according to their applications.
3. Have confidence in dealing with high-power equipments and upgrade their performance.
4. Use the knowledge acquired through this lab to design circuits which are useful in day-day life.

List of Experiments

1. To study V-I characteristics of silicon controlled rectifier (SCR) and determine the break over voltage, on state resistance, holding current and latching current.
2. To study and verify V-I characteristics of DIAC.
3. To study V-I characteristics of TRIAC in both directions and determine the break over voltage, on state resistance, holding current and latching current.
4. To verify the V-I Characteristic of Unijunction Transistor (UJT)
5. Design of an oscillator circuit using UnijunctionTtransistor (UJT)
6. To design a circuit for AC voltage control by using SCR and observe the effect of varying firing angle on average output voltage.
7. To design a circuit for illumination control of incandescent lamp using thyristor.
8. To study the performance of half wave controlled rectifier with R and RL load.
9. To design a fixed DC to variable DC convertor.
10. Mini Project

Evaluation Scheme

1. Mid Sem Evaluation	20 Marks
2. End Sem Evaluation	20 Marks
3. Attendance	15 Marks
4. Class response	30 Marks
5. File	15 Marks
Total Marks	**100 Marks**

Text Books

1. Ned Mohan, Tore Undeland, and William Robbins, Power Electronics: Converters, Applications, and Design, 3rd edition, Wiley India.

2. Rashid Muhammad H., Power Electronics Circuits, Devices, and Applications, 3rd edition, Prentice hall of India.

MOBILE COMMUNICATION

(Elective Subject)

Course Code:	10B1WEC731	Semester:	7th Semester, B. Tech (ECE)
Credits:	3	Contact Hours:	L-3, T-0,P-0

Course Objectives

1. To make students familier with fundamentals of mobile communication systems
2. To choose system (TDMA/FDMA/CDMA) according to the complexity, installation cost, speed of transmission, channel properties etc.
3. To identify the requirements of mobile communication as compared to static communication
4. To identify the limitations of 2G and 2.5G wireless mobile communication and use design of 3G and beyond mobile communication systems
5. As a prerequisite for the course in Wireless LANs

Course Outcomes

1. To make students familiar with various generations of mobile communications
2. To understand the concept of cellular communication
3. To understand the basics of wireless communication
4. Knowledge of GSM mobile communication standard, its architecture, logical channels, advantages and limitations.
5. Knowledge of IS-95 CDMA mobile communication standard, its architecture, logical channels, advantages and limitations.
6. Knowledge of 3G mobile standards and their comparison with 2G technologies.
7. To under multicarrier communication systems.
8. To differentiate various Wireless LANs.

Course Contents

Unit	Topics	**References** (chapter number, page no. etc)	Lectures
1.	Evolution of mobile communication systems. 1G, 2G, 2.5G & 3G systems. IMT2000, FDD, TDD, FDMA, TDMA, CDMA, SDMA. Radio frequency spectrum and communication technology. Block diagram of mobile communication system. Problems of mobile communication: spectrum, propagation. Near far problem.	T S Rapaport: Pages 1-39, Jochen Schiller: Pages 7-15	4
2.	The cellular Concept – Introduction, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Trucking and grade of services, Improving coverage & capacity in cellular system	T S Rapaport: Pages 57-93	6
3.	GSM standards and architecture, GSM Radio aspects, typical call flow sequences in GSM, security aspects. GPRS	Jochen Schiller: Pages 96- 120 Raymond Steel: 65-147	8

4.	CDMA standards**:** Spread spectrum, direct sequence and frequency hop spread spectrum, IS-95 CDMA architecture, forward link and reverse link,cdma2000	Raymond Steel: 205-281 T S Rapaport: Pages 569- 582	8
5.	WCDMA: Frame structure, UTRA FDD, UTRA TDD, UMTS, architecture	Jochen Schiller: 136-155	4
6.	Introduction to WLAN: Infrastructure based and adhoc networks, IEEE 802.11, IEEE 802.11a, IEEE 802.11b. Bluetooth, WiMAX	Jochen Schiller: 201-238, 269-290	8
7.	4G Systems: Introduction to OFDM and MC-CDMA	L. Hanzo, T. Keller: 1-18, 203-217	6
		Total Number of Lectures	**44**

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1) T. S. Rappaport, Wireless Communications, PHI, 2002.

2) Mobile Communication, Jochen Schiller, Pearson.

Reference Books

1) WilliamC.Y.Lee,MobileCellularTelecommunications-Analog&DigitalSystems, Mc.Graw Hill,1995

Robotic Systems and Control

(Elective Subject)

Course Code:	17B1WEC733	**Semester:**	7th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

The objectives are to study

1. The Robotics' chief objective has always been associated with working for new and updated technologies, for example embedded systems, microcontrollers and VLSI.
2. To use the robotic system for logic building and programming.
3. To use the robotic kits to do any given engineering task which may have not been taught in class.

Course Outcomes

After studying this course the students would gain enough knowledge

1. Students will be equipped with the automation and brief history of robot and applications.
2. Students will be equipped with the principles of various sensors, actuators and their applications in robots.
3. Be able to analyze any physical system using mathematical model.
4. Be able to do the path planning on robotic systems using various control strategies.
5. Students will be equipped with the simulation and hands on robotic kits.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Introduction to Robotics: Introduction – brief history, types, classification and usage, Science and Technology of robots, textbooks and research journals, introduction to simulation environment.	Spong : Chapter 1	3
2.	Elements of Robots: Joints, links, actuators, and sensors: Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.	Spong : Chapter 1, 2 eLSI project material	10

3	Robot Arm Kinematics and Dynamics: Forward kinematics, inverse kinematics, Lagrange formulation of dynamics.	Spong : Chapter 3, 4, 6	8
4	Motion Planning and Control: Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators.	Spong : Chapter 7, 8, 9	8
5	Modeling and Control of Flexible Robot Manipulators: Models of flexible links and joints, Kinematic modeling of multi-link flexible robots, Dynamics and control of flexible link manipulators, Numerical simulations results.	Craig: Chapter 5 NPTEL lectures	6
6	Robot Programming: MATLAB and other simulation platforms, Hands on experiment on robotic kits, working and implementing various Ad-on modules.	eLSI project material	6
		Total Number of Lectures	41

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Spong and Vidyasagar, “Robot Dynamics and Control”, John Wiley and Sons.
2. J. J. Craig, “Introduction to Robotics- Mechanics and Control”, Pearson.
3. Sciavicco and Siciliano, “Modeling and Control of Robot Manipulators”, McGraw Hill International Edition.

Reference Books/ Other resources

1. NPTEL Lectures: http://nptel.ac.in/courses/112101099/
2. Material provided by IIT Bomaby under eLSI project:

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY WAKNAGHAT, SOLAN (H.P.)

NAME OF DEPARTMENT: **Electronics and Communication Engineering**

1. Subject Code: **18B1WEC734** Course Title: **MEDICAL IMAGE PROCESSING (Elective Course)**

2. Contact Hours: **L: 3** **T: 0** **P: 0**

3. Credits: **3** **4.** Semester **7th Semester, B.Tech.(ECE)**

5. Course Objectives

Introducing various medical imaging modalities and understanding the requirement and development of different blocks of computer aided diagnosis (CAD) for medical images.

6. Course Outcomes

Students will be able to

Course Outcomes (18B1WEC734: MEDICAL IMAGE PROCESSING)		Level of Attainment
CO-1	Able to understand different types of medical imaging modalities and would be able to differentiate them with respect to their advantages and limitations.	Familiarity
CO-2	Acquire an ability to analyze and process medical images.	Usage
CO-3	Understand different feature extraction techniques and classifiers used for image classification.	Usage
CO-4	Understand the role of computer aided diagnosis (CAD) for medical images.	Assessment

7. Course Contents

S. No.	Contents	Contact Hours
1.	Image formation & representation – Image formation; Sampling and quantization; binary image; 3-D imaging; image file formats. Image enhancement & restoration: Spatial and histogram based enhancement; Noise modeling, Image restoration. Image transformation – Fourier transforms (1D, 2D, DFT, Matrix form representation, FFT).	8

2.	Edge Detection: Gradient based edge detection (Robert's operator, Sobel operator, Prewitt operator, Laplacian operator); Canny edge detector. Image Segmentation: Intensity thresholding based image segmentation; Region growing and region splitting algorithm; watershed segmentation.	8
3.	Working principle, application and limitation of Computed tomography (CT), X-ray, Magnetic resonance imaging (MRI) , Ultrasound (US) imaging, and Positron emission tomography (PET). Computer aided diagnosis (CAD): Flowchart and its requirement.	6
4.	Image Texture: Definition and its importance in CAD, Texture in biomedical images. Types of texture parameters: Statistical analysis of texture (First order statistics and Second order statistics), Grey level co-occurrence matrix (GLCM), grey-level run length matrix (GLRLM).	8
5.	Pattern classification: Supervised pattern classification, and Unsupervised pattern classification. Neural Network (NN): Single layer perceptron, learning rate, Activation functions, single layer NN, Deep NN (with large number of hidden layers), Measures of diagnostic accuracy, Reliability of features classifiers and decisions. Introduction to Support Vector Machine (SVM).	6
6.	CAD for diagnosing Liver ultrasound (US) images; Pre-processing , Segmentation, Feature extraction, and Classification of liver US images.	6
	Total	**42**

8. Evaluation Scheme

Test 1 : 15 marks (1 Hour)
Test 2 : 25 marks (1.5 Hours)
Test 3 : 35 marks (2 Hours)
Internal Assessment: 25 marks

- Class performance, Tutorials & Assignments : 10 marks
- Quizzes : 10 marks
- Attendance : 5 marks

Total : 100 marks

9. Text Books

S. No.	Name of Books/Authors	Year of Publication
1.	Rangaraj M. Rangayyan, "Biomedical Image Analysis", 1st Ed., CRC Press, New York.	2004
2	Chris Solomon, Toby Breckon:, "Fundamental of Digital Image Processing", 1st Ed., John Wiley & Sons.	2011

10. Reference Books

S. No	Name of Books/Authors	Year of Publication

1.	RC Gonzalez, RE Woods, "Digital Image Processing", 3rd Ed., Pearson Publisher.	2008
2.	Kayvan Najarian, Robert Splinter, "Biomedical Signal and Image Processing" 2nd Ed., CRC Press.	2012
3	Tamal Bose, "Digital Signal and Image Processing", 1st Ed., John Wiley & Sons.	2003

11. Web Resources

1	**NPTEL ONLINE COURSES** Digital Image Processing	http://www.nptelvideos.in/2012/12/digital-image-processing.html (Prof P.K. Biswas, IIT Kharagpur)

CMOS ANALOG CIRCUIT DESIGN

(Elective Subject)

Course Code:	13B1WEC731	**Semester:**	7th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

The objectives are to study

1. Differential Amplifier
2. Operational amplifier
3. Applications of operational amplifier
4. High gain amplifier architecture
5. Two stage CMOS operational amplifier

Course Outcomes

After studying this course the students would gain enough knowledge

1. To be aware about the designing of differential amplifier
2. configurations, equivalent circuit, parameters of an operational amplifier
3. regarding various applications of op-amp and compensation technique.
4. what are current amplifiers, output amplifiers and difference between voltage and current amplifiers
5. design of two stage CMOS operational amplifier and its applications.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures

1.	Differential Amplifier, Differential amplifier circuit configurations, DIBO, DIUO, SIBO, SIUO, FET Differential Amplifier, Constant current bias bias, current mirror, cascaded differential amplifier, level translator, cascode configuration, op-amp symbol, parameters, equivalent circuit of an op-amp, configurations,	Ramakant A. Gayakwad, Chapter 1-3	10
2.	Block diagram of feedback, voltage series feedback, voltage shunt feedback, differential amplifiers, compensating networks, frequency response of internally compensated op-amps, frequency response of non compensated op-amps, high frequency op-amp equivalent circuit, closed loop frequency response, slew rate.	Ramakant A. Gayakwad, Chapter 4-6	6
3	DC and AC amplifiers, peaking amplifiers, summing, scaling, averaging amplifiers, voltage to current converter, current to voltage	Ramakant A. Gayakwad, Chapter 7-10	8

	converter, integrator, differentiator, half wave circuit, full wave circuit, logarithmic amplifier, antilogarithmic amplifier, filters, oscillators, comparators, Schmitt trigger, voltage to frequency and frequency to voltage converter, A-D and D-A converter, clippers, clampers, switched capacitors, PLL		
4	Differential amplifiers, cascode amplifiers, current amplifiers, output amplifiers, high gain amplifier architectures.	Philip E. Allen, Douglas R. Holberg, Chapter 4-5	12
5	Design of CMOS op-amps, compensation, Design of two- stage op-amps, cascode op-amps, Buffered op-amps, high speed/ frequency op-amps. Differential op-amps, low voltage op-amps, low noise op-amps, high speed comparators	Philip E. Allen, Douglas R. Holberg, Chapter 6-7, Chapter 8	8
		Total Number of Lectures	44

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Ramakant A. Gayakwad, “Op-amps and linear integrated circuits”, PHI, 3rd edition.
2. Philip E. Allen, Douglas R. Holberg, “CMOS Analog circuit design”, Oxford, 2nd edition.

Reference Books

1. K. Lal Kishore, “Operational Amplifiers and Linear integrated circuits”, Pearson Education Asia, 2nd edition.
2. Adel S. Sedra, K. C. Smith, “Microelectronics Circuits”, Oxford 5th edition International Version.

FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

(Elective Subject)

Course Code:	10B1WEC734	**Semester:**	7th Semester, B.Tech. (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

1. Describe and explain basic principles of digital image processing.
2. Design and implement algorithms that perform basic image processing (e.g. noise removal and image enhancement).
3. Design and implement algorithms for advanced image analysis (e.g. image compression, image segmentation).
4. Assess the performance of image processing algorithms and systems.

Course Outcomes

This course provides the knowledge of analog and digital communication system analysis and design. After study through lectures and assignments, students will be able to

1. Analyze general terminology of digital image processing.
2. Examine various types of images, intensity transformations and spatial filtering.
3. Develop Fourier transform for image processing in frequency domain.
4. Evaluate the methodologies for image segmentation, restoration etc.
5. Implement image process and analysis algorithms.
6. Apply image processing algorithms in practical applications.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Digital Image Fundamentals: Fundamental steps in DIP, Components of digital image processing, elements of visual perception, Structure of the human eye, Image formation in the eye, Brightness adaptation and discrimination, light, Image sensing and acquisition, image formation model, definition and some properties of two dimensional system, Discrete 2D convolution, 2D discrete Fourier transform and its properties, optical and modulation transfer function, Spectral density function. Sampling and quantization of images, Two dimensional sampling theory, representation of digital image, Spatial and gray level resolution, zooming and shrinking, some basic relationships between pixels.	Gonzalez and Woods Chapter – 1 Pg. 1-29 Chapter – 2 Pg. 34-70 Chapter – 4 Pg. 149-166	7

2.	Image Enhancement in the Spatial Domain: Gray Level Transformations, Piecewise linear transformation, Histogram Processing, Enhancement Using Arithmetic/Logic Operations. Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filters, Use of first order and second order derivative in enhancement.	Gonzalez and Woods Chapter – 3 Pg. 76-130	7
3.	Image Enhancement in the Frequency Domain: Two dimensional Fourier Transform, properties of frequency domain, correspondence between filtering in spatial and frequency domain, Smoothing and Sharpening frequency domain filters, Homomorphic Filtering.	Gonzalez and Woods Chapter – 4 Pg. 148-193	7
4.	Image Restoration: Model of the Image Degradation/Restoration Process, Noise Models, Noise reduction in spatial domain and frequency domain, Inverse filtering, Wiener filtering.	Gonzalez and Woods Chapter – 5 Pg. 221 - 261	7
5.	Image Compression: Fundamentals of Image Compression, Image compression models, concepts of Information Theory, Fundamental coding theorems, Estimation of entropy, Variable length coding, Huffman coding, Near optimal variable length coding, Near optimal variable length coding, Arithmetic coding, constant area coding, run length coding, image compression standards (JPEG, JPEG2000).	Gonzalez and Woods Chapter – 8 Pg. 411- 456	7
6.	Image Segmentation: Detection of Discontinuities (point, line edge), Edge Linking and Boundary Detection, Thresholding, Basic global Thresholding, Adaptive Thresholding, Region-Based Segmentation, region growing, splitting and merging.	Gonzalez and Woods Chapter-10 Pg. 568-615	6
		Total Number of Lectures	**41**

Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. R.C.Gonzalas and R.E.Woods, Digital Image Processing, Prentice Hall, 3rd Ed.

Reference Books

1. A.K.Jain, Fundamentals of Digital Image Processing, Prentice Hall.
2. S.Sridhar, Digital Image Processing, Oxford University Press.

DIGITAL SYSTEM DESIGN

(Elective Subject)

Course Code:	12B1WEC732	**Semester:**	7th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

The objectives are to study

1. To design digital circuits based on the required application
2. It offers a profound understanding of the design of complex digital circuits and their implementation for real time applications.

Course Outcomes

After studying this course the students would gain enough knowledge

1. To use state machine diagrams to design finite state machines using various types of flip-flops and combinational circuits with prescribed functionality.
2. Design state machines to control complex systems.
3. Define and describe digital design flows for system design and recognize the trade-offs.
4. Understand and design System controllers.
5. The ability to identify and prevent various races and hazards and timing problems in a digital design.
6. Write synthesizable VHDL program.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Introduction to Digital Design Concepts, Review of digital design fundamentals, minimization and design of combinational circuits, sequential machine fundamentals: the need, concept of memory, Flip flops, sequential machine operations, classifications.	Text Book 1: Chapter 1-5	4
2.	Design of Synchronous Sequential Circuits-Sequential circuits, Finite state model – Basic definition, capabilities and limitation of finite state machines, state equivalence & machine minimization, simplification of incompletely specified machines, Extraction of maximal compatibles, synthesis & analysis of synchronous sequential circuits. Introduction to Multi-Input System controller design: system controllers, frequency and time consideration, MDS diagram generation, CPLD and FPGA	Text Book 1: Chapter 6	12

	level custom design.		
3	Design of Asynchronous Sequential Circuits - Introduction to asynchronous circuits, timing diagram, state diagram & flow tables, types of asynchronous circuits, fundamental mode circuits, pulse mode circuits, state assignment in asynchronous sequential circuits, Synthesis and analysis, ASM charts: Representation of sequential circuits using ASM charts, synthesis of output and next state functions, Data path control path partition-based design	Text Book 1: Chapter8	12
4	Hazards and Races - Introduction, gate delays, generation of spikes, production of static hazards in combinational networks, elimination of static hazards, design of hazard free combinational networks, hazard free asynchronous circuit design, dynamic hazards, essential hazards, Races and Cycles.	Text Book 3: Chapter 10	8
5	VHDL/ Verilog HDL - Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, System Tasks, Programming Language Interface (PLI), Module, Simulation and Synthesis Tools, Test Benches. Language constructs and conventions: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Memory, Operators, System Tasks, Exercises.	Text Book 4: Chapter 1-3	6
		Total Number of Lectures	42

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. John M Yarbrough : Digital Logic Applications and Design, 2nd Edition, Thomson Educaion

2. W. I. Fletcher :An Engineering approach to Digital Design , PHI
3. M.Morris Mano : Digital Design, 3rd edition, Pearson Education, 2007.
4. Michael D. Ciletti: Advanced Digital Design with Verilog HDL, PHI, 2005.

Reference Books

1. Digital Systems Design using VHDL – Charles H Roth, CENGAGE Learning.
2. Switching and Finite Automata Theory by ZVI Kohavi, TMH

Cognitive Radio Networks

(Elective Subject)

Course Code:	**14B1WEC733**	**Semester:**	**7th Sem. B. Tech (ECE)**
Credits:	**3**	**Contact Hours:**	**L-3, T-0,P-0**

Course objectives

1. To understand the spectrum scarcity problem and how cognitive radio deals with this problem.
2. The contribution of cognitive radio systems in wireless networks and its architectures that enable the development of the cognitive radio network (both centralized and distributed).
3. Technologies to allow an efficient use of TVWS for radio communications.
4. Discussion about various cognitive radio standards.
5. Understanding the various research challenges for deployment of cognitive radio network.
6. Update about current research scenario in this field

Course outcomes

Upon successful completion of this course the students will have developed following skills/abilities

1. Fundamental issues regarding dynamic spectrum access and radio-resource management.
2. Emerging issues in cognitive radio network.
3. Different spectrum sharing models.
4. Efficient sharing of the unutilized spectrum among cognitive and licensed users.
5. Interference avoidance at licensed user due to cognitive user's transmission.

Unit	Topics	Lectures
1.	**Introduction to Cognitive Radio:** Spectrum scarcity, Spectrum white space, Fixed spectrum allocation, Software defined radio (SDR), Limitations of SDR, Evolution of cognitive radio, Dynamic spectrum access**,** Introduction to cognitive radio concept, Cognitive cycle, Functions of cognitive radio; spectrum sensing, spectrum management, spectrum mobility, Cognitive radio architecture, Interference temperature and its models.	**8**
2.	**Spectrum Sensing and challenges in cognitive radio network:** Hypothesis model for spectrum sensing, Types of spectrum sensing; Non-cooperative sensing, Cooperative sensing, Interference-based sensing, Matched filter detection, Energy detection, Cyclostationary feature detection, advantages and disadvantages of various spectrum	11

	sensing techniques, False alarm, Miss detection, Optimal sensing framework for infrastructure based cognitive radio network. Research challenges in spectrum sensing, spectrum management and spectrum mobility, potential applications of cognitive radio, IEEE 802.22 for WRANs.	
3.	**Spectrum sharing and management:** Dynamic spectrum Access (DSA): models and architectures, Opportunistic spectrum access (OSA), Antenna Systems, MIMO systems, Smart antenna and beamforming. SDR architecture, Software tunable analog radio components, Reconfigurable digital radio technologies.	**8**
4.	**Cross layer adaptation and security in cognitive radio:** Why we need cross-layer design, adaptation and optimization, Cognitive radio cross layer design, security challenges in cognitive radio. **OFDM for cognitive radio:** OFDM based cognitive radio, Why OFDM is a good fit for Cognitive radio, Challenges to cognitive OFDM systems, Multiband OFDM, A step toward cognitive-OFDM: standards and technologies.	**9**
5.	**Cognitive radio regulation and standardization:** regulatory issues and new spectrum management regimes, spectrum planning, Spectrum authorization, Standards and international activities. **UWB cognitive radio:** Introduction, Fundamentals of impulse radio Ultra Wideband, Cognitive radio requirements versus IR-UWB, Merging impulse radio with cognitive radio.	**6**
	Total Number of Lectures	**42**

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Recommended Reading

1.	Dynamic Spectrum Access and Spectrum Management in Cognitive Radio Networks, Ekram Hossain, Dusit Niyato, and Zhu Han, Cambridge University Press, 2009.
2.	Cognitive Radio Networks, Yang Xiao and Fei Hu, CRC Press.
3.	Cognitive Radio Technology, Bruce Fette, Elsevier, 2006.
4.	Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Huseyin Arslan, Springer, 2007.
5.	Essentials of Cognitive Radio, Linda E. Doyle, Cambridge University Press, 2009.

NON–LINEAR AND DIGITAL CONTROL SYSTEMS
(Elective Course)

Course Code:	14B1WEC734	**Semester:**	7th Semester
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives
The objectives are to study

1. The ability to understand the characteristics of various types of nonlinearities present in physical systems.
2. The ability to carry out the stability analysis of non-linear control systems.
3. The ability to carry out the analysis and design of digital control systems.
4. The ability to design compensators for digital control system to achieve desired specifications.
5. The ability to represent digital control systems using state space models.
6. The ability to analyze the effect sampling on stability, controllability and observability.
7. The ability to design digital controllers for industrial applications.

Course Outcomes
After studying this course the students would gain enough knowledge

1. The ability to understand the characteristics of various types of nonlinearities present in physical systems.
2. The ability to carry out the stability analysis of non-linear control systems.
3. The ability to carry out the analysis and design of digital control systems.
4. The ability to design compensators for digital control system to achieve desired specifications.
5. The ability to represent digital control systems using state space models.
6. The ability to analyze the effect sampling on stability, controllability and observability.
7. The ability to design digital controllers for industrial applications.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	**Non-Linear Systems** Introduction to nonlinear systems, mathematical modeling, common physical nonlinearities in control systems: saturation, dead zone, backlash, Columb friction and on-off nonlinearity, concept of linearization of non-linear mathematical models, multivalued responses, describing function fundamentals, derivation of describing functions of nonlinearities and their applications to system analysis, unique characteristics of non-linear systems, jump resonance and limit cycle behavior, nonlinear state variable equations, nonlinear state variable models.	Text4/15	7
2.	**Stability Analysis of Non-Linear Systems**	Text 1/8, Text	10

	Stability analysis by describing function method, Phase plane analysis, types of phase portraits, singular points, analytical method, method of isoclines. Lyapunov functions for linear and non-linear systems, statement of various stability terms in sense of Lyapunov, stability analysis by Lyapunov's first and second methods, Methods of constructing Lyapunov's functions for non-linear systems, Krasovskii's and variable gradient methods, Popouv's stability theorem for non-linear systems.	1/10, Text 4/13, Text 4/15	
3	**Design of Digital Control System** Configuration of basic digital control scheme, sampleand- hold elements, Mapping from s-Plane to z-plane, various representations of sampled data feed-back systems, Pulse transfer function, Stability and controller design uses z transform and difference equations, Jury stability criterion, bilinear transformation, z-domain specifications of control system design, Root locus of digital control systems, design of digital controllers, design of digital compensators.	Text 1/3, Text 1/4	10
4	**State Variable Analysis of Digital Control Systems** State descriptors for digital processors, conversion of state variable models to transfer functions, conversion of transfer functions to canonical state variable models, state description of sampled continuous time plants, state description of systems with dead-time, solution of state difference equations, controllability and observability, effect of sampling on stability, controllability and observability.	Text 1/6	8
5	**Applications of Digital Control Systems** Digital temperature control system, Digital position control system, Building blocks of a PLC, Ladder diagram programming instructions, case studies of automatic control applications.	Text 1/3	9
		Total Number of Lectures	42

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Text 1 Gopal M., Digital Control and State Variable Methods TMH Publishers
2. Text 2 Ogata, K., Discrete-time Control Systems, Pearson Education.
3. Text 3 Kuo B.C, Digital Control Systems, Wiley Publications.
4. Text 4 Nagrath I.J, Gopal M, Control System Engineering, New age International.

Reference Books

1. Hassan K. Khalil, Non Linear Systems, 3rd Edition, Prentice Hall.
2. Horacio J. Marquez, Nonlinear Control Systems Analysis and Design, Wiley Publications.

EMBEDDED SYSTEM DESIGN

(Elective for B Tech)

Course Code:	14B1WEC735	**Semester:**	7th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

1. To have knowledge about the basic working of a microcontroller system and its programming in assembly language.
2. To provide experience to integrate hardware and software for microcontroller applications systems.

Course Outcomes

To acquire knowledge about microcontrollers embedded processors and their applications.

1. Foster ability to understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.
2. Foster ability to write the programs for microcontroller.
3. Foster ability to understand the role of embedded systems in industry.
4. Foster ability to understand the design concept of embedded systems.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	Introduction to embedded systems: Introduction to embedded systems, Difference between Embedded and General-Purpose Computing. Embedded microcontrollers and their architectures. Embedded system components.	Text Book #1 Chapter No. 1 Chapter No. 2	4
2.	8051 Microcontroller: 8051 Architecture, Pin configuration, Reset and system clock, timers and interrupts, Special function registers, Program/ data memory, addressing modes. Introduction to 8051 assembly language programming, Arithmetic instructions, Logic and Compare instructions, Branch and conditional instructions, Single bit instruction programming.	Text Book # 2 Chapter No. 2 Chapter No. 3 -8	9
3	8051 Interrupts: Introduction to 8051 interrupts, programming of timer interrupts, programming external hardware interrupts, programming the serial communication interrupts, interrupt priority in the 8051.	Text Book # 2 Chapter No. 9 Chapter No. 11	4
4	Serial Communication: Basics of serial communication, 8051 connection to RS 232, 8051 serial communications Programming.	Text Book # 2 Chapter No. 10	3

5	Real World Interfacing: Interfacing of A/D and D/A converter, interfacing stepper motor, interfacing of LCD, interfacing of sensors, interfacing keyboard.	Text Book # 2 Chapter No. 12	5
6	PIC18F Family: The Architecture of PIC family of devices, PIC18F instructions and assembly language, PIC18F programming model, instruction set, instruction format. Data copy, arithmetic, branch, logical, bit manipulation and multiply divide operations. Stacks, subroutines and macros.	Text Book # 3 Chapter No. 3-7	8
7	Interrupts and Timers of PIC: Concepts of Interrupts and Timers. Interrupts and their implementation in PIC18. The PIC18 timers. The CCP. Use of Interrupts in applications.	Text Book # 3 Chapter No. 10 Chapter No. 12	5
8	I/O Port and Interfacing: Concepts of I/O interfacing and PIC18 I/O ports. Interfacing output and input peripherals.	Text Book # 3 Chapter No. 13 Chapter No. 14	4
		Total Number of Lectures	**42**

Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. Embedded systems design by Steve Heath, Newnes.
2. The 8051 Microcontroller and embedded systems by Muhammad Ali Mazidi, PHI.
3. PIC microcontroller and embedded systems by Muhammad Ali Mazidi, PHI.

Reference Books

1. The 8051 microcontroller by Kenneth J. Ayala, Cengage Learning.

Design of Dependable Systems

COURSE CODE: 18B1WEC732

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-3

Pre-requisite: Graph Theory and Computer Communication Network

Course Objectives:

1. Incorporate the concepts of dependability in the design of critical systems.
2. Propose an architectural framework for the design of systems based on information and communication technologies.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Introduction to Dependability attributes.	Familiarity
CO-2	Explanation of dependability Analysis Technique.	Familiarity
CO-3	Methodology for dependability modeling and analysis.	Usage
CO-4	Design technique used for the dependable systems.	Usage
CO-3	Evaluation of survivability of networks, dependability evaluation of networks.	Assessment

Course Contents:

Unit	Contents	Lectures required
1	**Introduction to Dependability attributes:** availability, reliability, safety, QoS; SLA.	5
2	**Maximum bipartite matching. Analysis approach of Dependability:** The failure process, failure semantics, fault handling and maintenance, Failure rate, Probability distributions, Series/Parallel Systems, Markov Models.	6
3	**Dependability modeling:** Block diagrams and state diagrams - Discrete and continuous time Markov models, Fault Trees	8

	FMEA/FMECA/FMEDA Fault Injection. Modeling of software failure, prediction of software failure rates, impact of software failures on systems behavior.	
4	**Design of Dependability:** Fault tolerance, types of redundancy, design principles and mechanisms, the properties of designs; Fault Detection, Tolerance and Recovery, Lifetime improvement.	**8**
5	**Prediction of hardware failure rates:** software/hardware and architectural approaches space, information and time redundancy Design for Testability Data/Model-driven approaches Diagnosis.	**7**
6	Internet QoS, Survivability of networks, dependability evaluation of networks taking the traffic carrying (QoS) requirements into account. QoS guarantee analysis. Some applications of dependability in IT related services.	**8**
Total lectures		**42**

Suggested Text Book(s):

1. Ajit Kumar Verma and Srividya Ajit, Dependability of Networked Computer-based Systems, Springer Series in Reliability Engineering, 2013.
2. J.C. Geffroy, G. Motet,Design of Dependable Computing Systems, Springer-Science-Business Media B.V., 2002.
3. J.C. Laprie, Dependability: Basic Concepts and Terminology, Springer-Verlag, 1992.

Suggested Reference Book(s):

1. Dhiraj K. Pradhan, Fault-tolerant computer system design, 1st ed., Prentice-Hall, 1996.
2. M.L. Shooman, Reliability of Computer Systems and Networks: Fault Tolerance, Analysis, and Design, 1st ed., Wiley, 2002.
3. Krishna B. Misra, Handbook of Performability Engineering, Springer, 1st ed. 2008.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

RF and Microwave

COURSE CODE:15B1WEC732

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

Pre-requisite: Basic Knowledge of Electromagnetic Engineering

Course Objectives:

3. To lay strong foundations in RF and microwave engineering.
4. To apply the theoretical knowledge acquired in the design of different components in microwave systems.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To understand the basics of RF and microwave components	Familiarity
CO-2	To understand the parameters involved in microwave receiver	Familiarity
CO-3	To understand the parameters involved in microwave transmitter	Familiarity
CO-4	To know about the design of RF filters	Usage
CO-5	To understand active microwave components and their use in different applications	Usage

Course Contents:

Unit	Contents	Lectures required
1	**Review of Waves and Transmission Lines:**Wave Propagation, Transmission Line Equations, Reflection, Transmission, and impedance for a Terminated Transmission Line, Voltage Standing-Wave Ratio, Decibels, insertion Loss, Return Loss, Smith Charts, S-Parameters, Impedance Matching Networks	8
2	**Receiver System Parameters:**Typical Receivers, System Considerations, Natural Sources of Receiver Noise, receiver Noise Figure and Equivalent Noise Temperature, Compression Points, Minimum detectable Signal and Dynamic Range, Third-Order Intercept Point and Intermodulation, spurious Responses, Spurious-Free Dynamic Range	8

3	**Transmitter and Oscillator Systems:** Transmitter Parameters, Transmitter Noise, Frequency Stability and Spurious Signals, Frequency Tuning, Output Power, and Efficiency,Intermodulation, Crystal Reference Oscillators, Phase-Locked Oscillators, frequency Synthesizers	**6**
4	**Design of RF filters:**Periodic Structures, Filter Design by the Image Parameter Method, Filter Design by the Insertion Loss Method, Characterization by Power Loss Ratio Filter transformations, Filter Implementation, Stepped-Impedance Low-Pass	**8**
5	**Active RF and Microwave devices:**RF diodes, BJT, FET, microwave amplifier design, oscillators, frequency multipliers and mixers.	**8**
6	**Wireless Communication Systems:** Friis Transmission Equation, Space Loss, Link Equation and Link budget, Effective Isotropic Radiated Power and G/T Parameters, Radio/Microwave Links, Satellite Communication Systems, Mobile Communication Systems and Wireless cellular phones, Personal Communication Systems	**4**
Total lectures		**42**

Suggested Text Book(s):

4. Kai Chang,RF and Microwave Wireless Systems,John Wiley & Sons,2000.
5. Pozar, David M. "Microwave engineering" John Wiley & Sons,2009.

Suggested Reference Book(s):

4. R.E.Collin, "Foundations for microwave Engineering", 2nd edition,Tata Mc Graw Hill,1992.
5. Annapurna Das,Sisir.K.Das,"MicrowaveEngineering",Tata McGraw Hill, 2000.

Other useful resource(s):

1. Link to NPTEL course contents:https://nptel.ac.in/courses/117101119/
2. https://nptel.ac.in/courses/117105138/

2.Link to topics related tocourse:

i. https://nptel.ac.in/courses/117105138/ 1 to 20
ii. https://nptel.ac.in/courses/117101119/ 1 to 16

EvaluationScheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus

4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2) -10 Attendance - 5

TIME FREQUENCY ANALYSIS AND ITS APPLICATIONS

(Elective Subject)

Course Code:	**17B1WEC731**	**Semester:**	**7th Semester, B. Tech (ECE)**
Credits:	**3**	**Contact Hours:**	**L-3, T-0,P-0**

Pre-requisites: Signal & System, Digital Signal Processing

Course Objectives:

The objective of this course to provide the understanding of basics concept and MATLAB based implementation of time-frequency analysis (TFA) tools for various applications.

Course Outcomes

After the study of this course students will be able to:

1. Understand the spectral analysis of the signals.
2. Understand the basics concept of the short time Fourier transform.
3. Familiar with the basics concept of the discrete wavelet transform /continuous wavelet transform.
4. Understand the basic concept of the distribution based Time-Frequency Analysis tools
5. Develop the TFA based algorithms for various applications.

Course Contents :

Unit	Topics	Text book	Lectures
1	**Introduction to spectral analysis:** Parametric and Non-Parametric methods	[1]	**08**
2	**Basic Concepts & Definition of time-frequency tools:** Bandwidth Equation, uncertainty concept, Instantaneous Frequency, Analytic Signals, Multicomponent Signals etc.	[2]	**04**
3	**Short Time Fourier Transform:** Conditions for valid windows, Time domain and frequency domain formulations, Duality in the interpretations, MATLAB based implementation of STFT	[2] & [6]	**04**
4	**Wavelet transforms:** Introduction and basic concept of continuous and discrete wavelet transform, MATLAB based implementation of wavelet transform.	[3] &[6]	**04**
5	**Distributions based time-frequency tools:** Introduction and basic concept Wigner-Ville distribution & Cohen's class of distribution etc. MATLAB based implementation of distribution based time-frequency analysis tools.	[2] &[4]	**06**
6.	**Case studies:** Joint Time-Frequency Transform/ Inverse Synthetic Aperture Radar, Joint Time-Frequency Representations/Time-Varying Signals, Economic Data Analysis with the Gabor Spectgrogram, Gabor Spectrogram in Ultrasonic Nondestructive Materials Evaluation, Applications of Time-Frequency Signal Processing in Wireless Communications and Bioengineering	[2], [3], [4] & [5]	**16**
	Total Hours		**42**

Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    1. 10 Marks : Class performance, Tutorials & Assignments
    2. 10 Marks : Quizzes
    3. 5 marks : Attendance

Text Books

1. Hayes, M.H.,"Statistical digital signal processing and modeling" Willey publishers
2. Boualem Boashash, Time-Frequency Signal Analysis and Processing: A Comprehensive Reference, Elsevier publishers, 2003
3. S. Mallat, A Wavelet Tour of Signal Processing - The Sparse Way. Elsevier, Third Edition, 2009.
4. L. Cohen, Time-Frequency Analysis. Prentice Hall, 1995.
5. Hao Ling and Victor C. Chen, Time-frequency Transforms for Radar Imaging and Signal Analysis, Artech House Publishers, 2000
6. http://nptel.ac.in/courses/117101001/: The lecture series on Wavelets and Multirate Digital Signal Processing created by Prof. Vikram M. Gadre in NPTEL.

REFERENCE BOOKS

1. Stanskovic L., Dakovic, M., Thayparan, T., Time-Frequency Signal Analysis and Processing: A Comprehensive Reference, Artech House Publishers.
2. Karlheinz Gröchenig, Foundations of Time-Frequency Analysis, Birkhäuser publishers, 2001
3. M. Vetterli, J. Kovacevic, and V. K. Goyal, Fourier and Wavelet Signal rocessing. Booksite: **http://fourierandwavelets.org/terms.php**

OTHER RESOURCES

Time-frequency toolbox (MATLAB) is available for download from **http://tftb.nongnu.org/**

http://nptel.ac.in/courses/117101001/1

Advanced Communication System

(Core Subject-M.Tech, Elective Subject-B.Tech)

Course Code:	10M11EC111	**Semester:**	1 st Sem/7th sem , M.Tech/B.Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

The main objective of the course is to

1. Provide student with theoretical background and applied knowledge so that they can design an optimum Single and multi-carrier communication system under given power, spectral and error performance constraints.
2. Analyze the error performance of digital modulation techniques.
3. Explore M ary signaling

Course Outcomes

After studying this course the students would gain enough knowledge

1. Analyze the design parameters of a single and multi-carrier communication system.
2. Use mathematical tools to analyze the performance of communication systems.
3. Use probability theory and stochastic processes in communication system applications
4. Learn synchronization and adaptive equalization techniques.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	Introduction to analog and digital communication systems, communication channels and their characteristics, mathematical models for communication channels, deterministic and random signal analysis, baseband, band-pass and equivalent low-pass signal representations, orthogonal expansion of signals.	Proakis: Chapter 4	4
2.	Digital modulation Schemes: Gram Schmidt orthogonilazation procedure, Representations of digitally modulated signals, memory less modulation methods, PAM,PM,QAM, multidimensional signaling, Signaling scheme with memory, CPFSK,CPM, Power spectrum of Digitally modulated signals, PSD of a digitally modulated signals with memory, PSD of linearly modulated signals.	Proakis: Chapter 5	6
3	Optimum Receivers for AWGN Channels: Correlation demodulator, Matched filter	Proakis: Chapter 5	6

	demodulator, optimum detector, maximum likelihood sequence detector, A symbol by symbol MAP detector for signals, Probability of error calculations for binary modulation, M-ary PAM, M-ary PSK, QAM, orthogonal signals, biorthogonal signals. Optimum demodulation of CPM signals,		
4	Carrier and Symbol Synchronization: Likelihood function, carrier recovery and symbol synchronization in signal demodulation, ML carrier phase estimation, PLL, decision directed loops and non-decision directed loops, ML timing estimation, non-decision directed timing estimation, joint estimation of carrier phase and symbol timing.	Proakis: Chapter 6	6
5	Signal Design for Band Limited Channels: Characterization of band limited channels, design of band limited signals for no ISI, Design of band limited signals with controlled ISI, data detection for controlled ISI, signal design for channels with distortion, probability of error for detection of PAM with zero ISI and with partial response signals, .	Proakis: Chapter 10	6
6	Communication through Band Limited Linear Filter Channels: ML receiver for channels with ISI and AWGN, discrete time model for channel with ISI, Viterbi algorithm for discrete time white noise filter model, linear equalization – peak distortion criterion, MSE criterion and its performance, fractionally spaced equalizers, decision feedback equalization – coefficient optimization, performance characteristics.	Proakis: Chapter 11	6
7	Linear Predictive Coding (LPC): Basics of LPC, speech model-source filter model & signal processing consideration, LPC in voice conversion, vocoders, LPC analysis & synthesis filter, CELP (Code-Excited Linear Prediction), CSACELP(Conjugate-Structured Algebraic CELP).	B. P. Lathi: Chapter 3	5
8	Multicarrier Modulation Techniques: Multipath & fading in wireless communication systems, Doppler spread, delay spread, OFDM Vs (TDM, FDM, CDMA), building blocks of OFDM	Proakis: Chapter 12, 13	5

	transmitter & receiver, OFDM applications, direct sequence spread spectrum signals (DS-SS), frequency hopped spread spectrum signals (FH-SS), introduction to multicarrier (MC) DS-CDMA and time hopping TH/MC-CDMA.		
		Total Number of Lectures	44

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Proakis, John G., Digital Communications, McGraw-Hill (2000).
2. Bernard SKLAR: “Digital communications”, Pearson

Reference Books

1. Simon Haykin: “Digital communications”, Wiley Publications
2. B.P Lathi: “Modern Analog & Digital Communication Systems”, Oxford Publication

Web resources

1. http://www.nptel.ac.in/courses/117101051/

ADVANCED SATELLITE AND FIBRE OPTIC COMMUNICATION

(Elective Subject)

Course Code:	**10M11EC112**	**Semester:**	**8th Semester, B. Tech (ECE)**
Credits:	**3**	**Contact Hours:**	**L-3**

Course Objectives

1. To introduce the concept of optical fiber communication system starting from the basics ofelectromangnetic engineering.
2. To make the students learn the basic characteristics of optical fibers and satellite communication systems.
3. Design a satellite communication system for given parameters.

Course Outcomes

After studying the course, the student would gain enough knowledge of

1. The working of optical and satellite communication systems.
2. The practical issues concerning the launch ofsatellites.
3. The modulation and multiplexing schemes involved in satellite communicationsystems.
4. The types of interference in launching the satellites.
5. The design of satellite communication system.

S.No	Unit	Content	Lecture
1	Introduction to optical communication system	Review of Maxell's Equations, wave propagation, boundary conditions, optical communication system, need of optical communication system, Advantage of optical fibre system, attenuation windows.	3
	Propagation in Dielectric Waveguides	Wave propagation in an inhomogeneous medium, planar and cylindrical optical waveguide, TE-mode of a symmetric step-index planar waveguide, power distribution and confinement factor,	5
2	Optical Fibre	Introduction, Step-index Fibres, Graded Index Fibres, Modes & Rays, Slab Wave Guide, Ray propagation in optical fibre, Ray propagation in step-index fibre, ray propagation in graded index fibre, modal analysis of an ideal step-index fibre, fractional modal power distribution, limitation of multimode fibre, effects of material dispersion, combine effects of multipath and material dispersion.	8
3	Characteristics, of optical fibre	Characteristic parameters of single mode fibre, dispersion in single mode fibre, attenuation in single-mode fibre, design of single mode fibre, signal degradation in optical fibre, attenuation, scattering losses, bending losses, dispersion.	6
4	Satellite Communication	Introduction to the satellite communication system, earth satellite geometry, orbits of the satellite communication, Geo-stationary and non-geostationary orbits, ground segment and space segment.	2
5	Launch vehicles	Principle of rocket propulsion, powered flight, injection into final orbit, propulsion system	2
6	Spacecraft	Design of spacecraft, primary power, thermal subsystem, telemetry, tracking and command, altitude control, system	3

		reliability, estimation of mass of communication satellite	
7	RF Link	General consideration of RF link, noise, limits of the link performance, satellite links: uplink and down link, composite performance, optimization of RF links, noise temperature, antenna temperature, overall system temperature and propagation factors	5
8	Modulation and multiplexing	System engineering consideration, FDMA, TDMA system, beam switching and satellite switched TDMA, comparisons of multiple access techniques	2
9	Satellite transponder	Function of the transponder, transponder implementation and its technical issues.	2
10	Earth station	Transmitters, receivers, antennas, tracking systems, terrestrial interface	2
11	Interference	Calculation of C/I for single interfering satellite, calculation of C/i for multiple interfering satellite, interference specifications and protection ratio, special problems of satellite communication: delay and data communication	4

Text books:

- J M senior, "Optical Fiber Communications: Principles and Practice", 3rd Edition Prentice Hall.
- Dennis Roddy, "Satellite Communications", 4th Edition, McGraw-Hill.

Reference Books:

- G E Keiser, "Optical Fiber Communication", McGraw-Hill.
- M Richharia, "Satellite Communication System", Macmillian.
- W L Pritchard et al, "Satellite Communication Systems Engineering", Pearson Education.

Evaluation Scheme

Test 1 - 15
Test 2 – 25
Test 3 - 35
Continuous Evaluation-25 (Att.-5, Assignments -10, Quiz/Presentation-10)
Total-100

Text Books

1. Fiber Optics and Optoelectronics, R.P. Khare Oxford University Press.
2. Fiber Optic Communication Systems, G. P. Agarwal, Third Edition, Wiley.

ADVANCED TELECOMMUNICATION NETWORK

(Core Subject/Elective for B Tech)

Course Code:	10M11EC113	**Semester:**	1th Semester, M. Tech (ECE) 7th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

1. Understand the fundamental terminology and architecture of data communication, and implementations of data communication.
2. Describe layered communication, the process of encapsulation, and message routing in network.
3. Understand the standards and protocols of data communication.
4. Identify several codes that are used for error detection and how error correction is accomplished. Describe a data link protocol and define how it controls the transfer of frames
5. Apply the knowledge to properly analyze and describe network performance issues.

Course Outcomes

At the end of this course a student should be able to

1. Identify, describe and give examples of the networking applications used in everyday tasks such as reading email or surfing the web.
2. Investigate the solutions to improve wireless network (from physical layer level to transport layer level) and discuss pros and cons.
3. Student will develop an understanding of the underlying structure of networks and how they operate.
4. Analyze the network and issues associated with it.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Data Communication concepts and terminology, Wired vs Wireless, Circuit switching/ Packet switching, Transmission media, Connection oriented/connection less transmission, Errors.	Behrouz A. Forouzan Prakash C Gupta	5
2.	Network Architecture, OSI reference model, TCP/IP architecture, flow control and error control, Error detection and correction. Physical Layer: EIA-232-D	Behrouz A. Forouzan Prakash C Gupta	6
3	Data Link Layer: ARQ protocols – Stop and Wait ARQ, Go back N ARQ, Selective Repeat ARQ Transmission efficiency of ARQ protocols HDLC Data Link control. Random access – ALOHA, slotted ALOHA, CSMA, CSMA-CD and CSMA –CA. 4	Behrouz A. Forouzan Prakash C Gupta	6

4	Wireless LAN: Media Access control in wireless LAN, IEEE 802.11	Behrouz A. Forouzan Prakash C Gupta	5
5	Routing Protocols and Internet Protocols: IPv4-Addressing, Subnetting and Classless Addressing, Classless Inter-domain routing (CIDR). IPv6: Features and Addressing, IPv4 to IPv6 transition,	Behrouz A. Forouzan Prakash C Gupta	8
6	Transport Layer: TCP, UDP, Drawbacks of TCP for Reliable wireless Broadcast/Multicast, Congestion control.	Behrouz A. Forouzan Prakash C Gupta	6
7	Application Layer: DNS, FTP, SMTP and SNMP.	Behrouz A. Forouzan Prakash C Gupta	4
		Total Number of Lectures	**40**

Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. Data Communication And Computer networks PHI : Prakash C Gupta.
2. Data communications and Networking Pearson Education: Behrouz A. Forouzan.

Reference Books

1. Data and Computer Communications, 9th edition, Pearson: William Stallings.
2. Computer Networks, Pearson Education, 4th edition: A. Tanenbaum.

VLSI Circuits and System Design

(Core Subject for M.Tech/ Elective for B Tech)

Course Code:	10M11EC114	**Semester:**	M.Tech 1st Sem 7th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0,P-0

Course Objectives

The objectives are to study

1. To bring both Circuits and System views on design together.
2. It offers a profound understanding of the design of complex digital VLSI circuits, computer aided simulation and synthesis tool for hardware design.

Course Outcomes

After studying this course the students would gain enough knowledge

1. To learn concept of design rules.
2. To bring both Circuits and System views on design together. It offers a profound understanding of the design of complex digital circuits.
3. Synthesis of digital VLSI systems from register-transfer or higher level descriptions in hardware design languages.
4. To be aware about the trends in semiconductor technology, and how it impacts scaling and performance.
5. Understanding a hardware design language such as VHDL in detail – syntax as well as how it works under the hood for simulation and synthesis. To gain enough knowledge to design any circuit using CMOS and write HDL code for any circuit.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	A Brief History and Need of Integrated Circuits, Complexity of VLSI Design: Design Hierarchy, VLSI Design Cycle, Physical Design Cycle, Analog Design Flow, Digital Design Flow, Introduction to MOS Technology and its Electrical Properties, Basic Logic gates : n FET, P FET, CMOS: NOT gate, NAND gate, NOR gate, Stick Diagram, Layout.	John P. Uyemura : Chapter 1, 2	2 4
2.	Basic MOS transistors, Enhancement mode transistor action, Depletion mode transistor action, nMOS fabrication, CMOS fabrication, Drain to source current I_{ds} versus voltage V_{ds} relationships (Non saturated region, Saturated region), MOS transistor transconductance g_m and output conductance g_{ds}, figure of merit, MOS resistance and capacitance, MOS transistor circuit model	Kang : Chapter 3	12
3	nMOS inverter, Determination of pull up and pull down ratio for an nMOS inverter driven by another n MOS inverter, CMOS inverter, DC Characteristics of the CMOS Inverter , Inverter Switching Characteristics, Power Dissipation, DC	Kang : Chapter 4, 5	8

	Characteristics: NAND and NOR Gates, NAND and NOR Transient Response, Analysis of Complex Logic Gates, Gate Design for Transient performance, MOS circuit design process(STICK DIAGRAMS)		
4	Transmission Gates , Gate Delays, Driving Large Capacitive loads, Logical Efforts, Mirror Circuits, Pseudo-nMOS, Tri State Circuits, Clocked CMOS, Dynamic CMOS Logic Circuits, Dual-Rail Logic Networks, BiCMOS	Uyemura : Chapter 4, 5	10
5	**System Specification Using Verilog HDL :** Basic Concepts, Structural Gate-Level Modeling, Switch-level Modeling, Design Hierarchies, Behavioral and RTL Modeling **General VLSI System Components:** Gates Adders (Half and Full), Subtractors (Half and Full), Multipliers, Binary Decoders, Equality Detectors and Comparators, Priority Encoder, Shift and rotation Operation, Latches, D Flip-Flop, Registers **System Specification using SPICE :** By programming and by circuit level ,Gates (using Diodes, BJT and CMOS)	Uyemura : Chapter 6, 7	8
Total Number of Lectures			44

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. John P. Uyemura: Introduction to VLSI Circuits and Systems, Wiley Student Edition
2. Sung-Mo (Steve) Kang, Yusuf Leblebici, CMOS DIGITAL INTEGRATED CIRCUITS ANALYSIS & DESIGN 3rd Edition, Mc Graw-Hill 2003.J.

Reference Books

1. Bhasker , "A VHDL Primer", Pearson Education, 3rd Edition
2. Adel S. Sedra, Kenneth C. Smith : Microelectronics Circuits, 5th Ed., Oxford University Press, 2004
3. Jan M. Rabaey et al , Digital Integrated Circuits : A design Perspective, 2nd Edition

Web Resources

1. URL1:- http://nptel.ac.in/courses/117106093/
2. URL2:- http://nptel.ac.in/courses/Webcourse-contents/IIT-Bombay/VLSI%20Design/Course%20Objective.html

Machine Learning and Data Analytics–I

COURSE CODE:18B1WEC733

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

5. To provide a broad survey of approaches and techniques in machine learning;
6. To develop the basic skills necessary to pursue research in machine learning.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand the basic theory underlying machine learning.	Familiarity
CO-2	Apply machine learning algorithms to solve problems of moderate complexity.	Assessment
CO-3	Formulate machine learning problems corresponding to different applications.	Assessment
CO-4	Understand a range of machine learning algorithms along with their strengths and weaknesses.	Usage
CO-5	Read current research papers and understand the issues raised by current research.	Usage

Course Contents:

Unit	Contents	Lectures required
1	**Introduction:** Fixed, Adaptive and Intelligent systems; Adaptive techniques: Prediction, Classification, Forecasting, Filtering, Direct and Inverse modeling.	5
2	**Data Exploration and Pre-processing:** Data objects and attributes; Statistical measures, Visualization, Data cleaning and integration	5
3	**Dimensionality Reduction:** Discriminant analysis; Principal component analysis, Independent component analysis; Transform Domain and statistical feature extraction and reduction.	4
4	**Regression:** Linear regression, Multivariate regression, Logistic regression; Support vector machine.	6
5	**Clustering:** K-Means, Hierarchical and Density based clustering.	7
6	**Decision Tree based Learning:** Decision tree induction, Attribute selection and tree pruning.	4
7	**Artificial Neural Networks:** Single layer neural network, Multilayer Perceptron, Back Propagation learning, Functional link artificial neural network, Radial basis function network, Recurrent neural	11

	networks, Convolution neural network.	
Total lectures		**42**

Suggested Text Book(s):

6. C. M. Bishop: Pattern Recognition and Machine learning, Springer, 1st Edition, 2006.
7. J. Han, M. Kamber, J. Pei: Data Mining: Concepts and Techniques, Elsevier Amsterdam, 3rd Edition, 2011

Suggested Reference Book(s):

6. T. Hastie, R. Tibshirani, J. Friedman: The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer, 2nd Edition, 2013.
7. H. Simon: Neural Networks and Learning Machines, Prentice Hall, 3rd Edition, 2009.

Other useful resource(s):

1. H. Daume: A course in Machine learning, 2015.
http://ciml.info/
2. Link to NPTEL course contents:Introduction to Machine Learning
https://onlinecourses.nptel.ac.in/noc17_cs26/preview
3. Link to MITOPENCOURESEWARE: Machine Learning
https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-867-machine-learning-fall-2006/

EvaluationScheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (3) - 10 Quizzes(3) -10 Attendance - 5

Digital Signal Processing for VLSI

COURSE CODE: 11B1WEC832
COURSE CREDITS: 3

ELECTIVE/CORE:Elective

L-T-P: 3-0-0

Pre-requisite: DSP, VLSI technology and applications

Course Objectives:

7. Learn to analyze and implement high performance digital filter using latest technology
8. Learn high-performance VLSI architectures for signal processing
9. Learn use of digital filters in real-world DSP that can be bridge to VLSI
10. Synthesize efficient algorithm design in common engineering situations

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Analyze DSP system using different algorithms and iteration bound	Familiarity
CO-2	Analyze high-performance VLSI architectures for signal processing	Assessment
CO-3	Demonstrate pipelining and parallel processing	Assessment
CO-4	Apply the emerging integration of VLSI and biomedical sensors	Usage

Course Contents:

Unit	Contents	Lectures required
1	**Introduction to DSP Systems** : Typical DSP Programs, Area-Speed-Power Tradeoffs, Representation Methods of DSP systems, Representation of DSP Algorithms , Block Diagram , Signal Flow Graph, Data Flow Graph, Dependence Graph , Graphical Representation Method, Iteration Bound, Algorithms to compute iteration bound, Longest Path Matrix, Minimum Cycle Mean	8
2	**Pipelining and Parallel Processing** : Pipelining of FIR Digital Filters, Parallel Processing, Pipelining and Parallel Processing for Low Power, Unfolding, Applications of Unfolding, Sample Period Reduction, Parallel Processing, Folding and hardware optimization , Folding transformation, folding set, Forward Backward Register Allocation Technique, Systolic Architecture Design, CORDIC algorithm and multiplier less architectures	8

3	**Pipelined and Parallel Recursive and Adaptive Filters** : Introduction, Pipelining in 1st-Order IIR Digital Filters, Pipelining in Higher-Order IIR Digital Filters, Parallel Processing for IIR Filters, Combined Pipelining and Parallel Processing for IIR Filters, Scaling and Round-off Noise, State Variable Description of Digital Filters, Noise Computation, Round-off Noise Computation Using State Variable Description, Slow-Down, Retiming, and Pipelining.	**6**
4	**Fast Convolution** : Cook-Toom Algorithm and Modified Cook-Toom Algorithm, Winograd Algorithm and Modified Winograd Algorithm, Iterated Convolution, Cyclic Convolution, Design of Fast Convolution Algorithm by Inspection	**6**
5	**Bit Level Arithmetic Architectures** : Parallel Multipliers, Parallel Carry-Ripple Array Multipliers, Parallel carry-save array multiplier, Baugh-Wooley Multipliers, Parallel Multipliers with Modified Booth Recoding, Bit-Serial Multipliers, Bit-Serial Baugh-Wooley Multiplier, Bit-Serial FIR Filter, Bit-Serial IIR Filter	**8**
6	**Algorithmic Strength Reduction in Filters and Transforms** : Introduction, Parallel FIR Filters, Formulation of Parallel FIR Filter Using Polyphase Decomposition, Fast FIR Filter Algorithms, Discrete Cosine Transform and Inverse DCT, Algorithm-Architecture Transformation, Decimation-in-Frequency Fast DCT for 2^M - point DCT	**6**
Total lectures		**42**

Suggested Text Book(s):

8. K. K. Parhi :VLSI Digital Signal Processing: Design and Implementation, John Wiley and Sons, 2008
9. B. A. Bowen, R.A. Bowen, and William Roy Brown : VLSI Systems Design for Digital Signal Processing, Prentice Hall
10. M. A. Bayoumi and E. E. Swartzlander: VLSI Design Methodologies for Digital Signal Processing Architectures, The Springer International Series in Engineering and Computer Science
11. S.Y. Kung, H.J. Whitehouse, and T. Kailath : VLSI and modern signal processing, Prentice-Hall information and system sciences series

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

OPTICAL COMMUNICATION SYSTEMS

(Elective Subject)

Course Code:	11B1WEC834	**Semester:**	8th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

The objectives are to study

1. To introduce the concept of optical fiber communication system.
2. To make the students to know the constituents of the fiber optics communication system and optoelectronics.
3. To know the applications of fiber optics systems.

Course Outcomes

After studying this course the students would gain enough knowledge

1. Understand basics of optical communication systems.
2. The principles that govern optical communication systems.
3. Behavior of light as electromagnetic waves in different types of fibers.
4. The hardware components required to implement optical communication systems.
5. To efficiently design an optical communication system for practical purpose.
6. The practical techniques involved in optical communication systems.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Introduction to Fiber optics and Optoelectronics, Historical developments, Fiber optic communication system, Advantages, Emergence as a key technology, Role of Fiber optics technology.	Text Book 1, Chapter 1, Pages 1-16; Text Book 2, Chapter 1, Pages 1-11	3
2.	Ray Propagation in Optical Fibers - Introduction, review of fundamental laws of optics, Ray propagation in Step-index and Graded-index Fibers, Effect of material dispersion, The combined effect of multipath and material dispersion, Calculation of rms pulse width.	Text Book 1, Chapter 2, Pages 17-35 Text Book 2, Chapter 1, Pages 1-11	6
3	Wave propagation in Planar Waveguides- Introduction, Maxwell's equations, Solution in a inhomogeneous medium, Planar optical waveguide, TE modes of a symmetric step-index planar waveguide, Power distribution and	Text Book 1, Chapter 3, Pages 37-57;	5

	confinement factor.		
4	Wave propagation in Cylindrical Waveguides- Introduction, Modal analysis of an ideal SI optical fiber, fractional modal power distribution, Graded-index fibers, Limitations of multimode fibers.	Text Book 2, Chapter 4, Pages 1-61-80	4
5	Single-mode Fibers- Introduction, Single-mode fibers, Characteristics parameters of SMFs, Dispersion in SMFs, Attenuation in SMFs.	Text Book 1, Chapter 5, Pages 83-105;	4
6	Optoelectronic Sources - Introduction, Fundamental aspects of semiconductor physics, the p-n junction, Current densities and injection efficiency, Injection luminescence and the LED, the heterojunction, LED designs, Modulation response of an LED, Injection laser diodes, Source-fiber coupling	Text Book 1, Chapter 7, Pages 147-199; Text Book 2, Chapter 15	3
7	Optoelectronic Detectors - Introduction, The basic principle of optoelectronic detection. Types of photodiodes, Photoconducting detectors, Noise considerations.	Text Book 1, Chapter 8, Pages 200-218	5
8	Optoelectronic Modulators - Introduction, Review of basic principles, Electro-optic modulators, Accousto-optic modulators, Application areas of optoelectronic modulators	Text Book 1, Chapter 9, Pages 219-246;	4
9	Optical Amplifiers - Introduction, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers, Fiber Raman amplifiers, Application areas of optical amplifiers	Pages 247-272; Text Book 2, Chapter, Pages	5
10	Wavelength-division Multiplexing - Introduction, The concepts of WDM and DWDM, Passive components, Active components.	Text Book 1, Chapter 11, Pages 248-23;	3
		Total Number of Lectures	42

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks

- 10 Marks : Class performance, Tutorials & Assignments
- 10 Marks : Quizzes
- 5 marks : Attendance

Text Books

1. Fiber Optics and Optoelectronics, R.P. Khare Oxford University Press.
2. Fiber Optic Communication Systems, G. P. Agarwal, Third Edition, Wiley.

Reference Books

1. Optical Communication- principles and practice, John M Senior, Third edition, Pearson India.

SOFT COMPUTING TECHNIQUES

(Elective Subject)

Course Code:	13B1WEC831	Semester:	8th Semester, B. Tech (ECE), M.Tech(Ist year)
Credits:	3	Contact Hours:	L-3, T-0, P-0

Course Objectives

1. Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
2. Introduce students to artificial neural networks and fuzzy theory from an engineering perspective

Course Outcomes

Upon completion of the course, the student are expected to

1. Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
2. Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
3. To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
4. Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
5. Reveal different applications of these models to solve engineering and other problems.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	Introduction to fuzzy set theory: Probabilistic reasoning, Fuzzy sets, mathematics of fuzzy set theory, operations on fuzzy sets, comparision of fuzzy and crisp set theory.	Ross Ch 1,2 Sivanandam Ch 7,8	4
2.	Fuzzy mapping: one to one mapping, max-min principle, extension principle, implication rules – mamdani implications. Membership functions: Universe of discourse, mapping inside fuzzy domain, fuzzy membership mapping methods, and application to real world problems.	Ross Ch 2,3 Sivanandam Ch 9,10	10
3	Artificial Neural Networks (ANN) and their biological roots and motivations. Comparison	Sivanandam Ch1,2	8

	Between Artificial and Biological Neural Networks, Applications of Neural network. Network Architecture ,Taxonomy of neural networks: feed forward and recurrent networks with. Merits and limitations of neurocomputing.	Haykin Ch1,2	
4	Types of learning, supervised and unsupervised learning laws . Learnig Laws : Hebb's rule, Delta rule, Widrow - Hoff (The Least-Mean-Square) learning rule, correlation learning rule, instar and outstar learning rules, Competitive learning, Credit Assignment Problem, Error Correction learning, Memory based learning, , Boltzmann learning.	Sivanandam Ch 3 Haykin Ch 3,4	10
5	The Perceptron and its learning law, Classification of linearly separable patterns, Multi-Layer Perceptron, Supervised Learning, Back-Propagation Learning law. Feed forward networks, Recurrent Networks.	Sivanandam Ch 3 Haykin Ch 4	6
6	Winner takes-all Networks, Competitive Learning, Kohonen's Self organizing Maps, Introduction to Adaptive Resonance Theory.	Sivanandam Ch 5	4
		Total Number of Lectures	44

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   10 Marks : Class performance &Assignments
   10 Marks : Quizzes
   5 marks : Attendance

Text Books

1.Simon Haykin, "*ArtificialNeutral Networks"*.
3. Yegna Narayanan, *"Artificial Neural Networks"*.
4. Timothy J. Ross, " *Fuzzy Logic with Engineering Applications"*.
5. S.N.Sivanandam, S.N Deepa, "*Principles of Soft Computing*"

Reference Books

1. Bart Kosko, “Neural Network and Fuzzy Systems: A Dynamic System Approach to Machine” Prentice-Hall 1998
2. L. Fausett, “Fundamentals of Neural Networks: Architectures, Algorithms, and Applications”, Prentice-Hall, 1994
3. Jack M. Zurada, “Introduction to Artificial Neural Systems”, PWS Publishing Co., Boston, 2002.

ONLINE MATERIAL

http://nptel.ac.in/courses/117105084/
http://nptel.ac.in/courses/108104049/

Modern Antennas

(Elective Subject-B.Tech)

Course Code:	13B1WEC832	**Semester:**	8th sem B.Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

The main objective of the course is to

1. Learn the mechanism of antenna, antenna performance parameters,
2. Design and analysis of various antennas for different applications
3. Size reduction techniques, Broadbanding and multi band operation techniques in antenna design.

Course Outcomes

After studying this course the students would gain enough knowledge

1. To understand the mechanism of antenna radiation
2. To design and analyze various antennas for specific application.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Introduction: antenna types, radiation mechanism, use of potential functions, radiated field, far field, antenna parameters, radiation pattern, directivity, numerical evaluation of directivity, gain, efficiency, impedance, loss resistance, polarization, linear polarization, circular and elliptic polarization, equivalent area, Friss equation.	Balanis: Chapter 1,2,3	6
2.	Dipole Antennas: Potential functions for analysis of radiated fields, Duality theorem, Reciprocity theorem for antennas, Radiation from current element, infinetismal dipole, finite length dipole, half wave dipole	Balanis: Chapter 4	6
3	Antenna Arrays: Analysis and Synthesis Review of antenna array basics, Linear arrays, circular array, planar (2D) arrays, sum and difference patterns, Effect of mutual couplings, Phased array antennas, scan rinciples, Non uniform arrays, Dolph Chebyshev Arrays Binomial Arrays.	Balanis: Chapter 6	6
4	Broadband and Frequency Independent Antennas Helical antenna: Normal mode and	Balanis: Chapter 10	6

	axial mode helix Spiral antennas, Log Periodic antennas.		
5	Aperture Antennas Radiation from an aperture in an infinite ground plane, Radiation from rectangular and circular apertures, Radiation from a slotted rectangular waveguide Horn antennas: E plane and H plane sectoral horns, Pyramidal horn, Conical horn Reflector antennas parabolic reflector, methods of analysis, dual reflector antennas, offset reflector antenna, gain and efficiency calculations, scanning properties and cross polarization Lens antennas and their applications	Balanis: Chapter 12	7
6	Microstrip Antennas Rectangular patch antenna: cavity and transmission line models, Circular patch antenna Coupling mechanisms, circular polarization, Microstrip arrays, Broadband and Multi band microstrip antennas, Compact Microstrip Antennas.	Balanis: Chapter 14	6
7	Dielectric Resonator Antennas Introduction, radiation mechanism, advantages of DRA, types of DRA, feeding techniques, design method, modes.	Rajveer: Chapter 1, 2	6
		Total Number of Lectures	43

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Antenna Theory Analysis and Design, C. A. Balanis, 3rd Ed, 2005, John Wiley & Sons Inc.
2. Antennas for All Applications, J. D. Kraus and R. J. Marhefka, 3rd Ed., 2002, McGraw-Hill, Inc
3. Rectangular Dielectric Resonator Antennas, Rajveer S. Yaduvanshi Harish Parthasarathy, 1st Ed, 2016, Springer.

Reference Books

1. Antennas and Radiowave Propagation, R. E. Collin, 1985, McGraw-Hill, Inc.
2. Modern Antenna Design, T. A. Milligan, 2nd Ed., 2005, John Wiley & Sons
3. Antenna Arrays, R. L. Haupt, 2010, John Wiley & Sons, Inc.
4. Antenna Theory and Microstrip Antennas, D. G. Fang, 2010, CRC Press

BIO-ELECTRONIC SENSORS

(Elective Subject)

Course Code:	13B1WEC833	**Semester:**	8th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

The objectives are to study

1. transducers, sensors (bio sensor)
2. bio-potentials, electrodes and amplifiers
3. bio-signal amplifiers
4. Fuzzy implementation, petrinet implementation

Course Outcomes

After studying this course the students would gain enough knowledge

1. What are sensors, actuators and transducers?
2. How the students can design circuit diagram of bio-sensor for electrical and non- electrical signals?
3. the students will reach a sufficient knowledge of different types of bio electric amplifiers
4. the students will reach a sufficient knowledge and skill for being able of choosing novel solutions in terms of bio-signal Amplifiers
5. What are bio-potential and its amplifiers?
6. the students will reach a sufficient knowledge and skill for being able of choosing novel solutions in terms of bio-signal Amplifiers
7. Understand the design abstraction levels in bio-sensing Microsystems and design of signal acquisition interface for bio-sensing systems

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	**Introduction :** Introduction to Sensor, Bio electronic, Bioelectronics Sensor, Systems biology and Synthetic biology	Reddy : Chapter 1 Carr : Chapter 3, 4	3
2.	**Electrodes, Sensors and transducers :** Sensor/Actuators, Active v/s passive sensors, sensor error sources, sensor terminology, Types of Sensors, Bio sensor, Block diagram of Bio-sensor for electrical and non electrical signals, electrodes for biophysical sensing, transducers, performance parameters of sensors, complete circuit diagram of bio sensor.	Carr : Chapter 6	9
3	**Bio-potential Electrodes** : The electrode-electrolyte interface, polarization, polarizable	Ref Book : Point No 3	9

	and non-polarizable electrodes, Electrode behavior and circuit models, body surface recording electrodes, internal electrodes, micro electrode, macro electrode		
4	**Bio-electric Amplifiers** : Voltage, current, power amplifiers, Low gain, medium gain, high gain amplifiers	Carr : Chapter 7	9
5	**Bio-potentials:** ECG, EEG, EMG, ERG, EOG, its amplitude and bandwidth, Electrodes for Bio-potential Recordings, Electrical Interference Reduction.	Carr : Chapter 8	5
6	**Bio-potential Amplifiers:** Operational amplifiers, basic amplifier configurations, multiple input circuits, differential amplifiers, signal processing circuits, isolation amplifiers, IMRR, ECG Amplifier, functional block, interference from electric devices, transient protection, common mode and other interference reduction circuits, Driven right leg circuit, amplifiers for other bio-potential signals, pre amplifier.	Ref Book : Point No 4	6
7	**Bio-signal Amplifiers** : Instrumentation amplifier, Chopper Amplifier, Carrier Amplifier	Ref Book : Point No 6	3
		Total Number of Lectures	44

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. Carr, JJ , Brown, JM, "Introduction to Biomedical Equipment Technology", Pearson, 4th Ed.

2. Reddy, D.D., Hussian, O.M., Gopal, D.V. R., Rao, D. M., Sastry, K.S. : Biosensors and Bioelectronics, I.K. International Pub

Reference Books

1. Cromwell L, Weibell FJ, Pfeiffer EA, "Biomedical Instrumentation and Measurements", PhI
2. http://www.egr.msu.edu/classes/ece445/mason/Files/7-BioAmps.pdf

3. http://www.fis.uc.pt/data/20062007/apontamentos/apnt_134_5.pdf
4. https://ay14-15.moodle.wisc.edu/prod/pluginfile.php/74584/mod_resource/content/1/Ch06-MI4e-7-11-08.pdf
5. http://www.kau.edu.sa/Files/0003605/Files/69647_Origin%20of%20Bio-Potentials.pdf
6. http://www.fis.uc.pt/data/20062007/apontamentos/apnt_134_5.pdf
7. Neil Weste and David Harris, "CMOS VLSI Design", 4th Ed., Addison Wesley, 2011.
8. Gayakwad, R. A. " Op-amps and Linear Integarted Circuits" , PHI 3rd Ed.
9. Klir, G. J., Yuan, B "Fuzzy Sets and Fuzzy Logic PHI.
10. Douglas A Pucknell et al, "Basic VLSI Design", 3rd Ed., Prenctice Hall, 2004

QUANTUM EFFECTS IN SEMICONDUCTOR PHYSICS

(Elective Subject)

Course Code:	13B1WEC834	**Semester:**	8th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

3. About the physics of semiconductors and their devices, including aspects of growth, transport and optical characterization.
4. Describe the basic science behind the properties of materials at the nanometre scale, and the principles behind advanced experimental and computational techniques for studying nanomaterials.
5. Communicate clearly, precisely and effectively using conventional scientific language and mathematical notation.
6. Systematically solve scientific problems related specifically to nanotechnological materials using conventional scientific and mathematical notation.
5.

Course Outcomes

After completing the course students

6. Will have broad knowledge in the chosen discipline, with deep knowledge in its core concepts.
7. Will have knowledge in at least one discipline other than his/her primary discipline and some understanding of interdisciplinary linkages.
8. Will demonstrate well-developed problem solving skills, applying your knowledge and using his /her ability to think analytically and creatively.
9. Will develop a capacity for independent and self-directed work.
10. How to distill information from research articles and give scientific presentations.

Course Content

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1	Review of Quantum Mechanics Classical particles, Classical waves, Wave–particle duality, The Schrödinger wave equation, Wave mechanics of particles, Atoms and atomic orbital.	M. S. Tyagi & B.G. Streetman	6
2	Materials for nanoelectronics Semiconductors, Crystal lattices: bonding in	V.V.Mitin	

	crystals(Periodic structures, Cubic lattice, diamond lattice), Electron energy bands, Effective density of states, Semiconductor heterostructures, Lattice-matched and pseudomorphic heterostructures, Organic semiconductors, Carbon nanomaterials: nanotubes and fullerenes.	& S.M.Sze	8
3	Growth, fabrication, and measurement techniques for nanostructures Bulk crystal and heterostructure growth, Epitaxial growth, lattice matching in epitaxial growth, liquid phase epitaxy, Chemical- vapor deposition, molecular beam epitaxy, Nanolithography, etching, and other means for fabrication of nanostructures and nanodevices, Techniques for characterization of nanostructures, Atomic force microscopy,Transmission electron microscopy, Scanning electron microscopy, Spontaneous formation and ordering of nanostructures, Clusters and nanocrystals, Methods of nanotube growth (Arc discharge and laser ablation, chemical vapor deposition, Directed growth of single-walled nano tubes., Chemical and biological methods for nanoscale fabrication, Fabrication of nanoelectromechanical systems.	V. V. Mitin & B.G. Streetman	10
4	Electron transport in semiconductors and nanostructures Time and length scales of the electrons in solids, Statistics of the electrons in solids and nanostructures, The density of states of electrons in nanostructures, Electron transport in nanostructures	V. V. Mitin	7
5	Electrons in traditional low-dimensional structures Nanostructures and quantum confinement, Electrons in quantum wells, Electrons in quantum wires, Electrons in quantum dots, Single electron transport.	V. V. Mitin	7

Evaluation Scheme

5. Test 1 :15 marks
6. Test 2 : 25 marks

6. Test 3 : 35 marks
7. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

4. V.V.Mitin, V. A. Kochelap and M.A. Stroscio, Introduction to Nanoelectronics
5. B.G. Streetman: Solid State Electronic Devices, 5th Ed., Prentice Hall, 2000
6. S.M.Sze: Semiconductor Devices: Physics & Technology, John Wiley, 2002.
7. M.S. Tyagi, Introduction to Semiconductor materials & Devices, John Wiley, 1991

Reference Books

1. Eric L. Michelsen: Quirky Quantum Concepts, Online book, physics.uesd.edu/~emichels
2. Marius Grundmann: The Physics of Semiconductors, Springer

Antenna and Wave Propagation

COURSE CODE: 16B1WEC831

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

Pre-requisite: None

Course Objectives:

1. To make students understand the fundamental theory and concepts of antenna and propagation of waves.
2. Make them aware to the radiation characteristics of different types of antennas, their measurement and applications of various antennas.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Comprehend the fundamental theory and concepts of radiation, antenna and significance of antenna parameters.	Familiarity
CO-2	Assess the power and usefulness of UHF, VHF and Microwave Antennas, microstrip patch antennas their requirements, specifications, characteristics and design relations.	Assessment
CO-3	To define and distinguish between different phenomenon of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved.	Assessment
CO-4	Reveal different applications of the various types of antenna to solve engineering and other problems	Usage

Course Contents:

Unit	Contents	Lectures required
1	ANTENNA FUNDAMENTALS: Introduction, Radiation Mechanism – single wire, 2 wire, dipoles, Current Distribution on a thin wire antenna. Antenna Parameters - Radiation Patterns, Beamwidths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Antenna Apertures, Aperture Efficiency Antenna temperature and signal to noise ratio.	7
2	RADIATION OF ELECTRIC DIPOLE: Potential functions and the electromagnetic field, Oscillating electric dipole derivations for E and H field components in spherical coordinate systems, Power Radiated by a current element, Application to antennas, Radiation from quarter wave monopole and half wave dipoles, equality of directional patterns and effective lengths of transmitting and receiving antennas, directional properties of dipole antennas, antenna feeding methods.	8
3	ANTENNAS FOR SPECIAL APPLICATIONS: Broadband antenna, Frequency-independent antenna, log periodic antennas, Antennas design consideration for satellite communication, antenna for terrestrial mobile communication systems, GPR, Embedded antennas, UWB, Plasma	6
4	ANTENNA MEASUREMENTS: Radiation Pattern measurement, Distance requirement for uniform phase, uniform field amplitude requirement, Introduction to phase measurement; Gain Measurement: Comparison method, Near field method, Introduction to current distribution measurement, Measurement of antenna efficiency, measurement of Noise figure and noise temperature of an antenna polarization measurement, Anechoic Chamber measurement.	7

5	WAVE PROPAGATION - I: Concepts of Propagation – frequency ranges and types of propagations. Ground Wave Propagation–Characteristics, Parameters, Wave Tilt, Flat and Spherical Earth Considerations. Sky Wave Propagation – Formation of Ionospheric Layers and their Characteristics, Mechanism of Reflection and Refraction, Critical Frequency, MUF & Skip Distance – Calculations for flat and spherical earth cases, Optimum Frequency, LUHF, Virtual Height, Ionospheric Abnormalities, Ionospheric Absorption.	7
6	WAVE PROPAGATION – II: Fundamental Equation for Free-Space Propagation, Basic Transmission Loss Calculations. Space Wave Propagation – Mechanism, LOS and Radio Horizon. Tropospheric Wave Propagation – Radius of Curvature of path, Effective Earth's Radius, Effect of Earth's Curvature, Field Strength Calculations, M-curves and Duct Propagation, Tropospheric Scattering.	7
Total lectures		42

Suggested Text Book(s):

1. E.C.Jordan and Balmain: Electromagnetic waves and Radiating Systems, 2nd Edition, PHI, 2006
2. Constantine A. Balanis: Antenna Theory Analysis and Desin, John Wiley, 2nd Edition,2007.

Suggested Reference Book(s):

1. John D.Kraus, Ronald J Marhefka and Ahmad S Khan: Antennas for all Applications, Tata McGraw-Hill Book Company, 3rd Edition, 2007.
2. G.S.N.Raju: Antenna Wave Propagation, Pearson Education, 1st Edition, 2004.
3. R.E.Collins, "Antenna and Radiowave propagation",3rd Edition, Mc Graw Hill, 2005.

Other resources/ learning website:

www.nptel.ac.in
www.antenna-theory.com

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2) -10 Attendance - 5

ADVANCED DIGITAL SIGNAL PROCESSING

(Elective Subject)

Course Code:	10M11EC211	Semester:	8th Semester, B. Tech (ECE)
Credits:	3	Contact Hours:	L-3, T-0,P-0

Course Objectives

At the completion of this course, the student should have in depth knowledge of processing digital signals.

Course Outcomes

After the successful completion of the course, student should be able to:

1. Know the analysis of discrete time signals.
2. To study the modern digital signal processing algorithms and applications.
3. Have an in-depth knowledge of use of digital systems in real time applications
4. Apply the algorithms for wide area of recent applications.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	Review of Discrete time signals and systems and frequency analysis of discrete time linear time invariant systems. Discrete time systems, analysis of discrete time linear invariant systems, implementation of discrete time systems, correlation of discrete time systems ,z-transforms, linear time invariant systems as frequency selective filters. Sampling	John G. Proakis	8
2.	The Discrete Fourier transforms its properties and applications. Frequency domain sampling, properties of DFT, linear filtering methods based on DFT, Frequency analysis of signals using the DFT,Radix-2 decimation in time domain and decimation in frequency domain algorithms.	John G. Proakis	8
3	Design of Digital filters, Design of FIR filters, Design of IIR filters, frequency transformations	R.Rabiner	6
4	Multirate digital signal processing, Decimation, interpolation, sampling rate conversion, filter	John G. Proakis	6

	design and implementation for multirate conversion, sampling rate conversion by an arbitrary factor, applications of multirate signal processing.		
5	Linear prediction and optimum linear filters, Forward and backward linear prediction, solution of the normal equations, wiener filters.	John G. Proakis	7
6	Power spectrum estimation, Non-parametric and parametric methods for power spectrum estimation.	John G. Proakis	7
		Total Number of Lectures	42

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Digital Signal Processing Principles, Algorithms, and Applications John G. Proakis, Prentice-Hall International.Inc, 4th Edition, 2012.
2. Theory and Application of Digital Signal Processing by Lawrence R.Rabiner and Bernard Gold.

Reference Books

1. Oppenheim, Alan V. Discrete-time signal processing. Pearson Education India, 1999.
2. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing: a computer-based approach. Vol. 2. New York: McGraw-Hill Higher Education, 2006.

Advance Wireless and Mobile Communication

(Elective Subject)

Course Code:	10M11EC212	**Semester:**	2rd Sem. M. Tech (ECE) 8th Sem. B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0,P-0

Course Objectives

1. To make students familiar with fundamentals of mobile communication systems.
2. To identify the limitations of 2G and 2.5G wireless mobile communication and the design of 3G and beyond mobile communication systems.
3. To understand the fading and shadowing concept in wireless communication system.
4. To understand the multicarrier and multi-antenna advantages in wireless communication.
5. To become familiar with the diversity and equalization concepts in wireless channel.

Course Outcomes

Upon successful completion of this course the students will have developed following skills/abilities

1. Understanding of various generations of mobile communication technologies.
2. Concept of cellular communication technology.
3. Basics of wireless communication.
4. Knowledge of GSM mobile communication standard, its architecture, logical channels, advantages and limitations.
5. Knowledge of 3G and 4G mobile standards and their architectures.
6. The difference among the different generations of mobile standards.
7. Concept of multicarrier communication systems.
8. Multiple antenna concept in wireless communication to combat fading and to increase the channel capacity.

Course Contents

Unit	Topics	References	Lectures
1.	Introduction to Wireless Communication System: Evolution of Mobile Radio Communications, Cellular Phone Standards: 1G, 2G, 2.5G and 3G, FDD, TDD, FDMA, TDMA, CDMA, Cellular Telephone Systems, How a Cellular Telephone Call is Made.	T S Rappaport	2
2.	The cellular Concept – System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity: co-channel interference, adjacent channel interference, Trunking and Grade of Services, Improving Coverage & Capacity in Cellular System: cell splitting, sectoring and microcell concept.	T S Rappaport	4
3.	Mobile Radio Propagation-Path Loss & Shadowing: Radio Wave Propagation, Transmit and Receive Signal Models, Free Space Path Loss, Indoor and	T S Rappaport, A. Goldsmith	7

	Outdoor Propagation Models, Combined Path Loss & Shadowing, Outage Probability under Path Loss & Shadowing.		
4.	Mobile Radio Propagation-Small Scale Fading and Multipath: Small Scale Multipath Propagation, Factors affecting Small Scale Fading, Doppler Shift, Impulse Response Model of a Multipath Channel, Parameters of Mobile Multipath Channel, Types of Small Scale Fading: flat fading, frequency selective fading, slow fading and fast fading, Capacity of AWGN, Flat Fading and Frequency Selective Channels.	T S Rappaport, A. Goldsmith	7
5.	Diversity & Equalization: Diversity System Model, Receiver Diversity: selection diversity, feedback diversity, maximal ratio combining, equal gain combining, Equalizers, Types of Equalizers: linear equalizers, non-linear equalizers.	T S Rappaport, A. Goldsmith	7
6.	GSM System Architecture: GSM Channel Types, Traffic Channel, Control Channel, Frame Structure for GSM, Authentication Mechanism in GSM.	T S Rappaport, A. Goldsmith, J. Schiller, J. Tisal	4
7.	Introduction to OFDM and MIMO wireless communication: Introduction to OFDM, OFDM Block Diagram, MIMO Wireless Communication, Benefits of MIMO Technology, MIMO OFDM Building Block, STBC: Almounti code, Capacity Comparisons of SISO, SIMO, MISO, and MIMO.	D.Tse & P. Viswanath, E. Biglieri	5
8.	3G and 4G Networks Architecture: UMTS Network Architecture, UMTS Radio Interface, UTRAN, Handover, LTE Network Architecture, Air Interface and Radio Network, LTE Advanced, 802.16 WiMAX: Network architecture, Air Interface and Radio Network, Basic procedures.	J. Schiller, M. Sauter, S. G. Glisic	6
		Total Number of Lectures	**42**

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Reference Books

1. T. S. Rappaport: Wireless Communications, PHI, 2002.
2. Jochen Schiller : Mobile Communication , Pearson.
3. Raymond Steel : GSM, cdma one and cdma 2000, Wiley.
4. Andrea Goldsmith : Wireless Communications , Cambridge University Press.
5. Jochim Tisal : GSM Network: GPRS evolution one step towards UMTS , John Wiley & Sons.
6. David Tse & Pramod Viswanath: Fundamentals of Wireless Communication , Cambridge University Press.
7. Ezio Biglieri : MIMO Wireless Communications, Cambridge University Press.
8. Martin Sauter: Beyond 3G Bringing Networks, Terminals and the Web Together , John Wiley & Sons.
9. Savo G. Glisic: Advanced Wireless Communications, John Wiley & Sons

INFORMATION AND CODING THEORY

(B.Tech. Elective/M.Tech.Core Subject)

Course Code:	10M11EC213	**Semester:**	2nd Semester, M. Tech (ECE) 8th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

The objectives are to study

1. To bring both Circuits and System views on design together.
2. It offers a profound understanding of the design of complex digital VLSI circuits, computer aided simulation and synthesis tool for hardware design.

Course Outcomes

After studying this course the students would gain enough knowledge

1. Understand the static and dynamic behavior of MOSFETs (Metal Oxide Semiconductor Field Effect Transistors) and the secondary effects of the MOS transistor model.
2. To be aware about the trends in semiconductor technology, and how it impacts scaling and its effect on device density, speed and power consumption.
3. To understand MOS transistor as a switch and its capacitance.
4. Student will be able to design digital systems using MOS circuits (Static and Switching characteristics of inverters)
5. Able to learn Layout, Stick diagrams, Fabrication steps.
6. Understand the concept behind ASIC (Application Specific Integrated Circuits) design and the different implementation approaches used in industry.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Introduction to Information Theory, Uncertainty and information Theory, Average and mutual information, Entropy, information measures for continuous random variables, source coding theorem, Huffman coding, Shannon-Fano-Elias coding, Arithmetic Coding, Lempel-Ziv Algorithm, Run length encoding	Text Book 1: Chapter 1	6
2.	Channel capacity and Coding - Introduction, channel models, channel capacity, information capacity theorem, parallel Gaussian channels, Shannon limit, channel capacity for MIMO systems	Text Book 1 : Chapter 2	6
3	Error control coding (channel coding) - Linear	Text Book 1 : Chapter 3	10

	Block Codes for Error Correction: introduction, basic definitions, matrix description of linear block codes, equivalent codes, parity check matrix, decoding of linear block codes, syndrome decoding, error probability after coding, Hamming codes, Low Density Parity Check Codes, Optimal Linear Codes, Maximum distance separable codes, Space Time Block Codes.		
4	Cyclic Codes - Introduction, generation of cyclic codes, matrix description of cyclic codes fire codes, Golay codees, CRC codes.	Text Book 1 : Chapter 4	6
5	Bose-Chaudhuri Hocquenghem(BCH) codes - Introduction, Primitive elements, minimal polynomials, Reed-Solomom Codes	Text Book 1 : Chapter 5	6
6	Space-Time Codes - Introduction, Space-time code design criteria	Text Book 1: Chapter 6	4
7	Convolutional Codes - Introduction, Tree codes and Trellis codes, Matrix description, Viterbi decoding	Text Book 1: Chapter 6	4
		Total Number of Lectures	42

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Information Theory, Coding and Cryptography, Ranjan Bose, Third edition, TMH.
2. Information theory and Reliable communication, Robert G. Gallager, Wiley.

ADVANCED CMOS DIGITAL DESIGN TECHNIQUES

(Core/ Elective Subject)

Course Code:	14M1WEC231	**Semester:**	2nd Semester, M.Tech (ECE) and 8th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

1. To study advanced concepts of CMOS Digital Design. It will be helpful for the students when they work in VLSI industries or in R&D's.
2. To cover crucial real world system design issues such as signal integrity, power dissipation, interconnect packaging, timing and synchronization.
3. To provide unique coverage of the latest design methodologies and tools.
4. To learn Low-power design concepts and voltage-frequency scaling.

Course Outcomes

This course provides the knowledge of Advanced CMOS Digital Design Techniques. After study through lectures and assignments, students will be able to do the

1. Modeling and estimation of R, C, and L parasitics, effect of technology scaling, sheet resistance, techniques to cope with ohmic drop and capacitive cross talk, estimating RC delay, and inductive effects.
2. Several lab team assignments to design actual VLSI subsystems from high level specifications, culminating in a course project involving the software design of a modest complexity chip.
3. Several homework assignments based on core concepts and reinforcing analytical skills learned in class.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Introduction, The Wire, Coping with Interconnect: Impact of Interconnect Parasitic, Impact of Resistance, Impact of Capacitance, Cross-talk, Reducing RC-delay, Dealing with inductance.	Rabaey (Page 135-148, 445- 475)	5
2.	Designing Sequential Logic Circuits: Self Timed Circuit Design, Self Timed Signaling, Muller-C Element, Two Phase Handshake Protocol, Self Resetting CMOS, Synchronizer, Designing Latch and Edge triggered Register using different approach, Clock Overlaps, C2MOS Logic, TSPC Logic, Specialized edge triggered TSPCR, Pulse Registers, Pipelining, Designing Schmitt Trigger and multi-vibrators, Design Techniques for large Fan in, Sizing	Rabaey (Chapter 10.4, 10.5, Chapter 7) Rabaey Page (261-273)	16

	combinational circuits for minimum delay, Ratioed Logic: DCVSL, Pass transistor Logic, Differential Pass transistor Logic.		
3	Arithmetic Circuits: Adders (Ripple-Carry Adder, Complimentary Static CMOS FullAdder, Mirror Adder, Transmission Gate Full Adder, Carry-Bypass Adder, Carry-Select Adder, Logarithmic Look-Ahead Adder, Tree Adders). Multipliers (Array Multiplier, Wallace-Tree Multiplier, Booths Multiplier Algo), Shifters (Barrel Shifter, Logarithmic Shifter).	Rabaey (Chapter 11) Uyemura (Chapter 12)	11
4	Semiconductor Memories: Memory Timing, Memory Architecture, Read-Only Memory Cells, MOS OR ROM, MOS NOR ROM, MOS NAND ROM, Dual Data rate Synchronous Dynamic RAM, DRAM Timing, Sources of Power Dissipation in Memories, Data Retention in SRAM, Suppressing Leakage in SRAM, Data Retention in DRAM.	Rabaey (Chapter 12)	9
		Total Number of Lectures	**41**

Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. J. Rabaey, A. Chandrakasan; "Digital Integrated Circuits: A Design Perspective", 3rd and B. Nikolic Edition 2003.
2. John P. Uyemura;"Introduction to VLSI Circuits and Systems", John Wiley & Sons, Inc, 2002.

Reference Books

1. Sung-Mo Kang, Yusuf Leblebici,: CMOS Digital Integrated Circuits Analysis and Design",Tata McGraw-Hill Edition 2003

Web Resources

1. URL1:- http://nptel.ac.in/courses/117106092/
2. URL2:- http://nptel.ac.in/courses/117106093/

REAL-TIME EMBEDDED SYSTEM

(Elective Subject)

Course Code:	12M1WEC232	**Semester:**	B.Tech.(8th Sem.), M.Tech. (2nd Sem.)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

The objectives are to study

1. Introduction of the real-time systems.
2. Computing required for the real-time embedded systems.
3. Communication required for the real-time embedded systems.

Course Outcomes

After studying this course the students would gain enough knowledge

1. To present the mathematical model of the system.
2. To develop real-time algorithm for task scheduling.
3. To understand the working of real-time operating systems and real-time database.
4. To work on design and development of protocols related to real-time communication.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	**Introduction:** Applications of real-time systems, basic model and characteristics of a real-time system, safety and reliability, types of real-time tasks.	[1,chapter 1(1-22)], [2,3]	3
2.	**Modeling Timing constraints:** Timing constraints, events, classifications, modeling timing constraints.	[1,chapter 1(23-40)], [2,3]	3
3	**Scheduling Real-Time Tasks:** Task scheduling types, Types of Schedulers, clock driven, table-driven, Cyclic, EDF, RMA	[1,chapter 2(41-73)], [2,3]	5
4	**Handling Resource sharing among real-time tasks:** Resource sharing among real-time tasks, inversion, HLP,PCP	[1,chapter 3(74-97)], [2,3]	5
5	**Scheduling Real-Time Tasks in Multiprocessor and Distributed systems:** Multiprocessor task allocation, dynamic allocation of tasks, fault-tolerant scheduling of tasks, clocks in distributed real-time systems	[1,chapter 4(98-104)], [2,3]	5
6	**Real-time operating systems:** Features of real-time operating systems, time services	[1,chapter 5(1-40)], [2,3]	4
7	**Real-Time Communication:** Types of networks, QoS, traffic categorization, LAN architecture, soft and hard real-time	[1,chapter 7(139-177)], [2,3]	5

	communication, QoS framework, routing, resource reservation, rate control, QoS models.		
8	**Real-Time Databases:** Review, design issues, consistency, concurrency control, commercial real-time databases.	[1,chapter 8(178-190)], [2,3]	4
9	**Study of Practical Systems:** Networked control systems, cyber-physical system, controller area network.	[1,chapter 8], [2,3]	3
		Total Lecture	**42**

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Rajib Mall, Real-Time Systems: Theory and Practice, Pearson Education, 2007.

Reference Books

1. C. Siva Ram Murthy and G. Manimaran, 'Resource Management in Real Time Systems and Networks', the MIT Press, 2001.

ADVANCED DIGITAL IMAGE PROCESSING

(Elective Subject)

Course Code:	16M1WEC231	**Semester:**	8th Semester, B. Tech (ECE)/ 2nd semester M. Tech
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

Major Learning Objectives are:

1. Describe and explain basic principles of digital image processing;
2. Design and implement algorithms that perform basic image processing (e.g., noise removal and image enhancement);
3. Design and implement algorithms for advanced image analysis (e.g., image compression, image segmentation)
4. Assess the performance of image processing algorithms and systems.

Course Outcomes

After Completing this course students will be able to:

1. Analyze general terminology of digital image processing.
2. Examine various types of images, intensity transformations and spatial filtering.
3. Develop Fourier transform for image processing in frequency domain.
4. Evaluate the methodologies for image segmentation, restoration etc.
5. Implement image process and analysis algorithms.
6. Apply image processing algorithms in practical applications.

Course Content

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1	Digital image fundamentals Fundamental steps in DIP, Components of digital image processing system, elements of visual perception, Structure of the human eye, Image formation in the eye, Brightness adaptation and discrimination, light, Image sensing and acquisition, Image formation model, definition and some properties of two dimensional system, Discrete 2D convolution, 2D discrete Fourier transform and its properties, optical and modulation transfer function, Spectral density function. Sampling and quantization of images, Two dimensional	Gonzalez and Woods Chapter -1 Pg 1 - 29 Chapter -2 Pg 34 - 70	**7**

	sampling theory, representation of digital image, Spatial and gray level resolution, Zooming and shrinking, some basic relationships between pixels.	Chapter -4 Pg 149 - 166	
2	Image Enhancement in spatial domain Gray level transformations, Piecewise linear transformation, Histogram processing, enhancement using Arithmetic/ logic operations, Basics of spatial filtering, Smoothing and sharpening spatial filters, Use of first order and second order derivative in enhancement.	Gonzalez and Woods Chapter -3 Pg 76 - 130	**7**
3	Image Enhancement in frequency domain Two dimensional Fourier transform, properties of frequency domain, correspondence between filtering in spatial and frequency domain, Smoothing and Sharpening frequency domain filters, Homomorphic filtering	Gonzalez and Woods Chapter -4 Pg 148 - 193	**6**
4	Image Restoration Model of image degradation/ Restoration process, Noise models, Noise reduction in spatial domain and frequency domain, Inverse filtering, Wiener filtering.	Gonzalez and Woods Chapter -5 Pg 221 - 261	**7**
5	Image compression Fundamentals of Image compression, Types of redundancy. Image compression model, concepts of information theory, Fundamental coding theorems, Estimation of entropy, Variable length coding, Huffman coding, Near optimal variable length coding, Arithmetic coding, LWZ coding, Bit plane coding , constant area coding, run length coding, Lossless predictive coding, image compression standards (JPEG, JPEG2000)	Gonzalez and Woods Chapter -8 Pg 411 - 456	**7**
6	Image Segmentation Detection of discontinuities (point, line edge), Edge linking and boundary detection, Thresholding, Basic global thresholding, Adaptive thresholding, Region based segmentation, region growing, splitting and merging.	Gonzalez and Woods Chapter-10 Pg 568 - 615	**6**

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. R.C.Gonzalas and R.E.Woods: Digital Image Processing, Prentice Hall, 3rd Ed

Reference Books

1. A.K.Jain, Fundamentals of Digital Image Processing, Prentice Hall.
2. S.Sridhar, Digital Image Processing, Oxford University Press.

ADVANCED NEURAL NETWORKS

(Elective Subject)

Course Code:	13M1WEC231	**Semester:**	M. Tech. (ECE), 2nd year B.Tech. (ECE) 8th Sem.
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

1. To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
2. Expose the students to neural network applications in engineering design.

Course Outcomes

Upon completion of the course, the student are expected to

1. Comprehend the fundamental theory and concepts of neural networks, and compare Biological neuron and artificial neuron networks.
2. Assess the power and usefulness of artificial neural networks and identify different neural network architectures, algorithms, applications and their limitations.
3. Select appropriate neural network architectures for a given application (i.e. they shall recognize the class of applications and relate it to specific architectures).
4. To understand Reveal different applications of these models to solve engineering and other problems as pattern matching, control, optimization, and other areas.
5. Study and analyze a research paper on application of Neural networks and must orally present their projects in the class.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	INTRODUCTION TO NEURAL NETWORKS: Artificial Neural Networks (ANN) and their biological roots and motivations. Comparison Between Artificial and Biological Neural Networks, Applications of Neural network. Network Architecture, Taxonomy of neural networks: feed forward and recurrent networks.	Haykins Chapter 1 Sivanandam Chapter 1 and 2	6
2.	LEARNING PROCESS: Types of learning, Error Correction learning, Memory based learning, Boltzmann learning, Credit Assignment Problem. Learning paradigms: supervised and unsupervised learning laws. Learning Laws : Hebb's rule, Delta rule, Widrow - Hoff (The Least-Mean-Square) learning rule, correlation learning rule, instar	Haykins Chapter 2 Sivanandam Chapter 2 and 3	10

	and outstar learning rules, Competitive learning, Learning Tasks.		
3.	SUPERVISED LEANING: The Perceptron and its learning law, Classification of linearly separable patterns, Multi-Layer Perceptron, Supervised Learning, Back-Propagation Learning law. Feed forward networks, Recurrent Networks. RADIAL BASIS FUNCTION Neural Networks, Memory based learning, , Boltzmann learning.	Sivanandam Chapter 3,4 Haykin Chapter 3 ,4, 5	12
4.	UNSUPERVISED LEANING: Winner takes-all Networks, Competitive Learning, Kohonen's Self organizing Maps Self-organizing Feature-Mapping Algorithm; Properties of SOM algorithms; Examples of Feature Maps; Applications and Adaptive Resonance Theory.	Sivanandam Chapter 5 Haykin Chapter 9,14	8
5.	APPLICATIONS OF NN:ANNs as signal processing devices: Classification, Function approximation and pattern recognition problems. Solving Optimization Problems, Solving Traveling Salesman Problems. Application in Handwritten Character Recognition, Biomedical, Communication, and Healthcare.	Sivanandam Chapter 5,6	5
6.	One project- Research paper or design engineering problem		3
		Total Number of Lectures	**44**

Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. Simon Haykin, "Artificial Neutral Networks".
2. Yegna Narayanan, "Artificial Neural Networks".
3. S.N.Sivanandam, S.Sumathi, "Introduction to Neural Networks using MATLAB".

4. S.N.Sivanandam, S.N Deepa, “Principles of Soft Computing”.

Reference Books

1. L. Fausett, “Fundamentals of Neural Networks: Architectures, Algorithms, and Applications”, Prentice-Hall, 1994
2. Jack M. Zurada, “Introduction to Artificial Neural Systems”, PWS Publishing Co., Boston, 2002.

ONLINE MATERIAL

http://nptel.ac.in/courses/117105084/

http://nptel.ac.in/courses/106105079/

SPECTRAL ANALYSIS FOR SIGNAL PROCESSING

(Elective Subject)

Course Code:	**16B1WEC832**	**Semester:**	**8th Semester, B. Tech (ECE)**
Credits:	**3**	**Contact Hours:**	**L-3, T-0,P-0**

Pre-requisites: Signals & Systems, Digital Signal Processing

Course Objectives:

The objective of this course to provides well understanding of the spectral methods for signal processing

Course Outcomes

After the study of this course students will be able to:

1. Understand the spectral analysis of the signals.
2. Understand the basics difference between parametric and non-parametric methods of spectral analysis.
3. Familiar with the basics concept of filter bank method for spectral analysis.
4. Understand the basic concept of the spatial methods for spectral analysis of signals.

Course Contents :

Unit	Topics	Text book	Lectures
1	**Basic Concepts** Introduction, Energy Spectral Density of Deterministic Signals, Power Spectral Density of Random Signals, First Definition of Power Spectral Density, Second Definition of Power Spectral Density, Properties of Power Spectral Densities, The Spectral Estimation Problem	[1]&[2]	**06**
2	**Nonparametric Methods** Introduction ,Periodogram and Correlogram Methods, Periodogram ,Correlogram , Periodogram Computation via FFT Radix–2 FFT , Zero Padding , Properties of the Periodogram Method, Bias Analysis of the Periodogram ,Variance Analysis of the Periodogram ,The Blackman–Tukey Method ,The Blackman–Tukey Spectral Estimate, Non negativeness of the Blackman–Tukey Spectral Estimate, Window Design Considerations, Time–Bandwidth Product and Resolution–Variance Tradeoffs in Window Design, Some Common Lag Windows, Window Design Example,Temporal Windows and Lag Windows ,Other Refined Periodogram Methods ,Bartlett Method, Welch Method, Daniell Method,Sample Covariance Computation via FFT, FFT–Based Computation of Windowed Blackman–Tukey Periodograms,Data and Frequency Dependent Temporal Windows: The Apodization Approach	[1] & [3]	**08**

3	**Parametric Methods** Introduction, Signals with Rational Spectra ,Covariance Structure of ARMA Processes ,AR Signals,Yule–Walker Method ,Least Squares Method,Order–Recursive Solutions to the Yule–Walker Equations,Levinson–Durbin Algorithm,Delsarte–Genin Algorithm MA Signals ,ARMA Signals ,Modified Yule–Walker Method ,Two–Stage Least Squares Method ,Multivariate ARMA Signals ,ARMA State–Space Equations ,Subspace Parameter Estimation — Theoretical Aspects ,Subspace Parameter Estimation — Implementation Aspects ,Some Properties of Covariance ,The Burg Method for AR Parameter Estimation , Models of Sinusoidal Signals in Noise, Nonlinear Regression Model ARMA Model, Covariance Matrix Model , Nonlinear Least Squares Method , High–Order Yule–Walker Method, Pisarenko and MUSIC Methods Min–Norm Method, ESPRIT Method , Forward–Backward Approach , Mean Square Convergence of Sample Covariance's for Line Spectral Processes, The Carath´eodory Parameterization of a Covariance Matrix , Using the Unwindowed Periodogram for Sine Wave Detection in White Noise , NLS Frequency Estimation for a Sinusoidal Signal with Time Varying Amplitude, Monotonically Descending Techniques for Function Minimization, Frequency-selective ESPRIT-based Method , A Useful Result for Two-dimensional (2D) Sinusoidal Signals	[1],& [3]	**12**
4	**Filter Bank Methods** Introduction, Filter Bank Interpretation of the Periodogram , Refined Filter Bank Method, Slepian Baseband Filters , RFB Method for High–Resolution Spectral Analysis , RFB Method for Statistically Stable Spectral Analysis , Capon Method , Derivation of the Capon Method , Relationship between Capon and AR Methods , Filter Bank Reinterpretation of the Periodogram , Another Relationship between the Capon and AR Methods, Multiwindow Interpretation of Daniell and Blackman–Tukey Periodograms, Capon Method for Exponentially Damped Sinusoidal Signals, Amplitude and Phase Estimation Method (APES), Amplitude and Phase Estimation Method for Gapped Data (GAPES), Extensions of Filter Bank Approaches to Two–Dimensional Signals	[3], & [1]	**08**
5	**Spatial Methods** Introduction, Array Model, The Modulation–Transmission–Demodulation Process, Derivation of the Model Equation, Nonparametric Methods, Beam forming , Capon Method, Nonlinear Least Squares Method, Yule–Walker Method, Pisarenko and MUSIC Methods, Min–Norm Method, ESPRIT Method , On the Minimum Norm Constraint, NLS Direction-of-Arrival Estimation for a Constant-Modulus Signal ,Capon Method: Further Insights and Derivations, Capon Method for Uncertain Direction Vectors , Capon Method with Noise Gain Constraint , Spatial Amplitude and Phase Estimation (APES), The CLEAN Algorithm, Unstructured and Persymmetric ML Estimates of the Covariance Matrix	[3]	**08**
	Total Lecture Hours		**42**

Evaluation Scheme

1. Test 1 : 15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    1. 10 Marks : Class performance, Tutorials & Assignments
    2. 10 Marks : Quizzes
    3. 5 marks : Attendance

Text Books

1. Hayes, M.H.,"Statistical digital signal processing and modeling" Willey publishers
2. Proakis, John G. Digital signal processing: principles algorithms and applications. Pearson Education India.
3. P.Stoica,and Randolph Moses "Spectral analysis of signals " PHI, Publishers

Reference Book

1. Oppenheim, Alan V., Ronald W. Schafer, and John R. Buck. Discrete-time signal processing, 2nd edition, Pearson Education.
2. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing: a computer- based approach, 2nd edition, Tata McGraw-Hill.
3. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing, 3rd edition, Tata McGraw-Hill.
4. M. Vetterli, J. Kovacevic, and V. K. Goyal, Fourier and Wavelet Signal rocessing. Booksite: **http://fourierandwavelets.org/terms.php**