Course Structure of B.Tech

Department of Electronics and Communication Engineering.
Triguna Sen School of Technology,
Assam University, Silchar

Academic Session: 2019-2020

General, Course structure & Theme
&
Semester-wise credit distribution

A. Definition of Credit:

A. Definition of Credit:	
1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
2 Hours Practical/ Lab (L) per week	1 Credit

B. Range of credits- The total credit for the B.Tech. programme is kept as **160** which is within AICTE proposed range.

C. Structure of Undergraduate Engineering programme:

Sl. No	Category	Credit Breakup (ECE, TSSOT)	AICTE Proposed Credit
1.	Humanities and Social Sciences including Management courses	**13**	12
2.	Basic Science courses	22	25
3.	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	27	24
4.	Professional core courses	50	48
5.	Professional Elective courses relevant to ECE	21	18
6.	Open subjects – Electives from other technical and /or emerging specialization/branch	12	18
7.	Project work, seminar and internship in industry or elsewhere	15	15
8.	Mandatory Courses Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition, Industrial Training]	(non-credit)	
	Total Credit	160	160

D. **Credit distribution in the First year of Undergraduate Engineering program:**

	Lecture(L)	Tutorial(T)	Laboratory/Practical(P)	Total Credit(C)
Engineering Physics	3	1	0	4
Mathematics- I	3	1	0	4
English I	1	0	2	2
Engineering Physics Lab	0	0	4	2
Workshop/Manufacturing Practices	1	0	4	3
Engineering Graphics & Design	1	0	4	3
Engineering Chemistry	3	1	0	4
Mathematics- II	3	1	0	4
Programming for Problem Solving	3	0	0	3

Basic Electrical Engineering	3	1	0	4
English- II	1	0	2	2
Engineering Chemistry Lab	0	0	4	2

E. Category of Courses

BASIC SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	ASH 101	Engineering Physics	3	1	0	4	I
2.	ASH 102	Mathematics-I	3	1	0	4	I
3.	ASH 104	Engineering Physics Lab	0	0	4	2	I
4.	ASH 201	Engineering Chemistry	3	1	0	4	II
5.	ASH 202	Mathematics-II	3	1	0	4	II
6.	ASH 206	Engineering Chemistry Lab	0	0	4	2	II
7.	ASH 301A	Mathematics-III	**2**	**0**	**0**	**2**	III
		Total Credit				22	

ENGINEERING SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	ASH 105	Workshop/Manufacturing Practices	1	0	4	3	i
2.	ASH 106	Engineering Graphics & Design	1	0	4	3	I
3.	ASH 203	Programming for Problem Solving	3	0	0	3	II
4.	ASH 204	Basic Electrical Engineering	3	1	0	4	II
5.	ASH 207	Programming for Problem Solving Lab	0	0	4	2	II
6.	ASH 208	Basic Electrical Engineering Lab	0	0	2	1	II
7.	ASH 305	Basic Electronics	**2**	**0**	**0**	**2**	III

8.	ECE 407	Microelectronics Technology	**3**	**0**	**0**	**3**	IV
9.	ECE 408	Energy Science and Engineering	**2**	**0**	**0**	**2**	IV
10.	ECE 605	Electronic Instrumentation and Measurement	3	0	0	3	VI
11.	ECE 606	Electronic Instrumentation and Measurement Lab	0	0	2	1	VI
		Total Credit				27	

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	ASH 103	English I	1	0	2	2	I
2.	ASH 205	English- II	1	0	2	2	II
3.	ASH 302	Effective Technical Communication	**3**	**0**	**0**	**3**	III
4.	ASH 401	Management-I (Organisational Behaviour)	**3**	**0**	**0**	**3**	IV
5.	ASH 502	Management- II (Operations Research and Industrial Management)	**3**	**0**	**0**	**3**	V
		Total Credit				13	

PROFESSIONAL CORE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	ECE 301	Electronic Devices	**3**	**0**	**0**	**3**	III
2.	ECE 302	Electronic Devices Lab	**0**	**0**	**2**	**1**	III
3.	ECE 303	Digital System Design	**3**	**0**	**0**	**3**	III
4.	ECE 304	Digital System Design Lab	**0**	**0**	**2**	**1**	III
5.	ECE 305	Signal and Systems	**3**	**0**	**0**	**3**	III
6.	ECE 306	Network Theory	**3**	**0**	**0**	**3**	III
7.	ECE 307	Network Theory Lab	**0**	**0**	**2**	**1**	III
8.	ECE 401	Analog and Digital Communication	**3**	**0**	**0**	**3**	IV
9.	ECE 402	Analog and Digital Communication Lab	**0**	**0**	**2**	**1**	IV
10.	ECE 403	Analog Electronic Circuits	**3**	**0**	**0**	**3**	IV
11.	ECE 404	Analog Electronic Circuits Lab	**0**	**0**	**2**	**1**	IV

12.	ECE 405	Microprocessor and Microcontroller	**3**	**0**	**0**	**3**	IV
13.	ECE 406	Microprocessor and Microcontroller Lab	**0**	**0**	**2**	**1**	IV
14.	ECE 501	Electromagnetic Waves	**3**	**0**	**0**	**3**	V
15.	ECE 502	Electromagnetic Waves Lab	**0**	**0**	**2**	**1**	V
16.	ECE 503	Computer Architecture	**3**	**0**	**0**	**3**	V
17.	ECE 504	Probability Theory and Stochastic Process	**3**	**0**	**0**	**3**	V
18.	ECE 505	DSP	**3**	**0**	**0**	**3**	V
19.	ECE 506	DSP Lab	**0**	**0**	**2**	**1**	V
20.	ECE 601	Control Systems	**3**	**0**	**0**	**3**	VI
21.	ECE 602	Computer Network	**2**	**0**	**0**	**2**	VI
22.	ECE 603	Computer Network Lab	**0**	**0**	**2**	**1**	VI
23.	ECE 706	Antennas and Wave Propagation	**3**	**0**	**0**	**3**	VII
		Total Credit				50	

PROFESSIONAL ELECTIVE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	ECE 507	P. Elective-I	3			3	V
2.	ECE 607	P. Elective-II	3			3	VI
3.	ECE 701	P. Elective-III	3			3	VII
4.	ECE 702	P. Elective-IV	3			3	VII
5.	ECE 703	P. Elective-V	3			3	VII
6.	ECE 801	P. Elective-VI	3			3	VIII
7.	ECE 802	P. Elective-VII	3			3	VIII
		Total Credit				21	

OPEN ELECTIVE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	ASH 601	Open Elective – I **(Understanding Culture and Society through Literature)**	3	0	0	3	VI
2.	ECE 704	Open Elective – II **(Adv. Digital System Design)**	3	0	0	3	VII
3.	ECE 803	Open Elective – III	3	0	0	3	VIII
4.	ECE 804	Open Elective – IV	3	0	0	3	VIII
		Total Credit				12	

PROJECT WORK/SEMINAR/INTERSHIP

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	ECE 604	Mini Project	0	0	2	1	VI
2.	ECE 705	Final Year Project Stage -I	0	0	10	5	VII
3.	ECE 805	Final Year Project Stage -II	0	0	18	9	VIII
		Total Credit				15	

LIST OF PROFESSIONAL ELECTIVE COURSES UNDER THE SPECIALIZED TRACKS

Sl. No.	Tracks	Electives	Preferred Semester
1	Electronic Devices and Circuits	I. CMOS Design	V
		II. Power Electronics	V
		III. Nano Electronics	V
		IV. Mixed Signal design	VII
		V. High Speed Electronics	VIII
2	Wireless Communication and Networks	I. Mobile Communication and Networks	VII
		II. Fiber Optic Communication	VIII
		III. Satellite Communication	VIII
		IV. Wireless Sensors Networks (WSN)	VIII
		V. Wavelets	VIII
3	Information Processing	I. Information Theory and Coding	VI
		II. Speech and Audio Processing	VI
		III. Digital Image & Video Processing	VII
		IV. Adaptive Signal Processing	VII
4	Microwave and RF Systems	I. Microwave Theory and Techniques	VII
5	MEMS	II. Introduction to MEMS	V

6	Software and Embedded systems	I. Scientific Computing	VI
		II. Embedded Systems	VII
		III. Error Correcting Codes	VII

LIST OF OPEN ELECTIVE COURSES UNDER THE SPECIALIZED TRACKS

Sl. No.	Tracks	Electives	Preferred Semester
1	Human Resource Development and Organizational Behavior	I. Values and Ethics	V/VI
		II. Understanding Culture and Society through Literature	VI
2	History of Science and Technology	I. History of Science and Technology in India	V/VI
	Software Engineering	I. Operating System	VIII
	Bio-medical Electronics	I. Biomedical Instrumentation	VIII
2	Microelectronics and VLSI	I. Advanced Digital System Design	VII
		II. Analog VLSI Design	VIII

4 year Curriculum Structure
B.Tech in Electronics and Communication Engineering
Total credits (4 year course): 160

I. Mandatory Induction Program

Induction program (mandatory)	**3 weeks duration** (Please refer Appendix-A for guidelines & also details available in the curriculum of Mandatory courses)
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

First Semester

Sl. No.	Course Code	Course Title	Contact hours/week			Credits
			L	T	P	
1	ASH 101	Engineering Physics	3	1	0	4
2	ASH 102	Mathematics- I	3	1	0	4
3	ASH 103	English I	1	0	2	2
4	ASH 104	Engineering Physics Lab	0	0	4	2
5	ASH 105	Workshop/Manufacturing Practices	1	0	4	3
6	ASH 106	Engineering Graphics & Design	1	0	4	3
	Total Credits					**18**
9 10	MC Course CODE	Induction Program of 3 weeks (including Universal Human Values I)				**0 (Non-Credit)**

Second Semester

Sl. No.	Course Code	Course Title	Contact hours/week			Credits
			L	T	P	
1	ASH 201	Engineering Chemistry	3	1	0	4
2	ASH 202	Mathematics- II	3	1	0	4
3	ASH 203	Programming for Problem Solving	3	0	0	3
4	ASH 204	Basic Electrical Engineering	3	1	0	4
5	ASH 205	English- II	1	0	2	2

6	ASH 206	Engineering Chemistry Lab	0	0	4	2
7	ASH 207	Programming for Problem Solving Lab	0	0	4	2
8	ASH 208	Basic Electrical Engineering Lab	0	0	2	1
	Total Credits					**22**

Third Semester

Sl. No.	Course Code	Course Title	Contact Hrs/Week			Credit
			L	T	P	
1	ECE 301	Electronic Devices	**3**	**0**	**0**	**3**
2	ECE 302	Electronic Devices Lab	**0**	**0**	**2**	**1**
3	ECE 303	Digital System Design	**3**	**0**	**0**	**3**
4	ECE 304	Digital System Design Lab	**0**	**0**	**2**	**1**
5	ECE 305	Signal and Systems	**3**	**0**	**0**	**3**
6	ECE 306	Network Theory	**3**	**0**	**0**	**3**
7	ECE 307	Network Theory Lab	**0**	**0**	**2**	**1**
8	ASH 301A	Mathematics- III	**2**	**0**	**0**	**2**
	ASH 302	Effective Technical Communication	**3**	**0**	**0**	**3**
	ASH 305	Basic Electronics	**2**	**0**	**0**	**2**
Total						**22**

Fourth Semester

Sl. No.	Course Code	Course Title	Contact Hrs/Week			Credit
			L	T	P	
1	ECE 401	Analog and Digital Communication	**3**	**0**	**0**	**3**
2	ECE 402	Analog and Digital Communication Lab	**0**	**0**	**2**	**1**
3	ECE 403	Analog Electronic Circuits	**3**	**0**	**0**	**3**
4	ECE 404	Analog Electronic Circuits Lab	**0**	**0**	**2**	**1**
5	ECE 405	Microprocessor and Microcontroller	**3**	**0**	**0**	**3**
6	ECE 406	Microprocessor and Microcontroller Lab	**0**	**0**	**2**	**1**
7	ECE 407	Microelectronics Technology	**3**	**0**	**0**	**3**
8	ECE 408	Energy Science and Engineering	**2**	**0**	**0**	**2**
9	ASH 401	Management-I (Organisational Behaviour)	**3**	**0**	**0**	**3**
10	ASH 402	Environmental Science	**2**	**0**	**0**	**0 (Non-Credit)**
Total						**20**

Fifth Semester

Sl. No.	Course Code	Course Title	Contact Hrs/Week			Credit
			L	T	P	
1	ECE 501	Electromagnetic Waves	**3**	**0**	**0**	**3**
2	ECE 502	Electromagnetic Waves Lab	**0**	**0**	**2**	**1**
3	ECE 503	Computer Architecture	**3**	**0**	**0**	**3**
4	ECE 504	Probability Theory and Stochastic Process	**3**	**0**	**0**	**3**
5	ECE 505	DSP	**3**	**0**	**0**	**3**
6	ECE 506	DSP Lab	**0**	**0**	**2**	**1**
7	ECE 507	PE -1 A. CMOS Design B. Power Electronics C. Nano electronics D. Introduction to MEMS	**3**	**0**	**0**	**3**
8	ASH 502	Management- II (Operations Research and Industrial Management)	**3**	**0**	**0**	**3**
9	ASH 503	Constitution of India	**2**	**0**	**0**	**0 (Non-Credit)**
Total						**20**

Sixth Semester

Sl. No.	Course Code	Course Title	Contact Hrs/Week			Credit
			L	T	P	
1	ECE 601	Control Systems	**3**	**0**	**0**	**3**
2	ECE 602	Computer Network	**2**	**0**	**0**	**2**
3	ECE 603	Computer Network Lab	**0**	**0**	**2**	**1**
4	ECE 604	Mini Project	**0**	**0**	**2**	**1**
5	ECE 605	Electronic Instrumentation and Measurement	**3**	**0**	**0**	**3**
6	ECE 606	Electronic Instrumentation Measurement Lab	**0**	**0**	**2**	**1**
7	ECE 607	PE -2 A. Information Theory and Coding B. Speech and Audio Processing C. Scientific Computing	**3**	**0**	**0**	**3**
8	ASH 601	Understanding Culture and Society through Literature	**3**	**0**	**0**	**3**
Total						**17**

Seventh Semester

Sl. No.	Course Code	Course Title	Contact Hrs/Week			Credit
			L	T	P	
1	ECE 701	PE-3 A. Mixed Signal design B. Mobile Communication and Networks C. Microwave Theory and Techniques	**3**	**0**	**0**	**3**
2	ECE 702	PE-4 A. Digital Image & Video Processing B. Adaptive Signal Processing	**3**	**0**	**0**	**3**
3	ECE 703	PE-5 A. Embedded Systems B. Error Correcting Codes	**3**	**0**	**0**	**3**
4	ECE 704	OE-2 (Advanced Digital System Design)	**3**	**0**	**0**	**3**
5	ECE 705	Project Stage -1	**0**	**0**	**10**	**5**
6	ECE 706	Antennas and wave Propagation	3	0	**0**	**3**
7	ECE 707	Industrial training				**0 (Non-Credit)**
Total						**20**

Eighth Semester

Sl. No.	Course Code	Course Title	Contact Hrs/Week			Credit
			L	T	P	
1	ECE 801	PE-6 A. High Speed Electronics B. Wavelets	**3**	**0**	**0**	**3**
2	ECE 802	PE-7 A. Fiber Optic Communication B. Satellite Communication C. Wireless Sensors Networks	**3**	**0**	**0**	**3**
3	ECE 803	OE-3 A. Operating System B. Biomedical Instrumentation	**3**	**0**	**0**	**3**
4	ECE 804	OE-4 (Analog VLSI Design)	**3**	**0**	**0**	**3**
5	ECE 805	Project Stage -2	**0**	**0**	**18**	**9**
Total						**21**

Detailed Syllabus of the Courses offered by Dept. of Electronics and Communication Engineering Triguna Sen School of Technology Assam University, Silchar

Programme Outcome:

1. An ability to apply knowledge of mathematics, science, and technological concepts appropriate to the discipline of ECE.
2. An ability to design, implement and evaluate electronic and communication systems for public health and safety, cultural, societal, and environmental considerations.
3. An ability to design electronic circuits and conduct investigations, as well as to analyze data interpret the results.
4. An ability to use current techniques, skills, and modern tools necessary for practice.
5. An ability to function effectively as an individual and as a team leader in diverse and multidisciplinary situations.
6. An ability to communicate effectively through presentations and clear instructions with the engineering community and society.
7. An ability to develop life-long learning for the changing technological environment.

Semester – 1

First semester courses are offered by ASH department. Refer detailed syllabus of published by ASH department.

Semester – 2

Second semester courses are offered by ASH department. Refer detailed syllabus of published by ASH department.

Semester – 3

Course code: ECE 301
Course Name: ELECTRONIC DEVICES (SOLID STATE)

Course Objective

1. To provide an insight into the basic semiconductor concepts.
2. To provide a sound understanding of current semiconductor devices and technology to appreciate its applications to electronics circuits and system

Unit-1:
Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors

Unit-2:
Generation and recombination of carriers; Poisson and continuity equation, P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown,
Zener breakdown, Transport phenomena in semiconductor junctions. Junction current flow, semiconductor junctions and hetero-junctions.

Unit-3:
Zener diode, Schottky diode, tunnel diodes, Varactor, Semiconductor sensors and detectors, Opto-electronic Devices: Optical absorption, photo-detectors, photodiode and solar cell, LEDs and LCDs, Laser diode.

Unit-4:
Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model, Field Effect Transistors: V-I characteristics, MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor,

Unit-5:

Elements of device fabrications technology, Basic p-n junction and its fabrication, Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Course Outcomes:
At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor Physics
2. Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.
3. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Text /Reference Books:

1. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson,2014.
2. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley &Sons, 2006.

4. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.
6. A. K. Maini and Varsha Agrawal," Electronics Devices and Circuits" Wiley
7. R. L. Boylestad and L. Nashelsky - Electronics Devices and Circuit Theory- Pearson
8. J.Millman, C.C.Halkias, and S. Jit, "Electronic Devices and Circuits"Tata McGraw Hill
9. A. K. Singh," Electronics Devices and Integrated Circuits" –PHI
10. D.K. Bhattacharya and R. Sharma," Solid State Electronic Devices"-Oxford

Course code: ECE 302
Course Name: ELECTRONIC DEVICES LAB

Course Objective

The objective of this laboratory is to understand the diverse electronic components and their concepts, working and characteristics of Different Diodes, BJT, FET and MOSFET Transistors. And also gather basic knowledge of device fabrication.

Experiments:

1. Study of electronic components
2. P-N Junction Diode Characteristics
   Part A: Germanium Diode (Forward bias & Reverse bias)
   Part B: Silicon Diode (Forward bias only)
3. Zener Diode Characteristics
   Part A: V-I Characteristics
   Part B: Zener Diode act as a Voltage Regulator
4. V-I Characteristics of Schottky diode
5. V-I characteristics of LED
6. Photodiode in both the photovoltaic and photoconductive modes.
7. BJT Characteristics (CE Configuration)
   Part A: Input Characteristics
   Part B: Output Characteristics
8. BJT Characteristics (CC Configuration)
   Part A: Input Characteristics
   Part B: Output Characteristics
9. BJT Characteristics (CB Configuration)
   Part A: Input Characteristics
   Part B: Output Characteristics
10. FET Characteristics
    Part A: Drain (Output) Characteristics
    Part B: Transfer Characteristics
11. MOSFET Characteristics
    Part A:
    Part B:
12. Introduction to of device fabrications technology

Course Outcomes
At the end of this course students will demonstrate

1. An ability to identify various components and their different parts, measures and record parameters and use different electronic components.
2. An ability to verify the working of different diodes, transistors, and measuring instruments. Identifying the procedure of doing the experiment.
3. An ability to design the circuits with basic semiconductor devices (active & passive elements), measuring instruments & power supplies that serves many practical purposes.
4. An ability to construct, analyse and troubleshoot the designed circuits.
5. Ability to measure and record the experimental data, analyse the results, and prepare a formal laboratory report.
6. Ability to understand the basic of device fabrications technology

Course code: ECE 303
Course Name: Digital System Design

Course Objective: To familiarize the student with the analysis, design and evaluation of digital systems of complexity based on SSI, MSI, Logic Families and Programmable logic devices. Also, students will be acquainted with VLSI Design flow which will help them to design electronic circuits of high complexity with the help of Verilog/VHDL programming language.

Unit-I

Binary Number System, 1's and 2's Complement Arithmetic, Binary codes, Code Conversion, Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables.

Unit-II

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU. Sequential Logic Design: Building blocks like S-R, JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers.

Unit-III
Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL.

Unit-IV
ROM organization – PROM – EPROM – EEPROM –EAPROM – RAM organization – Write operation – Read operation – Memory cycle, Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) –Field Programmable Gate Arrays (FPGA).

Unit-V
VLSI Design flow: Design entry: Schematic, HDL, Data types and objects, Dataflow, Behavioral and Structural Modeling.

Course Outcomes: After studying the course, the student will be able to

1. Perform addition or subtraction using 2's complement arithmetic.
2. Design digital circuits with reduced number of gates, using Boolean Algebra and De Morgan's Theorem and applications of K-Map.
3. Generate multiple digital solutions to a verbally described problem.
4. Draw the timing diagrams for the identified signals in a digital circuit
5. Design Synchronous and Asynchronous digital circuits.

6. Design and implement Memory devices.
7. Design and implement VLSI circuits using Hardware Description language.

Text/Reference Books:

1. Fundamentals of Digital Circuits - A. Anand Kumar.
2. Modern Digital Electronics – R. P. Jain
3. A VHDL Primer – J. Bhasker

Course code: ECE 304

Course Name: Digital System Design Lab

Course Objective:

To familiarize the student with the basic aspects of the digital electronic logic gates and circuits, and to impart the ability in them to practically design and analysis the various digital electronic circuits.

Laboratory Practical Work:

1. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates.
2. Construction of half and full adder using XOR and NAND gates and verification of its operation.
3. Realization of logic functions with the help of Universal Gates (NAND, NOR).
4. Verify Binary to Gray and Gray to Binary conversion using NAND gates only.
5. Verify the truth table of one bit and two bit comparator using logic gates.
6. Verify the truth table of RS, JK, T and D flip-flops using NAND and NOR gates.
7. Design and Verify the 4-Bit Serial In - Parallel Out Shift Registers.
8. Implementation and verification of decoder or de-multiplexer and encoder using logic gates.
9. Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates.
10. Design and verify the 4- Bit Synchronous or Asynchronous Counter using JK Flip Flop.

Course Outcomes:

At the end of the course, the student will demonstrate the practical ability to

1. Verify the logic levels of various Logic Gates.
2. Realize the construction of half and full adder.
3. Realize the logic functions of Universal Gates.
4. Verify the logic levels of Flip-flops.
5. Design Synchronous and Asynchronous counters.
6. Design and analysis of basic electronic circuits and to verify their operation.

COURSE CODE: ECE 305

COURSE NAME: Signals and Systems

Course objective: To make the students understand the physical meaning of signals, systems and its various classifications. The students will be able to correlate the concept of the subject with the real life phenomenon

Unit I: Introduction to signals and systems

Definition of Signals, Basic Signals, Classification of Signals, Operations on Signals, Definition of Systems, System Properties: Linearity: Superposition and Homogeneity, Shift-Invariance, Causality, Stability, LTI Systems and its Properties, Convolution.

Unit II: Fourier analysis of Signals

Introduction, Fourier Series representation of Continuous Time (CT) Periodic Signals, Convergence of the Fourier series, Properties of CT Fourier series, Fourier series representation of Discrete Time (DT) periodic signals and its Properties. Fourier Transform of aperiodic signals in CT and DT, Properties of Fourier Transform, Basic idea of Discrete Fourier Transform.

Unit III: Laplace Transform

Introduction, Region of Convergence and its properties, Poles and Zeros of system, Properties of LT, Inverse Laplace Transform, Analysis and Characterization of LTI systems using Laplace Transform.

Unit IV: DT conversion from CT

State-space analysis, The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

Unit V: Z -Transform

Introduction, Region of Convergence and its properties, Properties of Z-Transform, Inverse Z-Transform, Analysis and Characterization of LTI systems using Z-Transform. Initial and Final theorem of Z-Transform.

Course outcomes:

At the end of this course students will

1. *Have better understanding of signals and Systems*
2. *Be able to represent continuous and discrete systems in time and frequency domain using different transforms*
3. *Be able to state about the stability of a given system*
4. *Have better understanding of sampling and reconstruction of a sign*

Text/Reference books:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. 4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
3. 5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
4. 9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.

Course code: ECE 306
Course Name: Network Theory

Course Objectives The goal of this course is to help the students have thorough

1) Understanding about the electrical network theorems
2) Understanding about transient analysis.
3) Understanding about two port networks and filters.

Unit 1:

Active Elements, passive Element, Kirchhoff's Laws,Nodal Analysis, MESH Analysis, Network Theorems: Superposition, Thevenin's ,Norton's Theorem, Maximum power Transfer, compensation ,reciprocity, and Tallegen's theorem.

Unit 2:

Transient analysis of RL, RC, and RLC networks with and without initial conditions by Laplace transform method with DC and AC excitation.

Unit 3:

Two Port Networks: Relationship of Two port network variables, short circuit admittance parameters, open circuit impedance parameters, transmission parameters, relationship between parameter sets,.

Unit 4:

Characterization of LTI two port networks Z, Y, ABCD and h-parameters, reciprocity and symmetry. Inter relationships between the parameters, inter-connections of two port networks.

Unit 5:

Introduction to filter, Butterworth type, band pass, low pass, high pass and band reject filters. Network topology, Network graphs, Trees, Incidence matrix, Tie-set matrix and Cut-set matrix.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand basics electrical circuits with nodal and mesh analysis.
2. Appreciate electrical network theorems.
3. Apply Laplace Transform for steady state and transient analysis.
4. Determine different network functions.

Text/Reference Books

1. Van, Valkenburg.; "Network analysis"; Prentice hall of India, 2000
2. Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill New Delhi, 1994
3. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education.
4. Donald E. Scott : "An Introduction to Circuit analysis: A System Approach" McGraw Hill Book Company.
5. A.Chakrabarti,'Circuit Theory" DhanpatRai and Co.
6. D.RoyChoudhary,"Networks and Systems" Wiley Eastern Ltd. W.H. Hayt and Jack E-Kemmerly, Engineering Circuit analysis" Tata McGraw Hill.

Course code: ECE 307
Course Name: Network Theory Lab

Course Objective: The objective of this laboratory is:

1) To understand the analytical techniques to solve basic electrical circuits and theorems.
2) Design and conduct experiments, as well as analyze and interpret data.

Experiments:

1) Verification KCL and KVL.
2) Verification of the principle of , superposition with ac and dc sources.

3) Verification of Thevenin, and Nortan theorems
4) Verification of Reciprocity Theorem
5) Verification of maximum power transfer theorem .
6) Study of unit step response of an RC circuit.
7) Study of unit step response of an RL circuit.
8) Study the unit step response of an RLC circuit.
9) Design a LPF for a given cut-off frequency.
10) Design a HPF for a given cut-off frequency.

Course Outcomes:

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

1) Apply different techniques to solve electrical circuits
2) Design and conduct experiments, as well as analyze and interpret data.
3) Analyze, design & simulate various electronic circuits.

Semester – 4

COURSE CODE: ECE 401

COURSE NAME: Analog and Digital Communication

Course objective:

To introduce the elements of communication systems and the types of communication systems. To explain the need for modulation and describe the concepts of modulation techniques. Introduce the basic concept of digital communication blocks and its error analysis

Unit I

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation.

Unit II

Representation of FM and PM signals, Spectral characteristics of angle modulated signals. Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.

Unit III

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Unit IV

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms-Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Unit V

Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques, Synchronization and Carrier Recovery for Digital modulation.

Course outcomes:

At the end of this course students will

1. Have better understanding of Communication systems
2. Identify and compare different pulse modulation techniques
3. Analyse the performance of digital communication systems at baseband and passband level.
4. Choose the appropriate modulation techniques based on their error performance and data rates.

Text/Reference books:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems”, Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.

COURSE CODE: ECE 402
COURSE NAME: Analog and Digital Communication Lab

Course objective:
To make the students familiar with various equipment and will be capable to design and measure AM, FM, QPSK, and spread spectrum communication systems; To measure and analyze the various factor affecting the performance of the communication systems.

Experiments List

USING MATLAB Coding/ Hardware kit:-

1. Design and develop AM Generation system
2. Design and develop AM Demodulation
3. Study of Time Division Multiplexing system.
4. Design and develop FM Generation
5. Design and develop FM demodulation
6. Design and develop PAM/PWM/PPM Generation (H/W & S/W)
7. Generation and detection of ASK modulation and demodulation
8. Generation and detection of FSK modulation and demodulation
9. Generation and detection PSK modulation and demodulation
10. Implementation of QPSK modulation and demodulation

Course outcomes:

At the end of this course students will

1. Have more practical or physical understanding of Communication systems.
2. Capable to operate various equipment.
3. Be able to quantify the performance by measuring parameters like SNR etc.

Course code: ECE 403
Course Name: Analog Electronic Circuits

Course Objective:
To familiarize the student with the basics of transistor amplifier circuits, power amplifiers, oscillators, ADC/DAC circuits and to grow up their comprehensive abilities in design and analysis of analog electronic circuits.

Unit-I

Load lines (AC and DC), Operating Points, Fixed Bias and Self Bias, Voltage Divider Bias, DC Bias with Voltage Feedback, Bias Stabilization, Design Operation..

Unit-II

BJT/MOSFET structure and I-V characteristics, BJT/MOSFET as a switch. BJT/MOSFET as an amplifier, High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Power amplifiers: Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc.

Unit-III

OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications

Unit-IV

Oscillations, frequency stability of oscillatory circuits, Tuned based Oscillators, Hartley Oscillator, Colpitts Oscillators, Clapp Oscillator, Crystal Oscillator, Phase Shift Oscillator, Wein Bridge Oscillator. Oscillator circuit design using BJT, FET. Concept of multi-vibratorastable, monostable, and bistable and their applications Block diagram of IC555 and its working, IC555 as monostable and astable multi-vibrator.

Unit-V

Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder etc. Analog- to digital converters (ADC): Single slope, dual slope, successive approximation, flash etc.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the concept of load lines and bias stabilization.
2. Understand the characteristics of transistors and their high frequency performance.
3. Design and analyze various multistage amplifier circuits.
4. Understand the effect of feedback on gain and bandwidth, and various topologies of feedback amplifiers.
5. Design sinusoidal and non-sinusoidal oscillators.
6. Understand the functioning of OP-AMP and design OP-AMP based circuits.
7. Design ADC and DAC.

Text Books:

1. Millman & Halkias – Integrated Electronics, Tata McGraw Hill.
2. Franco—Design with Operational Amplifiers & Analog Integrated Circuits, 3/e, TMH
3. Schilling &Belone—Electronic Circuit: Discrete & Integrated, 3/e , TMH
4. Gayakwad R.A -- OpAmps and Linear IC‘s, PHI
5. Coughlin and Drisscol – Operational Amplifier and Linear Integrated Circuits –Pearson Education Asia

Reference Books

1. Malvino, Electronic Principles , 6/e ,TMH
2. Millman & Taub- Pulse, Digital & switching waveforms- TMH
3. Horowitz & Hill- The Art of Electronics; Cambridge University Press.
4. Hayes & Horowitz- Student Manual for The Analog Electronics; Cambridge University Press.
5. Boyle‘stead & Nashelsky: Electronic Devices & Circuit theory, PHI.
6. Millman & Halkias: Basic Electronic Principles; TMH.
7. Tobey & Grame – Operational Amplifier: Design and Applications, McGraw Hill.

Course code: ECE 404

Course Name: Analog Electronic Circuits Lab

Course Objective:

To familiarize the student with the basic aspects of the active and passive elements of analog circuits, and to impart the ability in them to practically design and analysis the various analog electronic circuits of amplifiers and oscillators.

Laboratory Practical Work:

1. Obtain the Input and Output Characteristics of BJT in CE configuration.

2. Study of JFET drain and transfer characteristics.

3. Design and Test a single and multistage BJT (CE) amplifier and find performance parameters - Av, Ri, Ro, Ai

4. Study of MOSFET drain and transfer characteristics.

5. Design a Clipper circuit and obtain the characteristics.

6. Design a Clamper circuit and obtain the characteristics.

7. Design Wein bridge oscillator and obtain its characteristics.

8. Design a mono-stable and astable multi-vibrator circuit using IC 555 timer.

Course Outcomes:

At the end of the course, the student will demonstrate the practical ability to

1. Verify the transfer characteristics of transistors.
2. Design multistage amplifiers.
3. Design and verify the characteristics of Clipper and Clamper circuits.
4. Design and verify the principle of oscillation in oscillator.
5. Design multi-vibrator circuits using IC 555 timer, which will again help them to learn about generating pulses and clocks for digital electronic circuits.

Course code: ECE 405

Course Name: Microprocessors and Microcontrollers

Course Objectives:

The goal of this course is to help the students have thorough understanding with the programming and usage of microprocessor and microcontrollers so as to build simple systems. The students should be able to explain the architecture of 8086 microprocessors, analyze the programming techniques.

Unit 1:

Introduction :

Introduction to Microcomputer based system. History Evolution of Microprocessor and microcontrollers and their advantages and disadvantages. Architecture of 8085 Microprocessor. Address / Data Bus multiplexing and demultiplexing. Status and Control signal generation.

Unit 2:

Instruction set of 8085 Microprocessor. Classification of instructions, addressing modes, timing diagram of the instructions. Interrupts.

Unit 3:

The 8086 microprocessor: Architecture, Pin details, memory segmentation, addressing modes, Familiarization of basic Instructions, Interrupts.

Unit 4:

8051 architecture: 8051 micro controller hardware, input/output pins, ports, external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts. Assembly language Programming using 8051.

Unit 5:

Support IC chips: 8255, 8253 and 8251: Block Diagram, Pin Details, Modes of operation, control word(s) format. Interfacing of support IC chips with 8085, 8086 and 8051. Memory interfacing with 8085, 8086 & 8051. ADC / DAC interfacing with 8085, 8086 & 8051.

Course Outcomes

By the end of this course student will be able to:

1. Explain the functioning of microprocessor.
2. Do projects based on interfacing.
3. Enhance the programming skills.
4. Develop systems using different microcontrollers.

Textbooks / References

1. Kenneth J. Ayala, The 8086 Microprocessor: Programming and Interfacing The PC, Delmar Publishers, 2007.
2. Microprocessor architecture, programming and application with 8085 – R. Gaonkar
3. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley
4. A. K. Ray, K. M. Bhurchandi, Advanced Microprocessors and Peripherals, TMH, 2007.
5. A. N. Sloss, D. Symes, C. Wright, ARM System Developer's Guide, Morgan Kaufmann, 2004.
6. Microprocessors and Peripherals by- B.Brey, CBS.
7. Badri Ram., ―Advanced Microprocessors & Interfacing‖ , Tata MC Graw Hill, Edition 1st.
8. Rajiv Kapadia, ―8051 Microcontroller & Embedded Systems‖.,JaicoPublising House

Course code: ECE 406

Course Name: Microprocessors and Microcontrollers Lab

Course Objective:

The objective of this laboratory is to be

1) Taken hands on training on kits of 8085, 8086 and 8051 with the help of assembly language programming.
2) Develop programming of microprocessor and 8051 microcontrollers and its support devices.

List of Experiments:

1) Addition of two 8-bit/16-bit numbers using 8085 trainer kit.
2) Subtraction of two 8-bit/16-bit numbers using 8085 trainer kit.
3) Decimal addition/subtraction using 8085 trainer kit.
4) Complement (1's and 2's) of 8-bit/16-bit numbers using 8085 trainer kit.
5) Left and right shift of 8-bit/16-bit numbers using 8085 trainer kit.
6) Mask of MSB and LSB of 8-bit/16-bit numbers using 8085 trainer kit.
7) Find out square of a number from lookup table using 8085 trainer kit.

8) Find out largest number from array of numbers.
9) Ascending order and descending order.
10) Multiplication and division
11) Arithmetic and Logical Operation 8051 Microcontroller.
12) Find largest no from given data of N –bytes.
13) Find smallest no from given data of N –bytes.
14) Stepper motor interfacing with 8051 using 8255.
15) Interfacing of 7-segment display with 8051.
16) LED blinking.

Course Outcomes: By the end of this course, the student will be able to
1. Learn Architecture & Programming of 8085, 8051 microcontrollers.
2. Design and develop systems based on 8051 micro-controller and its interfaces.
3. Do projects based on interfacing.
4. Demonstrate microcontrollor based projects.
5. Enhance the programming skills

Course code: ECE 407

Course Name: MICROELECTRONICS TECHNOLOGY

Course Objectives

The goal of this course is to provide knowledge about

1) How devices and integrated circuits are fabricated.
2) Understand about modern trends in the microelectronics industry.
3) To introduce the basic concepts of micro systems and advantages of miniaturization.

Unit -1:

Introduction : Introduction, Trends & Projections in microelectronics. Semiconductor materials and their merits and demerits. Monolithic chips trends, Advantages, limitations & classification of ICs. Crystal growth techniques: Bridgeman method, float zone method, Czocharalski method, Wafer Preparation & Crystal Defects.

Unit -2:

Epitaxial Process:

Need of epitaxial layer, vapors phase epitaxy, chemistry of epitaxial process, molecular beam epitaxy, merits and demerits among epitaxial processes.

Oxidation:

Importance of oxidation, types of oxidation techniques, growth mechanism & kinetics, factors affecting the growth mechanisms, dry & wet oxidation, oxidation induced faults.

Unit -3:

Lithography:

Basic steps in lithography, lithography techniques-optical lithography, electron beam lithography, x-ray lithography, ion beam lithography, resists and mask preparation of respective lithographies, printing techniques-contact, proximity printing and projection printing, merits and demerits of lithographies.

Etching: Performance metrics of etching, types of etching- wet and dry etching, dry etching techniques-ion beam or ion-milling, sputter ion plasma etching and reactive ion etching (RIE), merits and demerits of etching.

Unit -4:

Diffusion and Ion Implantation:

Diffusion mechanisms, diffusion reactor, diffusion profile, diffusion kinetics, parameters affecting diffusion profile, Dopants and their behavior, choice of dopants. Ion Implantation- reactor design, impurity distribution profile, properties of ion Implantation, low energy and high energy ion implantation.

Unit -5:

Metallization and Packaging :

Desired properties of metallization for VLSI, metallization choices, metallization techniques –vacuum evaporation, sputtering. Introduction to packaging, packaging process, package design considerations, various package types.

Course Outcomes:

1. Understand the material properties, crystalline structure of silicon and different crystal growth techniques.
2. Kinetics of Silicon dioxide growth both for thick, thin and ultra thin films and oxidation modeling
3. Techniques for introducing dopants into the bulk material, comparison of diffusion and ion implantation, modeling .
4. Etching, photolithography and metallization method.

Text Books/REFERENCES :

1. S.M. Sze, "VLSI Technology", TMH
2. S.K. Gandhi, "VLSI Fabrication Principles", John Willey & Sons
3. S.D Senturia, "Microsystems design". Kluwer Academic Publishers,2001
4. N.P. Mahalik, " MEMS", Tata McGraw Hills Publishers.
5. G.T.A. Kovacs, "Micromachined transducer", McGraw Hill, 1998.
6. D. Nagchoudhuri, "Principles of Microelectronics Technology" PHI

Course code: ECE 408
Course Name: Energy Science & Engineering

Course Objective: To provide an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application.

Unit I:

Introduction to Energy Science: Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues.

Unit II:

Energy Alternatives: The Solar Option, The Nuclear Option, Tar sands and Oil Shale, Tidal Energy, Geothermal Energy Solar Energy: Solar Radiation, availability, measurement and estimation, Solar Thermal Conversion Devices and Storage, Wave Energy and Ocean Thermal Energy Conversion, Wind Energy Conversion, Biomass Energy Conversion Energy from Waste.

Unit III:

Energy and Climate: Carbon Cycle: Natural systems autotrophs, heterotrophs, Photosynthesis- efficiency of natural ecosystems. Climate Science Research: Climate history; Greenhouse gas effect; Anthropogenic climate change; Role of different gases. Climate Policy: Kyoto protocol; UNFCCC; IPCC; Geopolitics of GHG control; Carbon market; Relevance for India.

Unit IV:

Energy Devices: High efficiency solar cells, PERL Si solar cell, III-V high efficiency solar cells, GaAs solar cells, tandem and multi-junction solar cells, solar PV concentrator , thin-film solar cells, supercapacitor and hybrid; fuel cells

Unit V:
Systems and Synthesis: Nuclear radiation, fuel cycles, waste and proliferation, Climate change, Concept of Green Building and Green Architecture; Green building concepts, LEED ratings, Energy Audit.

Course outcomes: Upon successful completion of the course, the students will be able to**:**

1. List and generally explain the main sources of energy and their primary applications nationally and internationally
2. Have basic understanding of the energy sources and scientific concepts/principles behind them
3. Understand effect of using these sources on the environment and climate
4. Understand the working principles of various electronic/electrical energy devices.
5. List and describe the primary renewable energy resources and technologies.
6. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

Text/Reference Books:

1. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press
3. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to
4. Solar cells: Operating principles, technology and system applications, by Martin A. Green, Prentice-Hall Inc, Englewood Cliffs, NJ, USA, 1981.
5. Physics of Solar Cells: From Basic Principles to Advanced Concepts by Peter Wurfel, John Wiley & Sons, 2016
6. Energy and the Challenge of Sustainability, World Energy Assessment, UNDP, New York, (2000).
7. Energies: V Smil, MIT Press, Cambridge, 1999.
8. Global Warming: J Houghton, Cambridge University Press, New York, 1997
9. Volker V. Quaschning, Renewable Energy and Climate Change, 2nd Edition, John Wiley
10. Julie A. Kerr, Introduction To Energy and Climate : Developing A Sustainable Environment, T&F/Crc Press.
11. Michael B. McElroy, Energy and Climate: Vision for The Future, Oxford University Press
12. John Wiley, Vasilis M. Fthenakis, Paul A. Lynn, Electricity From Sunlight: Photovoltaic-Systems Integration And Sustainability, 2nd Edition
13. J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London 1986
14. D. D. Hall and R. P. Grover, Biomass Regenerable Energy, John Wiley, New York, 1987.

Semester – 5

Course code: ECE 501
Course Name: ELECTROMAGNETIC WAVES

Course Objective

1. Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
2. Provide solution to real life plane wave problems for various boundary conditions.
3. Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
4. Visualize TE and TM mode patterns of field distributions in a rectangular waveguide.
5. Understand and analyse radiation by antennas.

Unit 1:

Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Lossless and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

Unit 2:

Maxwell’s Equations- Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface.
Uniform Plane Wave- Uniform plane wave, Propagation of wave, Wave polarization, Poincare’s Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor

Unit 3:

Plane Waves at a Media Interface- Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary

Unit 4:
Waveguides-Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.

Unit 5:
Antennas-Radiation: Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna

Course Outcomes

At the end of this course students will demonstrate the ability to
1. Understand characteristics and wave propagation on high frequency transmission lines
2. Carryout impedance transformation on TL
3. Use sections of transmission line sections for realizing circuit elements
4. Characterize uniform plane wave
5. Calculate reflection and transmission of waves at media interface
6. Analyze wave propagation on metallic waveguides in modal form
7. Understand principle of radiation and radiation characteristics of an antenna

Text/Reference Books:

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005
2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
3. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
4. David Cheng, Electromagnetics, Prentice Hall
5. M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
6. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.
7. C. A. Balanis, "Antenna Theory: Analysis and Design", John Wiley & Sons, 2005

Course code: ECE 502
Course Name: ELECTROMAGNETIC WAVES LAB

Course Objective

1. This is an undergraduate level course in engineering electrodynamics that encompasses topics from all major areas of applied electromagnetics.
2. It constitutes a foundation for more advanced courses for students with emphasis in electromagnetics.
3. It serves as an introduction to wave phenomena and high-frequency concepts for students with areas of emphasis other than electromagnetics.

Laboratory Experiments:

1. Electric Field Pattern Between Two Circular Electrodes
2. Electric Field between Parallel Conductors
3. Electric Field And Potential Inside The Parallel Plate Capacitor
4. Capacitance And Inductance Of Transmission Lines
5. Magnetic Field Outside A Straight Conductor
6. Magnetic Field Of Coils
7. Magnetic Induction
8. Hertz's Experiment to demonstrate the production and reception of radio waves
9. Wireless RF Transmitter and Receiver
10. Simple AM Transmitter / Receiver

Course Outcomes

1. Students can write and interpret phasor Maxwell's equations in differential and integral forms, both in time and frequency domains.
2. Students understand the meaning of complex ε, μ, and σ, and perfect electric and perfect magnetic conductors.
3. Students can comfortably work with plane waves, derive Snell's laws from phase matching, and calculate the reflection and transmission coefficients at the interface of simple media.
4. Students understand the meanings of characteristic impedance and complex propagation constant and can relate them to the basic transmission line parameters
5. Students can calculate input impedance and reflection coefficient of an arbitrarily terminated transmission-line and can use Smith chart to convert these quantities.
6. Students understand the meaning of elemental electric and magnetic dipoles.
7. Students understand the basic parameters of antennas and can relate antenna radiation pattern to its directivity.

Text/Reference Books:

1. D. K. Cheng, Field and Wave Electromagnetics, Second Edition, Addison Wesley, 1989.

2. S. Ramo, J. R. Whinnery, T. V. Duzer, Fields and Waves in Communication Electronics, John Wiley and Sons, 1994.

Course code: ECE 503
Course Name: COMPUTER ARCHITECTURE

Course Objective:

1. Conceptualize the basics of organizational and architectural issues of a digital computer.
2. Learn the function of each element of a memory hierarchy.
3. Study various data transfer techniques in digital computer.
4. Articulate design issues in the development of processor or other components that satisfy design requirements and objectives.
5. This course will also expose students to the basic architecture of processing, memory and i/o organization in a computer system

Unit 1:
Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Ques, Subroutines., Addressing modes.

Unit 2:
Processor organization, Information representation, number formats. Addition and subtraction of signed numbers, Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats.

Unit 3:
Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers - CPU control unit**,** bus structures, Multiple bus organization.

Unit 4:
Memory organization, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory. Performance consideration, Secondary storage.

Unit 5:
System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces (PCI, SCSI, and USB), Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network. Data hazards, Instruction hazards, Influence on instruction sets.

Course Outcomes

At the end of this course students will demonstrate the ability to

1. learn how computers work.
2. know basic principles of computer’s working.
3. analyze the performance of computers.
4. know how computers are designed and built.
5. Understand issues affecting modern processors (caches, pipelines etc.).
6. Categorize memory organization and explain the function of each element of a memory hierarchy
7. Identify and compare different methods for computer I/O mechanisms

Text/Reference Books:

1. V.Carl Hammacher, "Computer Organisation", Fifth Edition.
2. A.S.Tanenbum, "Structured Computer Organisation", PHI, Third edition.
3. Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J.,Prentice Hall Edition.
4. M.M.Mano, "Computer System Architecture", Edition.
5. C.W.Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition.
6. Hayes J.P, "Computer Architecture and Organization", PHI, Second edition
7. William Stallings, "Computer Organization & Architecture –Designing for Performance", 6th Edition, Pearson Education, 2003 reprint.
8. David A. Patterson and John L. Hennessy, "Computer Organization & Design, the hardware / software interface", 2nd Edition, Morgan Kaufmann, 2002 reprint.

Course code: ECE 504

Course Name: PROBABILITY THEORY AND STOCHASTIC PROCESSES

Course Objective

1. Understand concepts of probability, conditional probability and independence
2. Understand random variables and probability distributions.
3. Understand moment generating and characteristic functions.
4. Understand convergence of a sequence of random variables. This include the weak and strong laws of large numbers and the central limit theorem
5. Understand the concepts of correlation functions and power spectral density
6. Understand and apply the concepts of filtering and prediction of a random process

UNIT-1 - 1:

Sets and set operations; Probability space; Axioms of Probability, Properties of Probabilities Conditional probability and Bayes theorem; Combinatorial probability and sampling models.

UNIT-2 - 2:

Discrete random variables, probability mass function, probability distribution function, example, random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions, Independent Random Variables.

UNIT-3 - 3:

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds, Convergence Concepts.

UNIT-4 - 4:

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem. Gaussian Function.

UNIT-5:

Random process. Stationary processes. Mean and covariance functions. Ergodicity. Transmission of random process through LTI. Power spectral density. Spectral Representation, Low-pass and Bandpass Noise Representation.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.
5. Obtain the distributions of functions of random variables
6. Relate probability theory to real statistical analysis.
7. Understand the classifications of random processes and concepts such as strict stationarity, wide-sense stationarity and ergodicity.

Text/Reference Books:

1. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
2. A. Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,
5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
6. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

COURSE CODE: ECE-505

COURSE NAME: Digital Signal Processing

Course objective:

To make students aware about the meaning and implications of the properties of systems and signals. Also, to make students familiar with the most important methods in DSP, including digital filter design, structures and effects in digital filters.

Unit I: Introduction to DSP

Introduction to DSP, Necessity and its Application, Sampling of signals and its reconstruction, Review of Discrete Time Signals and Systems, Review of Z-Transform, Analysis and Characterization of LTI systems using Z-Transform.

Unit II: Discrete Fourier Transform

Review of Discrete Fourier Transform and its Properties, Fast Fourier Transform and its Algorithms: Decimation in Time (DIT) and Decimation in Frequency (DIF).

Unit III: Digital Filters

Introduction to filters, Frequency selective filters: Lowpass, Highpass, Bandpass, and Bandstop filters, Design of IIR filters: Butterworth, Chebyshev and Elliptic Approximations, Design of FIR filters: Windowing method, Park-McClellan's method.

Unit IV: Implementation of DT systems

Introduction, Block diagram representation, Signal Flow graph representation, Realization of basic structures of IIR and FIR filters: direct form-I, direct form-II, cascade form and parallel form structures, Ladder and lattice structures.

Unit V: Finite Word-Length Effects in Digital Filters

Introduction: number representation, analysis of effect of coefficient quantization and rounding off, zero input limit cycles in fixed-point realizations, Introduction to Multirate DSP.

Course outcomes:

At the end of this course students will

1. Be able to represent signals mathematically in discrete time and frequency domains.
2. Have better understanding of digital filters
3. Be able to correlate the course with the real world applications

Text/Reference books:

1. S. K. Mitra, Digital Signal Processing: A computer based approach.TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.

COURSE CODE: ECE 506
COURSE NAME: Digital Signal Processing Lab

Course objective:

To practical implementation of the convolution, correlation, DFT, IDFT, Block convolution, Signal smoothing, filtering of long duration signals, and Spectral analysis of signals.

USING MATLAB Coding:-

1. To develop program for discrete convolution and correlation.
2. To develop program for finding response of the LTI system described by the difference Equation.
3. To develop program for computing inverse Z-transform.
4. To develop program for finding magnitude and phase response of LTI system described by system function H(z).
5. To develop program for computing DFT and IDFT.
6. To develop program for computing circular convolution.
7. To develop program for conversion of direct form realisation to cascade form realisation.
8. To develop program for cascade realisation of IIR and FIR filters.
9. To develop program for designing FIR filter.
10. To develop program for designing IIR filter.
11. Display filtered signals in time domain.
12. Determine the spectral characteristics of speech.

USING DSP KIT:-

1. Introduction to Code Composer Studio
2. Architecture and instruction set of DSP CHIP:- TMS320 series
3. Implementation of FFT of a given sequence.
4. Power Spectrum.
5. Implementation of LP/HP/BP FIR Filter of given sequence.
6. Implementation of LP/HP IIR Filter of given sequence.
7. Generation of DTMF Signal.

Course outcomes:
At the end of this course students will

1. Understand the handling of discrete/digital signals
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.

Course Name: CMOS Design
Course Code: ECE 507A

Course Objective:
To learn MOS transistors, structure, operation, characteristics, and model. To learn basic CMOS circuits. To inverter design and its characteristics. To learn delay model, parasitics, and CMOS layout. To learn design of combinational and sequential CMOS logic circuits.

Unit I
Review of MOS transistor models, Non-ideal behavior of the MOS Transistor. Transistor as a switch.

Unit II
Inverter characteristics, Integrated Circuit Layout: Design Rules, Parasitics.

Unit III
Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout.

Unit IV
Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic.

Unit V
Sequential Circuit Design: Static circuits. Design of latches and Flip-flops.

Text/Reference Books:
1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2011.
2. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

Course Outcomes:
At the end of the course the students will be able to
1. Design different CMOS logic circuits.
2. Model parasitics and delay of CMOS circuits.
3. Design the layout of CMOS circuits.

Course Name: Power Electronics
Course Code: ECE 507B

Course Objective:
To learn basic power electronic devices. To learn different rectifier circuits. To learn inverter and chopper circuits. To learn design of switching power supplies and their application.

Unit 1
Introduction to power electronics: Basic terminologies, definitions, comparison of conventional and power electronics; Characteristics of Selected Devices - Fast recovery diodes, Schottky diode, SCR, gate trigger and commutation circuits, protection circuits, series and parallel connection of SCRs, Diac, Triac, UJT, Power MOSFETs.

Unit 2
Controlled Rectifier **-** Half wave and full wave with resistive & R-L-E and resistive-inductive loads. Free-wheeling diode, three Phase rectifiers, and Bridge rectifiers -half controlled and fully controlled.

Unit 3
Inverters: Principle of operation, voltage driven inverters, current driven inverters; Single phase inverters – PWM techniques, Sinusoidal PWM, Choppers: Basic principles, Type A, B and C choppers Series and parallel turn-off choppers, Morgan choppers and Jones choppers. Cyclo-converter: single phase bridge cyclo-converter and its advantages and disadvantages .

Unit 4
Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter.

Unit 5
Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter – series loaded half bridge DC-DC converter.
Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

BOOKS RECOMMENDED
1. P.C. Sen, ―Power Electronics, Tata McGraw Hill Publishing Co., Ltd
2. S.K. Dutta, ―Power Electronics and Control Prentice Hall of India Pvt. Ltd
3. P.S . Bimbra, ― Power Electronics , Khanna publishers
4. Mohammed H Rashid, ― Power Electronics Circuits Devices and Applications , PHI , New Delhi
5. M D Singh and K . B. Khanchandani, ―Power Electronics, Tata McGraw Hill Publishing Co., Ltd

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Build and test circuits using power devices such as SCR.
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

Course Name: Nano electronics
Course Code: ECE 507C

Course Objective:
To learn basic of nano-electronics. To learn the architecture of nano-computer, Quantum DOT cellular Automata, Single electron circuits. To learn nano-fabrication techniques. To learn Spintronics and Memory Devices and Sensors.

Unit-I
Introduction: Recent past, the present and its challenges, Future, Overview of basic Nano electronics.

Unit-II
Introduction to Nano-computers, Nano-computer Architecture, Quantum DOT cellular Automata (QCA), QCA circuits, Single electron circuits, molecular circuits, Logic switches – Interface engineering – Properties (Self-organization, Size-dependent) – Limitations.

Unit -III
Nanofabrication – Nano-patterning of Metallic/Semiconducting nanostructures (e-beam/X-ray, Optical lithography, STM/AFM- SEM & Soft-lithography) – Nano phase materials – Self-assembled Inorganic/Organic layers.

Unit-IV
Spintronics: Introduction, Overview, History & Background, Generation of Spin Polarization Theories of spin Injection, spin relaxation and spin dephasing, Spintronic devices and applications, spin filters, spin diodes, spin transistors.

Unit-V
Memory Devices And Sensors: Memory devices and sensors – Nano ferroelectrics – Ferroelectric random access memory –Fe-RAM circuit design –ferroelectric thin film properties and integration – calorimetric -sensors – electrochemical cells – surface and bulk acoustic devices – gas sensitive FETs – resistive semiconductor gas sensors – electronic noses – identification of hazardous solvents and gases – semiconductor sensor array

TEXT BOOKS
1. Nanoelectronics & Nanosystems: From Transistor to Molecular & Quantum Devices: Karl Goser, Jan Dienstuhl and others.
2. Nano Electronics and Information Technology: Rainer Waser

REFERENCES
1. Concepts in Spintronics – Sadamichi Maekawa
2. Spin Electronics – David Awschalom

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Design nano-computer, and design circuits using QCA.
2. Design of single electron circuits, and molecular circuits.
3. Understand nano-fabrication techniques.
4. Understand Spintronics, Memory Devices And Sensors.

Course Code: ECE 507D
Course name: Introduction to MEMS

Course Objective: To familiarize the student with the fundamentals of Micro Electro Mechanical Systems (MEMS) and its technology, different materials used for MEMS, design, simulation and fabrication of MEMS devices, and the applications of MEMS to versatile disciplines of engineering.

Unit I:

Introduction to Design of MEMS, Overview and Applications, Commercialization of MEMS/NEMS, introduction to basic MEMS sensors and actuators.

Unit II:

Stresses, Strain, Hookes's law, Poisson effect, Force and Pressure Sensors, Resonant sensor, Accelerometers- types and applications, Vibratory Gyroscopes, Electrostatic Actuators- Comb Drive Actuators , Parallel –Plate Actuator, MEMS/NEMS resonators, micro-thrusters in Satellites, Introduction to Bio-MEMS.

Unit III:

Modeling Strategies: Lump Parameter Modeling, Distributed Parameter Modeling, Introduction to MEMS simulator: COMSOL Multiphysics.

Unit IV:

Wafer cleaning and surface preparation, Oxidation, Deposition Techniques: Sputter deposition, Evaporation, Spin-on methods and CVD, Lithography: Optical, X-ray and E-Beam, Etching techniques, Epitaxy, Principles of bulk and surface micromachining, Lift-off process, Doping: Diffusion and Ion Plantation, Wafer Bonding: Anodic bonding and Silicon fusion bonding, Multi User MEMS Process (MUMPs), Microfabrication and Micromachining of Microdevices, Bulk Micromachining , Surface Micromachining, High-Aspect-Ratio (LIGA and LIGA-Like) Technology, Photolithography, Etching,.

Unit V: Packaging for MEMS

Packaging: Types of packaging, Ceramic, Metal, Molded plastic, Hermetic packaging , Die-attach process, Interconnects .

Course Outcomes:

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

1. Comprehend the underlying working principles of MEMS devices.
2. Integrate the knowledge of semiconductor electronics and solid mechanics, and to apply them in other disciplines such as bio-technology, space science & technology etc.
3. Design and model MEMS devices with different modeling strategies
4. Understand the various fabrication and packaging technologies of MEMS.

Text Books:

1. "Principles of Mocroelectromechanical Systems" – Lee,Ki Bang, John Wiley &Sons, 2011
2. "MEMS and NEMS: Systems, Devices, and structures" – Sergey Edward Lyshevski, CRC Press, 2002.

Reference Books:

1. "An Introduction to Microelectromechanical Systems Engineering" – Nadim Maluf, Kirt Williams, 2nd edition, Artech House, 2004.
2. "Analysis and Design Principles of MEMS Devices" – Minhang Bao, Elsevier, 2005.
3. "Microsystem Design" – Stephen D. Senturia, Kluwer Academic Publishers, 2002

Semester – 6

COURSE CODE: ECE 601
COURSE NAME: Control Systems

Course objective:

To familiarize the students with the concept of control systems, the importance of stability and its analysis in time and frequency domain. Also, the students will have the basic concept of controllers and compensation techniques**.**

Unit I: Introduction to Control Systems
Introduction to Control Problem- Industrial Control Examples, Modeling of Physical Systems, Open Loop and Closed Loop Systems, System Response, Transfer Function, Block Diagram and Signal Flow Graph Analysis.

Unit II: Time domain Analysis
Standard Test Signals, Time Domain Analysis of First and Second Order Systems to Step, Ramp and Other Inputs, Steady State accuracy, Generalized Error Co-Efficient, Types of Systems, Stability Analysis, Absolute and Relative Stability, Routh Hurwitz Criterion, Root Locus Analysis.

Unit III: Frequency domain Analysis
Polar Plots, Phase Margin and Gain Margin, Bode Plot, Stability in Frequency Domain, Nyquist Plots, Nyquist Stability Criterion. Performance Specifications in Frequency-Domain, Frequency-Domain Methods of Design, Compensation & Their Realization in Time & Frequency Domain.

Unit IV: State Variable Analysis
State Variable Analysis- Concepts of State, State Variable, State Model, State Models For Linear Continuous Time Functions, Diagonalization of Transfer Function, Solution of State Equations, Concept of Controllability & Observability.

Unit V: Controllers and Compensation
Necessity of Compensation, Compensation Networks, Lead and Lag compensation and its applications, Controllers: Proportional Controllers, Integral Controllers, Derivative Controllers. PI, PD and PID Controllers. Basic Concept of Optimal Control & Nonlinear Control.

Course outcomes:

At the end of this course students will

1. *Have better understanding of a system and its characteristic behavior*
2. *Be able to examine the stability of a system*
3. *Be able to design various controllers*
4. *Have better understanding of linear, non-linear and optimal control problems*

Text/Reference books:

1. Gopal. M., “Control Systems: Principles and Design”, Tata McGraw-Hill, 1997.
2. Kuo, B.C., “Automatic Control System”, Prentice Hall, sixth edition, 1993.

3. Ogata, K., “Modern Control Engineering”, Prentice Hall, second edition, 1991.
4. 4. Nagrath & Gopal, “Modern Control Engineering”, New Age International, New Delhi

Course code: ECE 602
Course Name: COMPUTER NETWORK

Course Objective:

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement idea.

Unit I:

Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Unit II:

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction -Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA

Unit III:

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping –ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Unit IV:

Transport Layer: Process to Process Communication, User Datagram Protocol(UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality ofService, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit V:

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File TransferProtocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

Course Outcomes: The student will be able to

1. Explain the functions of the different layer of the OSI Protocol.
2. Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.

3. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component
4. For a given problem related TCP/IP protocol developed the network programming.
5. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Text/Reference Books:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
3. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
4. Bhavneet Sidhu, An Integrated approach to Computer Networks, Khanna Publishing House.
5. Anuranjan Misra, "Computer Networks", Acme Learning

Course code: ECE 603
Course Name: COMPUTER NETWORK LAB

Course Objective:

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To clarify network terminology.
- To provide an opportunity to do network programming using TCP/IP.
- To give the students experience working in programming teams.
- To provide a WLAN measurement experience.
- To expose students to emerging technologies and their potential impact.
- Understand state-of-the-art in network protocols, architectures, and applications
- Constraints and thought processes for networking research

Experiments

1. Network components such as Modem, Gateways, Routers, Switches, Cables etc.
2. Various network softwares, services and applications.
3. Network trouble shooting Techniques: Trouble shooting basic TCP/IP problems.
4. Commands like ipconfig, getmac, tracert, pathping, arp, ping, netstat, finger etc.
5. Straight cabling, Cross cabling, Signal testing, T568A and B wiring standards (including hands on practice)
6. Program that prints the address of www.aus.ac.in
7. Program that prints all the addresses of www.indianrail.gov.in
8. Program that scans lower ports and prints them.
9. Program to list host names from command line, attempt to open socket to each one and print the remote host, the remote port, the local address and the local port.
10. Program for splitting the URLs entered into command line into component parts.
11. Program to list all the interfaces available on a workstation.
12. Program for "echo" client. The Client enters data to the server, and the server echoes the data back to the clients.
13. Program for "echo" Server. The Server listens at the port specified and reads from client and echoes back the result.
14. Program to write out "Hello World" to a serial port or to a USB to Serial Converter

Course Outcomes: The student will be able to

1. master the terminology and concepts of the OSI reference model and the TCP-IP reference model.

2. master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks,
3. be familiar with wireless networking concepts,
4. be familiar with contemporary issues in networking technologies, be familiar with network tools and network programming

Course code: ECE 604

Course name: Mini Project

Course Objectives:
To design a circuit, system, program for solving a practical problem. To learn literature survey. To write technical reports and learn technical presentation.

Syllabus Contents:
Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.
Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

Students can take up small problems in the field of circuit design as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Course Outcomes:
At the end of the course, the student will be able to:
1. Solve a live problem using software/analytical/computational tools.
3. Write technical reports.
4. Develop skills to present and defend their work in front of technically qualified audience.

Course code: ECE 605
Course Name: Electronic Instrumentation and Measurement

Course Objective:
The goal of this course is to:
1) Aware students about the working of various instruments used to measure basic electronic parameters.
2) The student should be aware of the design features of some of the instruments and transducers.
3) The student should be able to identify and describe basic instrumentation systems.

Unit 1:
Basic Measurement Concepts:
Measurement systems – Static and Dynamic Characteristics – Units and Standards of measurements ,types of errors and their statistical analysis, Bridge measurements, Wheatstone Bridge, Kelvin, Wein, Maxwell, Hay, Schering and Anderson Bridges.

Unit 2:
DC & AC Measurement:
Analog Ammeter, Voltmeter and Ohmmeters, PMMC, Moving Iron, Electro-dynamometer, Electrostatic, Ohmmeter, Digital type voltmeter, AC voltmeter using rectifier, true RMS voltmeter, Digital VOM meter.

Unit 3:

TRANSDUCERS:

Principles, classification, Guidelines for selection, Requirements, Types and Application of Transducers, Resistance, Capacitance, inductance Transducers, Potentiometer, Strain gauges, LVDT, Piezo Electric transducers.

Unit 4:

INDICATING AND RECORDING SYSTEMS:

Digital frequency counters, X-Y and X-T recorders, general purpose oscilloscopes, delayed time base, sampling and digital storage type oscilloscopes, probes.

Unit 5:

Signal Generators & Analyzers:

Function generators, RF signal generators, Sweep Frequency generator, Frequency synthesizer, Wave analyzer, Harmonic distortion analyzer, Spectrum analyzer.

Course Outcomes:

By the end of this course, the student should be able to:

1. Operate various electronic instruments required for measuring electronic parameters
2. Troubleshoot the instruments associated.

Text Books:

1. Electronic Instrumentation& Measurement by William D Cooper & Albert C. Helfric, PHI Pub.
2. Electrical and Electronic Measurements and Instrumentation by A. K Sawhney.
3. Instrumentation, Measurement and Feedback – B Jones
4. Instruments & Measurement for Electronic by Clyde N. Herrick.

Course code: ECE 606

Course Name: Electronic Instrumentation and Measurement Lab

Course Objectives

The objective of this laboratory is:

1) The student should be able to acquire knowledge of analytical techniques.
2) To measure the parameters of measuring instruments.
3) Troubleshoot the instruments associated.

Experiments:

1) Design and analysis of Wheatstone bridge
2) Study different ac waveforms and measure peak, rms voltage and frequency using a Digital Storage Oscilloscope.
3) Study of Kelvin Bridge.
4) Study of Maxwell Bridge.
5) Study of Schering Bridge.
6) Verification of Digital to analog converter.

7) Verification of Analog to digital converter.

8) Temperature Detection using RTD.

9) Study of pressure transducer.

10) Study of displacement transducer.

Course Outcomes:

By the end of this course, the student will be able to:

1 Design and validate DC and AC bridges.

2. Analyze the dynamic response and the calibration of few instruments.

3. Learn about various measurement devices, their characteristics, their operation and their limitations

4. Understand statistical data analysis

COURSE CODE: ECE 607A

COURSE NAME: Information Theory and Coding

Course objective:

To define and apply the basic concepts of information theory (entropy, channel capacity etc.). Study different types of channels in communication. To learn the principles and applications of information theory in communication systems. Introduction to various data compression methods and describe the most common such methods. To understand the theoretical framework upon which error-control codes are built.

Unit I:

Introduction to information Theory, Information rate and entropy, Measure of Information, Properties of entropy of a binary memory less source.

Unit II:

Joint entropy, Conditional entropy, Relative entropy, Mutual information, Discrete memoryless channels - BSC, BEC, noise-free channel, Channel with independent I/O, Cascaded channels.

Unit III:

Channel capacity, Shannon limit, Source Coding, Shannon Fano coding, Shannon Fano Elias coding, Huffman coding, Minimum variance Huffman coding, Adaptive Huffman coding, Arithmetic coding.

Unit IV:

Dictionary coding – LZ77, LZ78, LZW, Channel coding, Channel coding theorem for DMC, Block codes- Hamming weight, Hamming distance, Minimum distance decoding – Single parity codes, Hamming codes.

Unit V:

Convolutional Codes: Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes (Viterbi Decoding), distance and performance bounds for convolutional codes, examples of convolutional codes

Course outcomes:

At the end of this course students will

5. *quantify the notion of information in a mathematically sound way*
6. *explain what is the significance of this quantitative measure of information in the communications systems*
7. *calculate entropy, joint entropy, relative entropy, conditional entropy, and channel capacity of a system*
8. *differentiate between lossy and lossless compression techniques*
9. *decide an efficient data compression scheme for a given information source*

Text/Reference books:

1. R. Togneri, C.J.S deSilva, "Fundamentals of Information Theory and Coding Design", 1e, CRS Press, Imprint: Taylor and Francis, 2003.

2. R. Bose, "Information Theory Coding and Cryptography", 3e, Tata McGraw Hill, 2016.

3. J. A. Thomas, "Elements of Information Theory", T. M. Cover, 2e, Wiley, 2008.

Course code: ECE 607B
Course Name: SPEECH AND AUDIO PROCESSING

Course Objective:

- To familiarize the basic mechanism of speech production and the basic concepts of methods for speech analysis and parametric representation of speech.
- To give an overall picture about various applications of speech processing
- To impart ideas of Perception of Sound, Psycho-acoustic analysis, Spatial Audio Perception and rendering.
- To introduce Audio Compression Schemes

Unit I:

Introduction- Speech production and modelling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid; Requirements of speech codecs – quality, coding delays, robustness. Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation

Unit II:

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of nonstationary signals – prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Unit III:

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types. Scalar Quantization of LPC- Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Unit IV:

Linear Prediction Coding- LPC model of speech production; Structures of LPC encoders and decoders; Voicing detection; Limitations of the LPC model. Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards.

Unit V:

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP

Course Outcomes:
At the end of the course, students will demonstrate the ability to:

1. Understand basic concepts of speech production, speech analysis, speech coding and parametric representation of speech and apply it in practical applications
2. Develop systems for various applications of speech processing
3. Learn Signal processing models of sound perception and application of perception models in audio signal processing
4. Mathematically model the speech signal
5. Analyze the quality and properties of speech signal.
6. Modify and enhance the speech and audio signals.

Text/Reference Books:

1. Lawrence Rabiner , Ronald Schafer, Digital Processing of Speech Signals, Pearson Education India; 1st edition (1 January 2003)
2. Rabiner and Yegnararayana, Fundamentals of Speech Recognition, Pearson Education; 1st edition (1 January 2008)
3. A. M. Kondoz, Digital Speech, Second Edition (Wiley Students" Edition), 2004.
4. W.C. Chu, Speech Coding Algorithms: Foundation and Evolution of Standardized Coders, ,WileyInter science, 2003

Course code: ECE-607C
Course name: Scientific computing

Course objectives:
To understand the scope and limits of mathematical modeling, especially sources of errors from approximation of the model and to provide an overview of some of the issues and problems that arise in scientific computation, such as (non-)linear systems, numerical and symbolic integration, differential equations and simulation.

Unit-1
Introduction: Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy Computer Arithmetic: Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating- Point Arithmetic, Cancellation

Unit-2
System of linear equations: Linear Systems, Solving Linear Systems, Norms and Condition Numbers, Accuracy of Solutions, Iterative Methods for Linear Systems. Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, Gram-Schmidt Orthogonalization.

Unit 3

Eigenvalues and Eigenvectors, Methods for Computing All Eigenvalues, Jacobi Method, Methods for Computing Selected Eigenvalues, Singular Values Decomposition, Application of SVD.

Unit 4:
Optimization: Optimization Problems, One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares. Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation.

Unit 5:
Numerical integration and differentiation, Initial Value Problems for ODES, Boundary Value Problems For ODES, Partial Differential Equations, Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods, Fast Fourier Transform, Random Numbers And Simulation.

Course Outcomes:
At the end of the course, students will demonstrate the ability to:

1. Understand the significance of computing methods, their strengths and application areas.
2. Perform the computations on various data using appropriate computation tools.

Text/ Reference Books:

1. Heath Michael T., “Scientific Computing: An Introductory Survey”, McGraw-Hill, 2nd Ed., 2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, “Numerical Recipes: The Art of Scientific Computing”, Cambridge University Press, 3rd Ed., 2007
3. Xin-she Yang (Ed.)., “Introduction To Computational Mathematics”, World Scientific Publishing Co., 2nd Ed., 2008
4. Kiryanov D. and Kiryanova E., “Computational Science”, Infinity Science Press, 1st Ed., 2006
5. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, “Scientific Computing With MATLAB And Octave”, Springer, 3rd Ed., 2010

Semester - 7

Course name: Mixed Signal design
Course code: ECE 701A

Course Objectives:
To understand the concepts of Switched capacitors Circuits. To know the concepts of PLLs. To study concepts of Data Converter Fundamentals. To understand the concepts of Nyquist Rate A/D Converters, and applications. To understand concepts of the Oversampling Converters and Continuous-Time Filters. To understand concepts of Continuous-Time Filters, CMOS Trans conductors.

Unit -I
Switched Capacitor Circuits: Introduction to Switched Capacitor circuits basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, Biquad filters.

UNIT-II
Phased Lock Loop (PLL): Basic PLL topology, Dynamics of simple PLL, Charge pump PLLsLock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non idealities, Jitter in PLLs, Delay locked loops, applications.

UNIT-III
Data Converter Fundamentals: DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters-Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters

UNIT-IV
Nyquist Rate A/D Converters: Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time-interleaved converters.

UNIT-V
Oversampling Converters: Noise shaping modulators, Decimating filters and Interpolating filters, Higher order modulators, Delta sigma modulators with multi-bit quantizers, Delta sigma D/A

Text Books:
1. Design of Analog CMOS Integrated Circuits- BehzadRazavi, TMH Edition, 2002
2. Analog Integrated Circuit Design- David A. Johns,Ken Martin, Wiley Student Edition, 2013

Reference Books:
1. CMOS Mixed-Signal Circuit Design **-** R. Jacob Baker, Wiley Interscience, 2009.
2. CMOS Analog Circuit Design –Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Design of Switched Capacitor Circuits.
2. Design of Phased Lock Loop (PLL).
3. Understand the design of Data Converters.
4. Understand Nyquist Rate A/D Converters and Oversampling Converters.

Course code: ECE-701B
Course name: Mobile Communication and Networks

Course Objectives:

- Acquire the knowledge of various Mobile communication standards and technology by its architecture and the functionality.
- Apply the ability to provide solutions by solving the design problems in terms of load calculation, resource management & allocation, traffic calculation, etc.
- Creates the platform to support research ability in the field of upcoming mobile/wireless communication technologies.

Unit-1

Cellular concepts- A Basic Cellular System, Cellular Communication Infrastructure: Cells, Clusters, Cell Spliting, Frequency Reuse, Cellular System Components, Operations of Cellular Systems, Handoff/Handover, Channel Assignment-Fixed And Dynamic, Cellular interferences, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Unit 2

Signal propagation-Propagation mechanism, Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

Unit-3

Capacity of flat and frequency selective channels. Antennas-Antennas for mobile terminal- monopole antennas, PIFA, base station antennas and arrays. Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulation schemes-BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

Unit 4

Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

Unit 5

MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing trade-off Performance measures-Outage, average snr, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:
1. Understand the working principles of the mobile communication systems.
2. Understand the relation between the user features and underlying technology.
3. Analyze mobile communication systems for improved performance

Text/Reference Books:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

Course Code: ECE 701C
Course name: Microwave Theory and Techniques

Course Objectives: To bring up student‘s comprehensive capabilities in Microwave engineering and technology through understanding of electromagnetic wave generation and propagation, transmission and measurements theory and technology by study of microwave transmission medium, media and microwave devices and components.

Unit I
Electromagnetic plane wave, Electric and magnetic wave equations, Poynting theorem, Microwave frequencies, Microwave Frequency bands; Applications of Microwaves, Concept of Mode, Features of TEM, TE and TM Modes, Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line Losses associated with microwave transmission, Impedance in transmission lines Microwave Antenna Microwave systems: Radio Aids to Navigation, RFID, GPS, RFMEMS.

Unit II
Microwave Tubes- construction, operation and properties of Klystron Amplifier; reflex Klystron, Magnetron, TWT, BWO, Crossed field amplifiers.

Unit III
Microwave Solid State Devices-Limitation of conventional solid state devices at MW, Transistors, Diodes, Transferred Electron Devices (Gunn diode), Avalanche transit time effect (IMPATT, TRAPATT, SBD), TWT

Unit IV
Microwave Components-Analysis of MW components using s-parameters, Junctions (E plane, H plane, Hybrid), Directional coupler, Isolator, Circulator, Gyrator , Cavity resonator.

Unit V
Microwave Measurements: Measurement of VSWR, Power measurements using calorimeters and bolometers, impedance, insertion loss, scattering parameters and dielectric constant measurement.

Course Outcomes: After studying the course, the student will be able to

1. Comprehend physics of electromagnetic propagation and various microwave system components their properties.
2. Comprehend the different modes of wave propagation (TE, TM and TEM) and waveguide structure.
3. Perform analysis/ synthesis of microwave systems, with the different mathematical tools required for microwave circuit analysis.
4. Design microwave systems for different practical application.
5. Perform measurement of different microwave parameters in microwave devices.

Text Books:
1. Liao, S.Y., Microwave Devices & Circuits, Tata McGraw Hill (2006) 2nd edition.
2. David M. Pozar, Microwave Engineering, Willy-India(2011) 3nd edition
3. Collins, Robert, Foundation of Microwave Engineering, McGraw Hill (2005) 3rd edition

Reference Books:
1. R.E. Collins, Microwave Circuits, McGraw Hill
2. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house
3. Wolf E.A., and kaul, R.., Microwave Engineering & Systems Applications, Wiley Interscience (2002) 4th edition.
4. Sze, S. M., Physics of Semiconductor Devices, Wiley Eastern (2003) 2nd edition.
5. Sarvate, V.V., Electromagnetic Fields & Waves, John Wiley & Sons (2004) 3rd edition.

Course Code: ECE 702A
Course name: Digital Image and Video Processing

Course objective: The primary objective of this course is to introduce students to basic principles of digital images, image processing algorithms, and its various applications. To provide an exposure to video processing and associated algorithm in various applications.

Unit I
Introduction to digital image processing, pixel, sampling and digitization, Relationship among pixels: Neighborhood, connectivity, adjacency, Distance measures: Euclidean distance, city block, chess board. Arithmetic operations such as addition, subtraction, multiplication and division, Logical operations for binary images,

Unit II
Image Enhancements and Filtering-Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters –low-pass and high-pass.

Unit III
Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening.

Unit IV
Image segmentation: discontinuity based approach (Point, line, and edge detection) and similarity based approach (Thresholding, region growing based, region splitting and merging), Color Segmentation, Image transformation, Need of transformation, Fourier transforms, DCT, Walsh Transform, K L transform.

Unit V
Introduction to video processing, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks and blocks; Compression standards and formats (MPEG & H.XXX), Video object detection and tracking.

Course outcomes:

At the end of this course students will

1. *The students shall be able to apply the knowledge gained during the course to solve various real time problems.*
2. *The students shall be able to develop new state of the art image and video processing method.*

Text/Reference books:

1. Digital Image Processing by Rafael C Gonzalez and Richard Woods 3rd Edition, Pearson
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Pearson, 2002
3. Yao wang, Joem Ostarmann and Ya – quin Zhang, Video processing and communication, 1st edition , PHI

Course code: ECE702B
Course Name: ADAPTIVE SIGNAL PROCESSING

Course Objective:

- Introduce to the concept and need of adaptive filters and popular adaptive signal processing algorithms
- Understand the concepts of training and convergence and the trade-off between performance and complexity.
- Introduce to common linear estimation techniques
- Demonstrate applications of adaptive systems to sample problems.
- Introduce inverse adaptive modelling

Unit I:

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices

Unit II:

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error and mis-adjustment

Unit III:

Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering. Signal space concepts - introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, GramSchmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces.

Unit IV:

Vector space of random variables, correlation as inner product, forward and backward projections,Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationshipwith AR modelling, joint process estimator, gradient adaptive lattice

Unit V:

Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array

Course Outcomes:
At the end of the course, students will demonstrate the ability to:
1. summarize multi-rate DSP and design efficient digital filters.
2. construct multi-channel filter banks.
3. select linear filtering techniques to engineering problems.
4. describe the most important adaptive filter generic problems.
5. describe the various adaptive filter algorithms.
6. describe the statistical properties of the conventional spectral estimators.
7. Understand the non-linear control and the need and significance of changing the control parameters w.r.t. real-time situation.

Text/Reference Books:

5. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
6. C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984
7. D.G.Manolakis, V. K. Ingle, and S. M. Kogon ,"Statistical and Adaptive Signal Processing",McGraw-Hill,2005
8. S.L.Marple,"Digital Spectral Analysis",1987.
9. M.H.Hays," Statistical Digital Signal Processing and Modeling", John-Wiley,2001.

Course code: ECE-703A

Course name: Embedded Systems

Course Objectives

- To make the students to understand the basics of Embedded Systems, peripherals, processors and operating systems associated with embedded systems.
- To understand the issues in hardware software co-design.
- To make the students to be able to understand the embedded firmware design and development.
- To program embedded systems using modern embedded processors.

Unit 1

Introduction to Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, Examples of Embedded systems.

Unit 2

Embedded Microcontroller Core, Embedded memory, Sensors and Actuators, Communication Interfaces (like UART, SPI, I2C, USB), Other System Components, PCB and Passive Components. Characteristics of Embedded System, Quality Attributes of Embedded System.

Unit 3

Hardware Software Co-Design: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language (UML), Design tradeoffs due to process compatibility, thermal considerations, etc., Embedded Hardware Design and Development: analog and digital components, embedded system interfacing.

Unit 4

Embedded Firmware Design and Development: Embedded firmware Design Approaches, Embedded firmware Development Languages, Programming in Embedded 'C', Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Processes and Scheduling: Putting them altogether, Task Communication, Task Synchronization, Device Drivers.

Unit 5

Integration and Testing of Embedded Hardware and Firmware: Integration of Hardware & Firmware, Board Power up. Integrated Development Environment (IDE), Types of files generated on cross-compilation, Disassembler/Decompiler, Simulators, Emulators & Debugging, Target Hardware Debugging, Boundary Scan.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Suggest design approach using advanced controllers to real-life situations.
2. Design interfacing of the systems with other data handling / processing systems.
3. Appreciate engineering constraints like energy dissipation, data exchange speeds etc.

Text Book:

1. Shibu K.V., Introduction to Embedded Systems, TMH Private Limited, New Delhi, 2009.

Reference Book

1. Wayne Wolf, Computers as Components, Morgan Kaufmann, 2001

2. G. De Micheli, Rolf Ernst and Wayne Wolf, eds, Readings in Hardware/Software Co-Design, Morgan Kaufmann, Systems-on-Silicon Series Embedded
3. Frank Vahid and Tony D. Givargis, System Design: A Unified Hardware/Software Introduction, Addison Wesley, 2002.
4. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
5. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
6. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
7. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.

Course code: ECE-703B
Course name: Error Correcting Codes

Course objective: To acquire the knowledge in measurement of information and errors. Study the generation of various code methods used in communications and its applications.

Unit -I:
Course overview; Basics of binary block codes for the binary symmetric channel; Mathematical preliminaries: groups, subgroups and cosets. Linear block codes: Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Hamming codes; Weight enumerators and the McWilliams identities; Perfect codes,

Unit -II:
Introduction to finite fields and finite rings; factorization of (X^n-1) over a finite field; Cyclic Codes

Unit -III:
BCH codes; Idempotents and Mattson-Solomon polynomials; Reed-Solomon codes, Justeen codes, MDS codes, Alterant, Goppa and generalized BCH codes;

Unit -IV:
Spectral properties of cyclic codes; Decoding of BCH codes: Berlekamp's decoding algorithm, Massey's minimum shift register synthesis technique and its relation to Berlekamp's algorithm. A fast Berlekamp– Massey algorithm.

Unit -V:
Convolution codes; Wozencraft's sequential decoding algorithm, Fann's algorithm and other sequential decoding algorithms; Viterbi decoding algorithm

Course outcomes:

At the end of this course students will

1. Able to transmit and store reliable data and detect errors in data through coding.
2. Understand the error sources
3. Able to understand the designing of various codes.

Text/Reference books:

1. F.J. McWilliams and N.J.A. Slone, The theory of error correcting codes, 1977.

2. R.E. Balahut, Theory and practice of error control codes, Addison Wesley, 1983.

3. P. V. Kumar, M. Win, H-F. Lu, C. Georghiades, "Error-Control Coding Techniques and Applications", Chapter 17 in Optical Fiber Telecommunications IV-B: Systems and Impairments, Editors: Ivan P. Kaminow and Tingye Li, Elsevier Science Press, 2002

Course code: ECE-704
Course name: Advanced Digital System Design

Course objectives:

- To understand HDL based digital design, HDL terminology, architecture and design of combinational and sequential circuit.
- To address the challenges in Hardware design by discussing the role of digital components in system design.

Unit-1
Introduction to Logic Design, Combinational Logic Design: Concept of hierarchical design, technology mapping, decoder & decoder based combinational circuit design, encoder & priority encoder, multiplexer & multiplexer based combinational circuit design, binary adders, binary subtractor, adder subtractor, other arithmetic functions: contraction, increment/decrement, constant multiplication/division, zero filling, extension. Hardware description language: Design Units, Modeling styles- Dataflow, Behavioral, and Structural.

Unit-2
Sequential Circuits: Basics of sequential circuits, latches, flip-flops, sequential circuit analysis, state equation, state diagram, state table, sequential circuit design, state assignment, state encoding, state machine diagram, design applications. Flip-flop timing, sequential circuit timing analysis, analysis of synchronous and asynchronous digital circuits.

Unit-3
Programmable Logic Design, Register, Counter: Read only memory, programmable logic array, programmable array logic, field programmable array logic, registers: serial-in-parallel out, serial-in-serial-out, parallel-in-serial-out, parallel-in-parallel-out, register transfer operations. Micro-operations, arithmetic, logic, shift, arithmetic & logic shift, barrel shifter, counters.

Unit 4:
Memory: Basic definitions, random-access memory, SRAM integrated circuit, SRAM array, DRAM integrated circuit, DRAM types, DRAM array, CAM.

Unit 5:
Computer design basics: Datapath logic, arithmetic-logic unit, datapath representation, control logic, control word, simple computer architecture, instruction formats, instruction decoder, basic operation cycle, operand addressing, addressing modes, instruction set architectures,.

Course outcomes:

At the end of this course students will demonstrate the ability to
1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder.
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital system design and simulation.

Textbooks:

1. Morris Mano, Charles R. Kime, Tom Martin, "Logic and Computer Design Fundamentals", Pearson.

Reference book:

1. Stephen Brown &ZvonkVranesic, "Fundamentals of digital logic with VHDL design", TMH.
2. Charles H. Roth Jr, "Fundamentals of logic design", Thomson Learning.
3. Donald G. Givone, "Digital principles and design", TMH.
4. Thomas L. Floyd, Digital fundamentals", Prentice Hall.

ECE-705
PROJECT STAGE -1

Course Objective:
The objective of Project stage- 1 is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work.

Guidelines:
The assignment to normally include:
1. Survey and study of published literature on the assigned topic
2. Working out a preliminary Approach to the Problem relating to the assigned topic
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility
4. Preparing a Written Report on the Study conducted for presentation to the Department
5. Final Seminar, as oral Presentation before a departmental committee

Course Outcome:
After completion of the this course, the student will able to

1. Find out solution to practical problem by utilising the concept or idea he/she acquired while studying a particular course.
2. Become familiar with the ways of starting a research oriented work.
3. Develop oral and written communication skills to present and defend their work in front of technically qualified audience

Course code: ECE-706
Course name: Antennas and Propagation

Course Outcomes:

After the completion of the course the student will be able to:

1. Provide an understanding of antenna radiating principle and discuss the fundamental characteristics and parameters of antennas.
2. Develop the performance characteristics of antennas arrays, its operating principles, methods and concepts to design.
3. Understand different practical antennas.
4. Understand the behaviour of nature on EM wave propagation.

Unit-1
Fundamental Concepts: Physical concept of radiation, antenna parameters: Radiation pattern, near-and far-field regions, gain, directivity, effective aperture, and reciprocity; Friis transmission equation, Radiation from dipoles of arbitrary length. Loop Antenna, Horn Antenna.

Unit-2

Antenna Arrays: Uniform linear arrays of isotropic elements, array factor and directivity. Broadside & Endfire array, principle of pattern multiplication. Synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method, Micro strip Antenna – Basic Characteristics, Feeding method, rectangular patch, circular patch, quality factor bandwidth and efficiency.

Unit-3

Broadband Antennas- Log-periodic and Yagi antennas, frequency independent antennas, broadcast antennas.

Unit-4

Parabolic reflector, basic Concepts of Smart Antennas-Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming.

Unit-5

Wave Propagation: Types of wave propagation, space wave propagation and line of sight distance for flat and curved surfaces.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the properties and various types of antennas.
2. Analyze the properties of different types of antennas and their design.

Text/Reference Books:

1. J.D. Kraus, Antennas, McGraw Hill, 1988.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw ill, 1984.
5. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
6. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005

Course code: ECE-707
Course name: INDUSTRIAL TRAINING

Course Objective

1. To provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.
2. To enhance students' knowledge in one particular technology.
3. To Increase self-confidence of students and helps in finding their own proficiency
4. To cultivate student's leadership ability and responsibility to perform or execute the given task.
5. To provide learners hands on practice within a real job situation.

Guidelines:

Student will go for one month or one & half month internship in reputed industries/companies or in national research laboratories or in institute like NITs/IITs/Central universities etc to get practical experience in the area of their choice out of the many areas that they learn in their course.

Course Outcomes:

After the completion of the course, students will be able to:

- Become master in one's specialized technology
- Become updated with all the latest changes in technological world.

- Ability to communicate efficiently.
- Knack to be a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills.
- Ability to identify, formulate and model problems and find engineering solution based on a systems approach.
- Capability and enthusiasm for self-improvement through continuous professional development and life-long learning
- Awareness of the social, cultural, global and environmental responsibility as an engineer.

Semester – 8

Course code: ECE 801A

Course name: High Speed Electronics

Course Objective: To familiarize the students with basic design concepts of high speed digital system with emphasis on signaling modes and timing fundamentals, signal propagation issues on transmission lines, noise analysis, PCB design and with the materials and physics of High speed semiconductor devices, which will help students to integrate the design of high speed semiconductor devices and signaling circuits.

Unit I

Introduction to high-speed digital system: Frequency, time - Capacitance and inductance effects, Speed- power product, Modelling of wires -Geometry and electrical properties of wires ,transmission lines - lossless LC transmission lines - lossy LRC transmission lines.

Unit II

Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion, Intermodulation, Cross-modulation, Dynamic range, Noise sources in digital system - power supply noise - cross talk - intersymbol interference.

Unit III

Signalling convention and circuits: Signalling modes for transmission lines, signalling over lumped transmission media, signalling over RC interconnect, driving lossy LC lines, simultaneous bi-directional signaling, Timing convention and synchronisation: Timing fundamentals: timing properties of clocked storage elements, open loop timing level sensitive clocking, pipeline timing, closed loop timing.

Unit IV

Introduction to high speed performance of semiconductor devices and circuits: Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, Materials: different SiC structures, silicon- germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices. High Electron Mobility Transistors (HEMT): Hetero-junction devices, High Frequency resonant –tunneling devices, Resonant-tunneling hot electron transistors.

Unit V

Introduction to High Speed PCB design, CAD tools for PCB design, Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand significance and the areas of application of high-speed electronics circuits.
2. Understand the properties of various components used in high speed electronics.
3. Design power distribution techniques that reduce noise.
4. Use signaling and coding strategies to improve signal integrity in high-speed serial links.
5. Design clock distribution techniques that ensure clock signal quality.
6. Design High-speed electronic system using appropriate components.
7. Know about the materials used in high speed device, and the physics of high speed semiconductor devices.
8. Understand the concepts of efficient PCB design.

Text/Reference Books:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall “High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices”, August 2000, Wiley-IEEE Press

2. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998
3. Howard Johnson & Martin Graham; High Speed Digital Design: A Handbook of Black Magic, Prentice Hall PTR, 1993
4. Masakazu Shoji; High Speed Digital Circuits, Addison Wesley Publishing Company, 1996
5. Jan M, Rabaey, et all; Digital Integrated Circuits: A Design perspective, Second Edition, 2003
6. C.Y. Chang, F. Kai, GaAs High-Speed Devices: Physics, Technology and Circuit Applications Wiley
7. Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related Compounds, John Wiley & Sons
8. David K. Ferry, Ed., Gallium Arsenide Technology, Howard W. Sams & Co., 1985
9. Avishay Katz, Indium Phosphide and Related materials: Processing, Technology and Devices, Artech House, 1992.
10. S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5
11. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

Course code: ECE 801B
Course Name: Wavelets

Course Objective: The objective of this course is

1) To expose the students to the basics of wavelet theory.
2) To illustrate the use of wavelet processing for data compression and noise suppression.
3) To apply the wavelet transforms theory in necessary application and related constructions.

Unit -1:

Introduction :

Stationary and non-stationary signals, Signal representation using basis and frames, Brief introduction to Fourier transform and Short time Fourier transform, Timefrequency analysis, Bases of time frequency: orthogonal, Filter banks, Multi resolution formulation: Wavelets from filters, Classes of wavelets: Haar, Daubechies, bi-orthogonal.

Unit -2:

Continuous Wavelet Transform:

Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain

Unit -3:

Discrete Wavelet Transform And Filterbanks :

Orthogonal and biorthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks, Discrete wavelet transform, Non-linear approximation in the Wavelet domain, multi resolution analysis, Construction and Computation of the discrete wavelet transform, the redundant discrete wavelet transform

Unit -4:

Multi Resolution Analysis :

Multirate discrete time systems, Parameterization of discrete wavelets, Bi-orthogonal wavelet bases, Two dimensional, wavelet transforms and Extensions to higher dimensions, wave packets

Unit -5:

Applications :

Signal and Image compression, Detection of signal changes, analysis and classification of audio signals using CWT, Wavelet based signal de-noising and energy compaction, Wavelets in adaptive filtering, Adaptive wavelet techniques in signal acquisition, coding and lossy transmission, Digital Communication and Multicarrier Modulation, Trans multiplexers , Image fusion, Edge Detection and object isolation.

Course Outcome:

Students will be able to

1. understand about windowed Fourier transform and difference between windowed Fourier transform and wavelet transform.
2. understand wavelet basis and characterize continuous and discrete wavelet transforms.
3. understand multi resolution analysis and identify various wavelets and evaluate their time- frequency resolution properties
4. implement discrete wavelet transforms with multirate digital filters

TEXT BOOKS/REFERENCES:

1. A Wavelet Tour of Signal Processing, 2nd edition, S. Mallat, Academic Press, 1999.

2. Wavelets and Sub band Coding, M. Vetterli and J. Kovacevic, Prentice Hall, 1995.

3. Wavelet transforms: Introduction, Theory and applications, Raghuveer rao and Ajit S.Bopardikar, Pearson Education Asia, 2000.

4. Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K. Chan, 2nd ed., Wiley, 2011.

5.Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, JeanMichel Poggi, John Wiley & Sons, 2010 .

6. A premier on Wavelets and their scientific applications, J S Walker, CRC press, 2002.

7. Wavelets and signal processing: An application based introduction, Stark, Springer, 2005.

Course code: ECE 802A

Course Name: FIBER OPTIC COMMUNICATION

Course Objective

1. To understand the basics of fibers, losses in fibers, types and principle of optical sources and detectors.
2. To know the receiver and amplifier structures, familiar with the design of optical communication link
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
4. Give the importance of soliton based systems and light wave networks in optical communication

Unit-1

The evolution of Fiber Optics Systems, Introduction to vector nature of light, Optical Laws, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model.

Unit-2 :

Light propagation in optical fiber Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

Unit 3:

Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, Avalanche Photodetector (APDs), detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties, Source to Fiber Launching.

Unit 4:
Optical switches - coupled mode analysis of directional couplers, electro-optic switches, isolators and circulators, multiplexers and filters, wavelength converters and splicer, Lensing Schemes for Coupling improvement. Fiber to Fiber joints, Fiber Splicing. Optical Fiber connectors. Optical amplifiers - EDFA, Raman amplifier.

Unit 5:
Optical Transmission, Modulation and Demodulation, Optical Networks, SONET/SDH Networks, WDM and DWDM systems. Principles of WDM networks, Optical CDMA. Nonlinear effects in fiber optic links. Concept of self-phase modulation, group velocity dispersion and solution-based communication.

Course Outcomes:
At the end of the course, students will demonstrate the ability to:

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors
4. Analyze system performance of optical communication systems
5. Design optical networks and understand non-linear effects in optical fibers
6. Explain the components and principle of operation of WDM systems

Text/Reference Books

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press,1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997
7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990)..
8. R.P. Khare, Fiber Optics and Optoelectronics, Oxford University Press
9. Govind P. Agrawal, Fiber-optic communication systems, John Wiley & sons

Course code: ECE 802B

Course Name: Satellite Communication

Course Objectives:
To learn basic of satellite communication, orbital mechanics, satellite sub-systems, typical phenomena in satellite communication, modulation and multiple Access Schemes.

Unit - 1
Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

Unit -2
Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

Unit - 3
Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

Unit - 4

Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift. Satellite link budget, Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

Unit - 5

Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

Text /Reference Books:

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009

Course Outcomes:

At the end of this course students will demonstrate the ability to
1. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3. Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Course code: ECE 802C

Course Name: Wireless Sensors Networks

Course Objectives:

1. To understand the WSN node Architecture and Network Architecture.
2. To identify the Wireless Sensor Network Platforms.
3. To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network.

Unit -1:

Introduction :

Wireless sensor networks: The vision, Networked wireless sensor devices Applications of wireless sensor networks, Key design challenges

Unit -2:

Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

Unit -3:

MAC protocols:

Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4

Unit -4:

Cognitive Radio Network (CRN):

Spectrum Sensing Techniques: ,Energy Detector, Cyclo stationary Detector, Marched Filter Detector, Radio Identification Detector, Cyclo Energy Detector

Unit -5:
Wireless characteristics and Medium-access :
Wireless link quality, Radio energy considerations, The SINR capture model for interference, Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols.

Course Outcomes: At the end of the course the students will be able to
1. Design wireless sensor networks for a given application.
2. Understand emerging research areas in the field of sensor networks.
3. Understand MAC protocols used for different communication standards used in WSN.
4. Explore new protocols for WSN.

Text/Reference Books:
1. Waltenegus Dargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications ,2011
2. Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009
3. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Elsevier Publications,2004
4. Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science
5. Philip Levis, And David Gay "TinyOS Programming” by Cambridge University Press 2009.
6. Jochen Schiller, "Mobile Communications", Pearson Education, 2nd Edition, 2003.
7. William Stallings, "Wireless Communications and Networks ", Pearson Education - 2004
8. C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education - 2008.

Course code: ECE 803A
Course name: Operating System

Course Objectives:
To learn the fundamentals of Operating Systems.
1. To learn the mechanisms of OS to handle processes and threads and their communication.
2. To learn the mechanisms involved in memory management in contemporary OS.
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols.
4. To know the components and management aspects of concurrency management.
5. To learn to implement simple OS mechanisms.

Unit I:
Introduction: Introduction to Operating system, Operating system functions, types of operating system, OS services, System calls, Operating system structure (simple, layered, virtual machine), Processes: definition, Process relationship, different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.

Unit II:
CPU scheduling: scheduling criteria, scheduling algorithms: preemptive& non-preemptive, FCFS, SJF, RR, priority, multi-processor scheduling. Process Synchronization: background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Unit III:

Memory Management: background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.

Virtual Memory: background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing.

Unit IV:

I/O Management: I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and nonblocking I/O), kernel I/Osubsystem (scheduling, buffering, caching, spooling and device reservation, error handling),performance.Disk Management: disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN), diskreliability, disk formatting, boot block, bad blocks.

Unit V:

File Systems: file concept, access methods, directory structure, file system structure, allocationmethods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping),directory implementation (linear list, hash table), efficiency & performance.Protection & Security: Goals of protection, domain of protection, security problem, authentication,one time password, program threats, system threats, threat monitoring, encryption.

Course Outcomes

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.
4. Design and implement file management system.

Textbooks:

1. Tanenbaum A.S., Operating System Design & Implementation, Practice Hall NJ.
2. Milenkovie M., Operating System: Concept & Design, McGraw Hill.
3. Silbersehatz A. and Peterson J. L., Operating System Concepts, Wiley.

References:

1. Dhamdhere, Operating System, TMH
2. Stalling, William, Operating Systems, Maxwell McMillan International Editions, 1992.

Course code: ECE-803B
Course name: BIOMEDICAL INSTRUMENTATION

Course Objective:

1. To make the student understand biomedical signals and their importance in diagnosis of diseases
2. To understand how electronic devices and circuits are used for acquisition and monitoring of biomedical signals
3. To make the student aware of various electronic instruments used in medical field

Unit 1

Sources of Biomedical Signals, Basic medical Instrumentation system, Performance requirements of medical Instrumentation system, use of microprocessors in medical instruments, PC based medical Instruments, general constraints in design of medical Instrumentation system & Regulation of Medical devices.

Unit 2

Origin of Bioelectric Signals, Electrocardiogram, Electroencephalogram, Electromyogram, Electrode-Tissue Interface, Polarization, Skin Contact Impedance, Motion Artifacts.Electrodes for ECG, Electrodes for EEG, Electrodes for EMG.

Unit 3

Introduction to Transducers, Classification of Transducers, Performance characteristics of Transducers, Displacement, Position and Motion Transducers. Photo emissive Cells & Biosensors or Biochemical sensor

Unit 4

Basic Recording systems, General considerations for Signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrostatic and Electromagnetic Coupling to AC Signals, Proper Grounding (Common Impedance Coupling) .

Unit 5

Patient monitoring systems, arrhythmia and ambulatory monitoring instruments, biomedical telemetry, telemedicine technology, audiometers and hearing aids, patient safety. Modern imaging systems,

Course Outcome:

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

1. Understand the application of the electronic systems in biological and medical applications.
2. Understand the practical limitations on the electronic components while handling biosubstances.
3. Understand and analyze the biological processes like other electronic processes.

References:

1. Handbook of biomedical instrumentation – MGH – R S Khandpur.
2. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
3. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
4. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

Paper Code: ECE-804
Paper Name: ANALOG VLSI DESIGN

Course Objectives:

1. To understand the construction, operation and mathematical models of MOSFETs
2. To analyze and design single stage and multistage amplifiers at low frequencies.
3. To study and analyze different current mirrors used to bias IC amplifiers.
4. To understand the frequency response of amplifier designed in integrated circuits.
5. To understand the principles of operation of Operational Amplifier.

UNIT I: Basic MOS Device Physics:

NMOS and PMOS transistors, CMOS logic, MOS transistor theory – Introduction, Band Diagram, Enhancement mode transistor action, Ideal I-V characteristics, DC transfer characteristics, Threshold voltage, Body effect- Design equations- Second order effects. MOS models and small signal AC characteristics, Simple MOS capacitance Models, Detailed MOS gate capacitance model, Detailed MOS Diffusion capacitance model.

UNIT II: CMOS TECHNOLOGY, DESIGN RULE and ANALOG CMOS SUB CIRCUITS

CMOS fabrication and Layout, CMOS technologies, P -Well process, N -Well process, MOS layers stick diagrams and Layout diagram, Layout design rules, Euler path technique in Layout.

MOS switch - MOS diode and active resistor – Current Source , Current Sink, Basic Current mirrors – Cascode current mirrors-active current mirrors- voltage references-supply independent biasing.

UNIT III: SINGLE STAGE AMPLIFIERS
Basic concepts, common-source stage, common-source stage with resistive load, CS stage with diode-connected load, CS stage with current-source load, CS stage with triode load, CS stage with source degeneration, source follower, common-gate stage, cascade stage, folded cascode .

UNIT IV: DIFFERENTIAL AMPLIFIERS & FREQUENCY RESPONSE
Differential operation - Basic differential pair - Common mode response Differential pair with MOS loads, MOSFET Differential amplifier with Diode Connected Active load, Current Source as a load, Current Mirror as a load, frequency response, compensation techniques ,Miller effect.

UNIT V: Operational Amplifiers
General considerations, performance parameters, one-stage op amps, two-stage op amps, gain boosting, comparison, common-mode feedback, input range limitations, slew rate, power supply rejection.

Course Outcomes:
1. At the end of the course student will be able -
2. Acquire knowledge of device physics related to MOSFET.
3. Acquire knowledge of amplifier design with the use of proper biasing techniques.
4. Identify appropriate circuit topology for given gain, input impedance, output impedance and bandwidth requirements.
5. Design single and multi-stage amplifiers for desired gain, bandwidth and terminal impedance specifications.
6. Acquire the knowledge of different op-amp topologies and to design op-amps for the given specifications

Text Books:
B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill, 2011.
R. Jacob Baker, “CMOS Circuit Design, Layout, and Simulation”, 3rd Edition, Wiley, 2010.

References:
1. P. R. Gray & R. G. Meyer, Analysis and Design of Analog Integrated Circuits, 5/e, John Wiley, 2012.
2. P. E. Allen & D.R. Holberg, “CMOS Analog Circuit Design”, 3rd Edition, Oxford University Press, 2011
3. K. Radhakrishna Rao," Electronics for Analog Signal Processing-I", NPTEL, Courseware, 2005.

ECE-805
PROJECT STAGE -2

Course Objective:
The objective of Project stage-2 is to enable the student to extend further the investigative study taken up under Project stage-1 either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/industry.

Guidelines:
The assignment to normally include:
1. In depth study of the topic assigned in the light of the Report prepared under Project stage-
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.

Course Outcomes:

After completion of the this course, the student will able to

1. Find out solution to practical problem by utilising the concept or idea he/she acquired while studying a particular course.
2. Become familiar with the ways of starting a research oriented work.
3. Students will be exposed to self-learning various topics.
4. Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
5. Students will learn to write technical reports.
6. Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.

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