Bachelor of Technology (Electronics & Communication Engineering)
Scheme of Studies/Examination
Semester VII

S. No.	Course No.	Subject	L:T:P	Hours/Week	Examination Schedule (Marks)				Duration of Exam (Hrs)
					Theory	Sessionals	Practical	Total	
1	ECE-401N	Microcontroller & Embedded Systems Design	3:0:0	3	75	25	0	100	3
2	ECE-403N	Digital Image Processing	4:0:0	4	75	25	0	100	3
3	ECE-405N	Power Electronics	3:0:0	3	75	25	0	100	3
4		Core Elective - I**	3:0:0	3	75	25	0	100	3
5		Core Elective - II**	3:0:0	3	75	25	0	100	3
6	ECE-407N	Microcontroller & Embedded Systems Design Lab	0:0:3	3	0	40	60	100	3
7	ECE-409N	Digital Image Processing Lab	0:0:3	3	0	40	60	100	3
8	ECE-411N***	Project-1	0:0:10	10	0	100	100	200	3
9	ECE-413N*	Industrial Training Viva	2:0:0	2	0	100	0	100	
		Total		**34**	**375**	**405**	**220**	**1000**	

** The performance of the student will be evaluated by the technical training (undertaken after 6th semester) seminar and the report submitted by the student which should also include the Industrial/Research problems faced & suggested solutions.*

*** The students should select two departmental electives subjects from the list of core elective subjects.*

****The project should be initiated by the student in the 7th semester beginning and will be evaluated in the end of the semester on the basis of a presentation and report submitted to the department.*

Bachelor of Technology (Electronics & Communication Engineering)

Scheme of Studies/Examination

Semester VIII

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Examination Schedule (Marks)				Duration of Exam (Hrs)
					Theory	Sessionals	Practical	Total	
1	ECE- 402N	Wireless & Mobile Communication	4:0:0	4	75	25	0	100	3
2	ECE- 404N	Microwave Engineering	3:0:0	3	75	25	0	100	3
3		Core Elective - III**	3:0:0	3	75	25	0	100	3
4		Core Elective - IV**	3:0:0	3	75	25	0	100	3
5	ECE- 406N ***	Project-II	0:0:14	14	0	100	100	200	3
6	ECE- 408N	Wireless & Mobile communication lab	0:0:3	3	0	40	60	100	3
7	ECE- 410N	Microwave Engineering Lab	0:0:3	3	0	40	60	100	3
8	ECE- 412N *	Seminar & Report Writing	2:0:0	2	0	100	0	100	3
		Total		**35**	**300**	**380**	**220**	**900**	
9	ECE- 440N****	General Fitness & Professional Aptitude						100	3

** The performance of the student will be evaluated by the presentation delivered and the report submitted by the student related to Industrial/Research problems & its suggested solutions.*

*** The students should opt two departmental electives subjects from the list of core elective subjects.*

****The project should be initiated by the student in continuation of the 7th semester and will be evaluated in the end of the semester on the basis of a presentation and Report.*

***** A viva of the students will be taken by external examiner (Principal/Director/Professor/or any senior Person with Experience more than 10 years) at the end of the semester and grades will be given according to the grade chart.*

S. No.	Core Electives-7th Sem.		S. No.	Core Electives-8th Sem.	
1	ECE-415N	Advance Digital Communication	1	ECE-414N	DSP Processor
2	ECE-417N	Nano Electronics	2	ECE-416N	Mobile Communication Networks
3	ECE-419N	Optical Communications	3	ECE-418N	MEMS
4	ECE-421N	Adaptive Signal Processing	4	ECE-420N	Transducers & Its Applications
5	ECE-423N	Satellite Communication	5	ECE-422N	Radar Engineering
6	ECE-425N	Digital VLSI Design	6	ECE-424N	High Frequency Circuit and Systems
7	ECE-427N	Analog CMOS IC Design	7	ECE-426N	Biomedical Signal Processing
8	ECE-429N	Consumer Electronics	8	ECE-428N	Multimedia Communications
9	ECE-431N	Robotics	9	ECE-430N	Mixed VLSI Design
10	ECE-433N	Non-Conventional Energy Resources	10	ECE-432N	Microstrip Antenna
11	ECE-435N	Microstrip line Analysis	11	ECE-434N	Strategic Electronics
12	ECE-437N	Software Defined Radios	12	ECE-436N	Cognitive Radios

KURUKSHETRA UNIVERSITY, KURUKSHETRA

ECE-401N	MICROCONTROLLER AND EMBEDDED SYSTEM DESIGN					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Pre-requisites: Microprocessor						
Course Outcomes						
CO1	*Acquired knowledge about the architecture of microcontrollers.*					
CO2	*Acquired knowledge about instruction set and programming concepts in C and assembly language.*					
CO3	*To understand peripheral interfacing to microcontrollers.*					
CO4	*To design the systems /models based on microcontrollers*					

Unit- I

INTRODUTION: Microprocessor and Microcontroller, Different types of Microcontrollers, 4 bit, 8 bit, 16 bit, and 32 bit Microcontrollers, Processor Architectures: Harvard & Princeton, CISC & RISC, Microcontrollers memory types, Microcontrollers features, Criteria for choosing a microcontroller, Applications of microcontrollers.

Embedded System, Embedded Processors, Hardware units, Devices and Software in a system, Embedded system on chip, Complex Systems design and processors, Design examples.

Unit- II

8051 ARCHITECTURE: 8051 Architecture, On-chip memory organization – general purpose registers, SFR registers, Internal RAM and ROM, Oscillator and Clock circuits. Pin Diagram of 8051, I/O Pins, Port, Connecting external memory, Counters and Timers, Purpose of TCON & TMOD registers, Serial data transmission/reception and transmission modes, Purpose of SCON & PCON registers, Different Types of Interrupts, Purpose of Time Delays.

Unit- III

8051 INSTRUCTION SET AND PROGRAMMING : Instruction syntax, Assembler directives, Addressing modes, Data transfer instructions, arithmetic and logical instructions, Jump and Call instructions, I/O port, Timer and Counter programming, Serial port and Interrupt programming.

PIC MICROCONTROLLER ARCHITECTURE: Introduction to PIC Microcontroller families, Different features of PIC16 Microcontrollers, PIC16 Architecture and Pipelining, Pin Configuration of PIC16, Program memory considerations, Register file structure, Addressing modes, Instruction set.

Unit-IV

APPLICATION DESIGN & HARDWARE INTERFACING WITH 8051: Interfacing Matrix Keyboards, LCD, ADC, DAC, Temperature Sensor, Stepper and DC motor, Relay and PWM.

Introduction of Advanced Microcontrollers: AVR and ARM microcontrollers.

Text Books:

1. Kenneth Ayala," The 8051 Microcontroller" 3rd ed. CENGAGE Learning.
2. M.A. Mazidi, J.G. Mazidi, R. D. McKinlay," The 8051 Microcontroller and Embedded systems using assembly and C" -2nd Ed, Pearson Education.
3. John. B. Peatman, "Design with PIC Microcontroller", Pearson Education, 2003.

References Books:

1. Myke Predko, "Programming and Customizing the 8051 Microcontroller", TMH.
2. Manish K Patel,"Microcontroller based embedded system", McGraw Hill Education.
3. Raj Kamal, "Embedded systems architecture, programming and design"-2nd nd. McGraw-Hill Companies.
4. Intel's manual on "Embedded Microcontrollers".
5. Myke Predko, "Programming and customizing PIC microcontroller" Mc- Graw Hill.

6. M.A. Mazidi, R. D. McKinlay,Causey," The PIC microcontroller and Embedded Systems using assembly and C for PIC18" -2nd Ed, Pearson.
7. M.A. Mazidi,Naimi" The AVR microcontroller and Embedded Systems using assembly and C" -2nd Ed, Pearson.

ECE-403N	DIGITAL IMAGE PROCESSING					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
4	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes						
CO1	***Students should be able to explain the basics of Digital Image processing***					
CO2	***Student will be able to explain sampling and quantization of digital image***					
CO3	***Student will be able to analyze the image enhancement operations on digital image***					
CO4	***Students will be able to analyze the various image analysis and computer vision algorithm***					

Unit-I

Introduction: Processing and applications, Image representation and modeling, Image Enhancement, Restoration, analysis, reconstruction from Projections, Image Data Compression. Image Perception: Light, Luminance, Brightness, Contrast, MFT of visual System, Visibility Function, Image fidelity, Color representation, color matching and reproduction, color vision Model

Unit-II

Image sampling and Quantization: Introduction, Two dimensional sampling theory, practical limitations in sampling and reconstruction, Image quantization, Optimum mean square or Lloyd-Max quantizer.

Unit-III

Image Enhancement: Introduction, Point Operation, Histogram Modeling, Spatial Operations, Transform Operations, Multispectral Image enhancement, Color Image enhancement.

Unit-IV

Image Analysis and Computer Vision: Introduction, Spatial Feature Extraction, Transform features, Edge Detection, Boundary Extraction, Shape features, Image segmentation.

Text Books:

1. Digital Image Processing, third edition by Rafael C. Gonzalez and Richard E Woods. Publisher: Pearson Education.
2. Digital Image Processing by S. Sridhar , Publisher: Oxford

Reference Books:

1. Fundamentals of Digital Image Processing by Anil K Jain, Publisher: Prentice Hall

ECE-405N	POWER ELECTRONICS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Purpose	***To understand and acquire knowledge about various power semiconductor devices. To prepare the students to analyze and design different power converter circuits.***					
Course Outcomes						
CO1	***Acquire knowledge about fundamental concepts and techniques used in power electronics.***					
CO2	***Ability to analyze various single phase and three phase power converter circuits and understand their applications.***					
CO3	***Foster ability to identify basic requirements for power electronics based design application.***					
CO4	***To develop skills to build, and troubleshoot power electronics circuits.***					

Unit-1

Introduction: Concept of Power Electronics, Applications of power electronics, Advantages and disadvantages of power-electronic converters, Power electronic systems, Power semiconductor devices, Types of power electronic converters. Power semiconductors: The p-n junction, Basic structure of power diodes, Characteristics of power diodes, Power transistors, Power MOSFETS, Insulated gate bipolar transistor, Static induction transistor.

Unit-II

Thyristors :Terminal characteristics of thyristors, thyristor turn on methods, Switching characteristics of thyristors, Thyristor gate characteristics, Two-transistor model of a thyristor, Thyristor ratings, Thyristor protection, Improvement of thyristor characteristics, Series and parallel operation of thyristors, Gate turn off thyristor, Firing circuits for thyristors.

Thyristor Commutation: Class A commutation: Load commutation, Class B commutation: Resonant commutation, Class C commutation: Complementary commutation, Class D commutation: Impulse commutation, Class E&F commutation.

Unit–III

Phase Controlled Rectifiers: Principle of phase control, Full wave controlled converters, Single phase full wave converters, Single phase symmetrical and asymmetrical semi converters, three phase rectifiers and thyristor converters, Performance parameters of three phase full converters, Effect of source impedance on the performance of converters. Principle of chopper operation, Control strategies, Step up choppers, Types of chopper circuits, Single phase voltage source inverters: Operating principle, Force commutated thyristor inverters, Voltage control in single phase inverters.

Unit-IV

AC Voltage Controllers: Principle of phase control, Principle of integral cycle control, single phase ac voltage controller with R load and RL load.

Cycloconverters: Principle of cycloconverter operation, step up and step down cycloconverters, Three phase half wave converters, Output voltage equation for a cycloconverter, Load commutated cycloconverter.

Text Books

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

Reference Books

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

ECE-407N	MICROCONTROLLER AND EMBEDDED SYSTEM DESIGN LAB					
Lecture	**Tutorial**	**Practical**	**Sessionals**	**Practical**	**Total**	**Time(Hrs)**
0	**0**	**3**	**40**	**60**	**100**	**3**
Course Objectives	*1. To design of microcontroller based systems.* *2. To impart practical knowledge of 8051 and PIC Microcontrollers*					
Course Outcomes						
CO1	*To familiarization with 8051 and PIC Microcontrollers.*					
CO2	*Ability to write a C language and assembly language program for 8051 Microcontroller.*					
CO3	*Ability to interfacing the various Peripheral to 8051 Microcontrollers.*					
CO4	*Ability to design the embedded systems based on 8051 Microcontrollers.*					

List of experiments to be performed using 8051 Microcontrollers

1. (a) To study different commands of 8051 trainer kit with their function.

   (b) To study architectural block and pin diagram of 8051 microcontroller and PIC16C74 microcontroller.
2. To write an ALP to perform addition, subtraction, multiplication and division of two unsigned numbers.
3. To write an ALP to perform logical operation i.e., AND, OR, XOR and Complement of two unsigned numbers.
4. To write an ALP to perform multi byte addition and subtraction of two unsigned number.
5. To write an ALP to perform rotate operations i.e., RL, RLC, RR, RRC.
6. To write an ALP for flashing message “WELCOME M51-02 KIT” on LCD screen.
7. To write an ALP for identifying pressed number is even or odd. If number is even, message displays on LCD “NUMBER IS EVEN” and if number is odd, message displays on LCD “NUMBER IS ODD”.
8. To write an ALP to perform data transfer between internal & external memory using all available addressing modes.
9. To write an embedded C program for interfacing LCD to port P0 and display message “LCD Display” on LCD screen.
10. To write an embedded C program for interfacing keypad to port P0 .Whenever a key is pressed; it should be displayed on LCD.
11. To write an embedded C program for interfacing a switch and a buzzer to two different pins of a Port such that the buzzer should sound as long as the switch is pressed.
12. To write an embedded C program for interfacing stepper motor to rotate clockwise and anticlockwise directions.
13. To write an embedded C program for interfacing relay and buzzer.
14. To write an embedded C program for interfacing PWM module to control speed of motor.
15. To write an embedded C program for interfacing LED to glow in different pattern i.e., even odd, rotate left, rotate right.
16. To write an embedded C program for interfacing temperature sensor.
17. Design an Obstacle Detector system through Ultra Sonic obstacle detection using ultrasonic transmitter receiver.

ECE-409N	DIGITAL IMAGE PROCESSING LAB					
Lecture	**Tutorial**	**Practical**	**Sessionals**	**Practical**	**Total**	**Time**
-	**-**	**3**	**40**	**60**	**100**	**3 Hr.**
Course Outcomes						
CO1	***Students should be able to explain the basics of Digital Image processing***					
CO2	***Student will be able to explain sampling and quantization of digital image***					
CO3	***Student will be able to analyze the image enhancement operations on digital image***					
CO4	***Students will be able to analyze the various image analysis and computer vision algorithm***					

List of Experiments:

1. Study of Image processing toolbox of Matlab.
2. WAP to read and show various images of at least five different formats.
3. WAP to extract R, G, B component of Color Image.
4. WAP to convert a color image into gray scale and save it in new format.
5. WAP to invert a gray scale image.
6. WAP to implement Morphological operations on an image.
7. WAP to implement Histogram equalization.
8. WAP to implement various edge detection algorithms.
9. WAP to implement image segmentation
10. WAP to implement boundary extraction of basic structure.

ECE-402N	WIRELESS & MOBILE COMMUNICATION					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
4	0	**0**	**75**	**25**	**100**	**3**
Purpose	*To introduce the concepts of wireless / mobile communication using cellular environment. To make the students to know about the various modulation techniques, ppropagation methods, and multi access techniques used in the mobile communication.*					
Course Outcomes						
CO 1	*It deals with the fundamental cellular radio concepts such as frequency reuse and handoff.*					
CO 2	*This also demonstrates the principle of trunking efficiency and how trunking and interference issues between mobile and base stations combine to affect the overall capacity of cellular systems.*					
CO 3	*It provides idea about analog and digital modulation techniques used in wireless communication.*					
CO 4	*It presents different ways to radio propagation models and predict the large – scale effects of radio propagation in many operating environment.*					

Unit–I

Introduction to Wireless Communication Systems: Evolution of mobile radio communications, examples of wireless comm. systems, paging systems, Cordless telephone systems, comparison of various wireless systems.

Modern Wireless Communication Systems: Second generation cellular networks, third generation wireless networks, wireless in local loop, wireless local area networks, Blue tooth and Personal Area networks.

Unit–II

Introduction to Cellular Mobile Systems: Spectrum Allocation, basic Cellular Systems, performance Criteria, Operation of cellular systems, analog cellular systems, digital Cellular Systems.

Cellular System Design Fundamentals: Frequency Reuse, channel assignment strategies, handoff Strategies, Interference and system capacity, tracking and grade off service, improving coverage and capacity.

Unit– III

Multiple Access Techniques for Wireless Communication: Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, packet ratio, capacity of a cellular systems.

Unit–IV

Wireless Standards-GSM, IS-95, UMTS-IMT-2000, Signaling, Call Control, Mobility Management and location Tracing.

Suggested Books:

1. Theodore S.Reppaport, Wireless Communications Principles and Practice, IEEE Press, Prentice Hall.
2. William C.Y.Lec, Mobile Cellular Telecommunications, Analog and Digital Systems, Mc-Graw Hill Inc.
3. Kamilo Feher, Wireless Digital Communications, Modernization & Spread Spectrum Applications, Prentice Hall of India, New Delhi.
4. Kaveh Pahlavan and Allen H. Levesque “Wireless Information Networks”, Wiley Series, John Wiley and Sons Inc.

ECE-404N	MICROWAVE ENGINEERING					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hrs**
Purpose	*As a part of RF communication technology the purpose of this course is to create awareness about conventional microwave resonators, generators, components and devices along with the importance of scattering parameters so that the learner is able to design and apply these basic approaches in commercial as well as defense applications.*					
Course Outcomes						
CO1	***Learner will be able to mathematically design basic resonator cavities and will be able to measure microwave parameters such as impedance, frequency and VSWR etc.***					
CO2	***Learner will learn the conventional methods to generate the microwaves.***					
CO3	***Learner will know about the importance of scattering parameters along with its applications in the analysis of basic microwave components.***					
CO4	***Learner will learn about transferred electron and avalanche transit time devices in detail.***					

Unit-I

Microwave Resonators: Brief description of waveguides, coplanar waveguides, cavity resonators: rectangular, cylindrical, spherical and coaxial, excitation and coupling of cavities, Q factor. Microwave Measurements: Measurement of Frequency, Impedance (using slotted section) attenuation, power, dielectric constant, measurement of V.S. W. R., insertion loss and permeability

Unit-II

Microwave Generators: Construction, characteristics, operating principle and typical applications of Klystron(two cavity, multicavity), Reflex Klystron, magnetron(Cylindrical magnetron and description of Π mode applications) and Traveling Wave Tube (TWT).

Unit-III

Matrix Description of Microwave Circuits: Scattering Matrix: properties, measurement of scattering coefficients, scattering matrices for common microwave systems. Microwave Components: Waveguide tees- E-plane, H-plane, magic tee, rat race, directional coupler, tuning screws and stubs, isolators and circulators-their constructional features and applications. Microwave filters, Phase shifters, attenuators, and frequency meter.

Unit-IV

Solid State Microwave Devices: Transferred Electron Devices- Gunn Effect; negative differential resistance phenomenon, field domain formation, Gunn diode structure. Avalanche transit time devices: IMPATT, TRAPATT, BARITT diodes, Parametric amplifiers

Text Book:

1. Samuel Y. Liao, Microwave Engineering, Pearson Education 3rd/4th/ higher Ed.

Reference Books:

2. Annapurna & Sisir K. Das, Microwave Engineering, Tata McGraw-Hill.
3. David M. Pozar, Microwave Engineering, John Wiley and Sons Inc.

ECE-408N	WIRELESS & MOBILE COMMUNICATION LAB					
Lecture	**Tutorial**	**Practical**	**Sessionals**	**Practical**	**Total**	**Time**
-		3	40	60	100	3 Hour
Purpose	***To give the students an idea about the Wireless communication theory and technology using the NI-Labview software and RF communication module.***					
Course Outcomes						
CO 1	***To study the wireless communication using NI-Labview***					
CO 2	***To learn about the functioning of Universal Software Radio Peripheral (USRP)***					
CO 3	***To learn the implementation of different analog modulation schemes using the USRP.***					
CO 4	***To learn the implementation of different digital modulation schemes using the USRP.***					

List of Experiments:

1. Introduction to NI-LabVIEW and familiarization with its basic functions.
2. Study of modulation toolkit and its usage in Wireless Communication.
3. Study the interfacing of hardware (USRP module) with the PC and configuring the same.
4. Implementation of AM using Software Defined Radio (SDR).
5. Implementation of FM using SDR with application such as transfer of files
6. Implementation of M-PSK transmitter using SDR concept.
7. Implementation of M-PSK receiver using SDR
8. Implementation of M-QAM transmitter using SDR.
9. Demonstrates the use of the Bluetooth functions to set up data transfer via Bluetooth between a server VI and a client VI.
10. Design two-dimensional convolution to perform image edge detection.
11. Implementation of M-QAM receiver using SDR.
12. Implementation of PSK Modulation system with Convolutional Coding.
13. Implementation of FSK Modulation system with BCH Coding.
14. Implementation of QAM Modulation system with Golay Coding

ECE-410N	MICROWAVE ENGINEERING LAB					
Lecture	**Tutorial**	**Practical**	**Sessionals**	**Practical**	**Total**	**Time**
-		3	40	60	100	3 Hour
Purpose	***To give the students an idea about the study and analysis of components used in Microwave Engg.***					
Course Outcomes						
CO 1	***Students will learn the steps to analyze microwave components.***					
CO 2	***Students will be able to find the characteristics of microwave components.***					
CO 3	***Students will learn the steps to analyze various antennas.***					
CO 4	***Students will be able to find the characteristics of various antennas.***					

List of Experiments:

1. To study microwave components.
2. To study the characteristics of the reflex Klystron tube and to determine its electronic tuning range.
3. To determine the frequency and wavelength in a rectangular waveguide working in TE_{10} mode.
4. To determine the standing wave ratio and reflection coefficient.
5. To study the I-V characteristics of gunn diode.
6. To study the magic Tee.
7. To study the isolator and attenuator.
8. To measure the coupling coefficient and directivity of a waveguide directional coupler.
9. To measure the polar pattern and the gain of a waveguide horn antenna.
10. To measure the insertion loss and attenuation.

ECE-415N	Advance Digital Communication					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
4	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Purpose	***To understand and acquire knowledge about various power semiconductor devices. To prepare the students to analyze and design different power converter circuits.***					
Course Outcomes						
CO1	***Acquire knowledge about fundamental concepts and techniques used in digital communications***					
CO2	***Ability to analyze various techniques of communication and understand their applications.***					
CO3	***Foster ability to identify basic requirements for power digital communication based design application.***					
CO4	***To develop skills to build, and troubleshoot on digital communication circuits***					

Unit-I

Probability and Stochastic Processes: Probability: Random Variables, Probability Distribution, and Probability Densities, Functions of Random Variables, Statistical Average of Random Variables, Some Useful Probability Distributions, Upper Bounds on the Tail Probability, Sums of Random Variables and Central Limit Theorem.Stochastic Processes: Statistical Averages, Power Density Spectrum, Response of a Linear Time - Invariant System to a Random Input Signal, Sampling Theorem for Band- Limited Stochastic Processes, Discrete-time Stochastic Signals and Systems, Cyclostationary processes.

Unit -II

Source coding: Mathematical Models for Information Sources, A Logarithmic Measure of information: Average Mutual Information and Entropy, Information Measure for Continuous Random Variables. Coding for Discrete Sources: Coding for Discrete Memory less sources, Discrete Stationary Sources, The Lempel-Ziv Algorithm.Coding for Analog Sources-Optimum Quantization: Rate- Distortion Function, Scalar Quantization, Vector Quantization. Coding Techniques for Analog Sources: Temporal Waveform Coding, Spectral Waveform Coding, Model- Based Source Coding.

Unit -III

Characterization of Communication Signal and Systems: Signal Space Representation: Vector Space Concept, Signal Space Concept, Orthogonal Expansion of Signals, Gram Schmitt Procedure.
Optimum Receivers for the Additive White Gaussian Noise Channel: Performance of the Optimum Receiver for Memory Less Modulation: Probability of Error for Binary Modulation, Probability of Error for M- ary Orthogonal Signals, Probability of Error for M- ary Binary- Coded Signals, Probability of Error for M-ary PAM, Optimum Receiver for Binary Signals.

Unit -1V

Carrier and Symbol Synchronization: Signal Parameter Estimation: The Likelihood Function, Carrier Recovery and Symbol Synchronization in Signal Demodulation.Carrier Phase Estimation: Maximum Likelihood Carrier Phase Estimation, The Phased – Locked Loop, Effect of Additive Noise on the Phase Estimate, Decision Directed Loops, Non- Decision Directed Loops.

Text Book: *Digital Communication*, J.G. Proakis, Prentice Hall India.
Reference Book: *Principles of Communication Systems*, Taub & Schilling, McGraw Hill Education; 3rd.

ECE-417N	NANO ELECTRONICS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
4	**0**	**0**	**75**	**25**	**100**	**3 Hour**
Course Outcomes						
CO 1	***Students will be using physics, mathematics, and material science engineering to understand the latest development in the area of Microelectronics leading to Nanoelectronics.***					
CO 2	***Students be able to understand the fundamentals of classical CMOS technology and issues in scaling MOSFET in the sub-100nm regime***					
CO 3	***Understanding basic principles of non -classical transistors with new device structure and nano materials.***					
CO 4	***Understand the issues in realizing Germanium and compound semiconductor MOSFET.***					
CO5	***Students will learn materials characterization techniques extensively.***					

Unit-I

Overview: Nano devices, Nano materials, Definition of Technology node, Basic CMOS Process flow, MOS Scaling theory, Issues in scaling, Short channel effects, Description of a typical 65 nm CMOS technology, Requirements for Non classical MOS transistor, MOS capacitor, Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO2 vs High-k gate dielectrics. Integration issues of high-k , Interface states, bulk charge, band offset, stability, etc.

Unit-II

Metal Gate Transistor : Motivation, requirements, Integration Issues, Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot, SOI - PDSOI and FDSOI., Ultrathin body SOI - double gate transistors, Vertical transistors - FinFET and Surround gate FET, Metal source/drain junctions - Properties of schotky junctions on Silicon, Germanium and compound semiconductors –Work function pinning, Germanium Nano MOSFETs : strain , quantization , Advantages of Germanium over Silicon.

Unit-III

PMOS versus NMOS, Compound semiconductors - material properties, MESFETs Compound semicocnductors MOSFETs in the context of channel quantization and strain , Hetero structure MOSFETs exploiting novel materials, strain, quantization.
Synthesis of Nanomaterials : CVD, Nucleation and Growth, ALD, Epitaxy, MBE. Compound semiconductor hetero-structure growth, emerging nano materials: Nanotubes, nanorods and other nano structures, LB technique, Soft lithography etc. Microwave assisted synthesis, Self assembly etc.

Unit-IV

Characterization : Quantum wells and Thickness measurement techniques: Contact - step height, Optical - reflectance and ellipsometry, AFM, Nanomaterials Characterization techniques: FTIR, XRD, AFM, SEM, TEM, EDAX and interpretation of results.

Books:

1. Fundamentals of Modern VLSI Devices, Y. Taur and T. Ning, Cambridge University Press. Silicon VLSI Technology, Plummer, Deal , Griffin , Pearson Education India.
2. Encyclopedia of Materials Characterization, Edited by: Brundle, C.Richard; Evans, Charles A. Jr.; Wilson, Shaun ; Elsevier.

ECE - 419N	OPTICAL COMMUNICATION					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Purpose	*To familiarize the students with the concepts of Optical communication covering the contents of optical fibers, losses in fibers, optical sources, detectors etc.*					
Course Outcomes						
CO1	*Students will be able to understand the structure of fiber and the mechanism of light travelling in the fiber.*					
CO2	*Students will be able to analyze various losses associated with fibers.*					
CO3	*Students will learn about the optical sources and optical detecters.*					
CO4	*Students will be able to understand the various components needed in optical networks*					

Unit – I

INTRODUCTION : Optical Fibers: Structure, Propagation within the fiber, Numerical aperture of fiber, step index and graded index fiber, Modes of propagation in the fiber, Single mode and multi mode fibers. Splices and connectors. Optical Power Launching and Coupling. Fiber-to-fiber joints.

Unit–II

LOSSES IN OPTICAL FIBER : Rayleigh Scattering Losses, Absorption Losses, Leaky modes, Mode coupling losses, Bending Losses, Combined Losses in the fiber.

DISPERSION EFFECT: Effect of dispersion on the pulse transmission Intermodal dispersion, Material dispersion, Wave guide dispersion, Polarization Mode Dispersion Total dispersion, Transmission rate. Dispersion Shifted Fibers, Dispersion Compensating Fibers.

Unit – III

LIGHT SOURCES : LEDS, Laser Action in semiconductor Lasers, Semiconductor Lasers for optical communication – Laser modes, Spectral Characteristics, Power Voltage Characteristics, Frequency response.

DETECTORS : P-I-N Photodiode, APD, Noise Analysis in detectors, Coherent and non-coherent detection, Infrared sensors. Bit error rate.

Unit– IV

THE FIBER-OPTIC COMMUNICATION SYSTEM: Design considerations of fiber optic systems: Analog and digital modulation. Optical Devices: Optical coupler, space switches, linear divider-combiners, wavelength
division multiplexer and demultiplexer, optical amplifier

OPTICAL NETWORKS: Elements and Architecture of Fiber-Optic Network, Optical link network-single hop , multihop, hybrid and photonic networks.

Suggested Books:

1. John Power, An Introduction to Fiber optic systems, McGraw Hill International.
2. John Gowar , Optical communication Systems.
3. R. Ramaswamy, Optical Networks, Narosa Publication
4. John M. Senior,Optical Fiber Communication
5. Gerd Keiser, Optical Fiber Communication

ECE - 421N	ADAPTIVE SIGNAL PROCESSING					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Purpose	*To familiarize the students with various stochastic processes and models, analysis of wiener filters, steepest descent algorithms. Also, students will be able to understand LMS & RLS algorithms and check the robustness and study the Finite-Precision effects on LMS and RLS algorithms.*					
Course Outcomes						
CO1	*To understand various stochastic processes and models in adaptive signal processing.*					
CO2	*To understand the analysis of wiener filters, the concept of the linear prediction and steepest descent algorithms.*					
CO3	*To understand the concept and use of Least-Mean-Square (LMS) & Recursive Least-Squares (RLS) algorithms with applications to specific engineering problems.*					
CO4	*To apply the concept robustness and analysis the Finite-Precision effects on LMS and RLS algorithms.*					

Unit -I

Stochastic Processes and Models: Partial Characterization of a Discrete-Time Stochastic Process, Mean Ergodic Theorem, Correlation Matrix, Correlation Matrix of Sine Wave Plus Noise, Stochastic Models, Wold Decomposition, Asymptotic Stationarity of an Autoregressive Process, Yule—Walker Equations.

Wiener Filters: Linear Optimum Filtering: Statement of the Problem, Principle of Orthogonality, Minimum Mean-Square Error, Wiener-Hopf Equations, Error-Performance Surface, Multiple Linear Regression Model.

Unit -II

Linear Prediction: Forward Linear Prediction, Backward Linear Prediction, Levinson-Durbin Algorithm, Properties of Prediction-Error Filters, Schur-Cohn Test.

Method of Steepest Descent: Basic Idea of the Steepest-Descent Algorithm, The Steepest-Descent Algorithm Applied to the Wiener Filter, Stability of the Steepest-Descent Algorithm, Example, The Steepest-Descent Algorithm as a Deterministic Search Method, Virtue and Limitation of the Steepest-Descent Algorithm.

Unit -III

The Least-Mean-Square (LMS) Algorithm: Signal-Flow Graph, Optimality Considerations, Applications, Statistical Learning Theory, Transient Behavior and Convergence Considerations, Efficiency.

The Recursive Least-Squares (RLS) Algorithm: Some Preliminaries, The Matrix Inversion Lemma, The Exponentially Weighted RLS Algorithm, Selection of the Regularization Parameter, Update Recursion for the Sum of Weighted Error Squares, Example: Single-Weight Adaptive Noise Canceller.

Unit -IV

Robustness: Robustness, Adaptation, and Disturbances, Robustness: Preliminary Considerations Rooted in H∞ Optimization, Robustness of the LMS Algorithm, Robustness of the RLS Algorithm, Comparative Evaluations of the LMS and RLS Algorithms from the Perspective of Robustness.

Finite-Precision Effects: Quantization Errors, Least-Mean-Square (LMS) Algorithm, Recursive Least-Squares (RLS) Algorithm, Summary and Discussion.

TEXT BOOKS:

1. S. Haykin, Adaptive filter theory, Pearson

REFERENCE BOOKS:

1. T. Adali and S. Haykin, Adaptive Signal Processing, Wiley India
2. B. Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall.

ECE-423N	SATELLITE COMMUNICATION					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Purpose	*To familiarize the students with the concepts of Satellite communication and various terms, laws and multiple access schemes used in its working***.**					
Course Outcomes						
CO1	***To understand the concept of basics of satellite communication and various basic laws and terms of satellite communication.***					
CO2	***To understand the concept and processes of various communication satellites used in satellite communication.***					
CO3	***To familiarize with the concept and design issues of satellite link design and satellite access.***					
CO4	***To familiarize with the concepts of Multiple access schemes used in satellite communication.***					

Unit -I

SATELLITE ORBITS: Orbital Mechanics- Kepler's laws ,locating the satellite in the Orbit, locating the satellite with respect to the earth, Orbital elements, look angle determination, Sub satellite point, Azimuth and elevation angle calculation, Orbital perturbations, Longitudinal and Inclination changes; Launches and launch vehicles-ELV's, Placing the satellite into geostationary orbit, Doppler shift, range variations, solar eclipse, sun transit outage.

Unit -II

COMMUNICATION SATELLITES: Satellite Subsystems, Attitude and Orbit Control system(AOCS), Telemetry, Tracking, Command and Monitoring (TTC&M), Power System, Communication Subsystems-description, Transponders, satellite antennas-basic antenna types, basic antennas in practice.

Unit -III

Satellite link design and Satellite access: Basic transmission theory**,** system noise temperature and G/T ratio; Downlink design-link budget; Uplink design; design for specified C/N, uplink and downlink attenuation in rain, communication link design procedure; system design examples.

Unit –IV

Multiple access schemes: FDMA, TDMA, CDMA, DAMA; VSAT systems-basic techniques, VSAT earth station engineering, system design; DBS systems-C-band and Ku band home TV, digital DBS; satellite mobile systems; GPS

Text Books:

1. Timothy Pratt, Satellite Communications, Wiley India edition

Reference Books:

1. Anil K Maini, Satellite Communication, Wiley India edition

ECE-425N	Digital VLSI Design					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**-**	**-**	**75**	**25**	**100**	**3 Hr.**
Purpose	*Analog CMOS circuits are used in amplifiers and various filters circuits. This course teaches design methods of CMOS IC circuits.*					
Course Outcomes						
CO1	*To understand MOS digital circuits concepts*					
CO2	*To understand the MOS inverter and its design*					
CO3	*To learn MOS combinational and sequential circuit design*					

Unit -I

Introduction: Introduction to MOSFETs : MOS Transistor Theory – Introduction MOS Device, Fabrication and Modeling , Body Effect, Noise Margin; Latch-up

Unit -II

MOS Inverter: MOS Inverter, MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, Design Equations, Static Load MOS Inverters, Transistor Sizing, Static and Switching Characteristics; MOS Capacitor.

Unit -III

MOS Combinational circuits: Combinational MOS Logic Circuits: Pass Transistors/Transmission Gates; Designing with transmission gates, Primitive Logic Gates; Complex Logic Circuits.

Unit -IV

MOS Sequential Circuits: Sequential MOS Logic Circuits: SR Latch, clocked Latch and flip flop circuits, CMOS D latch and edge triggered flip flop.

Books:

1. S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design, Third Edition,
MH, 2002.
2. N. Weste, K. Eshraghian and M. J. S. Smith, Principles of CMOS VLSI Design : A Systems Perspective, Second Edition (Expanded), AW/Pearson, 2001.
3.J. P. Uyemura, CMOS Logic Circuit Design, Kluwer, 1999.

ECE-427N	Analog CMOS IC Design					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**-**	**-**	**75**	**25**	**100**	**3 Hr.**
Purpose	*Analog CMOS circuits are used in amplifiers and various filters circuits. This course teaches design methods of CMOS IC circuits.*					
Course Objectives						
CO1	*To understand CMOS digital circuits concepts*					
CO2	*To design Analog circuits using CMOS.*					
CO3	*To learn modeling of CMOS based amplifiers circuits*					

Unit -I

Basic Analog CMOS Circuits: Introduction to analog design, Passive and active current mirrors, Switched Capacitor circuits - basic principles, sampling switches, switched capacitor integrator, switched capacitor amplifier.

Unit -II

CMOS single stage Amplifiers: Common-Source stage with resistive load and diode connected load, source follower, common-gate stage, cascode stage, folded cascode stage. Frequency responses of CS stage, CD stage, CG stage, cascode stage.

Unit -III

Differential Amplifier & Op-Amp: Single-ended and differential operation, basic differential pair – qualitative and quantitative analyses, common-mode response, differential pair with MOS loads, Performance parameters of op-amp, one stage op-amp, two-stage CMOS op-amp, slew rate, power supply rejection.

Unit -IV

Oscillators: General considerations, Ring oscillators, LC oscillators – cross-coupled oscillators, Colpitts oscillator, One-port oscillator, and voltage controlled oscillators.

Books:

1.Razavi, “Design of analog CMOS integrated circuits”, McGraw Hill, Edition 2002.

2. Allen, Holberg, “CMOS analog circuit design”,Oxford University Press, 2nd Edition, 2012.

ECE-429N	CONSUMER ELECTRONICS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Purpose	*To familiarize the students with the concepts of audio and video systems and also With various advanced electronic gadgets and home appliances*					
Course Outcomes						
CO1	***To understand the concept of basic audio system and AM/FM tuners.***					
CO2	***To understand the concept of Video Systems.***					
CO3	***To understand the various advanced electronic gadgets.***					
CO4	***To understand the various electronic home appliances.***					

Unit-I

Audio System: Wave motion, Microphones, Headphones and Headsets, Loudspeakers, Acoustics, Disc recording and Distortion in disc and tape, Optical recording and reproduction, Control circuits, Amplifying systems, Portable stereo, Theatre sound system and AM/FM tuners.

Unit-II

Video Systems: Monochrome TV standards and systems, Colour TV standards and systems, Monochrome and colour TV controls, Video Tape recording and reproduction, video disc recording and playback, Remote controls and Video systems.

Unit-III

Electronic Gadgets: Telecommunication Systems, Switching Systems, Modulation techniques, Fiber optics, Mobile Systems, Xerography and Fascimile fax, Automated Teller Machines and Top Boxes.

Unit-IV

Home Appliances: Digital clocks, In-Car Computers, Microwave ovens, Washing Machines, Air Conditioners and Refrigerators.

Reference Books:

1. Consumer Electronics By S.P. Bali, Pearson Education, 1st edition.
2. Colour Television-principles & practice R.R Gulati by Wiley Eastern Limited, New Delhi.
3. Colour Television & Video Technology by A.K. Maini CSB Publisher
4. VCR-principles, maintenance & repair by S.P. Sharma, Tata Mc Graw Hill, New Delhi
5. Colour TV by A. Dhak.

ECE-431N	ROBOTICS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes						
CO1	***The basic concepts related to robot, Parts of robots, End effectors and to make the student familiar with the various drive systems for robot.***					
CO2	***Various sensors and machine vision and their applications in robots.***					
CO3	***About various control system, robot programming, Artificial intelligence and safety standards of robots***					
CO4	***Industrial and Non-industrial Applications of robots.***					

Unit–I

Fundamentals of Robot: Definition, History and Development in robot technology. Robot Technology: Characteristics, Basic Components, Robot Anatomy, Robot Generations, Robot selection, Present and Future Applications.
Robot Drive Systems and End Effectors: Robot Classification: Arm geometry, Degrees of freedom, Power sources, Types of motion, Path Control. Robot End Effectors: Mechanical grippers, Vacuum, Magnetic, Adhesive. Special purpose grippers, Process tooling, Compliance, Robot Drive systems: Hydraulic, Pneumatic and Electric system.

Unit-II

Sensor : Requirements of a sensor, Sensor classification, Principles and Applications of the following types of sensors : Position of sensors (Potentiometer, Encoder, LVDT, Resolvers, LMDT, Hall – effect sensors),Velocity sensors(Encoder, Tachometer, Differentiation of position signal),Acceleration sensors, Force and Pressure Sensors(Piezoelectric, Force sensing resistor, Strain Gauge, Antistatic foam), Torque Sensors, Micro switches, Visible light and Infrared Sensors, Touch and Tactile sensors, Proximity Sensors(Magnetic, optical, Ultrasonic, Inductive, Capacitive, Eddy Current), Range Finder (Ultrasonic, Light-based, GPS), Sniff Sensors, Taste Sensors, Vision Sensors, Voice recognition devices, Voice synthesizers, RCC.
Machine Vision : Visual sensing, Architecture of robotics vision system, Machine vision: Image acquisition (Vidicon tube, CCD), Digitization, Image processing, Image Analysis, Image interpretation. Machine vision application, other optical methods.

Unit-III

Control System, Programming and Artificial Intelligence: Control Systems: PLC, PID, CNC, MPU, URC. Robot programming: Programming methods, Languages, levels of robot programming, Program statements. Elements of Artificial Intelligence, System architecture, Application of fuzzy logic in robotics, Robot Safety, safety standards.

Unit–IV

Robot Applications: Industrial applications, Automation in manufacturing, Robot applications, Material handling, Processing application, Assembly application, Inspection application, evaluating the potential of a robot application, future applications, challenge for the future, Innovations, Non-industrial application.
Text Books:

1. James G. Keramas, " Robot technology fundamentals", Delmar Publishers.
2. Saeed B. Niku, "Introduction to robotics analysis,control and applications", 2nd ed., Wiley India.
3. R. K. Mittal,I.J.Nagrath, "Robotics and Control", TMH Education Pvt. Lmt.

ECE-433N	NON-CONVENTIONAL ENERGY RESOURCES					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**-**	**-**	**75**	**25**	**100**	**3 Hour**
Course Outcomes						
CO 1	***To understand the energy demand of world, nation and available resources to fulfill the demand***					
CO 2	***To know about the conventional energy resources and their effective utilization***					
CO 3	***To acquire the knowledge of modern energy conversion technologies***					
CO 4	***To be able to understand and perform the various characterization techniques of fuels***					
CO5	***To be able to identify available nonconventional (renewable) energy resources and techniques to utilize them effectively.***					

Unit-I

Introduction: Energy demand of world and country and gap analysis, Fossil fuel based systems, Impact of fossil fuel based systems, Non conventional energy – seasonal variations and availability, Renewable energy – sources and features, Hybrid energy systems. Distributed energy systems and dispersed generation (DG).

Unit-II

Solar thermal systems: Solar radiation spectrum, Radiation measurement , Technologies, Applications, Heating, Cooling, Drying, Distillation, Power generation; Costing : Life cycle costing (LCC),Solar thermal system

Solar Photovoltaic systems ,Operating principle, Photovoltaic cell concepts ,Cell, module, array, Series and parallel connections, Maximum power point tracking, Applications ,Battery charging, Pumping , Lighting,Peltier cooling , Costing: Life cycle costing ,Solar PV system

Unit-III

Microhydel: Operating principle, Components of a microhydel power plant, Types and characteristics of turbines, Selection and modification, Load balancing, Costing: Life cycle costing -Microhydel

Wind ; Wind patterns and wind data, Site selection, Types of wind mills , Characteristics of wind generators, Load matching, Life cycle costing - Wind system LCC

Unit-IV

Biomass: Learning objectives, Operating principle, Combustion and fermentation, Anaerobic digester, Wood gassifier, Pyrolysis, Applications, Bio gas, Wood stoves, Bio diesel, Combustion engine, Life cycle costing - Biomass system LCC

Hybrid Systems, Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles

Suggested Books:

1. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 2003
2. Mittal K M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, New Delhi,2003
3.Ramesh R & Kumar K U, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 2004
4.Wakil MM, Power Plant Technology, Mc Graw Hill Book Co, New Delhi, 2004.

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ECE-435N	MICROSTRIP LINE ANALYSIS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**-**	**-**	**75**	**25**	**100**	**3 Hour**
Purpose	*To create awareness about the basics of designing the modern tuned circuit based on microstrip circuit theory.*					
Course Objectives						
CO 1	***To understand the need of microstrip line analysis.***					
CO 2	***To be able to acquire knowledge about the dispersion models and measurements.***					
CO 3	***To familiarize with quasi static analysis of microstrip line.***					
CO 4	***To acquire the knowledge of importance and applications of slotline type of microstrip..***					

Unit -I

Microstrip Lines I: Quasi- Static Analyses, Dispersion Models, and Measurements

Introduction, Quasi-Static Analyses of a Microstrip, Microstrip Dispersion Models, Microstrip Transitions, Microstrp Measurements.

Unit -II

Microstrip Lines II: Fullwave Analyses, Design Considerations, and Applications

Methods of Full Wave Analysis, Analysis of Open Microstrip, Analysis of Enclosed Microstrip, Design Considerations, Other Types of Microstrip Lines, Microstrip Applications.

Unit -III

Microstrip Discontinuities I: Quasi- Static Analysis and Characterization

Introduction, Discontinuity Capacitance Evaluation, Discontinuity Inductance Evaluation, Characterization of Various Discontinuities, Compensated Microstrip Discontinuities.

Unit -IV

Slotlines

Introduction, Slotline Analysis, Design Considerations, Slotline Discontinuities, Other Slotline Configurations, Slotline Transitions, Slotline Applications.

Text Book: K.C. Gupta, Ramesh Garg, Inder Bhal and Parkash Bhartia, ***Microstrip lines & Slotlines,*** Second ed., Artech House, London

ECE-437N	SOFTWARE DEFINED RADIOS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3		**-**	**75**	**25**	**100**	**3**
Purpose	***To understand Modern Radio Communication System that can be reconfigured.***					
Course Outcomes						
CO 1	***Conceptualize the SDR and implementation details***					
CO 2	***Design SDR for a specific application***					
CO 3	***Identify the challenges in the maintenance of SDR***					
CO 4	***Analyse the transmitter and receiver architectures***					

Unit-I

Introduction – Software Defined Radio – A Traditional Hardware Radio Architecture – Signal Processing Hardware History – Software Defined Radio Project Complexity.
A Basic Software Defined Radio Architecture – Introduction – 2G Radio Architectures Hybrid Radio Architecture- Basic Software Defined Radio Block Diagram- System Level Functioning Partitioning-Digital Frequency Conversion Partitioning.

Unit-II

Analog-to-Digital and Digital-to-Analog Conversion- Introduction – Digital Conversion Fundamentals- Sample Rate- Bandpass Sampling- Oversampling- Antialias Filtering – Quantization – ADC Techniques-Successive Approximation- Figure of Merit-DACs- DAC Noise Budget- ADC Noise Budget.

Unit-III

Digital Frequency Up- and Down Converters- Introduction- Frequency Converter Fundamentals- Digital NCO- Digital Mixers- Digital Filters- Halfband Filters- CIC Filters Decimation, Interpolation, and Multirate Processing-DUCs - Cascading Digital Converters and Digital Frequency Converters.
Signal Processing Hardware Components- Introduction- SDR Requirements for Processing Power- DSPs- DSP Devices- DSP Compilers- Reconfigurable Processors Adaptive Computing Machine- FPGAs

Unit-IV

Software Architecture and Components – Introduction- Major Software Architecture Choices – Hardware – Specific Software Architecture- Software Standards for Software Radio-Software Design Patterns- Component Choices- Real Time Operating Systems- High Level Software Languages- Hardware Languages.

Text Books

1. Paul Burns, Software Defined Radio for 3G, Artech House, 2002.
2. Tony J Rouphael, RF and DSP for SDR, Elsevier Newnes Press, 2008
3. Jouko Vanakka, Digital Synthesizers and Transmitter for Software Radio, Springer, 2005.
4. P Kenington, RF and Baseband Techniques for Software Defined Radio, Artech House, 2005.

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ECE-414N	DSP PROCESSOR					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**-**	**-**	**75**	**25**	**100**	**3 Hour**
Course Objectives	***1. To study Programmable DSP Processors.*** ***2. To provide an understanding of the fundamentals of DSP techniques.*** ***3. To study implementation & applications of DSP techniques.*** ***4. To understand architecture of DSP processor*** ***5. To understand DSP system design using FPGA.***					
Course Outcomes						
CO 1	*To describe the detailed architecture, addressing mode, instruction sets of TMS320C5X.*					
CO 2	*To write program of DSP processor.*					
CO 3	*To describe the detailed architecture, addressing mode, instruction sets of TMS320C54X.*					
CO 4	*To know DSP system design using FPGA.*					

Unit -I

INTRODUCTION: Digital Signal Processing, Advantages of DSP, Applications of DSP.
Fundamentals Of Programmable Dsps: Multiplier and Multiplier accumulator, Modified Bus Structures and Memory access in P-DSPs, Multiple access memory , Multi-ported memory , VLIW architecture, Pipelining , Special Addressing modes in P- DSPs , On chip Peripherals.

Unit -II

ARCHITECTURE OF TMS320C5X: Architecture, Bus Structure & memory, CPU, addressing modes. Programming TMS320C5X: Assembly language syntax, Assembly language Instructions, Simple ALP – Pipeline structure, Operation Block Diagram of DSP starter kit, Application Programs for processing real time signals.

Unit -III

PROGRAMMABLE DIGITAL SIGNAL PROCESSORS: Block diagrams of 54X internal Hardware, buses , internal memory organization, Data Addressing modes of S320C54XX Processors, Program Control, On-chip peripheral, Interrupts ofTMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

Unit -IV

ADVANCED PROCESSORS and FPGA: Code composer studio - Architecture of TMS320C6X, Introduction to FPGA, Design flow for an FPGA based system design, FPGA based DSP system design. Comparison of the performance of the system designed using FPGA and Digital signal processors, Application note on DSP systems.

Text- Books:

1. B. Venkataramani and M. Bhaskar, Digital Signal Processors -Architecture, Programming and Applications 2nd edition, Mc Graw Hills 2011.
2. Avtar Singh, S. Srinivasan DSP Implementation using DSP microprocessor with Examples from TMS32C54XX –Thamson.

Reference Books:

1. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. , S. Chand & Co, 2000.
2. Digital signal processing-Jonathen Stein John Wiley 2005.
3. S.K. Mitra, Digital Signal Processing, Tata McGraw-Hill Publication, 2001.
4. B. Venkataramani, M. Bhaskar, Digital Signal Processors, McGraw Hil

ECE-416N	MOBILE COMMUNICATION NETWORK					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3		**-**	**75**	**25**	**100**	**3**
Purpose	*To expose the students to the most recent technological developments in Mobile communication systems.*					
Course Outcomes						
CO 1	***Fundamental concepts in wireless, cellular technology***					
CO 2	***Standards evolved***					
CO 3	***Models of mobile radio channels***					
CO 4	***Communication technologies adapted, Wireless networks***					

Unit-I

Introduction To Mobile Radio Systems Evolution of Mobile radio communications – Mobile radio systems in the U.S. and around the world – Examples of Mobile radio systems. **Standards and Cellular Concept Cellular concept** – Frequency reuse – Channel Assignment strategies – Handoff strategies – Interference and System capacity – Trunking and Grade of service – Improving capacity in cellular systems.

Unit-II

Mobile Radio Propagation Small-scale multipath propagation – Impulse response of a multipath channel – Parameters of mobile multipath channel – Types of small-scale fading – Rayleigh and Rician distributions – Statistical models for multipath fading channels.

Unit-III

Mobile System and Network Architectures GSM Services and Features – GSM system architecture – GSM radio subsystem – Frame structure for GSM – Signal processing in GSM – GPRS network architecture – GPRS services and features – 3G UMTS network architecture – UMTS services and features.

Unit-IV

Wireless Standards Multiple access techniques – FDMA, TDMA and CDMA – Wireless networking – Design issues in personal wireless systems – Cordless systems and Wireless Local Loop (WLL) – IEEE 802.16 Fixed Broadband Wireless Access standard – Mobile IP and Wireless Application Protocol.

Text Books

1. Rappaport, T.S., "Wireless Communications", Principles and Practice, Prentice Hall, NJ, 1996.
2. William Stallings, "Wireless Communication and Networking", Pearson Education, 2002.
3. Siegmund M. Redl, Mathias K. Weber, Malcolm W. Oliphant, "An Introduction to GSM", Artech House Publishers, 1995.
4. Kraus, J.D., "Antennas", II Edition, John Wiley and Sons, NY, 1977. 5. Collin, R.E. and Zucker, F., - "Antenna theory: Part I", Tata McGraw Hill, NY, 1969.

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ECE-418N	MEMS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**-**	**-**	**75**	**25**	**100**	**3**
Course Outcomes						
CO 1	***Students will be using knowledge of mathematics, science, and engineering to understand various MEMS devices.***					
CO 2	***Students be able to understand various processes used such as oxidation, metallization, fabrication and packaging of MEMS devices.***					
CO 3	***Understanding basic principles of bulk micromachining and clean rooms practices***					
CO 4	***Understand materials and MEMS packaging techniques.***					
CO 5	***Students can write an engineering report on the one of potential MEMS devices and give an effective oral presentation.***					

Unit-I

Introduction to Microsystems: Overview of microelectronics manufacture and Microsystems technology. Definition - MEMS materials. Laws of scaling. The multi disciplinary nature of MEMS. Survey of materials central to micro engineering. Applications of MEMS in various industries.

Unit-II

Micro Sensors and Actuators: Working principle of Microsystems - micro actuation techniques, micro sensors – types, Microactuators and types,micropump, micromotors, micro – valves, microgrippers – micro- accelerometers.

Unit-III

Fabrication Process Substrates - single crystal silicon wafer formation, Clean room practices, Photolithography, Ion implantation, Diffusion, Oxidation, CVD - Physical vapor deposition, epitaxy - etching process.

Unit-IV

Micro System Manufacturing Bulk Micro manufacturing - surface micro machining – LIGA Micro system packaging materials - die level - device level - system level - packaging techniques – die preparation – surface bonding wire bonding - sealing. Introduction to assembly, Introduction to Micro-system design.

Text Books

1. MEMS and Microsystems Design and Manufacture" by Tai-Ran Hsu. Tata McGraw-Hill Publishing Company Ltd.
2. Foundation of MEMS" by Chang Liu. Pearson Education.
3. MEMS Handbook", Mohamed Gad – el – Hak, CRC Press, 2002.
4. Rai - Choudhury P. MEMS and MOEMS Technology and Applications", PHI Learning Private Limited, 2009.
5. Sabrie Solomon, "Sensors Handbook," Mc Graw Hill, 1998.

References

1. Francis E.H. Tay and Choong .W.O, "Micro fluidics and Bio mems application", IEEE Press New York, 1997.
2. Trimmer William S., Ed., "Micromechanics and MEMS", IEEE Press New York, 1997.

3. Maluf, Nadim, "An introduction to Micro electro mechanical Systems Engineering", AR Tech house, Boston 2000.
4. Julian W.Gardner, Vijay K.Varadan, Osama O. Awadel Karim, "Micro sensors MEMS and Smart Devices", John Wiby & sons Ltd., 2001.

ECE-420N	TRANSDUCERS & ITS APPLICATIONS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3		**-**	**75**	**25**	**100**	**3**
Purpose	*Understanding the structural and functional principles of sensors and transducers used for various physical and nonelectric quantities and how to use them to measure these quantities.*					
Course Outcomes						
CO 1	***Explain the principles of operation of the sensor parameters and generators***					
CO 2	***Interpretation of the measurement results by using transducers.***					
CO 3	***Development of measurement schemes for different non electrical quantities***					
CO 4	***Assimilating knowledge about the implementation of sensors and transducers.***					

Unit-I

Definition of transducer. Advantages of an electrical signal as out-put. Basic requirements of transducers, Primary and Secondary Transducer, Analog or digital types of transducers. Resistive, inductive, capacitive, piezoelectric, photoelectric and Hall Effect tranducers.

Unit-II

Measurement of Pressure – Manometers, Force summing devices and electrical transducers
Measurement of Temperature – Metallic resistance thermometers, semi conductor resistance sensors (Thermistors), thermo-electric sensors, pyrometers.

Unit-III

Measurement of Displacement – Potentiometric resistance type transducers, inductive type transducers, differential transformer (L.V.D.T), capacitive transducers, Hall effect devices, strain gage transducers.
Measurement of Velocity – variable reluctance pick up, electromagnetic tachometers, photoelectric tachometer, toothed rotor tachometer generator..

Unit-IV

Measurement of Force – Strain-gage load cells, pneumatic load cell, LVDT type force transducer.
Measurement of Torque – Torque meter, torsion meter, absorption dynamometers, inductive torque transducer, digital methods.

Suggested Books:

1. B.C. Nakra, K.K. Chaudhry, "Instrumentation Measurement and Analysis," Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Thomas G. Beckwith etc. all, "Mechanical Measurements (International Student Edition), Addison-Wesley Longman, Inc. England.
3. A.K. Sawhney, " A Course in Electrical and Electronic Measurements and Instrumentation," Dhanpat Rai & Sons, Delhi-6.

ECE 422N	RADAR ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Purpose	*To familiarize the students with the concepts of radar, various types of radar, radar mixers and various other technologies.*						
Course Outcomes							
CO1	***To understand the concept of basics of radar, its equation and signals associated with radar.***						
CO2	***To understand the concept of CW and MTI radar.***						
CO3	***To familiarize with the concept of tracking radar.***						
CO4	***To familiarize with the concept of radar receiver, mixers and duplexers.***						

Unit- I

Radar BASICS:
Radar Block Diagram & operation, Applications of Radar.

Radar Equation:
Simple form of Radar Equation, Detection of signals in noise,Signal to Noise ratio, Transmitter Power. Pulse repetition frequenc)' & range ambiguities, System losses, Propagation effects.

Unit- II

CW & Frequency Modulated Radar:
The Doppler effect, CW Radar, FM- CW Radar, Multiple Frequency CW Radar.

MTI & Pulse Doppler Radar:
Introduction, Delay Line Cancellors. Multiple or staggered Pulse repetition frequencies.range-Gated Doppler Filters, Limitation of MTI performance, Noncoherent MTI, Pulse Doppler radar, MTI from a moving platform.

Unit-III

Tracking Radar: Tracking with Radar, Sequential Lobbing, Conical Scan, Monopulse Tracking Radar, Tracking in range, Acquisition, Low angle tracking.

Unit-IV

Receivers, Displays & Duplexers:
Radar Receivers, Noise Figure, MixerLow-noise Front ends. Displays, Duplexer, Receiver protectors.

Text Book:
I. Introduction to Radar Systems: Merrill!. Skolnik,; MGH
Reference Book:
Electronic Communication Systems: Kennedy; TMH.

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ECE-424N	HIGH FREQUENCY CIRCUITS AND SYSTEMS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Purpose	*This course aims to introduce the design of high frequency CMOS circuits suitable for transmitter and receiver of modern communication devices*					
Course Outcomes						
CO1	***To explore the various performance measures of high frequency circuits.***					
CO2	***To learn the design of high frequency filters, amplifiers and oscillators.***					

Unit-I

PARAMETERS OF HIGH FREQUENCY CIRCUITS

Gain Parameters, Non-linearity parameters, Noise figure, Phase Noise, Dynamic range, RF front end performance parameters, performance trade offs in an RF circuit.

Unit-II

HIGH FREQUENCY FILTER DESIGN

Modern filter design, Frequency and impedance scaling, High Pass filter design, Band pass filter design, Band reject filter design, the effects of finite Q.

Unit- III

HIGH FREQUENCY AMPLIFIER DESIGN

Zero as bandwidth enhances,Shunt-series amplifier, Bandwidth enhancement with frequency Doublers, Tuned amplifiers, Neutralization and unilateralization , cascaded Amplifiers.

Unit -IV

MIXERS AND OSCILLATORS

Mixer fundamentals, Non linear systems as Linear mixers, multiplier based mixers, Subsampling mixers. Problems with purely linear oscillators, Tuned oscillator, Negative Resistance oscillators, frequency synthesis.

BOOKS

1. Aleksandar Tasic, Wouter.A.Serdijn, John.R.Long, “Adaptive Low Power Circuits for Wireless Communication (Analog Circuits and Signal Processing)”, Springer, 1st Edition, 2006.

2. Chris Bowick, “RF Circuit design”, Newnes (An imprint of Elesvier Science), 1st Edition, 1997. Thomas.H. Lee, “The design of CMOS Radio-Frequency Integrated Circuits”,Cambridge University Press, 2nd Edition, 2004.

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ECE-426N	BIO-MEDICAL SIGNAL PROCESSING					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3		**-**	**75**	**25**	**100**	**3**
Purpose	*To understand the concept of Bio-Medical Signal Processing.*					
Course Outcomes						
CO 1	*Introduction to signal and information.*					
CO 2	*Introduction to Biomedical Signals and ECG.*					
	Introduction to Adaptive filtering and EEG.					
CO 4	*Introduction to Event detection and waveform analysis.*					

Unit – I

Signals and Information: Definitions and properties of Laplace transform, Basic of DFT and FFT, z-transform, Sampling theorem.
Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, frequency response, group delay, phase delay, Applications of Digital Signal Processing.

Unit – II

Introduction to Biomedical Signal: General measurement and diagnostic system, classification of signals, introduction to biomedical signals, Biomedical signal acquisition and processing.
ECG: ECG signal origin, ECG parameters-QRS detection different techniques, ST segment analysis, Arrhythmia, Arrhythmia analysis, Arrhythmia monitoring system.

Unit – III

Adaptive Filtering: Introduction, General structure of adaptive filters, LMS adaptive filter, adaptive noise cancellation, cancellation of ECG from EMG signal, Cancellation of maternal ECG in fetal ECG.
EEG: EEG signal characteristics, Sleep EEG classification and epilepsy.

Unit – IV

Event Detection and waveform analysis: Need for event detection, Detection of events & waves, Correlation analysis of EEG signals, Identification of heart sounds, Morphological analysis of ECG waves.
Frequency Domain Analysis: Introduction, Spectral analysis, linear filtering, Removal of high frequency noise (power line interference), motion artifacts (low frequency) and power line interference in ECG.

Text Book:

1. Biomedical Signal Analysis" A case study approach, Rangaraj M Rangayyan, John Wiley publications.

Reference Books:

1. "Biomedical Signal Processing Time and Frequency Domains Analysis (Volume I)", Arnon Cohen, CRC press.
2. "Biomedical Signal Processing Principles and Techniques" D.C.Reddy, Tata Mc Graw-Hill
3. "Biomedical Digital Signal Processing", Willis J. Tompkins, PHI

ECE-428N	MULTIMEDIA COMMUNICATIONS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Purpose	*To familiarize the students with the concepts of basic multimedia communication systems and various compression algorithms of text, audio, image and video.*					
Course Outcomes						
CO1	***To understand the concept of basic multimedia comm. System and various types of networks and applications.***					
CO2	***To understand the concept text and image compression.***					
CO3	***To understand the concept of audio and video compression.***					
CO4	***To understand the concept of multimedia synchronization and video indexing.***					

Unit - I

Multimedia Communication: Introduction, Multimedia networks: Telephone networks, Data networks, ISDN, B-ISDN. Multimedia Applications: Interactive applications over the internet and entertainment applications.

Digitization Principles, Representation of Text, Images, Audio and Video.

Unit - II

Text Compression: Compression principles, Text Compression techniques: Static Huffman Coding, Dynamic Huffman Coding, Arithmetic Coding, Lempel Ziv and Lempel Ziv welsh coding.

Image Compression: Graphics interchange format, Tagged image file format, JPEG in detail.

Unit - III

Audio Compression: Differential Pulse Code Modulation, Adaptive Differential PCM, Adaptive Predictive coding, Linear predictive coding and MPEG audio coders,

Video Compression: Video Compression principles, Frame types, Motion estimation and compensation, H.261, H.263

Unit - IV

Multimedia Synchronization: Basic definitions and requirements, Time stamping and Pack architecture.

Video Indexing: Basics of content based image retrieval and video content representation.

Reference Books:

1. Multimedia communications: Fred Halsall; Pearson Education Asia.
2. Multimedia Systems" by Ralf Steinmetz and Klara Nahrstedt
3. Multimedia Systems, Standards, and Networks" by A. Puri and T. Chen

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ECE-430N	MIXED VLSI DESIGN					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Purpose	*This course teaches how in real life applications both analog and digital circuits can implemented for various system design.*					
Course Outcomes						
CO1	***To know mixed signal circuits like DAC, ADC, PLL etc.***					
CO2	***To gain knowledge on filter design in mixed signal mode.***					
CO3	***To acquire knowledge on design of different architectures in mixed signal***					

Unit-I

PHASE LOCKED LOOP

Characterization of a comparator, basic CMOS comparator design, analog multiplier design, PLL - simple PLL, charge-pump PLL, applications of PLL.

Unit- II

SAMPLING CIRCUITS

Basic sampling circuits for analog signal sampling, performance metrics of sampling circuits, different types of sampling switches. Sample-and-Hold circuit with miller capacitance.

Unit- III

D/A CONVERTER

Input/output characteristics of an ideal D/A converter, performance metrics of D/A converter, D/A converter in terms of voltage, current, and charge division or multiplication, switching functions to generate an analog output corresponding to a digital input.

Unit- IV

A/D CONVERTER

Input/output characteristics and quantization error of an A/D converter, performance metrics of pipelined architectures, Successive approximation architecture.

BOOKS:

1. S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design, Third Edition, TMH, 2002.
2. Razavi, “Design of analog CMOS integrated circuits”, McGraw Hill, Edition 2002.
3. Jacob Baker, “CMOS Mixed-Signal circuit design”, IEEE Press, 2009.
4. Gregorian, Temes, “Analog MOS Integrated Circuit for signal processing”, John Wiley & Sons, 1986.

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ECE-432N	MICROSTRIP ANTENNA					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Purpose	*To familiarize the students with the concepts of basic Antenna.*					
Course Outcomes						
CO1	***To understand the concept of basic Antenna. System and various types of applications.***					
CO2	***To understand the concept of microstrip antenna and its analytical modeling***					
CO3	***To understand the different designs of microstrip antenna***					
CO4	***To understand the applications of different designs of microstrip antenna***					

Unit-1

Micro Strip Radiator

Introduction, Microstrip Antenna Configurations, Feeding Techniques and Modeling of Microstrip Antenna, Radiation field, Surface wave and Photonic Bandgap Structures and Applications

Unit- 2

Analytical Modeling and Full Wave Analysis

Introduction, Transmission Line Model, Cavity model, Radiation Fields, Aperture and Mutual admittance, conductance. **Full wave analysis:** Input Impedance and Radiation efficiency, Radiation pattern, Mixed Potential Integral Equation Analysis, Greens function, Finite Difference Time-Domain Analysis.

Unit-3

Rectangular and Circular Microstrip Antenna

Introduction, Models for Rectangular Patch Antennas, Design Consideration for Rectangular Patch antennas, Tolerance Analysis, Mechanical Tuning, Quarter-wave Rectangular Patch Antenna, **Circular Microstrip Antenna:** Analysis of Circular disk, Cavity and Transmission line modeling of circular antennas.

Unit- 4

Circularly Polarized and Broadband Microstrip Antenna Design

Circular Polarization, Rectangular and Circular Circularly polarized Antennas, Power divider : T Junction and Wilkinson.
Effect of Substrate Parameter on Bandwidth, Selection of suitable Patch Shape, Feeding Techniques, Multimoding Techniques , Impedance Matching, Resistive Loading.

Text book: Ramesh Garg, Prakash Bhartiya, Inder Bahl, Apisak Ittipboon, "**Microstrip Antenna Design Handbook",** Artech House Boston, London.

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ECE-434N	STRATEGIC ELECTRONICS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes						
CO1	***Students will be aware of state-of the art in flexible electronics***					
CO2	***Students be able to understand the fundamentals of Smart Structure and Materials***					
CO3	***Understanding basic principles of fabrication techniques used for the fabrication of futuristic flexible electronic devices, structure, sensors and transducers.***					
CO4	***Understand the characterization techniques used in futuristic electronic devices, smart materials, structures, etc.***					

Unit-I

Emerging flexible electronics technology, involving new materials and processing techniques such as amorphous and nanocrystalline silicon, organic and polymeric semiconductors, solution cast films of carbon nanotubes, and graphene. Real device are discussed including high speed transistors, photovoltaics, flexible flat-panel displays, etc.

Unit – II

Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes. Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strain measurement – Inductively Read Transducers – The LVOT – Fiber optic Techniques. Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

Unit - III

Clean room practices, Photolithography, Ion implantation, Diffusion, Oxidation, CVD - Physical vapor deposition, epitaxy - etching process.
Bulk Micro manufacturing - surface micro machining – LIGA ,Micro system packaging materials - die level- device level - system level - packaging techniques – die preparation – surface bonding - wire bonding - sealing. Introduction to assembly, Introduction to Micro-system design

Unit - IV

Characterization Techniques: Quantum wells and Thickness measurement techniques: Contact - step height, Optical - reflectance and ellipsometry, AFM, Nanomaterials Characterization techniques: IV-CV Electrochemical Impedance, FTIR, XRD, AFM, SEM, TEM, EDAX and interpretation of results.

Books:

1. Flexible Electronics: Materials and Applications, Editors: **Wong**, William S., **Salleo**, Alberto (Eds.) 2.Brain Culshaw – Smart Structure and Materials Artech House – Borton. London-1996.
3. MEMS and Microsystems Design and Manufacture" by Tai-Ran Hsu. Tata McGraw-Hill Publishing Company Ltd
4. Marc F Madou, "Fundamentals of Micro Fabrication", CRC Press, 2nd Edition, 2002.
5. Semiconductor Material and Device Characterization By Dieter K. Schroder, Willey Publications

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ECE-436N	COGNITIVE RADIOS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessionals**	**Total**	**Time**
3		**-**	**75**	**25**	**100**	**3**
Purpose	***To understand the concept of Cognitive Radio and Spectrum sharing***					
Course Outcomes						
CO 1	*Conceptualize the CR and implementation details*					
CO 2	*Design CR for a specific application*					
CO 3	*Identify the challenges in the maintenance of CR*					
CO 4	*Analyse the transmitter and receiver architectures*					

Unit-I

RF System Design – Introduction- Noise and Channel Capacity- Link Budget- Receiver Requirements- Multicarrier Power Amplifiers- Signal Processing Capacity Tradeoff.

Unit-II

CR Architecture- Cognitive Radio Architecture, Dynamic Access Spectrum, Spectrum Efficiency, Spectrum Efficiency gain in SDR and CR ,Spectrum Usage, SDR as a platform for CR, OFDM as PHY layer ,OFDM Modulator, OFDM Demodulator, OFDM Bandwidth, Benefits of OFDM in CR, Spectrum Sensing in CR, CR Network

Unit-III

Smart Antennas Using Software Radio- Introduction- 3G smart Antenna Requirements Phased Antenna Array Theory- Applying Software Radio Principles to Antenna Systems Smart Antenna Architectures- Optimum Combining/ Adaptive Arrays- DOA Arrays- Beam Forming for CDMA- Downlink Beam Forming.

Unit-IV

Application of SDR -Application of SDR in Advance Communication System-Case Study, Challenges and Issues, Implementation, Parameter Estimation –Environment, Location, other factors, Vertical Handoff, Network Interoperability.

Text Books:

1. Jeffrey.H.Reed ,Software Radio : A Modern Approach to Radio Engineering , Pearson , Reference Books: 1. Markus Dillinger , KambizMadani ,Nancy Alonistioti, Software Defined Radio : Architectures , Systems and Functions ,Wiley
2. Tony .J. Rouphael , RF and DSP for SDR, Elsevier Newness Press ,2008
3. Dr.TajStruman ,Evaluation of SDR –Main Document
4. SDR –Handbook , 8th Edition , PENTEK 5. Bruce a. Fette , Cognitive Radio Technology, Newness, Elsevier.