Savitribai Phule Pune University

Faculty of Science &Technology

B.E. (Electronics & Telecommunication)
(2015 Pattern) Syllabus
(With effect from Academic Year 2018-19)

Savitribai PhulePune University
Final Year E&TC Engineering (2015 Course)
(With effect from Academic Year 2018-19)

Semester I												
Course Code	**Course**	**Teaching Scheme Hours / Week**			**Semester Examination Scheme of Marks**						**Credits**	
		Theory	**Tut**	**Pract**	**In-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH/TW**	**PR+OR**
404181	VLSI Design& Technology	3	--	--	30	70	--	--	--	100	3	--
404182	Computer Networks & Security	4	--	--	30	70	--	--	--	100	4	--
404183	Radiation & Microwave Techniques	3	--	--	30	70	--	--	--	100	3	--
404184	Elective I	3	--	--	30	70	--	--	--	100	3	--
404185	Elective II	3			30	70	--	--	--	100	3	--
404186	Lab Practice -I (CNS+ RMT)	--	--	4	--	--	50	--	50	100	--	2
404187	Lab Practice -II (VLSI + Elective I)	--	--	4	--	--	50	50		100	--	2
404188	Project Stage I	-	2	--	--	--	-	--	50	50	--	2
	Audit Course 5	--	--	--	--	--	--	--	--	--	----	
	Total	16	2	8	150	350	100	50	100	750	16	6
Total Credits											**22**	

Elective I	**Elective II**	**Audit Course 5**
1 Digital Image and Video Processing	1. Wavelets	1. Green Energy
2. Industrial Drives and Control	2. Electronics Product Design	2. Human Behaviour
3. Embedded Systems & RTOS	3. Optimization Techniques	
4. Internet of Things	4. Artificial Intelligence	
	5. Electronics in agriculture	

Final Year E&TC Engineering (2015 Course)

(With effect from Academic Year 2018-19)

Semester II

Course Code	Course	Teaching Scheme Hours / Week			Semester Examination Scheme of Marks						Credit	
		Theory	Tut	Pract	In-Sem	End-Sem	TW	PR	OR	Total	TH/TW	PR+OR
404189	Mobile Communication	3	--	--	30	70	--	--	--	100	3	--
404190	Broadband Communication Systems	4	--	--	30	70	--	--	--	100	4	--
404191	Elective III	3	--	--	30	70	--	--	--	100	3	--
404192	Elective IV	3	--	--	30	70	--	--	--	100	3	--
404193	Lab Practice –III (MC+BCS)	--	--	4	--	--	50	50	--	100	--	2
404194	Lab Practice –IV (Elective III)	--	--	2	--	--	--	--	50	50	--	1
404195	Project Stage II	--	6	-	--	--	150	--	50	200	--	6
	Audit Course 6	--	--	--	--	--	--	--	--	--		
Total		13	6	6	120	280	200	50	100	750	13	9
										Total Credits	**22**	

Elective III	**Elective-IV**	**Audit Course 6**
1. Machine Learning 2. PLC s and Automation 3. Audio and Speech Processing 4. Software Defined Radio 5. Audio Video Engineering	1. Robotics 2. Biomedical Electronics 3. Wireless Sensor Networks 4. Renewable Energy Systems 5. Open Elective*	1. Team Building, Leadership and Fitness 2. Environmental issues and Disaster Management

*Any one course from the list of Elective IV of computer/IT/Electrical/Instrumentation or Institute can offer elective IV based on any industry need with prior approval from BoS(Electronics & Telecommunication). Repetition of course or topics should be avoided.

404181 VLSI Design & Technology

Credits: 03

Teaching Scheme:			Examination Scheme:	
Lecture : 03 Hr/Week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To explore HDL and related design approach.
- To nurture students with CMOS circuit designs.
- To realize importance of testability in logic circuit design.
- To overview ASIC issues and understand PLD architectures with advanced features.

Course Outcomes:

On completion of the course, student will be able to

1. Write effective HDL coding for digital design.
2. Apply knowledge of real time issues in digital design.
3. Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
4. Design CMOS circuits for specified applications.
5. Analyze various issues and constraints in design of an ASIC
6. Apply knowledge of testability in design and build self test circuit.

Unit I : HDL Design **7 Hrs**

Design Flow, Language constructs, Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, HDL modeling of Combinational, Sequential circuits and FSM. Simulations, Synthesis, Efficient coding styles, Hierarchical and flat designs, Partitioning for synthesis, Pipelining, Resource sharing.

Unit II : Digital design and Issues **6 Hrs**

Sequential synchronous machine design, Moore and Mealy machines, HDL code for Machines, FIFO. Metastability and solutions, Noise margin, Fan-out, Skew, Timing considerations, Hazards, Clock distribution, Clock jitter, Supply and ground bounce, Power distribution techniques, Power optimization, Interconnect routing techniques; Wire parasitic, Signal integrity issues. I/O architecture.

Unit III : PLD Architectures and applications **6 Hrs**

Design Flow. CPLD Architecture, Features, Specifications, Applications. FPGA Architecture, Features, Specifications, Applications. The Simulation and Synthesis Tools, FPGA synthesis and implementation.

Unit IV:Digital CMOS circuits **7 Hrs**

N-MOS, P-MOS and CMOS, MOSFET parasitic, Technology scaling, Channel length modulation, Hot electron effect, Velocity saturation, CMOS Inverter, Device sizing, CMOS combinational logic design, Power dissipations, Power delay product, Body Effect, Rise and fall times, Latch Up effect, transmission gates.

Unit V : Application Specific Integrated Circuit **7 Hrs**

Design Flow, Cell design specifications, Spice simulation, AC and DC analysis, Transfer Characteristics, Transient responses, Noise analysis, Lambda rules, Design rule check, Fabrication methods of circuit elements, Layout of cell, Library cell designing for NAND & NOR, Circuit Extraction, Electrical rule check, Layout Vs. Schematic, Post-layout Simulation and Parasitic extraction, Design Issues like Antenna effect, Electro migration effect, Cross talk and Drain punch through, Timing analysis.

Unit VI : VLSI Testing and Analysis 6 Hrs

Types of fault, Need of Design for Testability (DFT), DFT Guideline, Testability, Fault models, Path sensitizing, Test pattern generation,Sequential circuit test, Built-in Self Test, JTAG & Boundary scan, TAP Controller.

Text Books:

1. Charles H. Roth, "Digital systems design using VHDL", PWS.
2. Wyane Wolf, "Modern VLSI Design (IP-Based Design)", 4E,Prentice Hall.
3. Steve Kilts "Advanced FPGA Design Architecture, Implementation and Optimization", Wiley.

Reference Books:

1. E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit &System Perspective", Pearson Publication.
2. R. Jacob Baker, "CMOS Circuit Design, Layout, and Simulation", 3E, Wiley-IEEE Press
3. John F. Wakerly, "Digital Design Principles and Practices" , 3E, Prentice Hall
4. M. Morris Mano , "Digital Design", 3E , Pearson
5. CemUnsalan, Bora Tar, "Digital System Design with FPGA: Implementation Using Verilog and VHDL", McGraw-Hill

404182Computer Networks & Security

Credits: 04

Teaching Scheme:			**Examination Scheme:**	
Lecture : 04 Hrs/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand state-of-the-art in network protocols, architectures, and applications
- To provide students with a theoretical and practical base in computer networks issues
- To outline the basic network configurations
- To understand the transmission methods underlying LAN and WAN technologies.
- To understand security issues involved in LAN and Internet.

Course Outcomes:

On completion of the course, student will be able to

1. Understand fundamental underlying principles of computer networking
2. Describe and analyze the hardware, software, components of a network and theirinterrelations.
3. Analyze the requirements for a given organizational structure and select the most appropriatenetworking architecture and technologies
4. Have a basic knowledge of installing and configuring networking applications.
5. Specify and identify deficiencies in existing protocols, and then go onto select new and betterprotocols.
6. Have a basic knowledge of the use of cryptography and network security.
7.

Unit I : Introduction to Local Area Networks **6Hrs**

TCP/IP Protocol Suit, Media Access Control:Random Access, Controlled Access- Reservation, Channelization. Wired LAN:Ethernet Protocol, Standard Ethernet, Fast Ethernet (100 MBPS), Gigabit Ethernet, 10 Gigabit Ethernet. Wireless LAN : Introduction, IEEE 802.11 Project, Bluetooth

Unit II :Network Layer Part I **7Hrs**

Introduction to Network Layer:Network-Layer Services, Packet Switching, Network-Layer Performance, IPv4 Addresses, Forwarding Of IPPackets,Network Layer Protocols:Internet Protocol (IP), ICMPv4, Mobile IP

Unit III : Network Layer Part II **6 Hrs**

Unicast and Multicast Routing:Introduction, Routing Algorithms, Unicast Routing Protocols, Introduction, Multicasting Basics, Intra-domain Multicast Protocols, Inter-domain Multicast Protocols, IGMP. Next Generation IP:IPv6 Addressing, The Ipv6 Protocol, TheICMPv6 Protocol, Transition From IPv4 toIPv6.

Unit IV : Transport Layer **6 Hrs**

Introduction to Transport Layer:Introduction, Transport-Layer Protocols,Transport Layer Protocols:Introduction, User Datagram Protocol, Transmission Control Protocol, SCTP.

Unit V : Application Layer 7 Hrs

Introduction to Application Layer, Standard Client Server Protocols:World Wide Web and HTTP , FTP, Electronic Mail, Telenet, SSH, DNS.Network Management: Introduction, SNMP.

Unit VI : Network Security **7Hrs**

Cryptography & Network Security: Introduction Confidentiality, Other Aspects Of Security.
Internet Security:Network-Layer Security, Transport-Layer Security, Application-Layer Security, Firewalls.

Text Books:

1. Behrouz A. Forouzan, "Data Communications and Networking" MacGraw Hill, 5th edition
2. James F. Kurouse& W. Rouse, "Computer Networking: A Top down Approach", 6thEdition, Pearson Education.

Reference Books:

1. Andrew S. Tannenbaum, "Computer Networks", Pearson Education, Fourth Edition,2003
2. Wayne Tomasi, "Introduction to Data Communication and Networking", 1/e, Pearson Education
3. Natalia Olifer, Victor Olifer, "Computer Networks" Wiley Student Edition

404183 Radiation and Microwave Techniques

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 Hr/Week				**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- To introduce fundamental theory of radiation and microwaves.
- To understand design principles of various radiating elements.
- To understand theory of passive and active components of microwave systems.
- To learn microwave measurement techniques.

Course Outcomes:

On completion of the course, student will be able to

1. Differentiate various performance parameters of radiating elements.
2. Analyze various radiating elements and arrays.
3. Apply the knowledge of waveguide fundamentals in design of transmission lines.
4. Design and set up a system consisting of various passive microwave components.
5. Analyze tube based and solid state active devices along with their applications.
6. Measure various performance parameters of microwave components.

Unit I : Fundamental Theory of Radiation and Radiating Elements 8Hrs

Fundamental equations for free space propagation, Friis transmission equation, Definition of antenna, radiation mechanism and types of antenna, performance parameters such as radiation pattern, directivity, gain, efficiency, half power beam width, bandwidth, polarization, input impedance, radiation efficiency, effective length, effective area, radiation sphere.

Unit II : Radiating elements and arrays7 Hrs

Comparison of various radiating elements such as infinitesimal dipole, small dipole, finite length dipole and half wave length dipole, analytical treatment of these elements. Planar, log periodic and YagiUda antenna. Types of arrays, two element array, N-element array, uniform amplitude uniformly spaced linear broad side and end-fire array.

Unit III : Transmission lines and Waveguides 6Hrs

General solution for TEM, TE and TM waves.Analysis of coaxial line and rectangular waveguides. Analysis of rectangular cavity resonators and their applications, Striplines: Structural details, types and applications.

Unit IV : Passive Microwave Components 6Hrs

Construction, working principle and scattering analysis of passive microwave components such as E-plane, H-plane and magic tee. Ferrite composition, characteristics and Faraday rotation principle. Construction, working principle and scattering analysis of isolator, circulator and directional coupler. Construction and operation of gyrator.

Unit V: Active Microwave Components 6Hrs

Limitations of conventional tubes, O and M type classification of microwave tubes, re-entrant cavity, velocity modulation.Construction, operation, performance analysis and applications of -Single cavity and two cavity klystron,Cylindrical wave magnetronandHelix traveling wave. Construction, working principle and applications of two terminal microwave devices such as tunnel diode, Gunn Diode, PIN Diode, Schottky Barrier Diode and Varactor.

Unit VI : Microwave Systems and Microwave Measurement Techniques 6Hrs

Microwave terrestrial and satellite communication system and industrial applications of microwaves such as microwave heating, thickness and moisture measurement, medical application such as microwave diathermy.Microwave measurement devices such as slotted line, tunable detector, VSWR meter, power meter, and their working principles. Microwave measurement techniques to measure S-parameters, frequency, power, attenuation, phase shift, VSWR, impedance.
Radiation hazards and protection.

Text Books:

1. C.A. Balanis, “Antenna Theory - Analysis and Design", John Wiley.
2. Samuel Y. Liao, “Microwave Devices and Circuits”, 3rd edition, Pearson
3. Annapurna Das and Sisir K. Das, “Microwave Engineering", Second edition, Tata McGraw Hill.

Reference Books:

1. David M. Pozar, “Microwave Engineering", Fourth edition, Wiley.
2. Ahmad Shahid Khan, “Microwave Engineering : Concepts and Fundamentals
3. K. D. Prasad, “Antenna &Wave Propagation”, SatyaPrakashan, New Delhi.
4. M. Kulkarni, “Microwave and Radar engineering”, 3rd edition, Umesh Publication
5. E.C. Jordon and E.G. Balman, “Electromagnetic Waves and Radiation Systems”, Prentice Hall India.

404184 Digital Image and Video Processing (Elective-I)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 Hr/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Understand the fundamental concepts of Digital Image Processing with basic relationship of pixels and mathematical operations on 2-D data.
- Learn design and integrate image enhancement and image restoration techniques
- Understand object segmentation and image analysis techniques
- Learn the need for effective use of resources such as storage and bandwidth and ways to provide effective use of them by data compression techniques
- Learn basic concepts of video processing

Course Outcomes:

On completion of the course, student will be able to

1. Develop and implement basic mathematical operations on digital images.
2. Analyze and solve image enhancement and image restoration problems.
3. Identify and design image processing techniques for object segmentation and recognition.
4. Represent objects and region of the image with appropriate method.
5. Apply 2-D data compression techniques for digital images.
6. Explore video signal representation and different algorithm for video processing.

Unit I : Fundamentals of Image Processing **5 Hrs**

Steps in Image processing, Human visual system, Sampling & quantization, Representing digital images, spatial and gray level resolution, Image file formats, Basic relationships between pixels, Distance Measures, Basic operations on images – image addition, subtraction, logical operations, scaling translation, rotation. Color fundamentals and models – RGB, HIS, YIQ

Unit II : Image Enhancement and Restoration **8 Hrs**

Point – Log transformation, Power law transformation, Piecewise linear transformation, Image histogram, histogram equalization, Mask processing of images, filtering operations- Image smoothing, image sharpening, frequency domains image enhancement: 2D DFT, smoothing and sharpening in frequency domein, Pseudo coloring. Image Restoration: Noise models, restoration using Inverse filtering and Wiener filtering

Unit III : Image Compression **6 Hrs**

Types of redundancy, Fidelity criteria, Compression models - Information theoretic perspective – Fundamental coding theorem, Lossless Compression: Huffman Coding- Arithmetic coding. Introduction to DCT, Lossy compression: DCT based compression, Wavelet based compression, Image compression standards JPEG and JPEG 2000.

Unit III : Image Segmentation **8 Hrs**

Pixel classification, Bi-level thresholding, Multi-level thresholding, Adaptive thresholding, Otsu's method, Edge detection – First order derivative Prewitt and Sobel, Second order derivative – LoG, DoG, Canny. Edge linking, Hough transform, Region growing and region merging. Morphological operators: Dilation, Erosion, Opening, Closing, Hit or Miss transform, Boundary detection, Thinning, Thicking, Skelton.

Unit V : Representation and Description 5 Hrs

Representation – Chain codes, Polygonal approximation, Signatures, Boundary descriptors, Shape numbers, Fourier descriptors, Stastical moments, Regional descriptors – Topological, texture, Principal components for description

Unit VI : Video Processing 6 Hrs

Fundamental Concepts in Video – Types of video signals, Analog video, Digital video, Color models in video, Motion Estimation; Video Filtering; Video Compression, Video coding standards MPEG.

Text Books:

1. Gonzalez and Woods, "Digital Image Processing", Pearson Education, 3rd edition
2. Iain E. G. Richardson, "H.264 and MPEG
3. Video Compression: Video Coding for Next Generation Multimedia", John Wiley and Son's Publication, 3rd Edition.

Reference Books:

1. A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.
2. Pratt William K. "Digital Image Processing", John Wiley & sons
3. A. Bovik, Handbook of Image & Video Processing, Academic Press, 2000

404184 Industrial Drives and Control (Elective-I)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 3Hours / Week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Describe the structure of Electric Drive systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology
- Study and understand the operation of electric motor drives controlled from a power electronic converter and to introduce the design concepts of controllers for closed loop operation
- Study DC, AC, special machines like stepper motor, servo motor and brushless motor and their control.

Course Outcomes:

On completion of the course, student will be able to

1. Understand the basic principles of power electronics in drives and its control, types of drives and basic requirements placed by mechanical systems on electric drives for various applications
2. Understand the operation of 1ϕ & 3ϕ converter drives for separately excited & series DC motors, dual converter drives, 2 quadrant and 4 quadrant DC chopper drives, Open-loop & closed-loop control of DC drives with transfer function, Dynamic and regenerative braking. Protection circuits for DC drives.
3. Learn speed control of induction motor drives in an energy efficient manner using power electronics. To study and understand the operation of both classical and modern induction motor drives like FOC or Vector control.
4. Learn and understand working of various types of synchronous motors and their drive systems
5. Learn stepper motors & drives, BLDC and SRM motors and drives
6. Understand modern control techniques of Fuzzy logic and ANN in motor drive application

Unit I :Motor Drive as system **5 Hrs**

Electrical drive as system, Parts of Electrical drives AC / DC drives, Components, nature and classification of load torques. Four quadrant operation of a motor drive. Control of Electrical drives, steady state stability Closed loop control, Selection of motor power rating

Unit II : DC Motors and drives6Hrs

Basic characteristics of DC motors, Operating modes, Motor performance parameters, 1ϕ & 3ϕ converter drives for separately excited & series DC motors for continuous & discontinuous operations. Chopper fed DC drives, Comparison of converter fed drive & chopper fed drive. Open loop & closed loop control of dc drives with transfer function PLL control, Microprocessor based control of dc drives, Dynamic and regenerative braking of DC motors

Unit III :Induction Motors and Drives 8Hrs

Induction motor characteristics, Control strategies like stator voltage control, v/f control, rotor resistance control, Variable frequency Square wave VSI Drives, Variable frequency PWM VSI Drives, Variable frequency CSI Drives, Closed loop control of Induction motors, v/f control of three phase IM using PWM inverter, Vector Control (Field oriented Control): Basic principle of vector control, Direct vector control & indirect vector control, DQ Transformation, Braking of induction motor, soft acceleration and deceleration, various protections.

Unit IV :AC and DC synchronous Motors and drives6Hrs

Cylindrical rotor motor Drive, Salient pole motor Drive, Switched reluctance motor (SRM) drive, Synchronous Reluctance motor drive, self-controlled synchronous motor drives Permanent magnet Brushless DC motor drive, Permanent magnet AC synchronous motor drive, Variable reluctance & permanent magnet stepper motor and drive. Servo motor Drives.

Unit V :Power Electronics applications inRenewable Energy 6Hrs

Wind power system: System component, Turbine rating, Electrical load matching, fixed speed and variable speed operation, System design features, Maximum power operations and System control requirement WECS: Principle of WECS, role of power electronics in WECS, Drive selection criteria for fixed speed and variable speed WECS, Stand-alone PV systems, Grid connected PV systems. Power Electronics for Photovoltaic Power Systems Basics of Photovoltaic: The PV cell, Module and array, I-V and P-V curves, PV system component, Stand-alone PV systems, Grid connected PV systems.

Unit VI :Artificial Intelligence in Motor Drives5Hrs

Fuzzy logic principle and applications: Introduction, Fuzzy sets, Fuzzy system, Fuzzy control, Fuzzy logic based induction motor speed control. Neural network principle and applications: Introduction, Neural network in identification and control, AI Applications in electrical machines and drives, Neural network based PWM controller.

Text Books:

1. Fundamental of Electrical Drives, Gopal K. Dubey, Narosa Publishing House .
2. Power Electronics, circuits, devises and applications by Muhammad Rashid, Pearson
3. Modern Power Electronics and AC Drives, Bimal K. Bose, Pearson

Reference Books:

1. Wind & Solar Power system, Mukund Patel , CRC Press
2. Thyristor DC drives, P. C Sen, John Wiley.
3. Power Electronics, Converters, Applications and Design, N. Mohan, T. M. Undeland &W. P. Robbins, John Wiley and Sons, 3rd Edition

404184 Embedded Systems and RTOS(Elective-I)

Credits: 03

Teaching Scheme:			Examination Scheme:	
Lecture : 03Hr/Week				In-Sem : 30 Marks End-Sem: 70 Marks

Course Objectives:

- To understand and able to design an application specific systems.
- To develop implementation skill for application specific systems.
- To understand design and implementation of real time system using RTOS.
- To understand open source platform for embedded system

Course Outcomes:

On completion of the course, student will be able to

1. Understand design of embedded system
2. Use RTOS in embedded application
3. Use modern architecture for embedded system
4. Use Linux for embedded system development
5. Use open platform for embedded system development

Unit I : Embedded System Overview 6 Hrs

Embedded System Introduction, Hardware and software architectures of ES, Design metrics(technical and techno- economical), Prototyping models, Development tool chain insights(GNU), guidelines for Selection of hardware and memory architecture, embedded C programming, embedded system design challenges, standard programming practices in embedded system.

Unit II :Real time system and RTOS 7 Hrs

Real time system, types, design approaches and considerations, Usage ofSharedresourcesand related issues**,** Concept of RTOS, Types of RTOS, differences from GPOS (Multitasking, Inter-process communication, Timers, Device drivers, protection mechanism etc.), real time scheduling algorithms, commercial RTOS , survey of RTOS.

Unit III :µcos-II –RTOS8 Hrs

µcos-II features, kernel structure, data structure, µcos-II services as task management, time management, inter-process communication (mailbox, queue,events,pipesetc.), memory management.µcos-II porting on ARM7/Cortex (M3/M4) architecture.

Unit IV : Advanced embedded architectures (Cortex-M3/M4)8 Hrs

Introduction to ARM CORTEX series, Design Philosophy, processors series, versions, features and applications. CMSIS standard for ARM Cortex. Survey of CORTEX M3/M4 based controllers. ARM-CM3 Based Microcontroller LPC1768: Features, Architecture (Block Diagram &itsDescription), System Control, Clock & Power Control, GPIO, Pin Connect Block, interfacing with RGB LED, Seven Segment, TFT Display, MOTOR control using PWM.

Unit V : Embedded Linux 8 Hrs

Linux for embedded systems, embedded Linux development system, kernel architecture and configuration, file systems, porting Linux on ARM architecture, boot loaders, tool utilities such as Minicomp, Busybox, Redboot, Libc, Device drivers- concept, architecture, types, sample character device driver.

Unit VI :Open hardware /development systems and Case study7 Hrs

Arduino open platform (IDE), development using ATMega328p based Uno board, structure of Arduino programs, introduction to Arduino library, sample GPIO program.

Case study of implementation with control, compute and communication modules using Arduino platform.

Text Books:

1. Jean J.Labrosse, "MicroC OS II, The Real-Time Kernel", 2nd edition, CMP Books.
2. Christopher Hallinan, "Embedded Linux Primer -A Practical, Real-World Approach "2nd edition, Prentice Hall.
3. Parag H Dave, Himanshu .H.Dave," Embedded systems" Concepts, design and programming, Pearson India

Reference Books:

1. Frank Vahid and Tony Givargis, " Embedded System Design – A Unified hardware/ Software introduction " 3rd edition, Wiley
2. David Simon, "Embedded system primer"
3. Raj Kamal, "Embedded Systems – Architecture, Programming and Design" 2nd edition,
4. http://www.ti.com/lit/an/slaa207/slaa207.pdf
5. MSP430x5xx: http://www.ti.com/product/msp430f5529
6. MSP430x4xx : http://www.ti.com/product/msp430f438
7. MSP430x2xx: http://www.ti.com/product/msp430g2302-ep

404184 Internet of Things (Elective-I)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 Hr/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To study fundamental concepts of IoT
- To understand roles of sensors in IoT
- To Learn different protocols used for IoT design
- To be familiar with data handling and analytics tools in IoT

Course Outcomes:

1. On completion of the course, student will be able to
2. Understand the various concepts, terminologies and architecture of IoT systems.
3. Use sensors and actuators for design of IoT.
4. Understand and apply various protocols for design of IoT systems
5. Use various techniques of data storage and analytics in IoT
6. Understand various applications of IoT

Unit I : Fundamentals of IoT **6Hrs**

Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.

Unit II :Sensors Networks **7Hrs**

Definition, Types of Sensors, Types of Actuators, Examples and Working, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.

Unit III :Wireless Technologies for IoT **6 Hrs**

WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus.

Unit IV :IP Based Protocols for IoT **6 Hrs**

IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT.

Unit V :Data Handling& Analytics6Hrs

Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Statistical Models, Analysis of Variance, Data Dispersion, Contingence and Correlation, Regression Analysis, Precision and Error limits.

Unit VI :Applications of IoT **7Hrs**

Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, IoT design Ethics, IoT in Environmental Protection.

Text Books:

1.Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Wiley Publications

2. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", WileyPublications

3. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.

References

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications

2. by Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

3. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

4. https://onlinecourses.nptel.ac.in/noc17_cs22/course

404185 Wavelets (Elective-II)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 Hr/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Learn and understand basic linear algebra
- Understand the need of time frequency resolution
- Understand the basics of Discrete Wavelet transform and various wavelets available
- Learn the signal analysis using multi-resolution analysis
- Study the applications of Wavelets in compression, enhancement, noise removal etc.

Course Outcomes:

1. On completion of the course, student will be able to
2. Explore and learn the basics of linear algebra.
3. Identify the need of Wavelet transform and its properties.
4. Analyze the 1-D and 2-D signal using discrete wavelet transform.
5. Analyze the signal using Multi resolution analysis
6. Use wavelet transform in different applications like data compression, denoising, enhancement etc.

Unit I : Fundamentals of Linear Algebra6 Hrs

Vector spaces, Orthogonality, Ortho-normality, Projection, Functions and function spaces. Orthogonal basis functions. Fourier series orthogonality of complex exponential bases, mathematical preliminaries for continuous and discrete Fourier transformer. Limitations of Fourier domain signal processing, Towards wavelet signal processing, signal representation with continuous and discrete Short Time Fourier Transform.

Unit II : Introduction to Wavelet 6 Hrs

Concept of time-frequency resolution, Resolution problem associated with STFT, Heisenberg's uncertainty principle and time frequency tiling, why wavelet transform? The origin of wavelets, Properties of Wavelet Transform, Wavelet and other wavelet like transformer, different communities and family of wavelets, different families of wavelets within wavelet communities, Continuous and discrete wavelet transform

Unit III : Discrete Wavelet Transform 8 Hrs

Haar scaling function and function spaces, translation and scaling of $\varphi(t)$, function spaces V0 Finer Haar Scaling Functions, concept of nested vectopr spaces, Haar wavelet function, scaled and translated Haar wavelet functions, orthogonality of $\varphi(t)$ and $\gamma(t)$. Normalization of Haar bases at different scales, daubechies wavelets, plotting of Daubechies wavelets. 1-D and 2-D decomposition (analysis) of signals using Wavelet.

Unit IV : Multi-resolution Analysis 6 Hrs

Signal decomposition and its relation with filter banks, frequencies response, signal reconstruction course to fine scale, upsampling and filtering, QMF conditions, concepts of multi-Resolution analysis and multi-rate signal processing, Perfect matching filters, Vanishing moments of wavelet function and filter properties, introduction to wavelet lifting.

Unit V : Wavelet Transform in Data Compression 6 Hrs

Transform coding, image compression using DWT, Embedded tree image coding, comparison of JPEG and JPEG 2000, Audio masking, MPEG Coding for audio, Wavelet based audio coding, video coding using Multi-resolution technique (introduction).

Unit VI : Applications of Wavelet Transform 4 Hrs

Waveletdenoising, speckle removal, Edge detection and object isolation Image fusion, wavelet watermark, image enhancement. Communication application scaling functions as signaling pulses, Discrete Wavelet Multitone modulation.

Text Books:

1. K.P Soman, K I Ramchandran, N G Resmi, "Insights into Wavelets from theory to Practice", Third edition, PHI publication.
2. Raghuveer M Rao, Ajit S. Bopardikar, "Wavelet Transforms, Introduction to Theory and Applications", Seventh Indian Reprint 2005, Pearson Education.

Reference Books:

1. Jaideva C. Goswami, Andrew K. Chan, "Fundamentals of Wavelets", Wiley Student Edition
2. V. M. Gadre, A. S. Abhyankar, "Multiresolution and Multirate Signal Processing, Introduction, Principles and Applications", MGH Publication

404185 Electronic Product Design (Elective-II)

Teaching Scheme:		Examination Scheme:
Lectures: 3 Hrs./ Week		In Sem: 30 Marks End Sem: 70Marks

Course Objectives:

- To understand the stages of product (hardware/ software) design anddevelopment.
- To learn the different considerations of analog, digital and mixed circuitdesign.
- To be acquainted with methods of PCB design and different tools used for PCBDesign.
- To understand the importance of testing in product design cycle.`
- To understand the processes and importance ofdocumentation.

Course Outcomes:

After Successfully completing the course students will be able to

- Understand various stages of hardware, software and PCBdesign.
- Importance of product test &testspecifications.
- Special design considerations and importance ofdocumentation.

Unit I: Introduction to Electronic Product Design 6 Hrs

Man machine dialog and Industrial design, user-centered design, five element of successful design, cognition, ergonomics. Packaging and factors, design for manufacture, assembly and disassembly, wiring, temperature, vibration and shock. Safety, noise, energy coupling, grounding, filtering and shielding.

Unit II: Hardware Design & testing methods 6 Hrs

Design process. Identifying the requirements, formulating specifications, design specifications, Specifications verses requirements, System partitioning, Functional design, architectural design, Functional model verses architectural model. Prototyping. Performance and Efficiency measures. Formulating a test plan, writing specifications, Test procedure and test cases, Egoless design, design reviews. Module debug and test: black box test, white box test, grey box test.

Unit III: Software Design and Testing methods 6 Hrs

Types of Software. Waterfall model of software development. Models, metrics andsoftware limitations. Risk abatement and failure preventions. Software bugs and testing. Good programming practice. User interface .Embedded, Real time software.

Unit IV: PCB design 6 Hrs

Fundamental Definitions, Standards. Routing Topology Configurations, Layer Stack up assignment, Grounding Methodologies, Aspect Ratio, Image Planes, Functional Partitioning, Critical frequencies, Bypassing and decoupling. Design techniques for ESD Protection,Guard Band implementation.

Unit V: Product Debugging and Testing 6 Hrs

Steps of Debugging, Techniques for troubleshooting, characterization, Electromechanical components, passive components, active components, active devices, operational amplifier, Analog-Digital Conversion, Digital Components, Inspection and test of components, Simulation, Prototyping and testing, Integration, validation and verification. EMI & EMC issues.

Unit VI : Documentation 6 Hrs

Definition, need, and types of documentation. Records, Accountability, and Liability. Audience. Preparation, Presentation, and Preservation of documents. Methods of documentation, Visual techniques, Layout of documentation, Bill of material.

Text Books:

1. Kim Fowler," Electronic Instrument Design" Oxford universitypress.
2. Robert J. Herrick, "Printed Circuit board design Techniques for EMC Compliance", Second edition, IEEE press.

Reference Books:

1. James K. Peckol, "Embedded Systems – A Contemporary Design Tool", Wiley publication
2. J C Whitakar," The Electronics Handbook", CRCpress.

404185 Artificial Intelligence (Elective II)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To learn various types of algorithms useful in Artificial Intelligence (AI).
- To convey the ideas in AI research and programming language related to emergingtechnology.
- To understand the concepts of machine learning, pattern recognition, and natural language processing.
- To understand the numerous applications and huge possibilities in the field of AI that gobeyond the normal human imagination.

Course Outcomes:

On completion of the course, student will be able to

1. Design and implement key components of intelligent agents and expert systems.
2. To apply knowledge representation techniques and problem solving strategies to common AI applications.
3. Applyand integrate various artificial intelligence techniques in intelligent system development as well as understand the importance of maintaining intelligent systems.
4. Build rule-based and other knowledge-intensive problem solvers.

Unit I :Foundation 6Hrs

Intelligent Agents, Agents and environments, Good behavior, The nature of environments, structure of agents, Problem Solving, problem solving agents, example problems, Searching for solutions, uniformed search strategies, avoiding repeated states, searching with partial information.

Unit II :Searching 6Hrs

Search and exploration, Informed search strategies, heuristic function, local search algorithms and optimistic problems, local search in continuous spaces, online search agents and unknown environments, Constraint satisfaction problems (CSP), Backtracking search and Local search for CSP, Structure of problems, Games: Optimal decisions in games, Alpha- Beta Pruning, imperfect real-time decision, games that include an element of chance.

Unit III :Knowledge Representation 6Hrs

First order logic, representation revisited, Syntax and semantics for first order logic, Using first order logic, Knowledge engineering in first order logic, Inference in First order logic, prepositional versus first order logic, unification and lifting, forward chaining, backward chaining, Resolution, Knowledge representation, Uncertainty and methods,Bayesian Probability and Belief network, probabilistic Reasoning,Bayesian networks, inferences in Bayesian networks,Temporalmodels,Hidden Markov models.

Unit IV :Learning 6Hrs

Learning from observations: forms of learning, Inductive learning, Learning decision trees, Ensemble learning, Knowledge in learning, Logical formulation of learning, Explanation based learning, Learning using relevant information, Inductive logic programming, Statistical learning methods, Learning with complete data, Learning with hidden variable, EM algorithm, Instance based learning, Neural networks - Reinforcement learning, Passive reinforcement learning, Active reinforcement learning, Generalization in reinforcement learning.

Unit V :Pattern Recognition and Expert System6 Hrs

Basic steps of pattern recognition system, Feature Extraction- Principal Component Analysis,Linear Discriminant Analysis, Classification, Object Recognition- Template Matching theory, Prototype Matching Theory, Speech Recognition, Pattern Mining- Apriori Algorithm,

Unit VI :Natural Language Understanding6Hrs

Why NL, Formal grammar for a fragment of English, Syntactic analysis, Augmented grammars, Semantic interpretation, Ambiguity and disambiguation, Discourse understanding, Grammar induction, Probabilistic language processing, Probabilistic language models

Text Books:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence”, A Modern Approach, Pearson Education/Prentice Hall of India.
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw-Hill.

Reference Books

404185 Optimization Techniques (Elective II)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand the need and origin of the optimization methods.
- To get a broad picture of thevarious applications of optimization methods used in engineering
- To define an optimizationproblem and its various components.

Course Outcomes:

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

1. Describe clearly a problem, identify its parts and analyze the individual functions.
2. Perform mathematical translation of the verbal formulation of an optimizationproblem.
3. Design algorithms, the repetitive use of which will lead reliably to finding an approximate solution
4. Discover, study and solve optimization problems.
5. Investigate, study, develop, organize and promote innovative solutions for various applications.

Unit I : Introduction to Optimization **6Hrs**

Introduction: Historical Development, Engineering Applications of Optimization, Statement of an Optimization Problem, Classification of Optimization Problems, Optimization Techniques, Engineering Optimization Literature, Mathematical Background.

Unit II :Classical Optimization Techniques **7Hrs**

Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints, Multivariable Optimization with Inequality Constraints, Convex Programming Problem.

Unit III : Linear Programming **6 Hrs**

Introduction, Applications of Linear Programming, Standard Form of a Linear Programming Problem, Geometry of Linear Programming Problems, Definitions and Theorems, Solution of a System of Linear Simultaneous Equations, Pivotal Reduction of a General System of Equations, Motivation of the Simplex Method, Simplex Method,Revised Simplex Method, Duality in Linear Programming, Decomposition Principle, Sensitivity or Post optimality Analysis,Transportation Problem.

Unit IV : Nonlinear Programming -I **7Hrs**

Unimodal Function, Elimination Methods:Unrestricted Search, Unrestricted Search, Dichotomous Search, Interval Halving Method, Fibonacci Method

Interpolation Methods:Quadratic Interpolation Method, Cubic Interpolation Method, Direct Root Methods, Practical Considerations,

Unit V :Nonlinear Programming-II7Hrs

Introduction to Unconstrained Optimization techniques, Direct Search Methods: Random Search Methods,Grid Search Method, Univariate Method, Pattern Directions, Powell's Method, Simplex Method. Indirect Search Methods: Gradient of a Function, Steepest Descent (Cauchy) Method, Conjugate Gradient (Fletcher–Reeves) Method, Newton's Method, Davidon–Fletcher–Powell Method, Test Functions.

Unit VI : Modern Methods of Optimization6 Hrs

Genetic algorithms, Simulated annealing, Particle Swarm Optimization, Ant Colony Optimization, Optimization of Fuzzy systems, Neural Network based optimization

Text Books:

1.Singiresu S Rao, "Engineering optimization Theory and Practice", New Age International, 2009
2.Kalynamoy Deb, "Optimization for Engineering Design, Algorithms and Examples",PHI

Reference Books:

1. Hadley, G. "Linear programming", Narosa Publishing House, New Delhi.
2.Ashok D Belegundu, Tirupathi R Chandrupatla, "Optimization concepts and Application inEngineering", Pearson Education.
3. KantiSwarup, P.K.Gupta and Man Mohan, Operations Research, Sultan Chand and Sons.
4. J. S. Arora, Introduction to Optimum Design, McGraw-Hill Book Company.
5. David Lay, Steven L Lay, "Linear Algebra and its Applications", Pearson Education.
6. Papalambros& Wilde, Principles of Optimal Design, Cambridge University Press, 2008

404185 Electronics in Agriculture (Elective II)

Credits: 03

Teaching Scheme:			Examination Scheme:	
Lecture : 03 Hr/Week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To inculcate the ability to recognize environmental problems and to provide solutions to agricultural sector.
- An over view of technology of advanced topics like DAS, SCADA and Virtual Instrumentation.
- The ability to select the essential elements and practices needed to develop and implement the Engineering Automation for Agricultural sector.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand Role of computers & virtual instrumentation.
2. Provide communication solution for interpreting environmental parameters with Electronics systems.
3. Describe Instrument technology used in agriculture.
4. Apply knowledge of Electronics in Agriculture.
5. Understand Greenhouse Technology & Role of Electronics Governance.

Unit I: Review of computers & Virtual instrumentation **6 Hrs**

Data loggers, Data acquisitions systems (DAS), Supervisory control and data acquisition (SCADA), Basics of PLC, Functional block diagram of computer control system, alarms, interrupts.Virtual Instrumentation: Historical Perspective, advantages, Block diagram and architecture of virtual instrument, data flow techniques, graphical programming in data flow, comparison with conventional programming.

Unit II:Communication Systems **6Hrs**

Use of field buses, functions, international standards, field bus advantages and disadvantages, Instrumentation network: sensor networks, Open networks-advantages and limitations, HART Network, Foundation field bus network.Profibus PA: Basics, architecture, model, network design.Foundation field bus segments: General consideration, network design.

Unit III:Instrument technology for agriculture **6Hrs**

Instrument for measurement of pH, Electrical conductivity, gas analysis, humidity, leaf area, chlorophyll content, and soil moisture & temperature.

Unit IV:Precision Farming **6Hrs**

An introduction to precision farming. GIS/GPS positioning system for precision farming, Yield monitoring and mapping, soil sampling and analysis. Computers and Geographic information systems. Precision farming- Issues and conditions. Role of electronics in farm machinery for precision farming.

Unit V:Electronics in Agriculture **6 Hrs**

Instrument for crop monitoring – moisture measurement – capacitive, infrared reflectance and resistance. Monitoring soil and weather – measurement of soil properties and meteorological parameters – irrigation control systems. Instruments for crop establishment monitoring. Crop spraying – selective crop spraying – flow control. Yield monitoring. Technology for precision farming. Instruments for protected cultivation – green house environment control – transducers and control system. Instruments and systems for crop handling processing and storage. ,

Unit VI:Applications & Electronics Governance **6Hrs**

Greenhouse: History of modeling and control of Greenhouse, Identification of control and manipulation variables for Greenhouse. Crop Preservation : Importance of Preservation of various commodities and parts of plants, Drying process for preservation, Variable identification for drying process, Electronic control system for grape drying process.Agriculture& Electronics Governance: Governance products & services in agriculture sector, Role of Electronics Governance in Agricultural sector.

Text Books:

1. Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education
2.Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication

Reference Books:

1. De Mess M. N. Fundamental of Geographic Information System. John Willy & sons, NewYork, Datta S.K.1987.
2. K. Krishna Swamy, "Process Control"; New Age International Publishers
3. Kuhar, John. E. 1977. The precision farming guide for agriculturalist.
4. Lori J. Dhabalt, USManual of Soil & Water conservation Engineering. Oxford & IBH Co. Sigma &Jagmohan, 1976.

404186 Lab Practice I

Credits:02

Teaching Scheme:			Examination Scheme:	
Practical : 04 Hrs/week				**Oral : 50 Marks** **Term-work :50 Marks**

Computer Networks & Security

List of the Experiments(Minimum 8 experiments are to be performed).

1. Implementation of LAN using suitable multiuser Windows operating System anddemonstrating client-server and peer to peer mode of configuration.
2. Installation and configuration of Web server, FTP Server.
3. Study of DNS, SMTP & POP3 Determine the local host address, Ping to a host using its NetBIOS name Add IP addresses/host name mappings to the local host file Configure DNS service on Windows 2000 server Use Domain Name Service to resolve hostnames into IP addresses. Interact with an Email server using SMTP and POP3 protocols commands.
4. Installation and configuration of Telnet server for Telnet communication.
5. Installation and configuration of Proxy server.
6. Installation and configuration of DHCP server.
7. Study of IP Addresses subnetting and CIDR
8. Study of Network Protocol Analyzer tool/software.
9. Study of network monitoring tool/software.
10. Simulating LAN or WAN using suitable network simulator.
11. Write a program to simulate leaky bucket/token bucket.
12. Echo Client and Server Program Using TCP or UDP or both in C/Java
13. Write a program for Encryption and Decryption
14. Study of HTTPS, IPSec and SSH using Wireshark.

Radiation & Microwave Techniques

List of Experiments[Minimum 08]

Group A [Any 2]

1. To measure and compare radiation pattern, return loss, impedance, gain, beam width of dipole antenna and folded dipole antenna at microwave frequency

OR

1. To measure radiation pattern and gain of horn or parabolic antenna at microwave frequency
2. Design, simulate and compare performance of microwave dipole antennas of length 2λ, λ, λ/2 and λ/4.
3. Design, simulate and compare the performance of two element broad side and end fire uniform amplitude and uniformly spaced linear array.

Group B[Any 6]

4. To measure and plot mode characteristics of reflex klystron.
5. To measure VI characteristics of Gunn Diode and study of PIN modulator.
6. To measure and verify port characteristics of microwave tees (E, H, E-H or magic planes).
7. To measure and verify port characteristics of directional coupler and calculate coupling factor, insertion loss and directivity.
8. To measure and verify port characteristics of isolator and circulator and calculate insertion loss and isolation in dB.
9. To measure wavelength of the microwave using microwave test bench and verify with its theoretical calculations.
10. To plot standing wave pattern and measure SWR for open, short and matched termination at microwave frequency using slotted section with probe carriage.
11. Study the network analyzer and carry out the measurements of s-parameters.

404186Laboratory Practice II

Credits: 02

Teaching Scheme:			**Examination Scheme:**	
Practical : 04 hr/week				**Practical : 50 Marks** **Termwork : 50 Marks**

Digital Image and Video Processing

List of Practicals

(Perform any 8 practical on appropriate software)

1. Perform basic operations on images.
2. Perform conversion between color spaces.
3. Perform histogram equalization.
4. Perform image filtering in spatial domain.
5. Perform image filtering in frequency domain.
6. Perform image restoration.
7. Perform image compression using DCT / Wavelet transform.
8. Perform edge detection using various masks.
9. Perform global and adaptive thresholding.
10. Apply morphological operators on an image.
11. Obtain boundary / regional descriptors of an image.
12. Extraction of frames from video, improve the quality and convert them back to compressed video.

Industrial Drives and Control

(Minimum 8 experiments are to be performed):

1. DC motor control using semi/full 1-Φ /3-Φ converter. (Open loop and closed loop)
2. 4-Quadrant chopper fed reversible DC drive
3. Dual converter fed DC Drive (Single phase/ Three phase)
4. Induction motor speed control using VFD
5. Speed Control of Universal Motor.
6. Stepper motor drive.
7. BLDC Motor drive.
8. Three phase brushless generator for wind energy applications.
9. Simulation of closed loop controlled DC motor drive using PSIM/Matlab/MathCad/ open source software

10 Simulation of closed loop controlled AC motor drive using PSIM / Matlab/MathCad/ open source software

Embedded Systems & RTOS

Minimum 08 experiments

Any 02 Lab exercise from Sr.No 2,3,4

Any 01 Lab exercise from Sr.No 05,06

List of Practicals:

1. Porting of ucos-II on ARM7/Cortex controller.
2. Implementation/Verification of multitasking (minimum 03 tasks) with ucos-II on ARM7/Cortex controller.
3. Implementation of semaphore with ucos –II service ARM7/Cortex controller for resource management and synchronization.
4. Implementation of interprocess communication with ucos-II mailbox and message queue service on ARM7/Cortex controller.
5. Programming with exploring onchip ADC of Cortex /MSP430 based microcontroller.
6. Programming on motor control with exploring onchip PWM of Cortex based microcontroller.
7. Exercise on Porting of Linux on ARM board (ARM9 preferably)
8. Programming for device driver with Embedded Linux.
9. Programming with Arduino development for GPIO on Arduino Uno board.

Case study of any compute/communication/control application on Arduino Uno board

Internet of Things

A Project based Learning approach will be followed for this course hence the experiments will be small projects to be built by the students.

Suggested List of the Experimental Projects(Minimum 6 are to be performed):

1. Study& Survey of various development boards for IoT.
2. Study & Survey of various IoT platforms.
3. Interfacing sensors and actuatorswithAurdino .
4. Build a cloud-ready temperature sensor with the Arduino Uno and the anyIoT Platform: This project shows the building of a temperature sensor.
5. Interfacing Sensors and actuators with Raspberry Pi 2.
6. IoT based Stepper Motor Control with Raspberry Pi: The combination of Raspberry Pi and IoT is an exciting one. Raspberry Pi has many general purpose I/O pins and has the ability to control different actuators like stepper motors. In this project, an internet control of stepper motor using

Raspberry Pi computer is developed. The connectivity is divided into server side software and client side software.

7.IoT based Web Controlled Home Automation using Raspberry Pi.

8. A Simple IoT Project with the ESP8266 WiFi module: Here is a simple project with ESP8266 wi-fimodule.This project collects the temperature and is displayed on the network.

9. Implement a RFID Based IoT Project

404188 Project Phase-I

Credits: 02

Teaching Scheme:		**Examination Scheme:**
Tutorial: 2 Hrs/week		OR :50Marks

Note:

1. Term work assessment is based on the project topic. It consists of Literature Survey and basic project work. The abstract of the project should be submitted before Term workassessment.
2. The report consists of the Literature Survey, basic project work and the size of the report should be maximum of 40pages.
3. The examination is conducted by two examiners (internal and external) appointed by the university. The examiners appointed must have minimum 5 years of experience with UG qualification or 2 years with PG qualification.
4. The assessment is based on Innovative Idea, Depth of understanding, Applications, Individual contributions, presentation, and the grade given by the internal guide based on the work carried out in a semester.
5. A log book of Work carried out during the semester will be maintained with monthly review remarks by the guide and HoD.
6. A certified copy of report is required to be presented to external examiner at the time of final examination.

Audit Course 5 (1):Green Energy

About the course

This course provides an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application. The students will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternate, renewable energy sources such as solar, biomass (conversions), wind power, geothermal, and hydro. Energy conservation methods will be emphasized

Course Objectives:

- To understand the conventional and non conventional energy sources
- To understand different renewable energy sources and their generation
- To understand the various applications & benefits of renewable energy sources
- To enable student to understand project management, energy audit and Installation

Course Outcomes:

After the successful completion of this course, the student is expected to have/be able to:

1. List and generally explain the main sources of energy and their primary applications in the India, and the world.
2. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
3. Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.
4. List and describe the primary renewable energy resources and technologies.
5. Describe/illustrate basic electrical concepts and system components.
6. Convert units of energy—to quantify energy demands and make comparisons among energy uses, resources, and technologies.
7. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

Unit 1: Introduction of conventional & renewable energy sources:

Environment aspects, Energy Efficient materials, Pollution Control techniques, Energy conservation, Energy Audits

Unit II: Details of renewable energy sources & various systems

Solar, Wind, Hydro, Bio-power, Waste to Power

Unit III: Various applications & benefits

Renewable power projects for smart cities & rural electrification, Power conversion techniques, Off-grid/Stand-alone systems, Grid connected systems, Design of Grid-tied & off-grid Solar PV systems, Design of Grid-tied & off-grid Wind systems, Design of Grid-tied & off-grid Hybrid systems, Storage technologies

Unit IV: Project management

Installation & commissioning techniques & standards, Remote monitoring & control techniques, Performance optimization & control, Practical's / Hands-on exposure, Maintenance & Service of plants, Government policies

Guidelines for Conduction (Any one or more of following but not limited to)

- Guest Lectures
- Group Activities
- Assignments
- Taking up small project for short duration

Guidelines for Assessment (Any one or more of following but not limited to)

- Practical Test
- Presentation
- Paper / (Theory assessment test)
- Report

Sources/ References:

1. Boyle, Godfrey. 2004. Renewable Energy (2nd edition). Oxford University Press, 450 pages (ISBN: 0-19- 926178-4).
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (eds.) 2004. Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press, 619 pages (ISBN: 0-19-926179-2)
3. Ashok Desai V, *Non-Conventional Energy*, Wiley Eastern Ltd, 1990.
4. Mittal K.M, *Non-Conventional Energy Systems*, Wheeler Publishing Co. Ltd, 1997.
5. Ramesh R, Kurnar K.U, *Renewable Energy Technologies*, Narosa Publishing House, New Delhi, 1997.
6. Renewable Energy Resources by John Twidell and Tony Weir.

Audit Course 5 (2) :Human Behavior

About the Course:

Human behavior is the responses of individuals or groups of humans to internal and external stimuli. It refers to the array of every physical action and observable emotion associated with individuals, as well as the human race. Social behavior is a subset of human behavior and includes the study of considerable influence of social interaction and culture. Additional influences include ethics, encircling, authority, rapport, hypnosis, persuasion and coercion.

The behavior of humans falls within a range with some behavior being common, some unusual, some acceptable, and some beyond acceptable limits. The acceptability of behavior depends heavily upon social norms and is regulated by various means of social control. Human behavior is experienced throughout an individual's entire lifetime. It includes the way they act based on different factors such as genetics, social norms, core faith, and attitude. An attitude is an expression of favor or disfavor toward a person, place, thing, or event.

Course Objectives:

- To develop understanding of Behavioral Aspects.
- To identify and develop Attitude and Core Faith values
- To expose students to Family Relations, time and career management
- To enable student to understand Creative Thinking and Problem solving
- To enable students to understand Humanistic Education.

Course Outcomes:

On completion of the course, society will observe –

1. Change in awareness levels, knowledge and understanding of student
2. Change in attitudes / behavior of students with regards to their education improved teamwork, institutional leadership and other life skills
3. Improvement in social health and attitude.

Unit 1:

Why Human Relations are so important? Understanding Behavior, Human Relations, and Performance, Personality, Stress, Learning, and Perception, Attitudes, Self-Concept, Natural acceptance of human values, and Ethics, Dealing with Conflict, Leading and Trust.

Unit 2:

Time and Career Management, Interpersonal Communication, Organizational Structure and Communication, Team Dynamics and Leadership, Teams and Creative Problem Solving and Decision Making

Unit 3:

Understanding Harmony in the Family and Society, Harmony in Human Relationship, Understanding the meaning of *Vishwas*; Difference between intention and competence, Understanding the meaning of *Samman*; Difference between respect and differentiation. Understanding the harmony in the society: *Samadhan, Samridhi, Abhay, Sahasttva*as comprehensive Human Goals.

Unit 4:

Justice in Humankind, Nurturing and Exploitation, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics.

Reference Books:

1. "Human Relations in Organizations Applications and Skill Building" RobartLussier, eighth edition, McGraw-Hill (2014).

2. Atkinson and Hilgard's, "Introduction to psychology" Nolen-Hoeksema, S., Fredrickson, B. L., Loftus, G. R., & Lutz, C., Cengage Learning EME.

3. "A Foundation Course in Human Values and Professional Ethics" R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi and Teacher's Manual, R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi

4. A Nagraj, 1998, JeevanVidyaekParichay, Divya Path Sansthan, Amarkantak.

5. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

Semester-II

404189 Mobile Communication

Credits: 03

Teaching Scheme:		**Examination Scheme:**
Lectures: 3Hrs/ Week		**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives

- To understand switching techniques for voice and data traffic.
- To nurture students with knowledge of traffic engineering to design networks.
- To realize importance of cellular concepts and its propagation mechanism.
- To understand architecture of GSM system.
- To overview 4G LTE and 5G technologies.

Course Outcomes

On completion of the course, student will be able to

1. Apply the concepts of switching technique and traffic engineering to design multistage networks.
2. Explore the architecture of GSM.
3. Differentiate thoroughly the generations of mobile technologies.

Unit I - Switching techniques for Voice and Data **8Hrs**

Switching techniques for Voice: Manual Switching System, Electronic Switching System and Time Division Switching. Single Stage networks, Gradings, Two stage and Three stage networks. Synchronization, **Control of switching systems:** Call processing Functions, Common Control, Reliability, Availability and Security.

Switching techniques for Data: Circuit switching, Message Switching and packet Switching in perceptive with mobile communication.

Unit II - Traffic Engineering and Signalling **8Hrs**

Telecommunication Traffic: Unit of Traffic, Traffic measurement, A mathematical model, Lost- call systems: Theory, traffic performance, loss systems in tandem, traffic tables. Queuing systems: Erlang Distribution, probability of delay, Finite queue capacity, Systems with a single server, Queues in tandem, delay tables and application of delay formulae.

Signaling: Customer line signaling. FDM carrier systems, PCM signaling, Inter-register signaling, Common channel signaling, CCITT signaling system and Digital customer line signaling.

Unit III - Cellular Concept **8Hrs**

Introduction to cellular telephone system, Cellular concept : Expansion of mobile system capacity through frequency reuse, Cell geometry, Selection of cluster size, Cell splitting and sectoring, Coverage and capacity in cellular system and Handoff strategies.

Propagation Mechanism: Free space and two ray propagation model, Basic propagation mechanism. Hata outdoor propagation model. **Small Scale Fading and Multipath:** Types of Small scale fading, Small scale multipath propagation, Impulse response model of multipath channel and Small scale multipath measurements.

Unit IV - GSM Fundamentals **8Hrs**

Introduction, Architecture of GSM, characteristics of GSM standards, services, Radio transmission parameters in GSM System, Applications.

Unit V - GSM Channels and Services **8Hrs**

Traffic and Logical Channels in GSM, GSM time hierarchy, GSM burst structure, Description of call setup procedure, Handover mechanism in GSM, Security in GSM.

Data transmission in GSM: Data Services, SMS, HSCSD, GPRS, EDGE.

Multiple Access Techniques-TDMA, CDMA and OFDMA.

Unit VI - Evolution of Mobile Technologies **6Hrs**

Evolution of Mobile Generation and its comparison(GSM & CDMA)

Overview of LTE : LTE basics , LTE frame structure, LTE Design parameters with Standardization and Architecture of LTE.

Overview of 5 G Networks : Comparison of 4G and 5G technology, Opportunities and requirements in 5G network, Open Wireless Architecture of 5G network and Disruptive technologies for 5G.

Text Books

1. Thiagarajan Vishwanathan, "Telecommunication Switching Systems and Networks"; PHIPublications
2. Theodore Rappaport, "Wireless Communications Principles and Practice" Second Edition, Pearson Education

Reference Books

1. Fei Hu, "Opportunities in 5G Networks : A research& development perspective", CRC Press
2. J. E. Flood , "Telecommunications Switching, Traffic and Networks", Pearson Education
3. Krzysztof Wesolowski, "Mobile Communication Systems", Wiley Student Edition
4. John C. Bellamy, "Digital Telephony", Third Edition; Wiley Publications
5. Mischa Schwartz, "Mobile Wireless Communications", Cambridge University Press
6. AdityaJagannatham,"Principles of Modern Wireless Communication Systems"

404190 Broadband Communication Systems

Credits: 04

Teaching Scheme:			**Examination Scheme:**	
Lecture : 04 hr/week				**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- To comprehend the three primary components of a fiber optic communication system.
- To understand the system design issues and the role of WDM components in advanced light wave systems.
- To understand the basics of orbital mechanics and the look angles from ground stations to the satellite.
- To apply subject understanding in Link Design.

Course Outcomes:

After successfully completing the course students will be able to:

1. Perform Link power budget and Rise Time Budget by proper selection of components and check its viability.
2. Perform Satellite Link design for Up Link and Down Link.

UNIT I: Light wave System Components **8Hrs**

Key Elements of optical fiber system, Optical fibers as a communication channel: Optical fiber modes and configurations, Mode theory for Circular waveguides, Single mode fibers, Graded index fiber structure, Signal degradation in optical fibers. Optical sources: Basic concepts and characteristics of LEDs and LASERs. Photo detectors: Basic concepts, Common photo detectors.

UNIT II: Light wave Systems **6 Hrs**

System architectures, Point to point links: System considerations, Design guidelines: Optical power budget, Rise time budget, Long - Haul systems.

UNIT III: Multichannel Systems **6 Hrs**

Overview of WDM, WDM Components: 2 x 2 Fiber coupler, Optical isolators and circulators, Multiplexers and De-multiplexers, Fiber Bragg Grating, FBG applications for multiplexing and de-multiplexing function, Diffraction gratings, Overview of optical amplifiers: SOA, EDFA and RFA in brief.

UNIT IV: Orbital Mechanics and Launchers **8 Hrs**

History of Satellite communication, Orbital mechanics, Look angle determination, Orbital perturbations, Orbital determination, Launchers and launch vehicles, Orbital effects in communication system performance.

UNIT V: Satellite sub systems **6 Hrs**

Satellite Subsystems, Attitude and Control Systems (AOCS), Telemetry, Tracking, Command and monitoring, Power systems, Communication subsystems, Satellite antennas, Equipment reliability and space qualification.

UNIT VI: Satellite communication link design **8Hrs**

Introduction, Basic transmission theory, System noise temperature and G/T Ratio, Design of downlinks, SatelHrsite systems using small earth stations, Uplink design, Design of specified C/N: Combining C/N and C/I values in satellite links system design examples.

Text Books:

1. Gerd Keiser, “Optical fiber Communications”, Tata McGraw Hill, 4th edition.
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, “Satellite Communications”, John Wiley & Sons.

Reference Books:

1. Govind P. Agrawal, “Fiber -Optic Communication Systems”, Wiley, 3rd edition.
2. Dennis Roody, “Satellite Communications”, McGraw Hill

404191 Machine Learning (Elective III)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 Hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Explore supervised and unsupervised learning paradigms of machine learning used forregression and classification.
- To design and analyze various machine learning algorithms using neural networks
- To explore Deep learning technique and various feature extraction strategies.

Course Outcomes:

On completion of the course, student will be able to

1. To compare and contrast pros and cons of various machine learning techniques and to get an in sight of when to apply a particular machine learning approach.
2. To mathematically analyze various machine learning approaches and paradigms.
3. To implement convolution neural networks in recognition applications.

Unit I :Introduction to Machine Learning **4Hrs**

Why Machine learning. Types of machine learning, basic concepts in machine learning like parametric and non-parametricmodeling, linear and nonlinear regression, overfitting and dimensionality reduction. Decision trees, Feature reduction.

Unit II : Models for Regression and Classification **8Hrs**

Linear Models for Regression :Least SquaresandNearestNeighbors ,Linear Basis Function Models,The Bias-Variance Decomposition,Bayesian Linear Regression,Bayesian Model ComparisonLinear Models for Classification : Discriminant Functions .Probabilistic Discriminative Models Multivariate Data,ParameterEstimation,MultivariateClassification,Multivariate RegressionKernal Methods : Support Vector machines and Relevance Vector Machines

Unit III :Clustering **6Hrs**

Dimensionality Reduction : Principal Components Analysis,Factor Analysis,Multidimensional Scaling,Linear Discriminant Analysis Clustering : k-Means Clustering,Mixtures of Gaussians.

Unit IV : Artificial Neural Networks I 6Hrs

Biological neuron, Artificial neuron model, concept of bias and threshold, Activation functions, McCulloch-Pits Neuron Model, learning paradigms,concept of error energy, gradient descent algorithm and application of linear neuron for linear regression,: Learning mechanisms: Hebbian, Delta Rule, Perceptron and its limitations.

Unit V : Artificial Neural Networks II **6 Hrs**

Multilayer perceptron (MLP) and back propagation algorithm, Application of MLP for classification, Self-Organizing Feature Maps,Learning vector quantization Radial Basis Function networks.

Unit VI : Deep Learning and Convolution Neural Networks **6Hrs**

Improvement of the Deep Neural Network:Vanishing Gradient, Overfitting, Computational Load,ReLU Function, Dropout Architecture of ConvNet, Convolution Layer, Pooling Layer, Applications of CNN's.

Text Books:

1. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
2. LaureneFausett ," Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education, Inc, 2008.

Reference Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elementsof Statistical Learning", Springer 2009.
3. Phil Kim, "MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence",a Press 2017.
4. EthemAlpaydın "Introduction to Machine Learning" Second Edition The MIT Press 2010.

5. SimonHaykin," Neural Networks : A comprehensive foundation, Prentice Hall International Inc. 1999.

404191 PLC & Automation (Elective III)

Credits: 03

Teaching Scheme:			Examination Scheme:	
Lecture : 03hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Student will get the ability to recognize industrial control problems suitable for PLC control
- The learners will get an over view of technology of advanced topics such as SCADA, DCS Systems, DigitalController, CNC Machines.
- Student will gain the ability to select the essential elements and practices needed to develop and implement the Engineering Automation using PLC approach.

Course Outcomes:

On successful completion of the course, students able to:

1. Understand PLC architecture
2. Develop PLC ladder programs for simple industrial applications
3. Design Automation systems for industrial applications
4. Implement the Engineering Automation using PLC approach.

Unit I: Process Control & Automation **6Hrs**

Process control principles, Servomechanisms, Control System Evaluation, Analog control, Digital control, Types of Automation; Architecture of Industrial Automation Systems, Advantages and limitations of Automation, Effects of modern developments in automation on global competitiveness.

Unit II: Transmitters and Signal Conditioning **6Hrs**

Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, 2-Wire & 3-Wire transmitters, Analog and Digital signal conditioning for RTD, Thermocouple, DPT etc , Smart and Intelligent transmitters.

Unit III: Controllers and Actuators **6Hrs**

PID Controller, Cascade PID control, Microprocessor Based control, PAC (Programmable automation controller), Mechanical switches, Solid state switches,Electrical actuators: Solenoids, Relays and Contactors, AC Motor, VFD, energy conservation schemes through VFD, DC Motor, BLDC Motor, Stepper Motor, Servo Motor, Pneumatic and hydraulic actuators.

Unit – IV Introduction to PLC **6Hrs**

PLC: Characteristics, Operation, function, Types of PLC, Architecture Of PLC, Applications of PLC, PC v/s PLC, PLC programming, Ladder diagram: of logic gates, multiplexer, Ladder diagram for different logical conditions or logical equations or truth table. Timers: types of timer, Characteristics, Function of timer in PLC, Classification of a PLC timer, Ladder diagram using timer, PLC counter, Ladder diagram using counter.

Unit – V Industrial Automation **6 Hrs**

Basic Concept, History and Hierarchy of DCS, Functions of each level, Advantages and Disadvantages, Architecture of SCADA , MTU- functions of MTU, RTU- Functions of RTU, Working of SCADA, Comparison, suitability of PLC, DCS and SCADA, Applications: Thermal power plant, Irrigation and Cement factory.

Unit VI: Automation and CNC (Computer Numeric Control) Machines **7 Hrs**

Introduction of CNC Machines: Basics and need of CNC machines, NC, CNC and DNC (Direct NC) systems, Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines. Industrial Communication:Devicenet, Interbus , Device network: Foundation Fieldbus -H 1, HART, CAN, PROFIBUS-PA, Control network: ControlNet, FF-HSE, PROFIBUS-DP, Ethernet, TCP/IP. Panel Engineering for Automation

Text Books:

1. Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education.
2. MadhuchhandaMitra, SamarjitSen Gupta, "Programmable Logic controllers and Industrial Automation"; Penram International Publishing India Pvt. Ltd.

Reference Books:

1. Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication.
2. John W. Webb, Ronold A Reis, "Programmable Logic Controllers, Principles and Applications"; 5th Edition, Prentice Hall of India Pvt. Ltd.
3. Kilian, "Modern control technology: components & systems, Delmar 2nd edition.
4. Bela G Liptak, Process software and digital networks, 3rd edition, 2002.
5. Pollack. Herman, W & Robinson., T. "Computer Numerical Control", Prentice Hall. NJ. Pabla, B.S. &Adithan, M. "CNC Machines", New Age Publishers, New Delhi

404191Audio and Speech Processing (Elective III)

Credits: 03

Teaching Scheme			**Examination Scheme**	
Lecture : 03 hr/week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand basics of speech production and perception mechanism.
- To understand classification of speech sounds based on acoustic and articulatory phonetics.
- To understand the motivation of short-term analysis of speech and audio.
- To understand various audio and speech coding techniques.
- To perform the analysis of speech signal using LPC.
- To extract the information of the speech or audio signals in terms of cepstral features.
- To provide a foundation for developing applications in the field of speech and audio processing.

Course Outcomes:

On completion of the course, student will be able to

1. Design and implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing.
2. Analyze speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).
3. Analyze speech signal for extracting LPC and MFCC Parameters of speech signal.
4. Apply the knowledge of speech and audio signal analysis to build speech processing applications like speech coding, speech recognition, speech enhancement and speaker recognition/verification.

Unit I : Fundamentals of speech production 6 Hrs

Anatomy and physiology of speech production, Human speech production mechanism, LTI model for speech production, Nature of speech signal, linear time varying model, articulators, articulatory phonetics, manner of articulation, place of articulation, acoustic phonetics, spectrogram, classification of speech sounds: vowels, semivowels, nasal diphthongs, stops, affricates, fricative, vowel triangle.

Unit II : Human auditory system and speech perception 6 Hrs

Anatomy and physiology of the ear, outer ear, middle ear and inner ear. Human auditory system, simplified model of cochlea. Sound perception, Auditory psychophysics, thresholds, just noticeable differences (JNDs), Sound pressure level and loudness. Sound intensity and Decibel sound levels. Pitch perception, masking, Concept of critical band and introduction to auditory system as a filter bank, Uniform, non-uniform filter bank, mel scale and bark scale. Speech perception: vowel perception. Coarticulation effects. Consonant perception, perception of manner of articulation feature. Perception of place of articulation.

Unit III: Time and frequency domain methods for speech and audio signal analysis. 6Hrs

Time-dependent speech processing. Short-time energy, short time average magnitude, Short time average zero crossing rate. Speech Vs. silence discrimination using energy and zero crossing rate. Short-time autocorrelation function, short-time average magnitude difference function. Pitch period estimation using autocorrelation method. Audio feature extraction, Spectral centroid, spectral spread, spectral entropy, spectral flux, spectral roll-off. Spectrogram: narrow band and wide band spectrogram.

Unit IV : Linear prediction and cepstral analysis 6Hrs

Basic principles of linear predictive analysis. Autocorrelation method, covariance method. Solution of LPC equations: Durbin's recursive solution, lattice formulations and solutions. Frequency domain interpretation of LP analysis. Applications of LPC parameters as pitch detection and formant analysis

Homomorphic processing of speech signal, application of cepstral analysis for vocal tract vocal cord parameter estimation (formants and pitch). Computation of MFCC.

Unit V : Speech and Audio coding 6Hrs

Time domain waveform coding: linear PCM, companded PCM, DPCM, DM, ADM.

Spectral coders: Filter bank analysis, sub-band coders, Adaptive transform coders (ATC), Harmonic coding. Linear predictive coders (LPC), Non-LP source voice coders: phase vocoders, channel vocoders, excitation for vocoders, Homomorphic (Cepstral) vocoders. Speech coding standards and applications.

Unit VI : Digital speech processing for man-machine communication 6Hrs

Automatic speech recognition (isolated word recognition, automatic telephone number dialing system etc. using statistical signal modeling e.g. GMM, GMM-HMM), Linear and dynamic time warping, text to speech synthesis, speaker recognition and verification, speech enhancement, Introduction to Musical instrument classification, Musical Information retrieval.

Text Books:

1. L. R. Rabiner and S.W. Schafer, "Digital processing of speech signals" Pearson Publication.
2. Douglas O'Shaughnessy, "Speech Communications: Human and Machine:, 2nd Edition Universities Press.

Reference Books:

1. Thomas F. Quateri , "Discrete-Time Speech Signal Processing: Principles and Practice" Pearson Publication.
2. ShailaApte, "Speech and audio processing", Wiley India Publication
3. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", Wiley India.
4. L. R. Rabiner , B. H. Juang and B. Yegnanarayana "Fundamentals of speech recognition". PearsonPublication

404191 Software Defined Radio (Elective III)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03Hr/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand "Modern Radio Communication System " that can be reconfigured
- To understand GNU Radio
- To understand how SDR platform provides easy access to wireless network system
- To understand how unlike simulation in Communication Projects, SDR allows easy
- access to both PHY and MAC layer
- To understand the concept of Cognitive Radio and Spectrum sharing

Course Outcomes:

On completion of the course, student will be able to

1. Compare SDR with traditional Hardware Radio HDR.
2. Implement modern wireless system based on OFDM, MIMO & Smart Antenna.
3. Build experiment with real wireless waveform and applications, accessing both PHY and MAC, Compare SDR versus MATLAB and Hardware Radio
4. Work on open projects and explore their capability to build their own communication System.

Unit I : Introduction to SDR and RF Implementation **6Hrs**

Introduction to SDR, Need of SDR, Principles of SDR , Basic Principle and difference in Analog radio and SDR , SDR characteristics, required hardware specifications, Software/Hardware platform, GNU radio -What is GNU radio, GNU Radio Architecture, Hardware Block of GNU,GNU software , MATLAB in SDR , Radio Frequency Implementation issues, Purpose of RF front End, Dynamic Range ,RF receiver Front End topologies, Flexibility of RF chain with software radio, Duplexer ,Diplexer ,RF filter ,LNA ,Image reject filters , IF filters , RF Mixers Local Oscillator , AGC, Transmitter Architecture and their issues, Sampling theorem in ADC, Noise and distortion in RF chain, Pre-distortion

Unit II :SDR Architecture **7Hrs**

Architecture of SDR-Open Architecture, Software Communication Architecture, Transmitter Receiver Homodyne/heterodyne architecture, RF front End, ADC, DAC, DAC/ADC Noise Budget, ADC and DAC Distortion, Role of FPGA/CPU/GPU in SDR, Applications of FPGA in SDR, Design Principles using FPGA, Trade –offs in using DSP, FPGA and ASIC, Power Management Issues in DSP, ASIC, FPGA

Unit III : Multi Rate Signal Processing **6Hrs**

Sample timing algorithms, Frequency offset estimation and correction, Channel Estimation, Basics of Multi Rate, Multi Rate DSP, Multi Rate Algorithm, DSP techniques in SDR, OFDM in SDR

Unit IV : Smart/MIMO Antennas using Software Radio **6Hrs**

Smart Antenna Architecture, Vector Channel Modeling , Benefits of Smart Antenna Phased Antenna Array Theory, Adaptive Arrays, DOA Arrays, Applying Software Radio Principles to Antenna Systems, Beam forming for systems-Multiple Fixed Beam Antenna Array, Fully Adaptive Array , Relative Benefits and Trade-offs OF Switched Beam and Adaptive Array, Smart Antenna Algorithms , Hardware Implementation of Smart Antennas, MIMO -frequency, time, sample Synchronization, Space time block coding-Space Time Filtering, Space Time Trellis Coding .

Case Study : Principles of MIMO-OFDM

Unit : Cognitive Radio **6Hrs**

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 VI : Applications of SDR **7Hrs**

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

Case Study : 1)CR for Public Safety –PSCR , Modes of PSCR, Architecture of PSCR
2)Beagle board based SDR 3)Embedded PCSR using GNU radio

Text Books:

1. Jeffrey. H. Reed ,Software Radio : A Modern Approach to Radio Engineering, Pearson LPE
2. Markus Dillinge, KambizMadani, Nancy Alonistioti, Software Defined Radio :Architectures , Systems and Functions ,Wiley

Reference Books:

1. Tony .J. Rouphael, RF and DSP for SDR, Elsevier Newness Press ,2008
2. Dr.TajStruman,Evaluation of SDR –Main Document
3. SDR –Handbook, 8th Edition , PENTEK
4. Bruce a. Fette, Cognitive Radio Technology, Newness, Elsevier

404191 Audio Video Engineering (Elective III)

Credits: 03

Teaching Scheme:		**Examination Scheme:**	
Lecture : 03Hr/Week			**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- After learning AVE course, students will get benefit to learn and understand the working of real life video system and the different elements of video system plus the encoding/decoding techniques.
- The learners will be groomed up to understand different channel allocations, difference between various systems present in this world, their transmission and reception techniques.
- Students will get insight on functioning of individual blocks, different standards of compression techniques and they will be acquainted with different types of analog, digital TV and HDTV systems.
- The students will get overview of fundamentals of Audio systems and basics of Acoustics

Course Outcomes:

On successful completion of the course, students able to:

1. Apply the fundamentals of Analog Television and Colour Television standards.
2. Explainthe fundamentals of Digital Television, DTV standards and parameters.
3. Study and understand various HDTV standards and Digital TV broadcasting systems and acquainted with different types of analog, digital TV and HDTV systems.
4. Understandacoustic fundamentals and various acoustic systems.

Unit I: Fundamentals of Colour Television **8Hrs**

The basic Television system and scanning principles, Composite video signal and television standards, Color TV systems, fundamentals, mixing of colours, colour perception, chromaticity diagram. NTSC, PAL, SECAM systems, colour TV transmitter, (high level, low level), colour TV receivers.

Unit II: Digital TV and Display Devices **6Hrs**

Introduction to Digital TV, Digital TV signals and parameters, Digital TV Transmitters, MAC signals, advanced MAC signal transmission, Digital TV receivers, Basic principles of Digital Video compression techniques, MPEG Standards. Digital TV recording techniques, Display devices: OLED, LCD, TFT, Plasma, Camcoder, Digicam.

Unit III: HDTV **6Hrs**

HDTV standards and systems, HDTV transmitter and receiver/encoder, Digital TV satellite Systems, video on demand, CCTV, CATV, direct to home TV, set top box with recording facility, conditional access system (CAS), 3D TV systems, HD video cameras, Digital broadcasting, case study (Cricket match, Marathon, Football match).

Unit IV: Advanced TV Systems **6Hrs**

IP Audio and Video, IPTV systems, Mobile TV, Video transmission in 3G/4G mobile System, Digital Video Recorders, Wi-Fi Audio / Video Transmitter and Receivers.

Unit V: Fundamentals of Audio-Video Recording **8Hrs**

Methods of sound recording & reproduction, optical recording, CD recording, audio standards. Digital Sound Recording, CD/ DVD player, MP3 player, Blue Ray DVD Players, MP3 Player.

Unit VI: Fundamentals of Acoustics 6Hrs

Studio acoustics & reverberation, P.A. system for auditorium, acoustic chambers, Cordless microphone system, special types of speakers & microphones, Digital Radio Receiver Satellite radio reception.

Text Books

1. Television and video Engineering, A. M. Dhake, TMH Publication.
2. R. R. Gulati, "Monochrome and colour television"

Reference Books

1. Television Engineering -Audio and Video Systems, D. S. Bormane, P.B. Mane& R RItkarkar, Wiley publication.
2. S. P. Bali, "Color TV Theory and Practice".
3. Bernard Grobb, Charles E, "Basic TV and Video Systems".
4. Video Demisified, Kelth jack, Penram International Publication.
5. Audio Video Systems, R.G. Gupta, TMH Publication

404192 ROBOTICS (Elective-IV)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03Hr/Week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand the history, concept development and key components of robotics technologies.
- To understand basic mathematics manipulations of spatial coordinate representation and transformation.
- Able to solve basic robot forward and inverse kinematic problems
- To understand and able to solve basic robotic dynamics, path planning and control problems

Course Outcomes:

On completion of the course, student will be able to

1. Familiar with the history, concept development and key components of robotics technologies.
2. Implement basic mathematics manipulations of spatial coordinate representation and transformation.
3. Solve basic robot forward and inverse kinematic problems
4. Understand and able to solve basic robotic dynamics, path planning and control problems

Unit I :Basic concepts in robotics 6Hrs

Definition ; anatomyof robot, basic structure of robot, Specifications and Classification of robot, Safety Measures in robotics ,Industrial Applications of Robots.

Unit II :Robot drivers,Sensors and Vision 6Hrs

Drives for robots: Electric, hydraulic and pneumatic.

Sensors: Internal-External,Contact-noncontact, position, velocity,force, torque, proximity and range.

Vision: Introduction to techniques, Image acquisition and processing

Unit III : End Effectors and Actuators **6Hrs**

Different types of grippers- Mechanical,Magnetics,vacuum,Adhesive, Gripper force Analysis&Gripper Design , overview of actuators, Power and torque, Acceleration and velocitySpecifications and characteristics of Stepper motors, AC motors, DC motors and servomotors.

Unit IV : Robot Kinematics and Dynamics **8Hrs**

Direct and inverse kinematics for industrial robots for position and orientation, Redundancy, Manipulator, direct and inverse velocity. Lagrangian formulation , Link inertia tensor and manipulator inertia tensor, Newton –Eller formulation for RP and RP manipulators, Trajectory planning, interpolation, static force and moment transformation, solvability, stiffness

Unit V:Programming methods **6Hrs**

Robot language classification, Robot language structure, elements and its functions. Simple programs on Sensing distance and direction., Line Following Algorithms, Feedback Systems Other topics on advance robotic techniques

Unit VI : Developing and building a robot **6Hrs**

Models of flexible links and joints, Robotic arm – Components and structure, Types of joints and workspace, Design models for mechanic arms and lifting systems

Case Study: 1. Robots in material handling and assembly.
2. Human Robot Interaction

Text Books:

1. Introduction to Robotics By S.K.Saha , Tata McGraw Hill
2. Robotics Control ,Sensing ,Vision and Intelligence by K.S. Fu, R.C .Gonzalez, C.S.G.Lee , Tata McGraw Hill

Reference Books:

1. J. Hirchhorn: Kinematics and Dynamics of Machinery, McGraw Hill book co.
2. Robert J. Schilling , Fundamentals of Robotics- Analysis and Control, Prentics Hall india.
3. Robotics Technology and Flexible Automation by S.R.Deb, S. Deb, Tata McGraw Hill
4. Robot Motion and Control (Recent Developments) by M.Thoma& M. Morari

404194 Biomedical Electronics (Elective-IV)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 hr/week				**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- To study Human Physiological Systems from Engineering Perspectives
- To understand the basic signals in the field of biomedical.
- To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, PCG, Pulse.
- To understand Sources and characteristics of noise and artifacts in bio signals.
- To understand use of bio signals in diagnosis, patient monitoring and physiological investigation

Course Outcomes:

After successfully completing the course students will be able to:

1. Model a biomedical system.
2. Understand various methods of acquiring bio signals.Understand various sources of bio

3. signal distortions and its remedial techniques.
4. Get an Overview of major Devices currently used in Medical field
5. The students will have an understanding of analyzing bio-signal and classifying them

Unit I: Introduction to Biomedical System **6Hrs**

Biomedical Instrumentation System, Cell structure, Bio-Cell potential , Concept of Bio-electrodes, Types of Bio-electrodes to measure Bio-signal, Transducers and Sensors to measure Bio signal EEG,ECG,EMG, Respiration, Body temperature, SPO2, and Pulse. Artifacts in Bio signal Acquisition: Noise, Power line, Baseline, Skin Impedance and Motion Artifacts, Techniques to reduce the artifacts.

Unit II: Cardiovascular System 6Hrs

Introduction to Heart**,** Physiology and anatomy of Heart, Lead Configurations to acquire ECG, ECG preamplifiers, ECG recorder, Heart Sounds and Murmurs, Phonocardiography

Unit III:Nervous System 6Hrs

Nerve Cell and nerve potential, Neural Communication, Brain structure, 10-20 electrode placement for EEG , Types of Montage configuration, Types of EEG signals and its significance, EEG machine, EEG applications for Epilepsy and Sleep apnea**.**

Unit IV: Medical Instrumentation **8Hrs**

Design of Instrumentation system for ECG acquisition, Isolation Amplifier, Right Leg drive Mechanism, Noise removal techniques using Active Filters, Wiener Filters, Adaptive Filters: Basic Concept, Principle noise cancellation model, removal of periodic events, using adaptive cancellation, adaptive cancellation of maternal ECG from fetal ECG of Interest. Grounding and shielding Concepts

Unit: Analysis of Electrical Activity of Heart **6Hrs**

ECG Signal Processing: Removal of Base line and Power line Interference, Muscle noise Filtering, Highlight ECG feature points, QRS detection, ECG classification for normal and abnormal state using Multilayer Perceptron. Use of Multiscale analysis for ECG parameter estimation.

Unit VI:Medical Devices **4Hrs**

Introduction To Blood Pressure Measurement (noninvasive), Life saving Devices Pacemakers and Defibrillators, Bedside Monitors, Central Monitoring system, Stress Test System, X Ray, CT scan , Dental instruments

Text Books:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", 4th Edition, Prentice Hall, 2000.
2. R. Rangayan, "Biomedical Signal Analysis", Wiley 2002.
3. R.S.Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003, Edition-II.

Reference Books:

1. John L Semmlow, "Bio-signal and Biomedical Image Processing", Marcel Dekker
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", 4thEdition, Prentice Hall, 2000.

404194 Wireless Sensor Networks (Elective-IV)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To learn basic concepts of Wireless sensor networks
- To be familiar with architecture and protocols used in Wireless sensor networks
- To provide knowledge of deployment and security issued of Wireless sensor networks

Course Outcomes:

On completion of the course, student will be able to

1. Explain various concepts and terminologies used in WSN
2. Describe importance and use of radio communication and link management in WSN
3. Explain various wireless standards and protocols associated with WSN
4. Recognize importance of localization and routing techniques used in WSN
5. Understand techniques of data aggregation and importance of security in WSN
6. Examine the issues involved in design and deployment of WSN

Unit1 : Introduction **6 Hrs**

What are Wireless Sensor Networks, Wireless Sensor Node, Anatomy of a Sensor Node, architecture of WSN , Performance metrics in WSNs, types of WSN

Unit 2: Radio Communication And Link Management **7 Hrs**

Radio Waves and Modulation/Demodulation, Properties of Wireless Communications, Medium Access Protocols, Wireless Links Introduction, Properties of Wireless Links, Error Control, Naming and Addressing, Topology Control

Unit 3: Wireless Standards And Protocol Stack **7 Hrs**

WSN Standards- IEEE802.15.4 Low rate WPAN, Zigbee, WirelessHART, ISA 100.11a, 6LoWPAN,IEEE802.15.3, Wibree,BLE, Zwave, ANT, Insteon, Wavenis, Protocol stack of WSNs, Cross Layer Protocol Stack

Unit 4: Localization And Routing **7 Hrs**

Localization : Localization Challenges and Properties, Deployment Schemes, Proximity Schemes. Ranging Schemes, Range-Based Localization, Range-Free Localization,
Routing Basics, Routing Metrics, Routing Protocols, Full-Network Broadcast, Location-Based Routing, Directed Diffusion, Collection Tree Protocol, Zigbee, Multi-Hop Communications

Unit 5: Data Aggregation And Security **7 Hrs**

Clustering Techniques, In-Network Processing and Data Aggregation, Compressive Sampling, Security Issues in Wireless Sensor Networks, Attacks, Defensive Measures, Securityrequirements and threat model,

Unit 6: Designing And Deploying WSN Applications **6 Hrs**

Designing and Deploying WSN Applications,Early WSN Deployments, General Problems, General Testing and Validation, Requirements Analysis, The Top-Down Design Process, Bottom-Up Implementation Process.

Text Books

1.Kazem Sohraby, Daniel Minoli and TaiebZnati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
2.Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.

Reference Books

1. HossamFahmy, "Wireless Senor Networks: Concepts, Application, experimentation and analysis", Springer Publication
2. Anna Forster, "Introduction to Wireless Sensor Networks", IEEE Press, Wiley Publication
3.Anna Hac, "Wireless Sensor Network Designs", John Wiley & Sons Ltd,

404194 Renewable Energy Systems (Elective-IV)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03hr/week				**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- To study energy generation, different energy sources and their utilization and impact on environment
- To gain knowledge of solar radiation and its applications
- To understand the wind energy and its nature
- To analyze the performance of solar collectors and wind turbines
- To learn fuel cell and its efficiency

Course Outcomes:

On successful completion of the course, students able to:

1. Interpret energy reserves of India and potential of different energy sources.
2. Measure the solar radiation parameters and performance of different solar collectors.
3. Calculate different parameters of wind turbine rotor.
4. Implicit the importance and applications of geothermal and ocean energy.
5. Demonstrate knowledge in field of fuel cell and potential for power generation.

Unit I : Energy Resources and Utilization: 6Hrs

Conservation and forms of energy, energy reserves in India, nuclear power, hydroelectric power potential, India's power scene, impact on environment, renewable energy sources, energy parameters, cogeneration, rational energy use of energy, energy efficiency and conservation, new technologies, distributed energy systems and dispersed generation.

Unit II :Solar Energy 8Hrs

Solar constant, spectral distribution of extraterrestrial radiation, terrestrial solar radiation, solar radiation geometry, computation of COSθ, sunrise, sunset, day length, LAT, Empirical equation, solar radiation measurement, Solar Thermal energy collectors, design parameters,laws of thermal radiation, radiation heat transfer between real bodies, radiation optics, transmitivity, heat losses and coefficient, Solar Thermal energy storage.

Unit III : Solar photovoltaic systems& Solar Applications 8Hrs

Solar photovoltaic systems: Photovoltaics, Different types of PV Cells, Mono-poly crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems

Solar Applications: Solar water heating, solar distillation, solar ponds, solar pumping system, solar cooker, solar green house.

Unit IV : Wind energy 8Hrs

Classification, types of rotors, terminology, operation of wind turbines, wind energy extraction, wind characteristics, wind speed, energy estimation, power density duration curve, density function, field data analysis, direction and wind speed, variation of wind speed, wind scale, energy pattern factor in wind power studies, land for wind energy, design of wind turbine rotor, regulating system, wind power generation curve, horizontal axis wind turbine generator, modes of wind power generation, advantages and disadvantages, wind energy farms.

Unit V: Ocean and Geothermal Energy **6Hrs**

Ocean Energy: Tidal Energy, Tidal characteristics, Tidal Energy estimation, Development of a tidal power scheme,Wave energy- characteristics-energy and power from the waves.

Geothermal energy: Structure of earth's interior, sites, field, gradient, resources, power generation, geothermal resources in India, utilization, global status of electricity generation from geothermal resources, advantages of geothermal energy

Unit VI : Fuel Cells **6Hrs**

Principle of operation of an acidic Fuel Cell, Technical parameter, Fuel Processor, methanol fuel cell, fuel cell types, Advantages of fuel cell power plants, comparison between acidic and alkaline hydrogen-oxygen fuel cells, state of art fuel cells, energy output of a fuel cell, efficiency and EMF of a fuel cell, Gibbs-Helmholtz equation, operating characteristics of fuel cells.

Text Books:

1. D.P. Kothari, K.C. Singal and RakeshRanjan, "Renewable Energy Sources and Emerging Technologies", Prentice Hall of India, New Delhi, 2009.
2. S.P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", TMH, New Delhi, 2008

Reference Books:

1. Chetan Singh Solanki, "Renewable Energy Technologies", Prentice Hall of India, New Delhi, 2009
2. G. D. Rai, "Non- conventional Energy Sources", Khanna publishers, New Delhi, 2011.
3. MaltiGoel, "Energy Souces and Global Warming", allied publishers Pvt Ltd. New Delhi, 2005.

404193 Laboratory Practice III

Credits: 02

Teaching Scheme:			Examination Scheme:	
Practical : 02 Hr/week				**TW : 50 Marks** **PR : 50 Marks**

Mobile Communication:

List of Practicals: (Any Eight)

1. Perform an experiment to explain PSTN TST switch.
2. Write a program to elaborate Lost call system/ delay system used in the analysis of voice/data traffic.
3. Write a program to measure bit error rate in presence of AWGN model.
4. Write a program to simulate speech coding and decoding technique used in mobile Communication.
5. Set up and carry out experiment on AT commands for call operation.
6. Write a program to simulate experiment on GMSK modulation.
7. Write a program to measure bit error rate in presence of Hata/ Multipath propagation model.
8. Set up and carry out experiment to explain VoIP call routing process.
9. Visit to Mobile Telephone Switching Office (MTSO).
10. Perform an experiment / Simulate to elaborate the operation of Multiple access techniques such as TDMA/CDMA/OFDMA.

Broadband Communication System:

List of the Experiments:

- **Minimum 8 experiments are to be performed excluding tutorials.**
- **Tutorials are mandatory. (Expt. 5 and 12)**

1. Estimation of Numerical aperture of fiber.
2. Plot the characteristics of various sources and detectors.
3. Measure attenuation of MMSI and SMSI fiber and comment on the result based on attenuation due to increase in length as well as loss due to bend.
4. Set up a digital link and analyze.
5. Tutorial on Power budget and time budget analysis of optical fiber system.
6. Establishing a direct communication link between Uplink Transmitter and Downlink Receiver using tone signal.
7. To set up an Active Satellite link and demonstrate Link Fail Operation.
8. To establish an AUDIO-VIDEO satellite link between Transmitter and Receiver.
9. To communicate VOICE signal through satellite link.
10. To transmit and receive three separate signals (Audio, Video, Tone) simultaneously through satellite Link.
11. To transmit and receive PC data through satellite link.
12. Tutorial on satellite link design
13. Students, as a part of their term work, should visit satellite earth station and submit a report of visit. (Optional).

404194 Laboratory Practice IV (Elective III)

Credits: 01

Teaching Scheme:			Examination Scheme:	
Practical : 02 Hr/week				Oral : 50 Marks

Machine Learning

List of Practical's:

(Use appropriate Software available in the Institute)

1. Implement simple logic network using MP neuron model
2. Implement a simple linear regressor with a single neuron model
3. Implement and test MLP trained with back-propagation algorithm
4. Implement and test RBF network
5. Implement SOFM for character recognition.
6. Implement SVM classifier for classification of data into two classes. Student can use datasets such as flower classification etc.
7. Implement and test Multiclass SVM classifier.
8. Implement and test CNN for object recognition.

PLC & Automation

List of Experiments (Minimum 8 experiments are to be performed).

1. Control the speed of servo motor using analog voltage 0-10V.
2. Rotate the servo motor according to X, Y co-ordinates.
3. Temperature detection using RTD & control the temperature of water at desired set point.
4. Control the flow of water using analog control valve.
5. Control the speed of AC 3ϕ motor using VFD.
6. Design simulation of 3 cylinder piston pump using pneumatic kit & PLC.
7. Detect the angle of shaft using Encoder & PLC.
8. Control the speed of 3ϕ AC motor from Mobile/HMI with PLC.
9. Interfacing of RFID with PLC & show the corresponding user data on SCADA to access the control.
10. Interface PLC with RTU & SCADA at remote location.
11. Exchange the data between two PLC's using Ethernet.
12. Interfacing of PLC to VFD over profibus& exchange the data

Audio and Speech Processing

List of Experiments (Minimum 8 experiments are to be performed):

NOTE: To perform the experiments software like MATLAB, SCILAB or any appropriate open source software can be used. For analysis of speech signals tools like PRAAT, Audacity can be used. Open source software is encouraged.

1. Record speech signal (isolated words, continuous speech) and analyze the speech signal using speech analysis tool (e.g. PRAAT). Observe spectrogram, pitch, formants, intensity etc.
2. Write a program to compute short time Energy and ZCR for different frame rates and comment on the result.
3. Write a program to classify voiced, unvoiced and silence frames using frame level energy and zero crossing rate
4. Write a program to compute narrow band and wide band spectrogram. Comment on the time and frequency resolution of wide band and narrow band spectrogram.
5. Write a program for extracting pitch period for a voiced part of the speech signal using autocorrelation method and average magnitude difference function (AMDF).
6. Write a program to design a Mel filter bank and using this filter bank write a program to extract MFCC features.
7. Write a program to perform the cepstral analysis of speech signal and detect the pitch from the voiced part using cepstrum analysis.
8. Write a program to find LPC coefficients using Levinson Durbin algorithm.
9. Write a program to enhance the noisy speech signal using spectral subtraction method.
10. Write a program to extract frequency domain audio features like SC, SF and Spectral roll off.

Software Defined Radio

List of the Experiments(Minimum 8 experiments are to be performed):

1. Introduction to GNU Radio
2. Introduction to Software Defined Radio Systems
3. Implementation of AM using SDR
4. Implementation of FM using SDR with application such as transfer of files
5. Implementation of M-PSK transmitter using SDR
6. Implementation of M-PSK receiver using SDR
7. Implementation of M-QAM transmitter using SDR
8. Implementation of M-QAM receiver using SDR
9. Implementation of Transmission of files on Wireless media using SDR
10. Implementation of OFDM using SDR
11. Implementation of Cognitive radio using SDR

Audio Video Engineering

List of Experiments (Minimum 8 experiments are to be performed).

1. Voltage and waveform analysis for color TV.
2. Study of direct to home TV and set top box.
3. Study Wi-Fi TV system
4. Study of Digital TV pattern generator.
5. Study of HDTV
6. Study of Digital TV.
7. Simulation of Video, Audio and Image compressing techniques (Software Assignments)
8. Study of Audio system: CD players and MP3 player.
9. Study of PA system with chord less microphone
10. Directivity pattern of Microphones / Loud speakers
11. Visit to TV transmitter/ Digital TV Studio/ All India Radio / TV Manufacturing factory

404195 Project Phase-II		
Credits:06		
Teaching Scheme:		**Examination Scheme:**
Tutorial: 6 Hrs/Week		**TW: 150 Mark** **OR: 50 Marks**

1. GroupSize

The student will carry the project work individually or by a group of students. Optimum group size is in 3 students. However, if project complexity demands a maximum group size of 4 students, the committee should be convinced about such complexity and scope of thework.

2. Selection and approval of topic

Topic should be related to real life application in the field of Electronics and Telecommunication

OR

Investigation of the latest development in a specific field of Electronics or Communication or Signal Processing

OR

The investigation of practical problem in manufacture and / or testing of electronics or communication equipment

OR

The Microprocessor / Microcontroller based applications project ispreferable.

OR

Software development project related to VHDL, Communication, Instrumentation, Signal Processing and Agriculture Engineering with the justification for techniques used / implemented is accepted.

OR

Interdisciplinary projects should be encouraged. The examination will be conducted independently in respective departments.

3. Note:

The group should maintain a logbook of activities. It should have entries related to the work done,problems faced, solution evolved etc., duly signed by internal and external guides.

Project report must be submitted in the prescribed format only. No variation in the format will be accepted. One guide will be assigned at the most 3 project groups.

Audit Course 6 (1)
Team Building, Leadership and Fitness

About the course

Team building allows students to work together in social situations just as they would in the classroom, their daily lives, or down the road in the workplace. Team building challenges students to solve problems and execute working with others. It shows them how to be accountable. It allows team members to stay motivated and energized to work on the project together. They work on jobs and tasks cohesively, rather than working alone without interaction. By working together, members of the team can "work together, stay together, and achieve together" .Trust and communication issues can also be noticed from team building exercises. Team building is known to improve performance in teams; members will remain motivated and can easily overcome indifferences to see the strengths in all team members.

Leadership is about the art of motivating, influencing and directing people so that they work together to achieve the goals of a team or broader organization. It's important for students to experience leadership opportunities during their schooling, to learn the art of building relationships within teams, defining identities and achieving tasks effectively. It also provides an opportunity to learn to identify and display effective communication and interpersonal skills. Leadership begins with identifying and understanding our values. Our values are our fundamental beliefs – those principles we consider to be worthwhile and desirable. Fitness does not only refer to being physically fit, but also refers to a person's mental state as well. If a person is physically fit, but mentally unwell or troubled, he or she will not be able to function optimally. Mental fitness can only be achieved if your body is functioning well. You can help relax your own mind and eliminate stresses by exercising regularly and eating right. People who are physically fit are also healthier, are able to maintain their most optimum weight and are least prone to cardiac and other health problems. In order to maintain a relaxed state of mind, a person should be physically active. A person who is fit both physically and mentally strong enough to face the ups and downs of life, and is not affected by drastic changes if they take place.

Course Objectives:

- To develop understanding of team skills and dynamics
- To identify and develop personal skills to become a more effective team member
- To introduce to the students the social change model of leadership
- To expose students to the leadership skills and imbibe within them that the fact that Leadership is a process, not a characteristic associated with an individual or role.
- To enable student to understand principles of fitness training and exercise
- To enable students to understand human posture, nutritional values and mental fitness

Course Outcomes:

On completion of the course, society will observe –

1. Change in awareness levels, knowledge and understanding of today's youth
2. Change in attitudes / behavior of students with regards to their improved teamwork, institutional leadership and other life skills
3. Increase in the body's fitness levels and also reduced health problems
4. Improvement in social health and attitude.

Unit 1: Team Building

Types of Teams, Characteristics of a Team, Stages of Team Development (Forming ,Storming, Norming, Adjourning) , Systematic Approach to Team Work , High Performing Team (Characteristics , Maintenance , Causes of low performance Why Teams Fail , People,Communication , Resources , Objectives)

Unit II: Leadership

Defining Leadership , Personal Leadership Profile, Leadership in the Context of Community, Leadership Theory, Leadership Concepts, Foundations of Group Behavior: The Meaning of Group, Group behavior & Group Dynamics, Types of Groups, The Five -Stage Model of Group Development Managing Organizational Change, Leadership Styles leading to Authenticity, Learning and Development, Positive Responses to Aggressive Behavior, Professionalism, Team Building

Unit III: Educational Leadership

Key challenges for educational leaders, Characteristics, Capabilities of authentic leader, values and ethics in decision making, Continuous professional Development suitable for 21st century pedagogy, Emotional intelligence for educational leaders. Need of Educational research for educational leadership

Unit IV: Fitness for Engineers

Fundamentals of Exercise Science: Skeletal, muscular, cardiovascular, nervous system, nutrition, flexibility, special population and injuries, Basics of fitness, Weight management and supplementation

Guidelines for Conduction (Any one or more of following but not limited to)

• Guest Lectures
• Group Activities
• Assignment
• Taking up assisted Health challenge for short duration (ex. Yoga and Pranayam, Weight management , stability in mental health)

Guidelines for Assessment (Any one or more of following but not limited to)

• Practical Test
• Presentation
• Paper / (Theory assessment test)
•• Report

Sources/ References:

1. Organizational Behavior by Fred Luthans
2. Organizational Behavior by M N Mishra
3. Leadership Development Activities, John Adair, 2nd Edition Jaico Publication
4. Leadership Games, Stephen S Kogan,
5. Mastering Leadership, 2nd Edition, Michael Williams, Viva Books
6. Sculpt and Shape: The Pilates Way by YasminKarachiwala
7. Total Fitness: The LeenaMogre Way by LeenaMogre
8. Don’t Lose Your Mind, Lose Your Weight: RutujaDiwekar
9. Yog Its Philosophy and Practice English by Swami Ramdevji

Audit Course 6 (2)
Environmental Issues And Disaster Management

About the Course:

The importance of environmental science and environmental studies cannot be disputed. The need for sustainable development is a key to the future of mankind. Continuing problems of pollution, loss of forget, solid waste disposal, degradation of environment, issues like economic productivity and national security, Global warming, the depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues.

It is clear that no citizen of the earth can afford to be ignorant of environment issues. Environmental management has captured the attention of health care managers. Managing environmental hazards has become very important. In spite of the deteriorating status of the environment, study of environment has so far not received adequate attention in our academic programmes.

Course objective :

- To develop understanding of Environment Issues and Biodiversity
- To introduce to the students the environment, Disaster Management
- To enable students to understand ecosystem and preservation of environment
- To understand Disaster Management and handling them

Course Outcomes :

On completion of course students will be able:

1. To learn the different environmental issues and disasters.
2. To deal with problems associated with environment and effectively handle the disasters.

Unit 1: Environmental Pollution

A) Definition, Cause, effects and control measures of :-

Air pollution,Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management, urban and industrial wastes.

Role of an individual in prevention of pollution. Pollution case studies.

B) Social Issues and the Environment:

Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns.

Unit 2 : Ecosystems, Biodiversity and its conservation

A) Concept of an ecosystem.

Structure and function of an ecosystem, Producers, consumers and decomposers, • Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.

Structure and function of the following ecosystem :

a. Forest ecosystem

b. Grassland ecosystem

c. Desert ecosystem

d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity at global, National and local levels, India as a mega-diversity nation

Hot-sports of biodiversity, Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Unit 3 : Disaster Management

a) Causes – Natural disaster and Manmade disaster
b) Speed of onset – Sudden and Slow

Natural Disasters

These types of disaster naturally occur in proximity to, and pose a threat to, people, structures or economic assets.
Examples are Storm, Flood, Earthquake, Tsunamis

Manmade Disasters

Accidents: Road, Rail, Air, Sea, Building collapse.
Industrial Mishaps: Gas leak, Explosion, Safety.
Fire: Building, Coal, Oil.
Forest Fire (In tropical counters, forest fires are often manmade)
Speed of onset
1 Sudden onset: little or no warning, minimal time to prepare. For example, an earthquake, tsunami, cyclone, volcano, etc.
2 Slow onset: adverse event slow to develop; first the situation develops; the second level is an emergency; the third level is a disaster.
For example, drought, civil strife, etc.

Unit 4: Case Studies

- Environmental ethics: Awareness, Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air and Water (Prevention and Control of Pollution) Act
- Wildlife Protection Act and Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Role of an individual in prevention of pollution and case studies.

References:

1. Disaster Management: Disaster Manager's Handbook by W. Nick Carter, Asian Development Bank.
2. An Introduction To Disaster Management EBook By S. Vidyanathan - Publisher: IKON
3. Textbook for environmental studies ,ErachBharucha For UGC.