Savitribai Phule Pune University

Faculty of Science & Technology

Curriculum

For

Bachelor of Engineering

(Electronics and Computer Engineering)

(Choice Based Credit System)

(With Effect from Academic Year 2020-21)

Savitribai Phule Pune University
Faculty of Science & Technology

Proposed curriculum

For

BE (Electronics & Computer Engineering)
(Choice Based Credit System)

(With Effect from Academic Year 2023-24)

Savitribai Phule Pune University, Pune
BE (Electronics & Computer Engineering) 2019 Course
(With effect from Academic Year 2023-24)

Semester-VII

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
1	Advanced Techniques for Electrical Vehicle	03	-	-	30	70	-	-	-	100	03	-	-	**03**
2	Internet of Things	03	-	-	30	70	-	-	-	100	03	-	-	**03**
3	*Elective – I	03	-	-	30	70	-	-	-	100	03	-	-	**03**
4	**Elective – II	03	-	-	30	70	-	-	-	100	03	-	-	**03**
5	Lab Practice-I (Advanced Techniques for Electrical Vehicle + IoT)	-	04	-	-	-	25	50	-	75	-	02	-	**02**
6	Lab Practice-II (Elective – I)	-	04	-	-	-	25	50	-	75	-	02		**02**
7	MOOC	-		-	-	-	50	-	-	50	-	-	-	**02**
8	Project Stage I	-	04	-	-	-	50	-	50	100	-	-	-	**02**
9	Audit Course 7 (Mandatory)	-		-	-	-	-	-	-	-	-	-	-	-
	Total	**12**	**12**	-	**120**	**280**	**150**	**100**	**50**	**700**	**12**	**04**	-	**20**

Abbreviations:

TH : Theory TW : Term Work PR : Practical
OR : Oral TUT : Tutorial

Note: Interested students of B.E. (Electronics/E&TC/Electronics & Computer) can opt any one of the audit course from the list of audit courses prescribed by BoS (E &T Engineering)

*Elective-I	**Elective-II
1.Embedded System and RTOS	1.Mobile Communication
2.VLSI Design	2.Robotics and Automation
3. Information and Cyber Security	3.Software Testing and Quality Assurance
4. Digital Image Processing	4.Artificial Intelligence and Machine Learning

Savitribai Phule Pune University, Pune
BE (Electronics & Computer Engineering) 2019 Course
(With effect from Academic Year 2023-24)

Semester-VIII

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
1	Computer Network	03	-	-	30	70	-	-	-	100	03	-	-	**03**
2	Cloud Computing	03	-	-	30	70	-	-	-	100	03	-	-	**03**
3	#Elective – III	03	-	-	30	70	-	-	-	100	03	-	-	**03**
4	##Elective – IV	03	-	-	30	70	-	-	-	100	03	-	-	**03**
5	Lab Practice-III (Computer Network)	-	02	-	-	-	25	50	-	75	-	01	-	**01**
6	Lab Practice-IV (Elective – III)	-	02	-	-	-	25	50	-	75	-	01	-	**01**
7	Project Stage II	-	12	-	-	-	100		50	150	-	-	-	**06**
8	Audit Course 8 (Mandatory)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**12**	**16**	-	**120**	**280**	**150**	**100**	**50**	**700**	**12**	**02**	-	**20**

Abbreviations:

TH : Theory TW : Term Work PR : Practical
OR : Oral TUT : Tutorial

Note: Interested students of B.E. (Electronics/E&TC/Electronics & Computer) can opt any one of the audit course from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

#Elective-III	**##Elective-IV**
1.Electronics System Design	1.Software Defined Radio
2.Optical Fiber Communication	2.Wireless Sensor Network
3.Data Mining and Ware Housing	3.Design and Analysis of Algorithm
4.Human Computer Interface	4.Software Engineering
	5.Open Elective

SEMESTER –I

Advanced Techniques for Electrical Vehicle

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination: Phase I: **30**
End Semester Examination: Phase II: **70**

Course Contents:

Unit I: Basics of EV — 6L

History of EV, Types of EVs, Block diagram and working Principle of EV, Major Components of EV, Advantages of EV over other vehicles, Limitations of EV.

Unit II: Components and their functions of EV — 6L

Major Electric/Electronic Components and their function, Major Mechanical (Mechatronics) Components and their function, Parameters consideration before design EV, Selection criteria of the component while designing the EV, Standards required as per AIS norms

Unit III: Drive train system — 6L

Types of Motors and its working principles of EV, Function of Controllers and their use EV drives, Types of Sensors and their functions, Functional block diagram of each stage in brief, Scope of Development of EV drive system

Unit IV: Battery Technologies — 6L

Traditional battery system, Current battery and their function, Function of batteries in EV, Battery parameter, Battery Management System (BMS), Comparison of Batteries and scope of development, Upcoming technologies in battery.

Unit V: Charging Infrastructure — 6L

Basics of charging and Infrastructure, Types of charging and its function, Points to be considered in design of charger, Types of chargers and working principles, Sources and utilization of renewable, energy for charging.

Unit VI: Challenges in EV and Solutions — 6L

Charging and Infrastructure issues, Troubles shootings in drive trains, troubleshooting in batteries, Maintenances of EVs, Safety and precaution for EVs

Books:

1. Basic Electric Vehicle Technology Explained John lawry- Wiley publications.
2. Electric & Hybrid vehicles -Tom Denton- Institute of the Motor Industry.
3. Modern Electric, Hybrid Ele. & fuel Cell vehicles - Mehrdad Ehsani, Yimin Gao -CRC Press.

Internet of Things

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination: Phase I: **30**
End Semester Examination: Phase II: **70**

Course Objectives:

- Introduction to different aspects of the IoT, including end devices, networks, programming, and security and privacy implications.
- Understand what constitutes an IoT design solution.
- To learn real world application scenarios of IoT along with its societal and economic impact using case studies.

Course Outcomes:

After successfully completing the course students will be able to

1. Discover key IoT concepts including identification, sensors, localization, wireless protocols, data storage and security.
2. Explore IoT technologies, architectures, standards, and regulation.
3. Realize the value created by collecting, communicating, coordinating, and leveraging the data from connected devices.
4. Examine technological developments that will likely shape the industrial landscape in the future.
5. Develop and implement IoT solutions and applications.

Course Contents:

Unit I: Fundamentals of IOT 6L

Introduction to Internet of Things, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Logical design of IoT, Sensors and actuators, Classification of sensors, types of Sensors and actuators and comparison of sensors and actuators, Introduction to IOT networking: Gateways and routing, IoT Protocols, IoT enabling technologies, IoT Issues and Challenges, IoT Security and privacy, Applications.

Unit II: IoT Protocols and Security 6L

SCADA and RFID Protocols, IEEE 802.15.4, BACNet Protocol, Modbus, HART, Zigbee, MQTT, IoT Security: Security Requirements, Challenges for Secure IoT, Key elements of IoT Security: Identity establishment, Access control, Data and message security, Security model for IoT.

Unit III: WSN & Cloud Computing 6L

WSN: introduction to WSN technology, Basic components of WSN, Characteristic features of WSNs, challenges, Application of WSN in: smart homes, healthcare, intelligent transportation, agriculture, etc. Cloud Computing: Cloud architecture standards and interoperability, Business concerns in the cloud, characteristics, Cloud types; IaaS, PaaS, SaaS, Public cloud, Private cloud, Benefits and challenges of

cloud computing, Development environments for service development: Amazon, Azure, Thingspeak, Google App-cloud platform in industry.

Unit IV: Implementation of IoT 6L

Implementation of IoT with Arduino: Introduction to arduino, arduino board overview, Programming environment, Simple assignments using arduino, Sending data to Cloud, analysis using any IoT platform Introduction to Raspberry Pi, Raspberry Pi board overview, Programming environment, introduction to python programming, Simple assignments using Raspberry Pi, Sending data to cloud, analysis of data using any IoT platform.

Unit V: Big Data - Data Storage and Analytics 6L

What is Big Data (BD), Modern Corporate need of BD Strategy, Main components of Big Data Solution, Basic Architecture of BD Solution, Introduction to Hadoop, Prototyping with any development board Data Analytics: Types of data analytics, Using Cloud Services to visualize live Data Streams. Data analytics using any platform like Amazon, Azure, Thingspeak or any other open source platform

Unit VI: Technological Aggregation & Case Studies 6L

Modern trends in IOT: Wearable, industrial standards, Open Data Management & API. Case studies, connected use cases in Real-life/Thematic areas – Smart Homes/Buildings, Smart Cities, Smart Industry, Smart Medical care, Smart Automation etc.

Text Book:

1. Arshdeep Bahga, Vijay Madisetti,, Internet of Things, A hands-on approach, Universities Press
2. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012

Reference Book:

1. David Easley and Jon Kleinberg, Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press, 2010.
2. Lyla B. Das, Embedded Systems: An Integrated Approach, Pearson.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, Architecting the Internet of Things, Springer, 2011.
4. Olivier Hersent, Omar Elloumi and David Boswarthick, The Internet of Things: Applications to the Smart Grid and Building Automation, Wiley, 2012.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , The Internet of Things – Key applications and Protocols, Wiley, 2012.
6. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2010.
7. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley, 2014

ELECTIVE-I

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination: Phase I: 30
End Semester Examination: Phase II: 70

Embedded System and RTOS

Course Objectives:

- To understand the embedded system design issues.
- To learn real time operating system concepts.
- To understand the Embedded Linux environment.
- To learn embedded software development and testing process.

Course Outcomes:

After successfully completing the course students will be able to

1. Get insight of design metrics of embedded systems to design real time applications to match recent trends in technology.
2. Understand Real time system concepts.
3. Understand Linux operating system and device drivers.
4. Get to know the hardware – software co-design issues and testing methodology for embedded system.

Course Contents:

Unit I: Introduction to Embedded Systems 6L

Introduction to Embedded Systems, Architecture, Classification and Characteristics of Embedded System, Design Process, Design Metrics and optimization of various parameters of embedded system. ARM9 architecture.ARM-CM3 Based Microcontroller LPC1768: Features, Architecture (Block Diagram & Its Description), System Control, Clock & Power Control, GPIO, Pin Connect Block.

Unit II: Real Time Systems Concepts 6L

Foreground/ Background systems, Critical section of code, Resource, Shared resource, multitasking, Task, Context switch, Kernel, Scheduler, Non-Preemptive Kernel, Preemptive Kernel, Reentrancy, Round robin scheduling, Task Priorities, Static & Dynamic Priority, Priority Inversion, Assigning task priorities, Mutual Exclusion, Deadlock, Clock Tick, Memory requirements, Advantages & disadvantages of real time kernels.

Unit III: µCOS II 6L

Features of µCOS II. Kernel structure. µCOS II RTOS services: Task management, Time management, Intertask Communication and Synchronization.

Unit IV: Embedded Linux Development Environment 6L

Need of Linux, Embedded Linux Today, Open Source and the GPL, BIOS Versus Boot loader, Anatomy of an Embedded System, Storage Considerations, Embedded Linux Distributions. Embedded

Development Environment, Cross-Development Environment, Host System Requirements, Hosting Target Boards. Development Tools, GNU Debugger, Tracing and Profiling Tools, Binary Utilities.

Unit V: Linux Kernel Construction 6L

Linux Kernel Background, Linux Kernel Construction, Kernel Build System, Kernel Configuration. Role of a Bootloader, Bootloader Challenges. A Universal Bootloader: Das UBoot. Porting U-Boot. Device Driver Concepts, Module Utilities, Driver Methods. Linux File System & Concepts.

Unit VI: Embedded Software Development, Testing Process and Tools 6L

Embedded Software development process and tools, Host and Target Machines, linking and Locating Software, Getting Embedded Software into the Target System, Issues in Harware- Software Design and Co-design. Testing on Host Machine, Simulators, Laboratory Tools. Case study of Embedded system like Automatic Chocolate Vending Machine, Mobile Phone, digital camera.

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.

Reference Books:

1. Raj Kamal, "Embedded Systems – Architecture, Programming and Design" 2nd edition, McGraw Hill.
2. Frank Vahid and Tony Givargis, "Embedded System Design – A Unified hardware/ Software introduction" 3rd edition, Wiley.

List of Experiments:

Group A: ARM7/ ARM Cortex- M3 & µCOS - II Based Experiments (any four)

1. Multitasking in µCOS II RTOS using minimum 3 tasks on ARM7/ ARM Cortex- M3.
2. Semaphore as signaling & Synchronizing on ARM7/ ARM Cortex- M3.
3. Mailbox implementation for message passing on ARM7/ ARM Cortex- M3.
4. Queue implementation for message passing on ARM7/ ARM Cortex- M3.
5. Implementation of MUTEX using minimum 3 tasks on ARM7/ ARM Cortex- M3.

Group B: ARM9 & LINUX Based Experiments (any four)

6. Download pre-configured Kernel Image, File System, boot loader to target device- ARM9.
7. Writing simple application using embedded Linux on ARM9.
8. Writing "Hello World" device Driver. Loading into & removing from Kernel on ARM9 board.
9. Write a program for I2C based RTC using embedded Linux on ARM9.
10. Using Device driver for GPIO, write a program to blink LED onARM9.

11. Write a program for external interrupt on ARM9.

VLSI Design

Course Objectives:

To understand CMOS technology and its application in VLSI Circuits.

- To design digital circuits using HDL.
- To implement digital circuits using FPGA.
- To design using CAD tools.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand VLSI Design Flow.
2. Design advance digital circuit using HDL.
3. Understand the importance of CAD tools.

Course Contents:

Unit I: Introduction to VLSI Circuits 6L

MOS Inverter: MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, Design Equations, Transistor Sizing, Voltage Transfer Characteristics, Power Dissipation, Noise Margin, Power Delay Product, Energy dissipation. Combinational MOS Logic Circuits: Pass Transistors/Transmission Gates; Designing with transmission gates.

Unit II: Digital Circuit Design and testing using HDL 6L

Module, Entity, Architecture, Modelling styles, Design of sequential circuits, asynchronous and synchronous design issues, state machine modelling (Moore and Mealy machines), attributes, Generics, Basic test benches, Test bench structure, constrained random stimulus generation.

Unit III: CMOS Subsystem Design 6L

Semiconductor memories, memory chip organization, Random Access Memories (RAM), Static RAM (SRAM), standard architecture, 6T cell, sense amplifier, address decoders, timings. Dynamic RAM (DRAM), different DRAM cells, refresh circuits, timings.

Unit IV: Floor Planning and Placement 6L

Clock skew, Clock distribution techniques, clock jitter. Supply and ground bounce, power distribution techniques. Power optimization. Interconnect routing techniques; wire parasitic, Signal integrity issues. I/O architecture, pad design.

Unit V: Design and Verification with PLD's 6L

Implementing Functions in FPGAs, Implementing Functions Using Shannon's Decomposition, Carry Chains in FPGAs, Cascade Chains in FPGAs, Examples of Logic Blocks in Commercial FPGAs, Dedicated Memory in FPGAs, Dedicated Multipliers in FPGAs, JTAG, Boundary scan, TAP Controller.

Unit VI: CAD Tools 6L

MOS Layers Stick/Layout Diagrams: Layout Design Rules, Issues of Scaling, Scaling factor for device parameters. Layout editors, Design rule checkers, circuit extractors – Hierarchical circuit extractors – Automatic layout tools, silicon compilers, modelling and extraction of circuit parameters from physical layout.

Text Book:

1. Neil H. Weste and Kamran, Principles of CMOS VLSI Design, Pearson Publication.
2. John F. Wakerly, Digital Design, Principles and Practices, Prentice Hall Publication.

Reference Book:

3. Douglas Perry, VHDL, McGraw Hill Publication.
4. Samir Palnitkar, Verilog HDL 2/e, Pearson Education.
5. Charles Roth, Digital System Design using VHDL, McGraw Hill Publication.
6. Preas, M. Lorenzatti, "Physical Design and Automation of VLSI Systems", The Benjamin Cummins Publishers, 1998.
7. R. Jacob Baker; Harry W.Li., David E. Boyce, CMOS Circuit Design, Layout and Simulation, IEEE Press, Prentice Hall of India.
8. M.Ciletti, Advanced Digital Design with Verilog HDL,Second Edition Pearson Education.
9. Sung-Mo (Steve) Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata McGraw Hill Publication.
10. Computer Aided Logical Design with Emphasis on VLSI – Hill & Peterson, Wiley, 1993.

List of Experiments:

PART-A (Perform any four)

Modelling and Functional Simulation, synthesis and implementation on PLDs of the following digital circuits (with Xilinx/ ModelSim tools/Pyxis) using VHDL/Verilog Hardware Description Languages. (Two experiments are to be performed using VHDL and two using Verilog.)

1. Parity generator
2. Cyclic Encoder / Decoder
3. Read Only Memory (ROM)/ Random Access Memory (RAM) implementation
4. Mealy State Machine/Moore State Machine-examples
5. Arithmetic Multipliers using FSMs
6. Digital calculator

PART-B (Perform any four) Experiments shall be carried out using Mentor Graphics/Cadence Tools/Microwind

Schematic Entry/ Simulation / Layout/ DRC/PEX/Post Layout Simulation of:

1. CMOS Inverter
2. NAND Gate/ OR Gate
3. Flip Flops (T & D)
4. Register Cell
5. Adder Circuits

PART- C (Optional)

VLSI system design using IP generator-Vivado software

Information and Cyber Security

Course Objectives:

- To offer an understanding of principle concepts, central topics and basic approaches in information and cyber security.
- To know the basics of cryptography.
- To acquire knowledge of standard algorithms and protocols employed to provide confidentiality, integrity and authenticity.
- To enhance awareness about Personally Identifiable Information (PII), Information Management, cyber forensics.

Course Outcomes:

1. Gauge the security protections and limitations provided by today's technology.
2. Identify information security and cyber security threats.
3. Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.
4. Build appropriate security solutions against cyber-attacks.

Course Contents:

Unit I: Security Basics **6L**

Introduction, Elements of Information Security, Security Policy, Techniques, Steps, Categories, Operational Model of Network Security, Basic Terminologies in Network Security. Threats and Vulnerability, Difference between Security and Privacy.

Unit II: Data Encryption Techniques And Standards **6L**

Introduction, Encryption Methods: Symmetric, Asymmetric, Cryptography, Substitution Ciphers. Transposition Ciphers, Stenography applications and limitations, Block Ciphers and methods of operations, Feistal Cipher, Data Encryption Standard (DES), Triple DES, DES Design Criteria, Weak Keys in DES Algorithms, Advance Encryption Standard (AES).

Unit III: Public Key And Management 6L

Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution, Deffie-Hellman Key Exchange, Elliptic Curve: Arithmetic, Cryptography, Security, Authentication methods, Message Digest, Kerberos, X.509 Authentication service. Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol.

Unit IV: Security Requirements 6L

IP Security: Introduction, Architecture, IPV6, IPv4, IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, Oakkey determination Protocol, VPN. WEB Security: Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol. Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction (SET).

Unit V: Firewall And Intrusion 6L

Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control. Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges.

Unit V: Confidentiality And Cyber Forensic 6L

Introduction to Personally Identifiable Information (PII), Cyber Stalking, PII impact levels with examples Cyber Stalking, Cybercrime, PII Confidentiality Safeguards, Information Protection Law: Indian Perspective.

Text Books:

1. Bernard Menezes, "Network Security and Cryptography", Cengage Learning India, 2014, ISBN No.: 8131513491
2. Nina Godbole, Sunit Belapure, "Cyber Security", Wiley India, 2014, ISBN No.:978-81-345-2179-1

Reference Books:

1. Eoghan Casey, "Digital Evidence and Computer Crime Forensic Science, Computers and the Internet", ELSEVIER, 2011, ISBN 978-0-12-374268-1
2. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN : 978-0-07-064823-4
3. William Stallings, "Cryptography and network security principles and practices", Pearson, 6th Edition, ISBN : 978-93-325-1877-3
4. Forouzan, "Cryptography and Network Security (SIE)", Mc Graw Hill, ISBN, 007070208X, 9780070702080
5. Dr. Nilakshi Jain-Digital Forensic: The Fascinating World of Digital Evidences-Wiley India-ISBN: 9788126565740

List of Experiments:

1. Implementation of S-DES
2. Implementation of S-AES
3. Implementation of Diffie-Hellman key exchange

4. Implementation of RSA.
5. Implementation of ECC algorithm.
6. **Mini Project 1:** SQL Injection attacks and Cross -Site Scripting attacks are the two most common attacks on web application. Develop a new policy based Proxy Agent, which classifies the request as a scripted request or query based request, and then, detects the respective type of attack, if any in the request. It should detect both SQL injection attack as well as the Cross-Site Scripting attacks.
7. **Mini Project 2:** This task is to demonstrate insecure and secured website. Develop a web site and demonstrate how the contents of the site can be changed by the attackers if it is http based and not secured. You can also add payment gateway and demonstrate how money transactions can be hacked by the hackers. Then support your website having https with SSL and demonstrate how secured website is.

Digital Image Processing

Course Objectives:

- To learn the fundamental concepts of Digital Image and video Processing.
- To study basic image and video processing operations.
- To understand image and video analysis algorithms.
- To expose students to current applications in the field of digital image and video processing.

Course Outcomes:

On completion of the course, student will be able to–

1. Develop and implement various mathematical operations on image.
2. Develop and implement algorithms for image enhancement and restoration.
3. Apply compression techniques for image and video processing.
4. Use segmentation and morphological operations for image processing applications.
5. Apply video processing algorithms for motion detection applications.

Course Contents:

Unit I: Digital Image Fundamentals **6L**

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

Unit II: Image Enhancement and Restoration **6L**

Spatial domain enhancement: Point operations-Log transformation, Power-law transformation, Piecewise linear transformations, Histogram equalization. Filtering operations- Image smoothing, Image sharpening. Frequency domain enhancement: 2D DFT, Smoothing and Sharpening in frequency

domain. Homomorphic filtering. Restoration: Noise models, Restoration using inverse filtering and Wiener filtering.

Unit III: Image Compression **6L**

Types of redundancy, Fidelity criteria, Lossless compression – Run length coding, Huffman coding, Bit-plane coding, Arithmetic coding. Introduction to DCT, Wavelet transform. Lossy compression – DCT based compression, Wavelet based compression. Image and Video Compression Standards – JPEG, MPEG.

Unit IV: Image Segmentation and Morphological Operations **6L**

Image Segmentation: Point Detections, Line detection, Edge Detection-First order derivative Prewitt and Sobel. Second order derivative – LoG, DoG, Canny. Edge linking, Hough Transform, Thresholding – Global, Adaptive. Otsu‟s Method. Region Growing, Region Splitting and Merging. Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Thinning, Thickening, Skeleton.

Unit V: Basics of Video Processing **6L**

Video formation, perception and representation: Principle of color video, video cameras, video display, pinhole model, CAHV model, Camera motion, Shape model, motion model, Scene model, two dimensional motion models. Three Dimensional Rigid Motion, Approximation of projective mapping

Unit VI: Motion estimation Techniques **6L**

Optical flow, motion representation, motion estimation criteria, optimization methods, pixel based motion estimation, Block matching algorithm, gradient based, Intensity matching, feature matching, frequency domain motion estimation, Depth from motion. Motion analysis applications: Video Summarization, video surveillance.

Text Book:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Third Edition, - Pearson Education.
2. Digital Video processing, A Murat Tekalp, Prentice Hall.

References:

1. S Sridhar, “Digital Image Processing”, Oxford University Press.
2. Video Processing and Communications, Yao Wang, J. Osternann and Qin Zhang, Pearson Education.
3. Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, “Digital Image Processing
4. Using MATLAB”, Second Edition, - Tata McGraw Hill Publication.
5. S Jayaraman, S Esakkirajan, T Veerakumar, “Digital Image Processing”, Tata McGraw Hill Publication.
6. “Handbook of Image and Video processing”, Al Bovik, Academic press, second Edition.

List of Experiments:

1. Conversion of 24 bit color image to 8 bit , 4 bit, 1 bit image.
2. Apply image negation and power-law correction operations on image.

3. Enhance image using histogram equalization and stretching.
4. Perform image smoothing and sharpening operations.
5. Detect image edges using Sobel, Prewitt and Roberts"s operator.
6. Perform Morphological operations on binary images.
7. Compress image using DCT / Wavelet transform.
8. Apply Global and adaptive thresholding to an image.
9. Using frequency domain technique estimates the motion in video.
10. Implement algorithm for video boundary detection.

Note: Experiments are to be performed preferably using open source software.

ELECTIVE-II

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination: Phase I: 30
End Semester Examination: Phase II: 70

Mobile Communication

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, students 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.

Course Contents:

Unit I - Switching techniques for Voice and Data **6L**

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 Signaling **6L**

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 **8L**

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 **8L**

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

Unit V: GSM Channels and Services **8L**

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 **6L**

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‖; PHI Publications
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. Aditya Jagannatham, Principles of Modern Wireless Communication Systems

Robotics and Automation

Course Objectives:

The objective of this course is to impart knowledge about basic mathematics related to industrial robots for their control, design and application in robotics & automation Industries.

Course Outcomes:

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

1. Perform kinematic and dynamic analyses with simulation.
2. Design control laws for a simple robot.
3. Integrate mechanical and electrical hardware for a real prototype of robotic device.
4. Select a robotic system for given industrial application.

Course Contents:

Unit 1: Introduction to Robotics: 6L

Types and components of a robot, Classification of robots, Kinematics systems; Definition of mechanisms and manipulators, Degrees of Freedom

Unit 2: Robot Kinematics and Dynamics: 6L

Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Singularity, and Statics.
Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation

Unit 3: Sensors 6L

Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc., Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations, Vision applications in robotics.

Unit 4: Robot Actuation Systems: 6L

Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.

Unit 5: Robot Control: 6L

Basics of control: open loop- closed loop, Transfer functions, Control laws: P, PD, PID Linear and Non-linear controls

Unit 6: Control Hardware and Interfacing: 6L

1) Embedded systems: Microcontroller Architecture and integration with sensors, actuators, components, Programming, Applications for Industrial robot - programming in – VAL II
2) AI in Robotics: Applications in unmanned systems, defense, medical, industries, etc.
3) Robotics and Automation for Industry 4.0
4) Robot safety and social robotics.

Text Books

1) Introduction to Robotics : J. Craig , Pearson
2) Robot Dynamics and Control, Spong & Vidyasagar, Mc Graw Hill
3) Robotics Engineering : R. Klafter, PHI
4) Robotics : Subir K Saha , Mc Graw Hill
5) Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hill

Software Testing and Quality Assurance

Course Objectives:

- Introduce basic concepts of software testing
- Understand white box, block box, object oriented, web based and cloud testing
- Know in details automation testing and tools used for automation testing
- Understand the importance of software quality and assurance software systems development.

Course Outcomes:

On completion of the course, student will be able to–

1. Describe fundamental concepts in software testing such as manual testing, automation testing and software quality assurance.
2. Design and develop project test plan, design test cases, test data, and conduct test operations
3. Apply recent automation tool for various software testing for testing software
4. Apply different approaches of quality management, assurance, and quality standard to software system
5. Apply and analyze effectiveness Software Quality Tools Course Contents

Course contents:

Unit I: Introduction 6L

Introduction, historical perspective, Definition, Core Components, Quality View, Financial Aspect, Customers suppliers and process, Total Quality Management(TQM), Quality practices of TQM, Quality Management through- Statistical process Control, Cultural Changes, Continual Improvement cycle, quality in different areas, Benchmarking and metrics, Problem Solving Techniques, Problem Solving Software Tools. Software Quality- Introduction, Constraints of Software product Quality assessment, Customer is a King, Quality and Productivity Relationship, Requirements of Product, Organization Culture, Characteristics of Software, Software Development Process, Types of Product, Criticality Definitions, Problematic areas of SDLC, Software Quality Management, Why Software has defects, Processes related to Software Quality, Quality Management System‟s Structure, Pillars of Quality Management System, Important aspects of quality management.

Unit II: Test Planning and Management 6L

Review of Fundamentals of Software Testing, Testing during development life cycle, Requirement Traceability matrix, essentials, Work bench, Important Features of Testing Process, Misconceptions, Principles, salient and policy of Software testing, Test Strategy, Test Planning, Testing Process and number of defects found, Test teem efficiency, Mutation testing, challenges, test team approach,

Process problem faced, Cost aspect, establishing testing policy, methods, structured approach, categories of defect, Defect/ error/ mistake in software, Developing Test Strategy and Plan, Testing process, Attitude towards testing, approaches, challenges, Raising management awareness for testing, skills required by tester.

Unit III: Software Test Automation **6L**

What is Test Automation, Terms used in automation, Skills needed for automation, What to automate, scope of automation, Design and Architecture of automation, Generic requirement for Test Tool, Process Model for Automation, Selecting Test Tool, Automation for XP/Agile model, Challenges in Automation, Data-driven Testing. Automation Tools like JUnit, Jmeter

Unit IV: Selenium Tool **6L**

Introducing Selenium, Brief History of The Selenium Project, Selenium‟s Tool Suite, Selenium- IDE, Selenium RC, Selenium Webdriver, Selenium Grid, Test Design Considerations

Unit V: Quality Management **6L**

Software Quality, Software Quality Dilemma, Achieving Software Quality, Software Quality Assurance. Elements of SQA, SQA Tasks, Goals, and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Six Sigma for Software Engineering, ISO 9000 Quality Standards, SQA Plan.

Unit VI: Software Quality Tools **6L**

Total Quality Management, Product Quality Metrics, In process Quality Metrics, Software maintenance, Ishikawa's 7 basic tools, Checklists, Pareto diagrams, Histogram, Run Charts, Scatter diagrams, Control chart, Cause Effect diagram. Defect Removal Effectiveness and Process Maturity Level.

Text Books:

1. M G Limaye, “Software Testing Principles, Techniques and Tools”, Tata McGraw Hill, ISBN: 9780070139909 0070139903.
2. Srinivasan Desikan, Gopalswamy Ramesh, “Software Testing Principles and Practices”, Pearson, ISBN-10: 817758121X

Reference Books:

1. Naresh Chauhan, “Software Testing Principles and Practices ", OXFORD, ISBN-10: 0198061846. ISBN-13: 9780198061847.
2. Stephen Kan, “Metrics and Models in Software Quality Engineering”, Pearson, ISBN-10: 0133988082; ISBN-13: 978-0133988086.

Artificial Intelligence and Machine Learning

Course Objectives:

- To understand human learning aspects and relate it with machine learning concepts.
- To understand nature of the problem and apply machine learning algorithm.
- To find optimized solution for given problem.

Course Outcomes:

On completion of the course, student will be able to,

1. Distinguish different learning based applications
2. Apply different preprocessing methods to prepare training data set for machine learning.
3. Design and implement supervised and unsupervised machine learning algorithm.
4. Implement different learning models
5. Learn Meta classifiers and deep learning concepts Course Contents

Course contents:

Unit I Introduction to Machine learning 6L

Classic and adaptive machines, Machine learning matters, Beyond machine learning-deep learning and bio inspired adaptive systems, Machine learning and Big data. Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches, Elements of information theory.

Unit II Feature Selection 6L

Scikit- learn Dataset, Creating training and test sets, managing categorical data, Managing missing features, Data scaling and normalization, Feature selection and Filtering, Principle Component Analysis(PCA)-non negative matrix factorization, Sparse PCA, Kernel PCA. Atom Extraction and Dictionary Learning.

Unit III Regression 6L

Linear regression- Linear models, A bi-dimensional example, Linear Regression and higher dimensionality, Ridge, Lasso and ElasticNet, Robust regression with random sample consensus, Polynomial regression, Isotonic regression, Logistic regression-Linear classification, Logistic regression, Implementation and Optimizations, Stochastic gradient descendent algorithms, Finding the optimal hyper-parameters through grid search, Classification metric, ROC Curve.

Unit IV Naïve Bayes and Support Vector Machine 6L

Bayes‟ Theorom, Naïve Bayes‟ Classifiers, Naïve Bayes in Scikit- learn- Bernoulli Naïve Bayes, Multinomial Naïve Bayes, and Gaussian Naïve Bayes. Support Vector Machine(SVM)- Linear Support Vector Machines, Scikit- learn implementation- Linear Classification, Kernel based classification, Non- linear Examples. Controlled Support Vector Machines, Support Vector Regression.

Unit V Decision Trees and Ensemble Learning 6L

Decision Trees- Impurity measures, Feature Importance. Decision Tree Classification with Scikit-learn, Ensemble Learning-Random Forest, AdaBoost, Gradient Tree Boosting, Voting Classifier. Clustering Fundamentals- Basics, K-means: Finding optimal number of clusters, DBSCAN, Spectral Clustering. Evaluation methods based on Ground Truth- Homogeneity, Completeness, Adjusted Rand Index. Introduction to Meta Classifier: Concepts of Weak and eager learner, Ensemble methods, Bagging, Boosting, Random Forests.

Unit VI Clustering Techniques 6L

Hierarchical Clustering, Expectation maximization clustering, Agglomerative Clustering-Dendrograms, Agglomerative clustering in Scikit- learn, Connectivity Constraints. Introduction to Recommendation Systems- Naïve User based systems, Content based Systems, Model free

collaborative filtering-singular value decomposition, alternating least squares. Fundamentals of Deep Networks-Defining Deep learning, common architectural principles of deep networks, building blocks of deep networks.

Text Books

1. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited, ISBN- 10: 1785889621, ISBN-13: 978-1785889622
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioners Approach", O"REILLY, SPD, ISBN: 978-93-5213-604-9, 2017 Edition 1st.

Reference Books

1. Ethem Alpaydin, " Introduction to Machine Learning", PHI 2nd Edition-2013, ISBN 978-0- 262-01243-0
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012, ISBN-10: 1107422221; ISBN-13: 978- 1107422223
3. Tom Mitchell "Machine Learning" McGraw Hill Publication, ISBN: 0070428077 9780070428072
4. Nikhil Buduma, "Fundamentals of Deep Learning", O"REILLY publication, second edition 2017, ISBN: 1491925612

LAB PRACTICE –I

Teaching Scheme:
Practical: 4 Hrs./ Week

Examination Scheme:
Termwork (TW): 25
Practical (PR): 50

Advanced Techniques for Electrical Vehicle

List of Experiments:

1. Study of major components of Electric vehicles.
2. Study and test function of Mechatronics component of Electric vehicle.
3. Function of Motor and Controller of Electrical Vehicles.
4. Study the function of accelerator and impact on motor speed and torque.
5. Study of load variations on various motors of Electrical Vehicles on different gradient/load.
6. Study of battery and its parameter at loading and unloading of motor.
7. Study of chargers and effect on charging time by change in voltage, current and battery type.
8. Study the trouble shooting and testing waveforms of different drive trains of Electrical Vehicles and Battery parameter.
9. Visit to any Electrical Vehicles manufacturing plant.

Internet of Things

List of Experiments:

Perform any 4 experiments from group A and Any 4 from Group B, Any 1 from Group C

Group A

1. Study of Connectivity and configuration of Arduino board circuit with basic peripherals, LEDs. Understanding GPIO and its use in program.
2. Interfacing touch sensor, LDR, with Arduino board.
3. Interfacing of DC motor and servo motor with Arduino Board.
4. Interfacing temperature and humidity sensor using I2C protocol with Arduino board.
5. Interfacing of ultrasonic sensor with Arduino
6. Wireless communication between Arduino and PC using Bluetooth protocol.
7. Interfacing Wifi module with Arduino.
8. Interfacing Xbee module with Arduino.

Group B

9. Study of different operating systems for Raspberry-Pi /Beagle board. Understanding the process of OS installation on Raspberry-Pi /Beagle board.
10. Study of Connectivity and configuration of Raspberry-Pi /Beagle board circuit with basic peripherals, LEDS. Understanding GPIO and its use in program.
11. Understanding the connectivity of Raspberry-Pi /Beagle board circuit with temperature sensor. Write an application to read the environment temperature. If temperature crosses a threshold value, the application indicated user using LEDs.
12. Understanding the connectivity of Raspberry-Pi /Beagle board circuit with IR sensor. Write an application to detect obstacle and notify user using LEDs.
13. Understanding and connectivity of Raspberry-Pi /Beagle board with IR sensor. Write an application to for obstacle detection.
14. Understanding and connectivity of Raspberry-Pi /Beagle board with a Zigbee module. Write a network application for communication between two devices using Zigbee.
15. Write a server application to be deployed on Raspberry-Pi /Beagle board. Write client applications to get services from the server application.
16. Create a simple web interface for Raspberry-pi/Beagle board to control the connected LEDs remotely through the interface.

Group C

17. Develop a Real time application like smart home with following requirements: When user enters into house the required appliances like fan, light should be switched ON. Appliances should also get controlled remotely by a suitable web interface. The objective of this application is student should construct complete Smart application in group.
18. Develop a Real time application like a smart home with following requirements: If anyone comes at door the camera module automatically captures his image send it to the email account of user or send notification to the user. Door will open only after user's approval.

LAB PRACTICE –II

Teaching Scheme: **Examination Scheme:**

Practical: 4 Hrs./ Week

Termwork (TW): 25
Practical (PR): 50

Elective-I

Experiments to be chosen based on Elective I

MOOC

Teaching Scheme:
Practical: Hours/ Week

Examination Scheme:
Termwork (TW): 50

Course Objectives:

- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online

Course Outcomes:

On completion of the course, learner will acquire additional knowledge and skill.

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you're interested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWYAM, NPTEL, edx or similar ones can help.

World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.

The courses hosted on SWAYAM is generally in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: They are NPTEL for engineering and UGC for post-graduation education.

Guidelines:

Instructors are requested to promote students to opt for courses (not opted earlier) with proper mentoring. The departments will take care of providing necessary infrastructural and facilities for the learners.

References:

1. **https://swayam.gov.in/**
2. **https://onlinecourses.nptel.ac.in/**
3. **https://www.edx.org**

Project Stage I

Teaching Scheme:
Practical: 4 Hrs./ Week

Examination Scheme:
Termwork (TW): 50
ORAL (OR): 50

Course Objectives:

- To Apply the knowledge for solving realistic problem
- To develop problem solving ability
- To Organize, sustain and report on a substantial piece of team work over a period of several months
- To Evaluate alternative approaches, and justify the use of selected tools and methods
- To Reflect upon the experience gained and lessons learned,
- To Consider relevant social, ethical and legal issues,
- To find information for yourself from appropriate sources such as manuals, books, research journals and from other sources, and in turn increase analytical skills.
- To Work in TEAM and learn professionalism.

Course Outcomes:

On completion of the course, student will be able to–

1. Solve real life problems by applying knowledge.
2. Analyze alternative approaches, apply and use most appropriate one for feasible solution.
3. Write precise reports and technical documents in a nutshell.

4. Participate effectively in multi-disciplinary and heterogeneous teams exhibiting team work, Inter-personal relationships, conflict management and leadership quality.

Guidelines

Project work Stage – I is an integral part of the Project work. In this, the student shall complete the partial work of the Project which will consist of problem statement, literature review, SRS, Model and Design. The student is expected to complete the project at least up to the design phase. As a part of the progress report of project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected project topic. The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

The examinee will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers and report.

AUDIT COURSE 7

SEMESTER – II

Computer Network

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination: Phase I: 30
End Semester Examination: Phase II: 70

Course Objectives:

- To understand the fundamental concepts of networking standards, protocols and technologies.
- To learn different techniques for framing, error control, flow control and routing.
- To learn role of protocols at various layers in the protocol stacks.
- To learn network programming.
- To develop an understanding of modern network architectures from a design and performance perspective

Course Outcomes:

On completion of the course, student will be able to–

1. Analyze the requirements for a given organizational structure to select the most appropriate networking architecture and technologies
2. Demonstrate LAN and WAN protocol behavior using Modern Tools.
3. Analyze data flow between peer to peer in an IP network using Application, Transport and Network Layer Protocols.
4. Illustrate applications of Computer Network capabilities, selection and usage for various sectors of user community.
5. Develop Client-Server architectures and prototypes by the means of correct standards and technology.

Course Contents

Unit I: Physical Layer 7L

Introduction of LAN; MAN; WAN; PAN, Ad-hoc Network, Network Architectures: Client-Server; Peer To Peer; Distributed and SDN, OSI Model, TCP/IP Model, Topologies: Star and Hierarchical; Design issues for Layers, Transmission Mediums: CAT5, 5e, 6, OFC and Radio Spectrum, Network Devices: Bridge, Switch, Router, Brouter and Access Point, Manchester and Differential Manchester Encodings; IEEE802.11: Frequency Hopping (FHSS) and Direct Sequence (DSSS)

Unit II : Logical Link Control 7L

Design Issues: Services to Network Layer, Framing, Error Control and Flow Control. Error Control: Parity Bits, Hamming Codes (11/12-bits) and CRC. Flow Control Protocols: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol, WAN Connectivity: PPP and HDLC

Unit III: Medium Access Control 6L

Channel allocation: Static and Dynamic, Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, WDMA, IEEE 802.3 Standards and Frame Formats, CSMA/CD, Binary Exponential Back -off algorithm, Fast Ethernet, Gigabit Ethernet, IEEE 802.11a/b/g/n and IEEE 802.15 and IEEE 802.16 Standards, Frame formats, CSMA/CA.

Unit IV: Network Layer **7L**

Switching techniques, IP Protocol, IPv4 and IPv6 addressing schemes, Subnetting, NAT, CIDR, ICMP, Routing Protocols: Distance Vector, Link State, Path Vector, Routing in Internet: RIP ,OSPF, BGP, Congestion control and QoS, , MPLS, Mobile IP, Routing in MANET : AODV, DSR

Unit V: Transport Layer **7L**

Services, Berkley Sockets, Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, TCP, TCP Timer management, TCP Congestion Control, Real Time Transport protocol(RTP), Stream Control Transmission Protocol (SCTP), Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless.

Unit VI: Application Layer **6L**

Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP).

Text Books:

1. Andrew S. Tenenbaum, "Computer Networks",5th Edition, PHI, ISBN 81-203-2175-8.
2. Fourauzan B., "Data Communications and Networking", 5th Edition, Tata McGraw- Hill, Publications, 2006

References:

1. Kurose, Ross "Computer Networking a Top Down Approach Featuring the Internet", Pearson; 6th edition (March 5, 2012), ISBN-10: 0132856204
2. Matthew S. Gast "802.11 Wireless Networks", O'Reilly publications; 2nd Edition.
3. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols" Prentice Hall, 2004
4. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", Wiley, ISBN: 0-470-09510-5

Cloud Computing

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination: Phase I: 30
End Semester Examination: Phase II: 70

Course Objectives:

- To become familiar with Cloud Computing and its ecosystem.
- To learn basics of virtualization and its importance.
- To evaluate in-depth analysis of Cloud Computing capabilities.

- To give technical overview of Cloud Programming and Services.
- To understand security issues in cloud computing.
- To be exposed to Ubiquitous Cloud and Internet of Things.

Course Outcomes:

1. To understand the need of Cloud based solutions.
2. To understand Security Mechanisms and issues in various Cloud Applications
3. To explore effective techniques to program Cloud Systems.
4. To understand current challenges and trade-offs in Cloud Computing.
5. To find challenges in cloud computing and delve into it to effective solutions.
6. To understand emerging trends in cloud computing.

Course Contents

UNIT I: FUNDAMENTALS OF CLOUD COMPUTING 6L

Origins and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges, Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models, Federated Cloud/Inter cloud, Types of Clouds.

Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology, Web Technology, Multitenant Technology, Service Technology.

UNIT II: Virtualization and Common Standards in Cloud Computing 6L

Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management Virtualization for Data-Center Automation.

Common Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP), Syndication (Atom, Atom Publishing Protocol, and RSS), Standards for Security.

UNIT III: CLOUD PROGRAMMING, ENVIRONMENTS AND APPLICATIONS 6L

Features of Cloud and Grid Platforms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments, Understanding Core Open Stack Ecosystem.

Applications: Moving application to cloud, Microsoft Cloud Services, Google Cloud Applications, Amazon Cloud Services, Cloud Applications (Social Networking, E-mail, Office Services, Google Apps, and Customer Relationship Management).

UNIT IV: CLOUD SECURITY AND ISSUES 6L

Cloud Security Mechanisms: Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Hardened Virtual Server Images.

Cloud Issues: Stability, Partner Quality, Longevity, Business Continuity, Service-Level Agreements, Agreeing on the Service of Clouds, Solving Problems, Quality of Service, Regulatory Issues and Accountability.

UNIT V: UBIQUITOUS CLOUDS AND THE INTERNET OF THINGS 6L

Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud, Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System), Online Social and Professional Networking.

UNIT VI: FUTURE OF CLOUD COMPUTING 6L

How the Cloud Will Change Operating Systems, Location-Aware Applications, Intelligent Fabrics, Paints, and More, The Future of Cloud TV, Future of Cloud-Based Smart Devices, Faster Time to Market for Software Applications, Home-Based Cloud Computing, Mobile Cloud, Autonomic Cloud Engine, Multimedia Cloud, Energy Aware Cloud Computing, Jungle Computing.

Docker at a Glance: Process Simplification, Broad Support and Adoption, Architecture, Getting the Most from Docker, The Docker Workflow.

Text Books

1. Jack J. Dongarra, Kai Hwang, Geoffrey C. Fox, Distributed and Cloud Computing: From Parallel
2. Processing to the Internet of Things, Elsevier, ISBN :9789381269237, 9381269238, 1st Edition.
3. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology &
4. Architecture, Pearson, ISBN :978 9332535923, 9332535922, 1st Edition.

Reference Books

1. Srinivasan, J. Suresh, Cloud Computing: A practical approach for learning and implementation, Pearson, ISBN :9788131776513.
2. Brian J.S. Chee and Curtis Franklin, Jr., Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center, CRC Press, ISBN :9781439806128.
3. Kris Jamsa, Cloud Computing: Saas, Paas, Iaas, Virtualization, Business Models, Mobile, Security,and More, Jones and Bartlett, ISBN :9789380853772.
4. John W. Ritting house, James F. Ransome, Cloud Computing Implementation, Management, andSecurity, CRC Press, ISBN : 978 1439806807, 1439806802.
5. Karl Matthias, Sean P. Kane, Docker: Up and Running, OReilly, ISBN:9781491917572, 1491917571.
6. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing: Foundations and Applications Programming, McGraw Hill, ISBN: 978 1259029950, 1259029956.
7. Barrie Sosinsky, Cloud Computing Bible, Wiley, ISBN: 978 8126529803.
8. Gautham Shroff, Enterprise Cloud Computing, Cambridge, ISBN: 9781107648890.

ELECTIVE-III

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination: Phase I: 30
End Semester Examination: Phase II: 70

Electronics System Design

Course Objectives:

- To understand the stages of system (hardware/ software) design and development.
- To learn the different considerations of analog, digital and mixed circuit design.
- To be acquainted with methods of PCB design and different tools used for PCB Design.
- To understand the importance of testing in product design cycle.
- To understand the processes and importance of documentation.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand various stages of hardware, software and PCB design.
2. Analyze reliability of product design.
3. Design and test various electronic products/modules.
4. Suggest special design considerations and understand need of documentation.

Course contents:

Unit I: Introduction 6L

Stages in product design- Market survey, Product Specifications (Electrical, Mechanical, Environmental), R&D and Engineering Prototypes, Pilot Production Batch, Environmental testing, Documentation, Manufacturing. Electronic Products Classification: Consumer, Industrial and Military, their peculiarities in terms of Cost/performance ratio and Reliability. Case study of a typical Industrial Product. Reliability: Bath tub curve, Measures taken (at Component and Product level and various soldering techniques including Surface Mount Technology) to improve reliability.

Unit II: Hardware Design- Analog Circuits 6L

Analog signal conditioning: Factors affecting choice of Op-Amps in signal conditioning, applications, Need for Instrumentation Amplifiers- Case study of an Instrumentation amplifier circuit designed using discrete components and special purpose IC. Error budget analysis with case study. Interpretation of ADC and DAC specifications from design view point, considerations in selecting references (Vref for ADC).

Unit III: Hardware Design- Digital Circuits 6L

Interfacing of LED, HB LED, LCD, Keyboard, Relays (Electromagnetic and Solid State) with Microcontrollers. Comparative study of different Microcontroller architectures, Factors affecting choice of Microcontroller for particular application with case study of one application. Comparison of buses and protocols used in electronic products- I2C, SPI, CAN, LIN, Flexray.

Unit IV: Software Design and Testing for Electronic Product 6L

Different approaches for development of application software for Electronic Product. Assemblers, Factors affecting choice between Assembly language and High level languages like C and C++. Documentation

practices and templates for above software. Debugging tools and techniques for software- Features of Simulators, ICE, IDE.

Unit V: PCB Design and EMI/EMC 6L

PCB Design practices for Analog and Mixed signal circuits: Ground Loops, Precision circuits, shielding and guarding. PCB Design Practices for High speed digital circuits, Signal integrity and EMC, EMI/EMC testing standards and compliance for PCB design.

Unit VI: Fault Finding and Testing 6L

Analyses- DC/ Operating Point Analysis, AC (Frequency Response), Transient, Sensitivity, Monte Carlo. Debugging/ Fault finding- Features and limitations of Analog CRO, DSO, Spectrum analyzer, Logic Analyzer and Mixed Signal Oscilloscopes in finding hardware/software faults. Environmental Testing: Need for Environmental Testing. Temperature, Humidity, Vibration and Shock tests. Introduction to EMI/EMC testing standards and compliance.

Text Books:

1. Bernhard E. Bürdek, History, Theory and Practice of Product Design, Springer Science, 2005.
2. Paul Horowitz, Art of Electronics, Cambridge University Press.

Reference Books:

1. Howard Johnson, Martin Graham, High-speed Digital design- A Handbook of Black Magic, Prentice Hall Publication.
2. G. Pahl and W. Beitz J. Feldhusen and K.-H. Grote, Engineering Design – A Systematic Approach_, Springer, 2007.
3. Tim Williams, EMC for Product Designers, Elsevier, Fourth edition 2007.
4. Jerry C Whitaker, The Electronics Handbook, CRC Press, IEEE Press, ISBN 0-8493-8345-5.
5. David Bailey, Practical Radio Engineering and Telemetry for Industry, Elsevier, ISBN 07506 58037.
6. Pressman, Software Engineering - A Practitioner's Approach.
7. David Bailey, Practical Radio Engineering & Telemetry for Industry, Elsevier, ISBN 07506 58037.
8. Domine Lenders, Johan van der Tang, Cicero S. Vaucher , Circuit Design for RF Transceivers, Kluwer Academic Publishers, 2003.

List of Experiments:

1. Design and implement low dropout regulated power supply (Estimation of current requirement)
2. Design of SPAN ZERO circuit.
3. Design and implement Transducer interface using Wheatstone bridge.
4. Study of Error budget analysis of instrumentation amplifier or any other complicated circuit using ADC/ DAC.
5. Design Data Acquisition System (DAS) using appropriate Microcontroller.
6. PCB Design for Mixed Signal Circuit (Involving ADC and Signal Conditioning). Test the circuit using MSO.
7. DC and AC analysis of given circuit.
8. Sensitivity analysis for given circuit.
9. Reliability calculations from given data.

10. Visit to product based industry to study various processes.

Optical Fiber Communication

Course Objectives:

- To understand the about the various optical fiber modes, configuration and transmission characteristics of optical fibers.
- To learn about the various optical sources, detectors and transmission techniques.
- To explore various idea about optical fiber measurements and various coupling techniques.
- To enrich the knowledge about optical communication systems and networks.

Course Outcomes:

After successfully completing the course, students will be able to

- Understand advantages and applications of optical communication.
- Identify different optical devices with their operating principle.
- Formulate optical communication problem for synthesis.

Course Contents:

Unit I: Fundamentals of FOC **6L**

Basic block diagram of Optical Fiber Communication system, Principles of light propagation through a fiber, Different types of fibers and their characteristics, Attenuation, Distortion, Pulse broadening in GI fibers, Mode coupling, Coupling losses, Material dispersion, Dispersion in single-mode and multimode fibers, Connectors & splicers.

Unit II: Optical Sources **6L**

Working principle and characteristics of sources (LED, LASER),Tunable lasers, Quantum well lasers , Charge capture in Quantum well lasers, Multi Quantum well Laser diodes, Surface Emitting Lasers: Vertical cavity Surface Emitting Lasers

Unit III: Optical Detectors **6L**

Working principle and characteristics of detectors (PIN, APD),Material requirement for RCEPD, Resonant cavity enhancement (RCE) Photo Detector ,Noise analysis in detectors, coherent and noncoherent detection, receiver structure, bit error rate of optical receivers, and receiver performance

Unit IV: Fiber Optic Components **6L**

Fiber fabrication (VAD,MCVD), fiber joints, fiber connectors, splices Couplers, multiplexers, filters, fiber gratings, Fabry Perot filters, switches and wavelength converters, Optical amplifiers, basic applications and types, semiconductor optical amplifiers, EDFA.

Unit V: Optical Link **6L**

Introduction, Point to point links, system considerations, link power budget, and rise time budget. RF over fiber, key link parameters, Radio over fiber links, microwave photonics.

Unit VI: Optical Communication Systems and Networks 6L

System design consideration: Point to Point link design,Link power budget, rise time budget, WDM, Passive DWDM Components, Elements of optical networks, SONET/SDH ,Optical Interfaces-SONET/SDH Rings and Networks-High speed light wave Links, OADM configuration, Optical ETHERNET Soliton

Text Books:

1. Optical Fiber Communication -Gerd Keiser, 4th Ed., MGH, 2008.
2. Optical Fiber Communications--John M. Senior, Pearson Education. 3rd Impression, 2007.

Reference Books:

1. Fiber optics communications-Harold Kolimbiris
2. Introduction to optical fibers, Cheri, McGraw Hill.
3. An introduction to fiber optics, A. Ghatak and K.Thyagrajan, Cambridge Univ, press 10
4. Optical fiber communication and sensors-M. Arumugam Agencies, 20002 optic sensors.
5. Fiber optic communication-Joseph C Palais: 4th Edition, Pearson Education.

List of Experiments:

1. DC Characteristics of LED and PIN Photo diode
2. Mode Characteristics of Fibers.
3. Characteristics of light detector.
4. Measurement of Numerical Aperture.
5. Measurement of attenuation of optical Fiber Cable of Various lengths.
6. Measurement of connector and bending losses.
7. Study of any two optical instruments: Optical Power Meter, OTDR, OSA etc.
8. Fiber optic Analog and Digital Link- frequency response(analog) and eye diagram (digital) .

Data Mining and Ware Housing

Course Objectives:

- To understand the fundamentals of Data Mining
- To identify the appropriateness and need of mining the data
- To learn the preprocessing, mining and post processing of the data
- To understand various methods, techniques and algorithms in data mining

Course Outcomes:

On completion of the course the student should be able to-

1. Apply basic, intermediate and advanced techniques to mine the data
2. Analyze the output generated by the process of data mining
3. Explore the hidden patterns in the data

4. Optimize the mining process by choosing best data mining technique

Course Contents

Unit I: Introduction 7L

Data Mining, Data Mining Task Primitives, Data: Data, Information and Knowledge; Attribute Types: Nominal, Binary, Ordinal and Numeric attributes, Discrete versus Continuous Attributes; Introduction to Data Preprocessing, Data Cleaning: Missing values, Noisy data; Data integration: Correlation analysis; transformation: Min-max normalization, z-score normalization and decimal scaling; data reduction: Data Cube Aggregation, Attribute Subset Selection, sampling; and Data Discretization: Binning, Histogram Analysis

Unit II: Data Warehouse 7L

Data Warehouse, Operational Database Systems and Data Warehouses(OLTP Vs OLAP), A Multidimensional Data Model: Data Cubes, Stars, Snowflakes, and Fact Constellations Schemas; OLAP Operations in the Multidimensional Data Model, Concept Hierarchies, Data Warehouse Architecture, The Process of Data Warehouse Design, A three-tier data warehousing architecture, Types of OLAP Servers: ROLAP versus MOLAP versus HOLAP.

Unit III: Measuring Data Similarity and Dissimilarity 6L

Measuring Data Similarity and Dissimilarity, Proximity Measures for Nominal Attributes and Binary Attributes, interval scaled; Dissimilarity of Numeric Data: Minskowski Distance, Euclidean distance and Manhattan distance; Proximity Measures for Categorical, Ordinal Attributes, Ratio scaled variables; Dissimilarity for Attributes of Mixed Types, Cosine Similarity.

Unit IV: Association Rules Mining 7L

Market basket Analysis, Frequent item set, Closed item set, Association Rules, a-priori Algorithm, Generating Association Rules from Frequent Item sets, Improving the Efficiency of a-priori, Mining Frequent Item sets without Candidate Generation: FP Growth Algorithm; Mining Various Kinds of Association Rules: Mining multilevel association rules, constraint based association rule mining, Meta rule-Guided Mining of Association Rules.

Unit V: Classification 7L

Introduction to: Classification and Regression for Predictive Analysis, Decision Tree Induction, Rule-Based Classification: using IF-THEN Rules for Classification, Rule Induction Using a Sequential Covering Algorithm. Bayesian Belief Networks, Training Bayesian Belief Networks, Classification Using Frequent Patterns, Associative Classification, Lazy Learners-k-Nearest-Neighbor Classifiers, Case-Based Reasoning.

Unit VI: Multiclass Classification 6L

Multiclass Classification, Semi-Supervised Classification, Reinforcement learning, Systematic Learning, Wholistic learning and multi-perspective learning. Metrics for Evaluating Classifier Performance: Accuracy, Error Rate, precision, Recall, Sensitivity, Specificity; Evaluating the Accuracy of a Classifier: Holdout Method, Random Sub sampling and Cross-Validation

Text Books:

1. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques", Elsevier Publishers, ISBN:9780123814791, 9780123814807.
2. Parag Kulkarni, "Reinforcement and Systemic Machine Learning for Decision Making" by Wiley-IEEE Press, ISBN: 978-0-470-91999-6

References Books:

1. Matthew A. Russell, "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More" , Shroff Publishers, 2nd Edition, ISBN: 9780596006068
2. Maksim Tsvetovat, Alexander Kouznetsov, "Social Network Analysis for Startups:Finding connections on the social web", Shroff Publishers , ISBN: 10: 1449306462

Human Computer Interface

Course Objectives:

- To design, implement and evaluate effective and usable Human Computer Interfaces.
- To describe and apply core theories, models and methodologies from the field of HCI.
- Learn a variety of methods for evaluating the quality of a user interface
- To implement simple graphical user interfaces based on principles of HCI.

Course Outcomes:

On completion of the course, student will be able to–

1. Evaluate the basics of human and computational abilities and limitations.
2. Inculcate basic theory, tools and techniques in HCI.
3. Apply the fundamental aspects of designing and evaluating interfaces.
4. Apply appropriate HCI techniques to design systems that are usable by people

Course Contents

Unit I Foundations of Human–Computer Interaction 7L

What is HCI – design, models, evaluation, Need to understand people, computers and methods. Basic human abilities - vision, hearing, touch, memory.

Computers – speed, interfaces, widgets, and effects on interaction. Humans – Memory, Attention Span, Visual Perception, psychology, ergonomics. Understanding Users.

Methods for evaluation of interfaces with users: goals of evaluation, approaches, ethics, introspection, extracting the conceptual model, direct observation, constructive interaction, interviews and questionnaires, continuous evaluation via user feedback and field studies, choosing an evaluation method.

Unit II: The Design Process 7L

Interaction Design Basics, Interaction Styles. HCI in the Software Process. HCI design principles and rules: design principles, principles to support usability, golden rules and heuristics, HCI patterns,

design rules, HCI design standards. Direct Manipulation - Overview, Scope, Applications. Universal Design, User-centered design, task analysis/GOMS, Graphic Design

Unit III: Implementation **6L**

Implementation Tools, Technology and change designing for the Web, designing for portable devices. Handling errors and Designing Help. Prototyping and UI Software.

Unit IV: Evaluation and User Support **7L**

Evaluation of User Interfaces. Web Browsers - Fonts, Color Palette, Color Depth, Resolution, Layout, Size, Orientation. Mobile devices issues – design, limitations, what next. User Support.

Unit V: Users Models **7L**

Predictive Models, Cognitive Models. Interaction with Natural Languages, Next Generation Interface. Socio-organizational Issues and Stakeholder Requirements. Heuristic Evaluation, Evaluation with Cognitive Models, Evaluation with Users.

Unit VI: Task Models and Dialogs **7L**

Task Analysis, DOET (Design of Everyday Things). Design Dialogs Notations, Warnings, and Error messages. Model-based Evaluation. User Testing, Usability Testing, User Acceptance Testing.

Text Books:

1. Alan J, Dix. Janet Finlay, Rusell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004, ISBN 81-297-0409-9
2. Jenny Preece, Rogers, Sharp, "Interaction Design-beyond human-computer interaction", WILEY-INDIA, ISBN 81-265-0393-9

Reference Books:

1. Jonathan Lazar, Jinjuan Feng, Harry Hochheiser, "Research Methods in Human-Computer Interaction", Third Edition, Morgan Kaufmann, 2017, ISBN: 9780128053904.
2. Mary Beth Rosson and John M. Carroll, "Usability Engineering: Scenario-Based Development of Human-Computer Interaction", Morgan Kaufmann, 2001, ISBN-13: 978-1558607125

ELECTIVE-IV

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination: Phase I: 30
End Semester Examination: Phase II: 70

Software Defined Radio

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
4. MAC, Compare SDR versus MATLAB and Hardware Radio Work on open projects and explore their capability to build their own communication System.

Course Contents:

Unit I: Introduction to SDR and RF Implementation 6L

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 7L

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 6L

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 6L

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: PrinciplesofMIMO-OFDM

Unit V: Cognitive Radio 6L

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 7L

Application of 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

Wireless Sensor Network

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 issues of wireless sensor networks.

Course Outcomes:

On completion of the course, students will be able to

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

Course Contents:

Unit I: Introduction 6L

What are Wireless Sensor Networks, Wireless Sensor Node, Anatomy of a Sensor Node, Architecture of WSN, Performance metrics in WSN, types of WSN.

Unit II: Radio Communication & Link Management 6L

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 III: Wireless Standards & Protocol Stack 6L

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

Unit IV: Localization & Routing 6L

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 V: Data Aggregation & Security 6L

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

Unit VI: Designing & Deploying WSN Applications 6L

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

Text Books:

1. Dargie W. and Poellabauer C., "Fundamentals of Wireless Sensor Networks: Theory and Practice," John Wiley and Sons.
2. Anna Hac, "Wireless Sensor Network Designs," John Wiley and Sons.
3. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks,” John Wiley and Sons.

Reference Books:

1. Edgar H. Callaway Jr. and Edgar H. Callaway, "Wireless Sensor Networks: Architectures and Protocols," CRC Press.
2. Sohraby K., Minoli D. and Znati T., "Wireless Sensor Networks: Technology, Protocols and Applications,” John Wiley and Sons.

Design and Analysis of Algorithm

Course Objectives:

- To develop problem solving abilities using mathematical theories
- To analyze the performance of algorithms
- To study algorithmic design strategies

Course Outcomes:

On completion of the course, student will be able to–

1. Formulate the problem
2. Analyze the asymptotic performance of algorithms
3. Decide and apply algorithmic strategies to solve given problem
4. Find optimal solution by applying various methods

Course Contents

Unit I: Fundamentals 7L

The Role of Algorithms in Computing - What are algorithms, Algorithms as technology, Evolution of Algorithms, Design of Algorithm, Need of Correctness of Algorithm, Confirming correctness of Algorithm – sample examples, Iterative algorithm design issues

Unit II: Models and Design 7L

Functional Model – Features, Recursive processes, Scope rules, Tail recursion, Checking correctness of Iterative process. Imperative Model – Basics, Specifications and Prototyping, Stepwise Refinement, Proof Rules – Basics, For loops, Goto and Exit loops, Functions and Procedures, Problem Solving using Greedy strategy - Knapsack problem, Huffman code generation algorithm

Unit III: Abstract Algorithms 7L

Dynamic Programming, Divide and Conquer, Greedy strategy, Branch-n-Bound, Natural Algorithms – Evolutionary Algorithms and Evolutionary Computing, Introduction to Genetic Algorithm, Simulated Annealing, Artificial Neural Network and Tabu Search.

Unit IV: Complexity Theory 7L

Complexity theory – Counting Dominant operators, Growth rate, upper bounds, asymptotic growth, O, Ω, Θ, o and ω notations, polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P-class problems, NP-class of problems, Polynomial problem reduction NP complete problems- vertex cover and 3-SAT and NP hard problem - Hamiltonian cycle

Unit V: Amortized Analysis 7L

Amortized Analysis – Binary, binomial and Fibonacci heaps, Dijkstra's Shortest path algorithm, Splay Trees, Time-Space tradeoff, Introduction to Tractable and Non-tractable Problems, Introduction to Randomized and Approximate algorithms, Embedded Algorithms: Embedded system scheduling (power optimized scheduling algorithm), sorting algorithm for embedded systems.

Unit VI: Multithreaded and Distributed Algorithms 7L

Multithreaded Algorithms - Introduction, Performance measures, Analyzing multithreaded algorithms, Parallel loops, Race conditions. Problem Solving using Multithreaded Algorithms - Multithreaded matrix multiplication, Multithreaded merge sort. Distributed algorithms - Introduction, Distributed breadth first search, Distributed Minimum Spanning Tree. String Matching- Introduction, The naive string matching algorithm, The Rabin-Karp algorithm Books:

Text Books:

1. Parag Himanshu Dave, Himanshu Bhalchandra Dave, " Design And Analysis Of Algorithms", PEARSON Education, ISBN 81-7758-595-9
2. Gilles Brassard, Paul Bratley, Fundamentals of Algorithmics, PHI, ISBN 978-81-203-1131-2

Reference Books:

1. Michael T. Goodrich, Roberto Tamassia , Algorithm Design: Foundations, Analysis and Internet Examples, Wiley, ISBN 978-81-265-0986-7
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, MIT Press; ISBN 978-0-262-03384-8
3. Horowitz and Sahani, "Fundamentals of Computer Algorithms", 2ND Edition. University Press, ISBN: 978 81 7371 6126, 81 7371 61262
4. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithns", Cambridge University Press, ISBN: 978-0-521-61390-3
5. Dan Gusfield, "Algorithms on Strings, Trees and Sequences", Cambridge University Press,ISBN:0-521-67035-7

Software Engineering

Course Objectives:

- To learn and understand the principles of Software Engineering
- To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.
- To apply Design and Testing principles to S/W project development.
- To understand project management through life cycle of the project.
- To understand software quality attributes.

Course Outcomes:

On completion of the course, student will be able to–

- Decide on a process model for a developing a software project
- Classify software applications and Identify unique features of various domains
- Design test cases of a software system.
- Understand basics of IT Project management.
- Plan, schedule and execute a project considering the risk management.
- Apply quality attributes in software development life cycle. Course Contents

Course Contents:

Unit I Introduction to Software Engineering, Software Process Models 7L

Software Engineering Fundamentals: Nature of Software, Software Engineering Principles, The Software Process, Software Myths. Process Models :A Generic Process Model, Prescriptive Process Models: The Waterfall, Incremental Process(RAD), Evolutionary Process, Unified Process, Concurrent. Advanced Process Models & Tools: Agile software development: Agile methods, Plan-driven and agile development, Extreme programming Practices, Testing in XP, Pair programming. Introduction to agile tools: JIRA, Kanban, Case Studies: An information system (mental health-care system), wilderness weather system.

Unit II Software Requirements Engineering& Analysis 7L

Requirements Engineering: User and system requirements, Functional and non-functional requirements, Types & Metrics, A spiral view of the requirements engineering process. Software Requirements Specification (SRS): The software requirements Specification document, The structure of SRS, Ways of writing a SRS, structured & tabular SRS for an insulin pump case study, Requirements elicitation & Analysis: Process, Requirements validation, Requirements management. Case Studies: The information system.

Case study - Mental health care patient management system (MHC-PMS).

Unit III: Design Engineering 6L

Design Process & quality, Design Concepts, The design Model, Pattern-based Software Design. Architectural Design :Design Decisions, Views, Patterns, Application Architectures, Modeling Component level Design: component, Designing class based components, conducting component-level design, User Interface Design: The golden rules, Interface Design steps & Analysis, Design Evaluation, Case Study: Web App Interface Design.

Unit IV Project Management: Process, Metrics, Estimations & Risks 7L

Project Management Concepts: The Management Spectrum, People, Product, Process, Project, The W5HH Principle, Metrics in the Process and Project Domains, Software Measurement : size & function oriented metrics(FP & LOC), Metrics for Project and Software Quality, Project Estimation :Observations on Estimation, Project Planning Process, Software Scope and feasibility, Resources: Human Resources, Reusable software, Environmental Resources. Software Project Estimation, Decomposition Techniques, Empirical Estimation Models: Structure, COCOMO II, Estimation of Object-oriented Projects, Specialized Estimation Case Study: Software Tools for Estimation, Project Scheduling: Basic Concepts, Defining a Task Set for the Software Project, Defining Task Network, Scheduling with time-line charts, Schedule tracking Tools:- Microsoft Project, Daily Activity Reporting & Tracking (DART)

Unit V: Project management: risk management, configuration management, maintenance & reengineering 6L

Project Risk Management : Risk Analysis & Management: Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Risks Monitoring and Management, The RMMM plan for case study project Software Configuration Management : The SCM repository, SCM process, Configuration management for WebApps, Case study: CVS and Subversion Tools, Visual Source Safe from Microsoft & Clear Case. Maintenance &

Reengineering: Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering

Unit VI: Software Testing **7L**

Introduction to Software Testing, Principles of Testing, Testing Life Cycle, Phases of Testing, Types of Testing, Verification & Validation, Defect Management, Defect Life Cycle, Bug Reporting, GUI Testing, Test Management and Automation

Text Books:

1. Roger Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill, ISBN 0–07–337597–7
2. Ian Sommerville, " Software Engineering", Addison and Wesley, ISBN 0-13-703515-2

Reference Books:

1. Carlo Ghezzi, "Fundamentals of Software Engineering", Prentice Hall India, ISBN-10: 0133056996
2. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India, ISBN-13: 978-8120348981
3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, ISBN 13: 9788173192715.
4. S K Chang, "Handbook of Software Engineering and Knowledge Engineering", World Scientific, Vol I, II, ISBN: 978-981-02-4973-1
5. Tom Halt, "Handbook of Software Engineering", Clanye International, ISBN- 10: 1632402939

Open Elective

Lab Practice III

Teaching Scheme:
Practical: 2 Hrs./ Week

Examination Scheme:
Termwork (TW): 25
Practical (PR): 50

Computer Network

List of Experiments:

(Perform any 8 experiments)

1. Study of network commands & IP address configurations.
2. Study of Cable tester for fault detection of UTP-CAT5 Cross / Straight LAN cable.

3. Implementation of LAN using star topology and connectivity between two computers using cross over UTP CAT5 cable. (Cisco Packet Tracer)
4. Installation and configuration of Web Server and hosting web page using HTML programming. (Cisco Packet Tracer)
5. Installation and configuration of Proxy Server.
6. Installation and configuration of FTP server for FTP communication.
7. Installation and configuration of Telnet server for Telnet Communication. (Teamviewer)
8. Write a program in „C" for Encryption and Decryption (RSA Algorithm).
9. Write a program in „C" for Shortest Path algorithm.
10. Connectivity of LAN computers to Internet using Dial-Up modem/leased line Modem /Mobile Handset. (Installation and configuration).
11. Installation of Suitable Protocol Analyzing software and Analysis of Intranet activities. (Wireshark)
12. Configure RIP using packet Tracer.
13. Study of any network simulation tools-To create a network with three nodes & establish a TCP connection between node 0 & node 1 such that node 0 will send TCP packet to node 2 via node 1.

Lab Practice IV

Teaching Scheme:
Practical: 2 Hrs./ Week

Examination Scheme:
Termwork (TW): 25
Practical (PR): 50

Elective-III

Experiments to be chosen based on Elective III.

Project Stage II

Teaching Scheme:
Practical: 12 Hrs./ Week

Examination Scheme:
Termwork (TW): 100
ORAL (OR): 50

Course Objectives:

- To follow SDLC meticulously and meet the objectives of proposed work
- To test rigorously before deployment of system
- To validate the work undertaken
- To consolidate the work as furnished report.

Course Outcomes:

On completion of the course, student will be able to–

1. Show evidence of independent investigation
2. Critically analyze the results and their interpretation.
3. Report and present the original results in an orderly way and placing the open questions in the right perspective.
4. Link techniques and results from literature as well as actual research and future research lines with the research.
5. Appreciate practical implications and constraints of the specialist subject

Guidelines

In Project Work Stage–II, the student shall complete the remaining project work which consists of Selection of Technology and Tools, Installations, UML implementations, testing, Results, performance discussions using data tables per parameter considered for the improvement with existing/known algorithms/systems and comparative analysis and validation of results and conclusions. The student shall prepare and submit the report of Project work in standard format for satisfactory completion of the work that is the duly certified by the concerned guide and head of the Department/Institute.

AUDIT COURSE 8