Faculty of Science and Technology

Syllabus
B.E. (Electronics) 2015 Course

(With effect from Academic Year 2018 - 19)

SAVITRIBAI PHULE PUNE UNIVERSITY

THE SYLLABUS IS PREPARED BY:
B.O.S. in Electronics & Telecommunication,
Savitribai Phule Pune University

Savitribai Phule Pune University
Final Year Electronics Engineering (2015 Course)

(With effect from Academic Year 2018-19)

Semester I												
Course Code	**Course**	**Teaching Scheme Hours / Week**			**Semester Examination Scheme of Marks**						**Credits**	
		TH	**TUT**	**PR**	**In-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH/TW**	**PR+OR**
404201	VLSI Design	3	--	--	30	70	--	--	--	100	3	--
404202	Advanced Power Electronics	4	--	--	30	70	--	--	--	100	4	--
404203	Electronics System Design	3	--	--	30	70	--	--	--	100	3	--
404204	Elective I	3	--	--	30	70	--	--	--	100	3	--
404205	Elective II	3			30	70	--	--	--	100	3	--
404206	Lab practice -I (APE+ ESD)	--	--	4	--	--	50	50	--	100	--	2
404207	Lab practice -II (VLSI + Ele I)	--	--	4	--	--	50	50	--	100	--	2
404208	Project Stage I	-	2	--	--	--	-	--	50	50	--	2
	Audit Course 5	--	--	--	--	--	--	--	--	--	----	
Total		16	2	8	150	350	100	100	50	750	16	6
Total Credits											**22**	

Elective I	**Elective II**
Digital Image and Video Processing	Mobile communication
Audio and Speech Processing	Bio-Medical Electronics
Embedded Systems & RTOS	Optimization techniques
Internet of Things	Computer modelling and simulation
Software Defined Radio	Digital Signal Processor TMS320C67X

Audit Course 5	Foreign Language (Japanese Module 3)
	Critical Thinking

Final Year Electronics Engineering (2015 Course)

(With effect from Academic Year 2018-19)

Semester II												
Course Code	**Course**	**Teaching Scheme Hours / Week**			**Semester Examination Scheme of Marks**						**Credit**	
		TH	**TUT**	**PR**	**In-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH/TW**	**PR+OR**
404209	Computer Networks & Security	3	--	--	30	70	--	--	--	100	3	--
404210	Process Instrumentation	4	--	--	30	70	--	--	--	100	4	--
404211	Elective III	3	--	--	30	70	--	--	--	100	3	--
404212	Elective IV	3	--	--	30	70	--	--	--	100	3	--
404213	Lab practice -III (CNS+PI)	--	--	4	--	--	50	50	--	100	--	2
404214	Lab practice -IV (Elective- III)	--	--	2	--	--	--	50	--	50	--	1
404215	Project Stage II	--	6	--	--	--	150	--	50	200	--	6
	Audit Course 6	--	--	--	--	--	--	--	--	--		
Total		13	6	6	120	280	200	100	50	750	13	9
Total Credits											**22**	

Elective III	**Elective-IV**
Automotive Electronics	Robotics
Artificial Intelligence and Machine Learning	Wireless Sensor Networks
Optical and Microwave Communication	Renewable Energy Systems & DSM
Audio Video Engineering	TM4C123GH6PM Microcontroller
Testing and verification for SoC Design	Open Elective*

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

Audit Course 6	Foreign Language (Japanese Module 4)
	Technologies, Disruptions and Entrepreneurial Opportunities

SEMESTER - I

404201 VLSI DESIGN

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

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.

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 Books

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 Books

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

404202 ADVANCED POWER ELECTRONICS

Teaching Scheme:
Lectures: 4 Hrs/Week

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

Course Objectives:

- Study operation and implementation of dual converters, Multilevel Inverters and cycloconverters.
- Study and understand the operation of electric motor drives controlled from a power electronic converter and to introduce the design concepts of controllers for closed loop operation.
- Specify appropriate power circuit configuration amongst the phase controlled rectifiers and Choppers for DC drive system, Induction motor drive and Special purpose motor drive.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand operation and implementation of dual converters, Multilevel inverters, cycloconverters and power factor improvement techniques for controlled rectifiers.
2. Select and Design a suitable power converter to meet the demand of DC drive system.
3. Select and Design a suitable power converter to meet the demand of 3 phase inductor motor drive.
4. Understand working of BLDC, Stepper, Servo drive system.
5. Understand implementation of Solar and Wind Power System.

Unit I: Dual Converters and Power factor improvement of converters 8L

Single-phase and three-phase dual converters: Ideal and practical dual converter, control schemes for non-circulating current type dual converter, analysis of circulating current type dual converter.

Power factor improvement of converters: Phase angle control: EAC, SAC, PWM, sequence control of series converters, comparative evaluation of schemes. Power factor conditioning of diode rectifiers, Double sided PWM converter systems.

Unit II Multilevel Inverters and Cycloconverters 7L

Cycloconverters: Single phase to single phase cycloconverters, three phase to Single phase cycloconverters, three phase to three phase cycloconverters.

Multilevel Inverters: Concept of multilevel inverter, Types of multilevel inverter: Diode clamped, Flying Capacitor and Cascade Multilevel inverters.

Unit III: DC Motor Drives 8L

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

control of dc drives, Dynamic and regenerative breaking of DC motors.

Unit IV: Induction Motor Drives 8L

Induction motor characteristics ,Control strategies like stator voltage control, v/f control, rotor resistance control ,Variable frequency Square wave VSI Drives ,Variable frequency SPWM VSI Drives ,Variable frequency CSI Drives , Open loop & closed loop control of 3 phase induction motor drive, Vector Control (Field oriented Control): Basic principle of vector control, Direct & Indirect vector control, Breaking of induction motor, soft acceleration and deceleration, various protections.

Unit V: Special Purpose Motor Drive 6L

Brushless DC drives, Stepper motor drive, Servo motor drive, Switched reluctance motor drive, Synchronous reluctance motor drive.

Unit VI: Solar and Wind power System 6L

Solar Power System: PV characteristics, working of solar power system, Types of PV system: Stand-alone PV systems, Grid connected PV systems. Case study to implement solar power system: Selection of Solar panel, inverter, battery, charge controller, Metering of solar based system.

Wind Power System: Working of wind power system, Types: Standalone wind energy systems, Grid connected wind energy systems, types of wind generator Control of wind turbines.

Text Books:

1. M H Rashid, “Power Electronics – circuits, devices and applications”, 3rd edition, Pearson Education.
2. Power Electronics, M.D. Singh & K.B.Khanchandani, TMH

Reference Books:

1. Ned Mohan, T. Undeland & W. Robbins, “Power Electronics Converters applications and design” 2nd edition, John Willey & sons, Singapore
2. P.C. Sen, “Modern Power Electronics”, S Chand & Co New Delhi
3. Dr. P. S. Bimbhra, “Power Electronics”, Khanna Publishers, Delhi.
4. Nagrath Kothari, “Electrical Machines”, TMH.
5. M. H. Rashid, " Handbook of Power Electronics”

404203 ELECTRONIC SYSTEM DESIGN

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 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.

404204 ELECTIVE I

Teaching Scheme:
Lectures: 3Hrs/Week
Credits: 3

Examination Scheme:
In Semester Examination: 30 Marks
End Semester Examination: 70 Marks

DIGITAL IMAGE AND VIDEO 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:

After successfully completing the course students 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.

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 Books

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

Reference Books

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 Using MATLAB", Second Edition, - Tata McGraw Hill Publication.
4. S Jayaraman, S Esakkirajan, T Veerakumar, "Digital Image Processing", Tata McGraw Hill Publication.
5. "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.

404204 ELECTIVE I

Teaching Scheme:
Lectures: 3Hrs/Week
Credits: 3

Examination Scheme:
In Semester Examination: 30 Marks
End Semester Examination: 70 Marks

AUDIO AND SPEECH PROCESSING

Course Objectives:

- To introduce the models of speech production and acoustic phonetics.
- To understand time and frequency domain techniques for estimating speech parameters.
- To understand predictive techniques for speech coding.
- To introduce speech recognition applications.

Course Outcomes:

After successfully completing the course students will be able to

1. State and describe the concepts of speech production mechanism, phoneme classification, digital models for speech production, homomorphic speech processing and LPC analysis.
2. Identify, classify and explain types of speech production mechanism, phoneme classification, digital models for speech production, homomorphic speech processing and LPC analysis.
3. Apply signal processing theory for estimation of speech parameters in time and Frequency domain.
4. Analyze applications of speech processing in speech compression and speech recognition

UNIT I: Speech Production, Acoustic Phonetics and Auditory Perception **6L**

Anatomy and physiology of speech organs, articulatory phonetics, acoustic phonetics, acoustic theory of speech production, discrete time model for Speech Production. Ear physiology and psychoacoustics.

UNIT II: Speech Analysis in Time Domain **6L**

Time, energy, average magnitude, and zero-crossing rate, speech vs silence discrimination, short-time autocorrelation, pitch period estimation using short-time autocorrelation, median smoothing.

UNIT III: Speech Analysis in Frequency Domain **6L**

Time dependent Fourier representation for voiced and unvoiced speech signals, Linear filtering interpretation, spectrographic displays Pitch period estimation based on FFT and harmonic peak detection method, estimation of formants using log spectrum.

UNIT IV: Speech Coding **6L**

Time domain waveform coding: linear PCM, companded PCM, DPCM, DM, ADM. Spectral coders: Filter bank analysis, sub-band coders, Adaptive Transform Coders (ATC),

Introduction, Vocoders, Cepstral vocoders, Sub-band coding, Vector Quantization coder, Perceptual audio coding, MPEG audio standards.

UNIT V: Linear Predictive Coding (LPC) of Speech 6L

Introduction, Estimation of LPC coefficients, Lattice formulation & Solution, Choice of LPC order & window length, Frequency domain Interpretation of LPC.

UNIT VI: Speech Processing Applications 6L

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

Text books:

1. Rabiner and Schafer, "Digital Processing of Speech Signals", Pearson Education, Delhi, 2004.
2. Shaila D. Apte, "Speech and Audio Processing", Wiley India, New Delhi, 2012.

Reference Books:

1. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing", Wiley India (P) Ltd, New Delhi, 2006.
2. A.R.Jayan, "Speech and Audio Signal Processing", PHI learning pvt ltd, Delhi-110092, 2016.
3. Douglas O'Shaughnessy, "Speech Communications: Human and Machine: 2nd Edition Universities Press.
4. L. R. Rabiner , B. H. Juang and B. Yegnanarayana "Fundamentals of speech recognition". Pearson Publication.

List of Experiments:

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

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

404204 ELECTIVE I

Teaching Scheme:
Lectures: 3 Hrs/ Week
Credits: 3

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

EMBEDDED SYSTEMS & 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.

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 signalling & 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.

404204 ELECTIVE I

Teaching Scheme:
Lectures: 3 Hrs/Week

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

INTERNET OF THINGS

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.

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, 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

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, Gas sensor, Sound Sensor 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. Wireless communication between Arduino and PC using Bluetooth protocol.
6. Interfacing Wifi module with Arduino.
7. Interfacing Xbee module with Arduino.

Group B

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

Group C

16. 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.
17. 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.

404204 ELECTIVE I

Teaching Scheme
Lecture: 3 hr/week

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

SOFTWARE DEFINED RADIO

Course Objectives:

- The course gives students knowledge of fundamental and state-of the-art concepts in software-defined radio.
- Learn the design of the wireless networks based on the cognitive radio.
- Understand the concepts of wireless networks and next generation network

Course Outcomes:

After successfully completing the course students will be able to

1. Describe the basics of the software defined radio.
2. Implement modern wireless system.
3. Design the wireless networks based on the cognitive radio.
4. Explain the concepts behind the wireless networks and next generation networks

Unit I Software Defined Radio fundamentals 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 6L

Architecture of SDR-Open Architecture, Software Communication Architecture, Transmitter Receiver Homodyne/heterodyne architecture, RF front End, Power amplifier, 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: Introduction to Cognitive Radio **6L**

Defining CR: History, Applications and Related Concepts , A Brief History of Elastic Spectrum Management ,A View of Wireless Network Futurists ,Ambiguity in CR Definitions ,Definition of Cognitive Radio Network ,Spectrum Management , Computational Platforms . CR Terminology Standardization - IEEE 1900.1 ,IEEE 1900.2 ,IEEE 1900.3 , IEEE 1900.4 , IEEE 1900.5 ,IEEE 1900.6, Related Standardization Efforts

Unit V : Cognitive Radio Architecture **6L**

Cognitive Radio network architecture– Resource manager frame work, architecture for spectrum sensing, network optimization through utilities , Value of Perfect Information ,Policy Support as a Part of the Architecture ,Spectrum Brokering Services Information Modelling, Topology Aware CRN Architectures - Statistical Characterization of Node Locations ,Spatial Statistics of Spectrum Usage, Publish-Subscribe CRN Architecture.

Unit VI: Public safety and cognitive radio **6L**

Introduction - Requirements, Commercial Wireless Communication Networks , Economic Value of the Spectrum , Benefits of Cognitive Radio. Standards for Public Safety Communication - TETRA ,C2000 Applications of Cognitive Radio – Disaster management, Bandwidth Requirements ,Spectrum Organization , Propagation Conditions , White Space Assessment , System Spectral Efficiency, Antijamming .

Text Books:

1.Jeffrey.H.Reed ,“Software Radio : A Modern Approach to Radio Engineering “, Pearson , LPE

2.Alexander M. Wyglinski, Worcester Maziar Nekovee., Thomas Hou, “Cognitive Radio Communications and Networks Principles and Practice”, 2010 ELSEVIER

Reference Books:

1. Markus Dillinger , KambizMadani ,Nancy Alonistioti, “Software Defined Radio : Architectures , Systems and Functions” ,Wiley
3. Tony .J. Rouphael , “RF and DSP for SDR”, Elsevier Newness Press ,2008
4. SDR –Handbook , 8th Edition , PENTEK
5. Bruce a. Fette , “Cognitive Radio Technology, Newness”, Elsevier

List of Experiments:

Part A: (Perform any seven)

Use GNU and SDR kit

1. To observe SNR clipping.
2. To generate multi tone.
3. To implement AM transmitter and receiver.
4. To implement FM transmitter and receiver.
5. To generate and measure bit error rate.
6. To implement FFT filter.
7. To generate BPSK signal.
8. To generate QAM signal.
9. To generate OFDM signal.

Part B: MATLAB Code

10. Spectrum sensing of Cognitive radio.
11. Optimization in cooperative spectrum sensing in Cognitive radio network.
12. Energy Detection Simulation: Cognitive Radio.

404205 ELECTIVE II

Teaching Scheme
Lecture: 3hr/week

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

MOBILE COMMUNICATION

Course Objectives:

- To introduce the concepts and techniques associated with wireless cellular communication systems.
- To give an exposure to students of various techniques used for modulation, equalization, diversity, coding & multiple access in cellular communication system.
- To familiarize with state of art systems & standards used in wireless cellular systems.

Course Outcomes:

After successfully completing the course students will be able to
1. Understand the fundamentals of cellular system & radio propagation.
2. Design mobile communication system by appropriately selecting necessary techniques.
3. Analyse different wireless networking & communication systems & standards.

Unit I: Fundamentals of Wireless Communication 6L

Evolution of mobile radio communication, Examples of mobile radio system, Overview of 2G, 2.5G, 3G ,4G ,5Gwireless networks, Cellular fundamentals: frequency reuse, channel assignment strategies, handoff strategies, Interference & system capacity, Trunking & grade of service, Techniques of improving coverage & capacity of cellular system.

Unit II: Mobile Radio Propagation 6L

Radio wave propagation, Free space propagation model, Propagation mechanisms: reflection, ground reflection model, diffraction, scattering. Small scale multipath propagation, Impulse response model of multipath channel, Small scale multipath measurements, Parameters of mobile multipath channels, Types of small scale fading.

Unit III: Modulation, Equalization & Diversity Techniques 6L

Linear modulation techniques, Constant envelope modulation techniques, Combined linear & constant envelope modulation techniques, Spread spectrum modulation techniques. Equalization: fundamentals, training & survey of equalization techniques, Linear & Non-linear Equalization, Algorithms for Adaptive Equalization, Fractionally spaced equalizers, Diversity Techniques, RAKE receiver, Interleaving.

Unit IV: First and Second Generation Mobile Systems 6L

First Generation Cellular Systems, AMPS, GSM Cellular Telephony: Introduction, Basic GSM Architecture, Basic radio transmission parameters in GSM system, Logical Channels,

GSM time hierarchy, GSM burst structure, Description of call setup procedure, Handover, Modifications and derivatives of GSM.

Unit V: Third and fourth Generation Mobile Systems **6L**

3G Wireless Standards: CDMA2000: Overview, Radio & Network Components, Network Structure, Packet - Data Transport Process Flow, Radio Network, EVDO, BCMCS, EVDV, CDMA Channel Allocation.TD-CDMA: Overview, Generic Architecture, Core Network, Radio Network, Interference – Mitigation Techniques, RAN Traffic Planning, Handover, Implementation

TD-SCDMA: Overview, Generic Architecture, Core Network, Radio Network, Interference – Mitigation Techniques, RAN Traffic Planning, Handover, Implementation.

4G Wireless Standards- LTE: Network Architecture and Interfaces, FDD Air Interface and Radio Network, TD-LTE Air Interface, Scheduling , Mobility Management and Power Optimization, LTE Security Architecture Overview of WiMAX.

Unit VI: Wireless Networking **6L**

Wireless Networks: Introduction, Development, Fixed network transmission hierarchy, Traffic routing in wireless networks, Wireless data services, Common channel signalling , ISDN, SS7, PCS/PCN, Protocols for network access, Network databases, UMTS.

Text Books

1. T. S. Rappaport, “Wireless Communications: Principles & Practice” Second Edition, Pearson Education.
2. A. Goldsmith, “Wireless Communications”, First Edition, Cambridge University Press.

Reference Books

1. A. F. Molisch, “Wireless Communications”, Second Edition, Wiley India.
2. W. C. Y. Lee, “Wireless and Cellular Telecommunications”, Third Edition, Tata McGraw-Hill Education.
3.Clint Smith, P. E. Daniel Collins ,”3G Wireless Networks” ,Second Edition, Tata Mc-Graw Hill
4. Martin Sauter From ,”GSM To LTE: An Introduction To Mobile Networks And Mobile Broadband”, First Edition, Wiley

404205 ELECTIVE II

Teaching Scheme
Lecture:3hr/week

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

BIOMEDICAL ELECTRONICS

Course Objectives:

- To familiarize students with various medical equipments and their technical aspects.
- Analyze how noise from the environment, instruments and other physiologic systems can create artefacts in instrumentation.
- To introduce students to the measurements involved in some medical equipments like ECG, EEG, EMG etc.
- To learn and understand principles of different clinical lab instrumentation and Radiology Instrumentation.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand operation of the cardiac, respiratory and neural physiological systems.
2. Understand the principle, operation, design of biomedical instruments and specific applications of biomedical engineering.
3. Understand working principle of Clinical Lab Instruments.
4. Understand working principle and applications of Radiology Instrumentation.

UNIT I: Biomedical sensors and transducers 6L

Overview of Biomedical Instrumentation system, Sources of bioelectric potential, Types Bio-Signals, Biomedical Instrumentation System and its components.
Sensors and Transducers for bio-signal measurement, Biomedical Electrodes, Model of biomedical electrode, Silver-Silver chloride reference electrode, Types of electrodes for measurement of EEG, ECG, EMG, PCG, Respiration, Temperature. Chemical Sensors to measure pH, pO2, Glucose, O_2, Skin contact impedance, Artefacts and noise in medical instrumentation.

Unit II: Cardiovascular System 6L

Heart Structure, Functioning of Heart System, Cardiac cycle, ECG Electrodes, Electrocardiograph, Lead Configurations to measure ECG, Einthoven Triangle, Vectocardiography, Normal and abnormal ECG, ECG Signal Processing, ECG Amplifiers and Filters , ECG Machine, Heart sounds.

Unit III: Nervous System and Electromyography 6L

Introduction to Nervous System-Anatomy: The anatomy of the nervous system, The Autonomic nervous System, 10-20 electrode placement system for EEG measurement, Evoked Potentials, Types and significance of EEG Signal, EEG machine, EEG amplifiers and filters, Analysis of Diseases using EEG.

Electromyography (EMG), Muscle contraction mechanism, Myoelectric voltages, EMG Machine.

Unit IV: Medical Instruments and Measurements **6L**

Life Saving Devices: Pacemakers, Defibrillators, Ventilators, Introduction to Blood Pressure Measurement (Direct and Indirect Methods). Blood Flow Measurement, Finger Plethysmography, Echocardiography, Stress Testing System, Bedside Monitors, Central Monitoring System.

Unit V: Clinical Lab Instruments **6L**

Blood Cell Counter, Electron Microscope, Colorimeter, Autoanalyser, Flame photometer, PH measurement/Blood Gas Analyzer for measurement of pH, pO2 & pCO2, Pulse Oximeter, Introduction to Dialysis System. Electrical Safety of Instruments: Grounding and Shielding, Issues of Noise Pollution around Hospitals.

Unit VI: Radiology Instrumentation & Biotelemetry **6L**

Introduction to Radiology Instrumentation such as X-Ray Machine, Computer Tomography, PET, MRI Machine, Ultrasonic Doppler Machine, 2D echo, Fitness band.

Laser applications in Biomedical. Electronics in dental field: Digital OPG Machine, Orthodontic Welder.

Biotelemetry: Introduction to Biotelemetry, Physiological Parameters adaptable to biotelemetry, components of Biotelemetry system, Implantable Units, Application of Telemetry in Patient Care.

Text Books

1. Carr and Brown, Biomedical Instrumentation.
2. Cromwell, Biomedical Instrumentation and Measurement, PHI.

Reference Books

1. Webster, Application and Design of Medical Instruments.
2. R. S. Khandpur, Biomedical Instrumentation.

404205 ELECTIVE II

Teaching Scheme
Lecture:3hr/week

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

OPTIMIZATION TECHNIQUES

Course Objectives:

- To study basic concept of optimization technique and problems.
- To understand classical optimization techniques.
- To solve problems on linear programming and non-linear programming.
- To study various algorithms for solving optimization techniques problems.

Course Outcomes:

After successful completion of the course students will be able to

1. Understand basic concept of optimization technique and problems.
2. Understand classical optimization techniques.
3. Solve problems on linear programming and non-linear programming.
4. Analyze various algorithms for solving optimization techniques problems.

UNIT I: Introduction to Optimization **6L**

Motivation, mathematical review, Basic Concepts of Optimization-Convex and Concave Functions, Necessary and sufficient conditions for Stationary Points, Formulation of Various Optimization Problems, Classification of optimization problems.

UNIT II: Classical optimization Techniques **6L**

Optimization of one-dimensional Functions, Multivariable Optimization with no constraints: semi defined case, saddle point, Multivariable Optimization with equality constraints: Solution by direct substitution, solution by method of constrained variation. Multivariable Optimization with inequality constraints: Kuhn-Tucker conditions.

UNIT III: Linear Programming **6L**

Standard form of Linear Programming problem, Definitions and theorems, Solution of a linear simultaneous equation, Pivotal reduction of general system of equation, Simplex algorithm: Identifying an optimal point, improving a non optimal basic feasible solution.

UNIT IV: Nonlinear Programming I **6L**

One dimensional minimization methods: Elimination Methods, Unrestricted search, Exhaustive search, Dichotomous search, interval halving method. Interpolation methods: Quadratic interpolation, Cubic interpolation. Direct root method: Newton's method, Quasi-Newton's method, Secant Method.

UNIT V: Nonlinear Programming II **6L**

Unconstrained optimization Techniques: Direct Search Methods, Random Search, Grid Search, Univariate search, Powell's method. Indirect Search: Gradient of a function, steepest descent method, Conjugate gradient Method

UNIT VI: Nonlinear Programming III **6L**

Constrained optimization Techniques: Necessary and Sufficient Conditions for Constrained Optimum, Quadratic Programming, Generalized Reduced Gradient Method.

Text Books:

1 Singiresu S. Rao, "Engineering Optimization- Theory and Practice" Fourth Edition, 2009 by John Wiley & Sons, Inc.
2 G.V.Rekllaitis, A.Ravindran, Schechter and K.M.Ragsdell, "Engineering Optimization-Methods and Applications", John Wiley, New York (1983)

Reference Books:

1 Edgar, Himmelblau and Lasdon, "Optimization of chemical processes", McGraw Hill, International edition, 2001.
2 R. Fletcher, "Practical Optimization (2nd Edition)", John Wiley & Sons, New York, 1987.
3 M.S.Bazaraa ,H.D.Sherali and C.Shetty , "Nonlinear Programming, Theory and Algorithms", John Wiley and Sons, New York, 1993.

404205 ELECTIVE II

Teaching Scheme
Lecture: 3hr/week

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

COMPUTER MODELING AND SIMULATION

Course Objectives:

- To study different methods of computer modeling.
- To study different methods of computer simulation.
- To study real time applications of computer modeling and simulation.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand methods for modeling of systems using discrete event simulation.
2. Understand the importance of simulation in IT sector, manufacturing, telecommunication, and service industries etc.
3. Formulate simulation model for a given problem and perform simulation analysis of the system.

Course contents:

UNIT I: Simulation Techniques 6L

Introduction to Simulation -Simulation Examples: Simulation of queuing systems, inventory systems and other examples - General Principles: Concepts in discrete event system simulation - List Processing.

UNIT II: Queueing Systems 6L

Simulation of Queueing Systems: Queueing System Characteristics - Queueing Notation - Transient and Steady-State Behaviour of Queues - Long-Run Measures of Performance of Queueing Systems - Steady- State Behaviour of Infinite-Population Markovian Models - Network of Queues.

UNIT III: Inverse Transformation Techniques 6L

Random-Number Generation: Properties of Random Numbers - Generation of Pseudo-Random Numbers - Techniques for Generating Random Numbers - Tests for Random Numbers. Random Variate Generation: Inverse Transformation Technique:- Uniform Distribution - Exponential Distribution - Weibull Distribution - Triangular Distribution - Empirical Continuous Distribution - Discrete Distribution - Direct Transformation for the Normal Distribution - Convolution Method for Erlang Distribution - Acceptance-Rejection Technique: Poisson Distribution - Gamma Distribution.

UNIT IV: Simulation Model **6L**

Input Data Analysis: Data Collection - Identifying the Distribution with Data - Parameter Estimation - Goodness-of- Fit Tests: Chi-Square Test - Kolmogorov-Smirnov Test; Selecting Input Models without Data - Multivariate and Time-Series Input Models. Verification and Validation of Simulation Models: Model Building, Verification and Validation - Verification of Simulation Models - Calibration and Validation of Models:- Face Validity - Validation of Model Assumptions - Validating Input-Output Transformations - Input-Output Validation using Historical Input Data - Input-Output . Validation using a Turing Test.

UNIT V: Output data analysis **6L**

Output Data Analysis: Stochastic Nature of Output Data - Types of Simulation with respect to Output Analysis - Measures of Performance and their Estimation - Output Analysis for Terminating Simulations - Output Analysis for Steady-State Simulation

UNIT VI: Case studies **6L**

Case Studies: Simulation of manufacturing systems, Simulation of Material Handling system, Simulation of computer systems, Simulation of super market, Cobweb model, and any service sectors.

Text Books:

1. J. Banks, J. S.Carson II and B. L. Nelson, 1995, Discrete-Event System Simulation, 2nd Edition, Prentice Hall of India, New Delhi.
2. Averill M.Law and W.David Kelton, 1991, Simulation Modeling & Analysis, 2nd Edn., Tata McGraw Hill.

Reference Books:

1. Geoffrey Gardon, 1992, System Simulation, 2nd Edn., Printice Hall of India.
2. Narsingh Deo, 1979, System Simulation with Digital Computers, Prentice Hall of India.
3. C.Dennis Pegden, Robert E.Shannon and Randall P.Sadowski, 1995, Introduction to Simulation using SIMAN, 2nd Edn., Tata McGraw-Hill.

404205 ELECTIVE II

Teaching Scheme
Lecture: 3hr/week

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

DIGITAL SIGNAL PROCESSOR TMS320C67X

Course Objectives:

- To study DSP processor
- To study detail architecture of TMS320C67X
- To study applications of TMS320C67X

Course Outcomes:

After successfully completing the course students will be able to

1. Understand concept of DSP processors.
2. Understand architecture of TMS320C67X
3. Use TMS320C67X Microcontroller for general and industrial applications

Course contents:

Unit I: Architecture 6L

Introduction, Computer Architectures for signal processing, General purpose Digital signal Processors, selecting digital signal processors, Special purpose DSP Hardware, Architecture of TMS320C67X, Features of C67X processors, CPU, General purpose register files, Functional units and operation, Data paths, Control register file.

Unit II: Memory 6L

TMS320C67X Functional units, Internal memory, External memory, on chip peripherals, peripheral register descriptions, signal groups description, device configurations, cache configuration (CCFG) register description

Unit III: Interrupts 6L

Interrupts, Instruction set and addressing modes, Fixed point instructions, Floating point instructions, Conditional operations, Parallel operations, Pipeline operations, Code Composer studio

Unit IV: Communication 6L

PLL and PLL controller, power-down mode logic, multichannel audio serial port (McASP) peripherals, I2C.

Unit V: General applications of TMS320C67X 6L

Adaptive filtering, Convolution, Correlation, Digital filtering, Fast Fourier transforms, Hilbert transforms, Waveform generation, Windowing.

Unit VI: Industrial applications of TMS320C67X **6L**

Numeric control, Power-line monitoring, Robotics, Security access.

Reference: TMS320C67X datasheet : www.ti.com

404206 LAB PRACTICE –I

Teaching Scheme
Practical: 4 Hours/Week

Examination scheme
Term Work: 50 Marks
Practical: 50 Marks

ADVANCED POWER ELECTRONICS

List of Experiments:

Perform any 10 experiments

1. Dual converter (Single phase/ Three phase)
2. Power Factor improvement techniques for single phase converters (SAC, EAC, PWM)
3. Study of 1 phase to 1 phase/ 3 phase to 1 phase Cycloconverter
4. Feedback Controlled DC Motor Drive.
5. Chopper fed 4-Quadrant reversible DC drive.
6. Microcontroller based DC drive.
7. V/F controlled three phase induction motor drive.
8. Stepper motor drive.
9. Servo motor drive.
10. BLDC motor drive.
11. Simulation of closed loop controlled DC drive using PSIM/MATLAB.
12. Simulation of three phase induction motor drive using PSIM / MATLAB/ MathCad.
13. Wind Power System
14. Solar Power System.

ELECTRONIC SYSTEM DESIGN

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.

404207 LAB PRACTICE -II

Teaching Scheme:
Practical: 4 Hrs/week

Examination Scheme:
PR: 50Marks
TW:50Marks

VLSI DESIGN

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.

ELECTIVE I

Experiments to be chosen based on Elective I.

404208 PROJECT PHASE-I

Teaching Scheme:
Tutorial: 2Hrs/week

Examination Scheme:
OR: 50 Marks

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

2. Selection and approval of topic
Topic should be related to real life application in the field of Electronics OR
Investigation of the latest development in a specific field of Electronics or Communication or Signal Processing
OR
The investigation of practical problem in manufacture and / or testing of electronics or communication equipment
OR
The Microprocessor / Microcontroller based applications project is preferable.
OR
Software development project related to VHDL, Communication, Instrumentation, Signal Processing and Agriculture Engineering with the justification for techniques used / implemented is accepted.
OR
Interdisciplinary projects should be encouraged. The examination will be conducted independently in respective departments.

3. Note:
The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by internal and external guides.
Project report must be submitted in the prescribed format only. No variation in the format will be accepted. One guide will be assigned at the most 3 project groups.

4. Oral is based on presentation of the project work carried throughout the semester.
Assessment is based on the project topic. It consists of Literature Survey and basic project work. The abstract of the project should be submitted before Term work assessment.
The report consists of the Literature Survey, basic project work and the size of the report should be maximum of 40 pages. The examination is conducted by two examiners (internal and external) appointed by the university. The examiners appointed must have minimum 5 years of experience with UG qualification or 2 years with PG qualification.
5. The assessment is based on Innovative Idea, Depth of understanding, Applications, Individual contributions, presentation, and the grade given by the internal guide based on the work carried out in a semester.

6. A certified copy of report is required to be presented to external examiner at the time of final examination.

AUDIT COURSE 5

FOREIGN LANGUAGE (JAPANESE MODULE 3)

About Course: With changing times, the competitiveness has gotten into the nerves and ‗Being the Best' at all times is only the proof of it. Nonetheless, ‗being the best' differs significantly from Communicating the best'. The best can merely be communicated whilst using the best suited Language!

Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer's companion in current times with an assertion of a thriving future. Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market & find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the ‗resume' since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it. The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcome:

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

- Have ability of basic communication.
- Have the knowledge of Japanese script.
- Get introduced to reading, writing and listening skills for language Japanese.
- Develop interest to pursue professional Japanese Language course

Course Contents:

1. Introduction to Kanji Script, Describing one's daily routine. To ask what someone does. Expressions of Giving & Receiving.

2. Adjectives (Types of adjectives), Asking impression or an opinion about a thing / person / place that the listener, has experienced, visited, or met, Describing things / person / places with the help of the adjectives.

3. Expressions of Like & Dislikes. Expressing one's ability, hobby, Comparison between objects, persons & cities, which resulted from a certain action in the past.

References:

1. Minna No Nihongo, Japanese for Everyone‖, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
2.http://www.tcs.com(http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx

AUDIT COURSE 5
CRITICAL THINKING

Course Objective:

- To make students a better thinker, sharpen their mind, clarify thoughts, and help them to make smarter decisions (especially about career).
- To overcome shortcomings of fresh graduates that they are incapable of "independent decision making". We intend to overcome this shortcoming

Course Outcome:

- Students can expect to be smarter, stronger and more confident thinkers.
- Students can embark on a life-long journey of "self-directed learning".

Course Content:

Unit No.	Topics and their descriptions

1	An introduction to Critical Thinking
	• What is Critical Thinking
	  ○ It's role in problem solving
	  ○ The difference between a critical thinker and one who is not
	• Barriers that prevent us from thinking critically

2	The importance of being logical • Key concepts of "Thinking fast and slow" - Logical fallacies & Mistakes we make when do not think "statistically"
3	Patterns in deductive logic • Hypothetical syllogism - Categorical syllogism(Set theory concepts) • Argument by elimination, based on maths, based on definition • Evaluating deductive arguments – validity & soundness
4	Argumentation – the foundation of critical thinking • Recognizing arguments and their structural components & indicator words Analysis of arguments • Categorical logic - VENN Diagrams to test logical "validity" • Propositional logic - Complex statements & arguments • Truth Tables – to test validity of complex statements
5	Inductive reasoning • The importance of inductive reasoning in hypothesis testing, analytics, belief systems, . • Evaluating the strength of an inductive argument
6	Basic probability concepts • Probability & frequency distributions • Important parameters & measures • Bayesian probability

References:

1. "Thinking Fast and Slow"- Daniel Kahneman – Penguin Books
2. "Critical Thinking – Students Introduction" - Bassham, Irwin, Nardone, Wallace – McGraw Hill

SEMESTER - II

404209 COMPUTER NETWORKS AND SECURITY

Teaching Scheme
Lecture:3hr/week

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

Course Objectives:

- To make students able to describe how computer networks are organized with the concept of layered approach.
- To make students able to pursue advanced courses in computer networking.
- To develop skills to design simple computer networks.

Course Outcomes:

After successfully completing the course students will be able to

1. Design, implement, and analyze simple computer networks.
2. Identify, formulate, and solve network engineering problems.
3. Use techniques, skills, and modern networking tools necessary for engineering practice.
4. Have a basic knowledge of cryptography and network security

Unit I: Introduction to Computer Networks 6L

Definition & Uses of computer Network, Network Hardware-LAN, WAN, MAN & Internet, Network Software-design Issues for layers, Service primitives and relationship of services to Protocols, Reference models-OSI &TCP/IP, network architectures introduction, Addressing types-Physical, Logical & port address, Protocols and Standards.

Unit II: Physical Layer 6L

Physical layer-Data rate limits, Transmission media-guided and Unguided, Switching systems- Circuit switching, Datagram Switching & Virtual circuit switching, Example of networks- X.25, Frame Relay & ATM, Structure of circuit and packet switch networks, cable modem and DSL technologies, Communication satellites (LEO/MEO/GEO), Introduction to physical layer in 802.11 LAN & 802.15 WPAN.

Unit III: Data link layer 6L

Data link layer: Framing, Flow & Error control Protocols, noiseless channels, Noisy channels, HDLC, PPP, Multiple access techniques-random access, controlled access & Channelization, Ethernet types-bridged, Switched, Full duplex, Fast & gigabit Ethernet. Introduction to Data link layer in 802.11 LAN, Connecting devices like passive hubs, repeaters, Active hubs, Bridges, Two-layer Switches, Routers, three layer switches, Gateway etc., Backbone networks, Virtual LANs.

Unit IV: Network Layer and Transport Layer 6L

Network Layer: IPv4 address, IPv6 address, Address mapping-ARP, RARP & DHCP, IPv4 datagram detail format, IPv6 datagram detail format, ICMP, IGMP, Network layer issues like

Delivery, forwarding, intradomain and Interdomain routing, Routing algorithms like Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Path vector routing etc., Simple Router architecture. Transport layer-Process to process delivery, Connection oriented & Connectionless Transport, UDP, TCP, congestion control and Quality of Service.

Unit V: Application Layer **6L**

Application layer protocols and applications like Ping, FTP, telnet, http (www), SMTP, SNMP, Trace route, TFTP, BOOTP, DNS, NFS, RPC, X-server, E-mail, Introduction to streaming Audio/Video,P2P file sharing, Introduction to socket & Socket Interface, Introduction to HTML programming.

Unit VI: Basics of Network Security and Network administration **6L**

Network security: Introduction to Cryptography, Secret key algorithm, public key algorithm, Hash Functions, Basics of Security Requirements/Services/Dimensions, Basics of Security attacks, Basics of Security mechanisms / solutions. Network Administration: UTP Cabling for PC to PC communication, Network tester, network monitoring, Protocol Analyzer, Network Simulation, internet access through Dialup/DSL/Leased Line/Mobile handset.

Text Books

1.Behrouz A. Forouzan, Data Communications and Networking, 4th Edition, TATA McGraw Hill
2. Andrew Tenenbaum, Computer Networks, 4th Edition, Pearson Education.

Reference Books

1. William Stallings, Computer Networks and Cryptography, 3rd edition, Pearson Education
2. Behrouz A. Forouzan, TCP/IP protocol Suit, 3rd edition, TATA McGraw Hill
3. Stevens, TCP/IP illustrated Volume - I & II, Pearson education.
4. Feibel Werner, Encyclopaedia of networking, Pearson education.
5. Frank J. Derfler, Practical Networking, 2nd edition, QUE international Publishing.
6. Atul Kahate, Cryptography and Network Security, 2nd edition, TATA McGraw Hill
7. Kenneth Mansfield, Computer Networking from LANs to WANs: Hardware, Software & Security, CENGAGE learning.
8. Nurul Sarkar, Computer Networking & Hardware concepts, Information Science Publisher, USA.
9. Kurose & Ross, Computer Networking: A top Down Approach featuring the Internet. 3rd edition, Pearson Education

404210 PROCESS INSTRUMENTATION

Teaching Scheme
Lecture: 4 hr/week

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

Course Objectives:

- To make the students familiar with different process dynamics in Process industries and different control schemes generally used to get best output.
- To introduce process control action which are helpful for process design
- To aware various analysis and design methods for multivariable systems.
- To introduce about state process control and Batch process

Course Outcomes:

After successfully completing the course students will be able to

1. Handle any kind of process by framing it in block diagram, mathematical model and different process variables.
2. Handle different types of controller like electronic, pneumatic and hydraulic.
3. Implement different control schemes to various processes.
4. Design relay logic for various processes.
5. Understand batch process with an example
6. Design process control scheme

Unit I: Process Characteristics 8L

Types of processes (dead time single & multi capacity, self & non-self-regulating, interacting & non-interacting, Linear & non-linear), Process gain, process reaction curve, process time constant & constant step analysis method for finding time constant, dead time, dynamic elements in control loops

Unit II: Process Control Action 8L

Elements of process control, Controller Principle, Process Characteristics, Control system parameters, discontinuous, continuous and composite controller modes/actions (P,I,D,PI,PD and PID).

Unit III: Process Controllers and Tuning 8L

General features, construction and working of Pneumatic, Hydraulic and Electronic controller. Process reaction curve method, Zigler-Nichols method, Cohencoon correction for quarter amplitude, Frequency response method, Relay based tuning.

Unit IV: Control Schemes 8L

Feedback, feed forward, cascade, ratio, split range, selective control, adaptive control, and model based control.

Unit V: Multivariable and Discrete-State Control **8L**

Block diagram analysis of multivariable systems, Interaction, Tuning of Multivariable controllers, relative gain analysis, Discrete state process control characteristics of the system, Introduction to Batch Process with example

Unit VI: Process control Design **8L**

Defining the problem, measurements, final elements, Process Operability, Control Structure, Control Algorithm, Control for safety, performance Monitoring. Managing the Design Process: Sequence of design steps, hierarchy of control structure, process Decomposition, Integrating the control design methods, key guidelines.

Text Books:

1. Curtis D. Johnson, *Process Control Instrumentation Technology*, PHI /Pearson Education 2002.
2. F.G. Shinsky, *Process Control System*, TMH.

Reference Books:

1. M.Chidambaram, *Computer Control of Processes*, Narosa, 2002.
2. Deshpande P.B and Ash R.H, *Elements of Process Control Applications*, ISA Press, New York,1995.
3. George Stephenopolos, *Chemical process control*, PHI-1999.
4. D. Patranabis, *Principles of Process Control*, Second edition, TMH.
5. N.E. Battikha,Condensed Handbook of Measurement and Control,3rd Ed., ISA Publication.
6. Donald P. Eckman, Automatic Process Control, Wiley Eastern Ltd.

List of Experiments:

1. Design and test of ON-OFF Controller. (Simulation+Hardware).
2. Testing of controller modes (pure and composite) on a PID controller (Simulation).
3. Tuning of a PID controller (Simulation).
4. Study of various pneumatic and hydraulic system components
5. Development, implementation and testing of pneumatic circuits. (simulation+Hardaware)
6. Development, implementation and testing of hydraulic circuits(simulation+Hardaware)
7. Analysis of temperature control loop Using PID controller (Hardware)
8. Analysis of pressure control loop Using PID controller (Hardware)
9. Analysis of flow control loop Using PID controller (Hardware)
10. Design and implementation of cascade controller for a given application.
11. Design & implementation of feed-forward controller for a given application.

404211 ELECTIVE III

Teaching Scheme
Lecture:3 hr/week

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

AUTOMOTIVE ELECTRONICS

Course Objectives

1. To understand the concepts of Automotive Electronics and it's evolution and trends
2. Automotive systems & subsystems overview.
3. To understand sensors and sensor monitoring mechanisms aligned to automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.
4. To understand, design and model various automotive control systems using Model based development technique.
5. To understand role of Microcontrollers in ECU design and choice of appropriate Hardware and Software.
6. To describe various communication systems, wired and wireless protocols used in vehicle networking.
7. To understand Safety standards, advances in towards autonomous vehicles.
8. To understand vehicle on board and off board diagnostics.

Course Outcomes

After successfully completing the course students will be able to:

1. Obtain an overview of automotive components, subsystems, design cycles, communication protocols and safety systems employed in today's automotive industry
2. Interface automotive sensors and actuators with microcontrollers
3. Develop, simulate and integrate control algorithms for ECUs with hardware

Course contents:

UNIT I: Automotive Systems, Design Cycle and Automotive Industry Overview 6L

Overview of Automotive Industry: Leading players, Automotive supply chain, Global challenges, Role of technology in Automotive Electronics and interdisciplinary design, Tools and processes.

Introduction to Modern Automotive Systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles. Spark and Compression Ignition Engines: Ignition systems, Fuel delivery systems, Engine control functions, Fuel control, Electronic systems in engines.

Automotive transmissions: Transmission fundamentals, Types MT, AT, CVT and DCT. Vehicle Braking Fundamentals: Vehicle dynamics during braking, Hydraulic brake system components, Introduction to antilock braking systems.

Steering Control: Steering system basics, Fundamentals of electronically controlled power steering, Electronically controlled hydraulic systems and electric power steering systems, Passenger safety and convenience, Occupant protection systems, Tyre pressure monitoring systems.

ECU Design Cycle: V-Model development cycle, Components of ECU, Examples of ECU on chassis, and in body electronics, infotainment and clusters. Overview of hybrid vehicles.

UNIT II: Automotive Sensors and Actuators 6L

Systems Approach to Control and Instrumentation: Concept of a system, Analog and digital systems, Basic measurement systems, Analog and digital signal processing, Sensors, Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in ECUs, Avoiding redundancy, Sensor modeling, Smart Nodes.

Examples of Sensors: Accelerometers, Wheel speed, Brake pressure, Seat occupancy, Engine speed, Steering wheel angle, Vehicle speed, Throttle position, Turbine speed, Temperature, Mass air flow (MAF) rate, Exhaust gas oxygen concentration, Throttle plate angular position, Crankshaft angular position/RPM, Manifold Absolute Pressure (MAP), Differential exhaust gas pressure and Air bag sensors.

Actuators used: Solenoids, Various types of electric motors and piezoelectric force generators.

Examples of Actuators: Relays, Solenoids and motors. Chassis control systems and Automatic transmission control systems.

UNIT III: Microcontrollers/Microprocessors in Automotive domain 6L

Critical review and overview of development within the automotive context of microprocessors, microcontrollers and digital signal processors (architecture of 8/16 bit microcontrollers with emphasis on Ports, Timer/Counters, Interrupts, Watchdog timers and PWM). Criteria to choose the right microcontroller/processor for various automotive applications. Understanding various architectural attributes relevant to automotive applications. Automotive grade processors viz. Renesas, Quorivva, Infineon. Understanding and working on tool chains for different processors. Development of control algorithms for different automotive subsystems, Look-up tables and maps, Need of maps, Procedure to generate maps, Fuel maps/tables, Ignition maps/tables, Engine calibration, Torque table, Dynamometer testing.

UNIT IV: Communication protocols, Infotainment systems 6L

Communication protocols: Overview of automotive communication protocols, CAN, LIN , Flex Ray, MOST , Ethernet, D2B and DSI, Communication interface with ECUs, Interfacing techniques and Interfacing with infotainment gadgets, Relevance of Protocols such as TCP/IP for automotive applications, Wireless LAN standards such as Bluetooth, IEEE 802.11x communication protocols for automotive applications. Infotainment Systems: Application of telematics in automotive domain, Global positioning systems (GPS) and General packet radio service (GPRS).

UNIT V: Automotive Control Systems and Model Based Development 6L

Automotive Control System & Model Based Development: Control system approach in Automotive Electronics, Analog and digital control methods, Modelling of linear systems, System responses, Modelling of Automotive Systems with simple examples. Model based Development: Introduction to MATLAB, Simulink and SIMSCAPE tool boxes, Model-Based Design for a small system, Motor Model, Generator Model, Controller Model, SimDriveline, Introduction to Simulink simulations, Exploring the system response using different control methods, Tuning the system, Exploring system limitations, Understanding and refining motor models, Real time simulations on a simple target (Arduino / Rasberry Pi etc), Study of modeling and simulation of any one Automotive System.

UNIT VI: Safety Systems in Automobiles and Diagnostic Systems 6L

Active Safety Systems: ABS, TCS, ESP, Brake assist, etc. Passive Safety Systems: Airbag systems, Advanced Driver Assistance Systems (ADAS): Combining computer vision techniques as pattern recognition, feature extraction, learning, tracking, 3D vision, etc. to develop real-time algorithms able to assist the driving activity. Examples of Assistance Applications: Lane Departure Warning, Collision Warning, Automatic Cruise Control, Pedestrian Protection, Headlights Control, Connected Cars technology and trends towards Autonomous vehicles.

Functional Safety: Need for safety systems, Safety concept, Safety process for product life cycle, Safety by design, Validation

Diagnostics: Fundamentals of Diagnostics, Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system, Fault finding and corrective measures, Electronic transmission checks and Diagnosis, Diagnostic procedures and sequences, On-board and off-board diagnostics in Automobiles, OBDII, Concept of DTCs, DLC, MIL, Freeze Frames, History Memory, Diagnostic tools, Diagnostic protocols KWP2000 and UDS.

Text Books:

1. Williams. B. Ribbens: “Understanding Automotive Electronics”, 6th Edition, Elsevier Science, Newnes Publication, 2003.
2. Robert Bosch: “Automotive Electronics Handbook”, John Wiley and Sons, 2004.

Reference books:

1. Ronald K Jurgen: “Automotive Electronics Handbook”, 2nd Edition, McGraw-Hill, 1999.
2. ames D. Halderman: “Automotive Electricity and Electronics", PHI Publication.
3. Terence Rybak & Mark Stefika: “Automotive Electromagnetic Compatibility (EMC)”, Springer, 2004.
4. Allan Bonnick: “Automotive Computer Controlled Systems, Diagnostic Tools and Techniques”, Elsevier Science, 2001.
5. Uwe Kieneke and Lars Nielsen: “Automotive Control Systems: Engine, Driveline and Vehicle”, 2nd Edition, Springer Verlag, 2005.
6. David Alciatore & Michael Histand: "Introduction to Mechatronics and Measurement Systems (SIE)”, TMH, 2007.

7. Iqbal Husain: "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003.
8. Tom Denton: "Advanced Automotive Diagnosis", 2nd Edition, Elsevier, 2006.
9. G. Meyer, J. Valldorf and W. Gessner: "Advanced Microsystems for Automotive Applications", Springer, 2009.
10. Tracy Martin: "How to Diagnose and Repair Automotive Electrical Systems" Motor Books / MBl Publishing Company, 2005.
11. Mehrdad Ebsani, Ali Emadi & Yimin Gao: "Modern Electronic Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", 2nd Edition, CRC Press, 2009.
12. Marc E. Herniter and Zac Chambers: "Introduction to Model Based System Design", Rose-Hulman Institute of Technology.

List of Experiments

Note: Experiments 1 to 6 are compulsory; perform any three experiments from 7 to 12.

1. Develop and implement wiper control system using microcontroller.
2. Interface accelerometer sensor to microcontroller and display data.
3. Simulate and implement Vehicle indoor lighting system.
4. Study and implement CAN protocol to transmit data between two ECUs
5. Study the functional design aspects of Hybrid Automotive Systems.
6. Implement any one automotive application using VM Lab software

Using MATLAB Simulink/Stateflow, design :

7. Fault-Tolerant Fuel Control System
8. Automatic Climate Control System
9. Vehicle Electrical System
10. Manage the Data for a Fuel Control System
11. Anti-Lock Braking System
12. Power Window Control

404211 ELECTIVE III

Teaching Scheme
Lecture:3 hr/week

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

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Objectives:

- To learn various types of algorithms useful in Artificial Intelligence.
- To understand the concepts of machine learning.
- To understand the applications in the field of AI and machine learning.

Course Outcomes:

After successfully completing the course students will be able to

- Develop AI algorithms for various applications.
- Design neural networks
- Use machine learning techniques for various applications

Unit I: Foundation 6L

Introduction and Intelligent systems, What Is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Applications of A.I. Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents, How the components of agent programs work.

Unit II: Searching 6L

Solving Problems by Searching**,** Depth-first search, Breadth-first search, Greedy best-first search A* search, Local Search Algorithms, Hill-climbing search, Simulated annealing search, Local beam search, Genetic algorithms, AND-OR search trees, Searching with Partial Observations.

Unit III: Knowledge Representation 6L

First order logic, representation revisited, Syntax and semantics for first order logic, Using first order logic, Knowledge engineering in first order logic, Inference in First order logic, prepositional versus first order logic, unification and lifting, forward chaining, backward chaining.

Unit IV: Machine learning 6L

Need of machine learning, Applications, Linear classifiers, decision tree, Bayesian Networks.

Unit V: Neural networks 6L

Artificial neural networks, types of ANN, multilayer neural network, back propagation algorithm, CNN, RBF.

Unit VI: Supervised learning **6L**

Forms of Learning, Supervised Learning, Learning Decision Trees, support vector machine, unsupervised learning, k-Means Algorithm.

Text Books:

1. Artificial Intelligence: A Modern Approach, Stuart Russel, Peter Norvig.
2. Artificial Intelligence and Machine Learning, by Chandra S.S.V, PHI

Reference Books:

1. Artificial Intelligence, 2nd Edition, Rich and Knight
2. Machine Learning, Tom M. Mitchell
3. Building Machine Learning Systems with Python, Richert & Coelho

List of Experiments:

Perform any 8 experiments from the list given below:

1. Implementation of any 2 uninformed search methods with some application.
2. Implement A* approach for any suitable application.
3. Implement genetic algorithm for any suitable application
4. Implementation of Unification algorithm
5. Two clusters of data, belonging to two classes, are defined in a 2-dimensional input space. Classes are linearly separable. Construct a Perceptron for the classification of data.
6. Implement Neural network for any suitable application.
7. Implement CNN network for any suitable application.
8. Implement RNN network for any suitable application.
9. Design, Implement SVM for classification with proper data set of your choice. Comment on Design and Implementation for Linearly non separable Dataset.
10. Implement K - Nearest Neighbor Classifier on Data set of your choice.

404211 ELECTIVE III

Teaching Scheme
Lecture:3 hr/week

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

AUDIO VIDEO ENGINEERING

Course Objectives:

1. Provide students with a strong understanding of the fundamental principles and practical applications of audio and video engineering with latest updates.
2. Make students familiar with basics of Digital television, High Definition Television and various display Devices
3. Provide the latest developments in audio-video engineering with emphasis on HDTV, DTV, LCD, Plasma etc
4. Provide hands-on practice on TV kits to study normal operation and fault diagnosis.

Course Outcomes:

After successfully completing the course students will be able to

1. Describe and differentiate working principles of Digital TV, HDTV etc.
2. Understand the concept of basic television signal processing
3. Identify globally accepted color TV standards.
4. Demonstrate the need of audio and video compression techniques in real life.

Course contents:

UNIT I: Vision Characteristics, Scanning System and Analog Video 6L

Introduction To Basic Television Systems, Characteristics of Human Eye, Resolution Of Brightness, Perception, Persistence of Vision Scanning, Aspect Ratio, Flicker, The Keel Factor, Horizontal And Vertical Resolution, Video Bandwidth, Interlaced Scanning, Composite Video Signal: Video Signal Components, Video Modulation, Vestigial Side Band Signal, Sound Modulation and Inter-Carrier System, Reception of Vestigial Side Band Signal, Television Broadcast Channels And Standards.

UNIT II: Colour Television and standards 6L

Color television: Compatibility considerations, Perception of brightness and color, Color theory, chromaticity diagram, Luminance signal (Y), Color difference signal, Formation of chrominance signal, Color subcarrier frequency.

Standards: NTSC, PAL, SECAM colour system, generalized colour TV receiver block diagram, study of functionality of each block, alignment issues.

Digital video: Concept, sampling of video signal, Digitization, pixel array, Viewing distance and angle, composite vs component video.

UNIT III: Advanced TV systems and techniques **6L**

Introduction to UHDTV: 4K and 8K, IPTV/web TV, smart TV, Wi-Fi TV, digital surveillance, 3D TV concept, over view of H.264 features, camcorders, webcams, HD Video projectors, Video Intercom systems/ Video door phones.
Display techniques: LED, LCD, OLED, 3D, 4D, 5D, 7D, 9D, Smart whiteboard

UNIT IV: Digital TV **6L**

Introduction to Digital TV, Digital TV signals and parameters, Digital TV Transmitters, MAC signals, advanced MAC signal transmission, Digital TV receivers, Video compression: MPEG 2, MPEG 4. Video restoration, Video streaming, DTH, comparison of SDTV, EDTV and HDTV.

UNIT V: Acoustics **6L**

Human Hearing and sound, frequency range, dynamic range, masking, digital representation of sound wave, intensity, decibel sound level, sound waves in rooms, reverberation, room/studio acoustics as a component in speech system, PA systems, special types of microphones and speakers.

UNIT VI: Audio Engineering **6L**

Fundamentals of Audio-Video Recording: Methods of sound recording & reproduction, optical recording, CD recording, audio standards. Digital Sound Recording, CD/ DVD player, MP3 player, Blue Ray DVD Players, MPEG, MP3 Player.
Characteristics of Sound, Noise Distrotion and High Fidelity, Stereo Control, Surround Sound System, multichannel/Dolby 5.1 sound in DTV.

Text Books:

1. A.M. Dhake, Television and video Engineering, TMH Publication, 2nd Edition,2001
2. R.G.Gupta, Audio and Video Systems, McGraw Hill l Education (India), 2nd Edition,2010.

Reference Books

1. S. P. Bali, Color Television Theory and Practice, McGraw Hill Education (India),1994
2. A.M. Tekalp,Digital Video, Prentice Hall, 1995
3. R.P. Gulathi, Modern Television Practice, 4th edition, New Age International Publisher, 2014
4. Kelth jack, Video Demystified: A Handbook for the Digital Engineer,5th Edition, Newnes, 2007.

List of experiments:

Perform any eight experiments from 1-10.

1. To evaluate the fault simulation and step by step fault finding procedure of different section in color TV Receiver.
3. DTH and STB
4. Study of Digital TV pattern generator.
5. Study of HDTV/UHDTV
6. Study of Wi-Fi TV system
7. To study DVD / Blu Ray player and observe various signal waveforms.
8. Study of audio player: MP3 player
9. Study of audio and video coding scheme (soft)
10. To design and study PA system.
11. Directivity pattern of microphone/speakers.
12. Visit to TV transmitter/ Digital TV studio/ All India Radio/ TV manufacturing factory. (Compulsory)

404211 ELECTIVE III

Teaching Scheme
Lecture:3hr/week

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

Testing and Verification for SoC Design

Course Objectives:

1. To introduce design process in VLSI
2. To understand the logical and Fault simulation models
3. To learn techniques for design of testability
4. To study hardware and software verification issues for testing

Course Outcomes:

After successfully completing the course students will be able to

1. Accept challenges in VLSI Testing at different abstraction levels
2. Understand fault models for generation of test vectors.
3. Calculate observability and controllability parameters of circuit
4. Enhance testability of a circuit.
5. Use simulation techniques for designing and testing of VLSI circuits
6. Identify characteristics of verification methods.

Unit I: Introduction to Testing **6L**

Testing Philosophy, Role of Testing , Digital and Analog VLSI Testing, VLSI Technology Trends Affecting Testing, VLSI testing process and test equipment: How to Test Chips?, Automatic Test Equipment, Electrical Parametric Testing

Unit II: Fault Modeling **7L**

Defects, Errors, and Faults, Functional Versus Structural Testing, Levels of Fault Models, A Glossary of Fault Models, Single Stuck-at Fault

Unit III: Logic and Fault Simulation **7L**

Simulation for Design Verification, Simulation for Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-Value Simulation , Algorithms for Fault Simulation, Statistical Methods for Fault Simulation

Unit IV: Combinational & Sequential Circuit Test Generation **6L**

Algorithms and Representations, Redundancy Identification, Testing as a Global Problem, Significant Combinational ATPG Algorithms, Simulation-Based Sequential Circuit ATPG

Unit V: Digital DFT and scan design **6L**

Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan, Random Logic BIST

Unit VI: Boundary Scan Standard 7L

Memory BIST, Motivation, System Configuration with Boundary Scan, Boundary Scan Description Language

Text Books

1. M. L. Bushnell and V.D. Agrawal, *Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuits*, Springer, 2005
2. M. Abramovici, M. Breuer, and A. Friedman, *Digital System Testing and Testable Design*, IEEE Press, 1994

Reference Books

1. H. Fujiwara, *Logic Testing and Design for Testability*, MIT Press, 1985
2. M. Huth and M. Ryan, Logic in Computer Science, Cambridge Univ. Press, 2004
3. T. Kropf, Introduction to Formal Hardware Verification, Springer Verlag, 2000

List of Experiments:

Perform any eight using front end and backend tools

1. Write VHDL/Verilog code for MUX -D scan cell and Level Sensitive/edge triggered MUX - D scan cell.
2. Write a VHDL/Verilog code to realize functioning of clocked scan cell and LSSD scan cell design.
3. To develop an exhaustive test bench for lower level combinational designs:
   a. Adder
   b. Multiplexer.
4. To prepare a complete Test vector set for all possible stuck at faults for parity checker where the data word is of 2-bit.
5. Design and implement ATPG for given combinational circuit
6. To prepare a complete Test vector set for all possible stuck at faults for a 8-line- to-1-line multiplexer
7. To prepare a complete Test vector set for all possible stuck at faults for a 3- to-8 decoder
8. Implement a full adder using AND, OR, and NOT gates and determine the total number of single stuck-at-faults
9. Implement a full adder using AND, OR, and NOT gates and determine the total number of multiple stuck-at-faults
10. Generate and implement a minimum set of test vectors to detect all single-stuck at faults for an n-bit parity checker

404211 ELECTIVE III

Teaching Scheme:
Lectures: 3 Hrs/Week

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

OPTICAL AND MICROWAVE COMMUNICATION

Course Objectives:

- To lay the foundation for optical and microwave communication engineering.
- To understand the applications of optical and microwave communication engineering.
- To carry out the analysis of optical and microwave network.

Course Outcomes:

After successfully completing the course, students will be able to

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

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 and Detectors 6L

Introduction to optical sources: Wavelength and Material Considerations, LEDs & semiconductor LASERs: principle of working & their Characteristics, Line coding.

Introduction to optical detectors: Material Considerations, PIN, Avalanche photodiodes & photo transistors: Principle of working & characteristics, relative merits and demerits of photodiodes. Numericals based on above topics.

Unit III: Multichannel Systems 6L

Overview of WDM, WDM Components: 2 x 2 Fiber Coupler, Optical Isolators and Circulators, Multiplexers and De-multiplexers, Fiber Bragg Grating, FBG applications for multiplexing and De-multiplexing function, Diffraction Gratings, Overview of Optical Amplifiers: SOA, EDFA.

Unit IV: Microwave Devices and Components 6L

Introduction to microwaves, advantages and applications of microwaves, Basic concepts and properties of wave guides, Scattering matrix of microwave passive Network, Properties of S matrix, S matrix formulation of two-port junction, Tee junctions- H plane, E plane and EH plane Tee junctions, its S matrix and properties, Applications of Hybrid Tee junction, Directional coupler, Gyrator, Isolator, Circulator.

Unit V: High Power Microwave Sources 6L

High frequency limitations of conventional tubes, Microwave tubes, Velocity modulation, Two cavity klystron amplifier: construction and working with apple gate diagram, Multi cavity klystron amplifier, Reflex klystron: construction, working, mode curves and characteristics, Travelling Wave Tube: construction, working, advantages of slow wave structures, Magnetron: types, construction and working of Cavity Magnetron

Unit VI: Microwave Solid State Devices and Applications 6L

Unipolar and bipolar microwave transistors, Principle of operation, advantages and applications of Gunn diode, Tunnel diode, PIN diode, Varactor diode, Schottky diode, Transit time devices like IMPATT, TRAPATT diodes.

Text Books:

1. G. Keiser, "Optical fiber communication systems", McGraw-Hill, 3rd Edition, New York, 2000.
2. Mishra and Ugale, "Optical Fiber Communication: system and components", John Wiley,
   India, 2012.
3. Samuel Liao, "Microwave devices and circuit", PHI.

Reference Books:

1. G. P. Agrawal, "Fiber optic communication systems", 3rd Edition, John Wiley & Sons, New York, 2002.
2. M. Kulkarni, "Microwave and Radar Engineering", Umesh Publications.
3. A. K. Maini, "Microwave and Radar", Khanna Publishers.
4. David M. Pozar, "Microwawe Engineering" Wiley India.

List of Experiments:

1. V-I & I-P characteristics of LED.
2. Characteristics of light detector.
3. Measurement of Numerical Aperture.
4. Study of any two optical instruments: Optical Power Meter, OTDR, OSA etc.
5. Measurement of attenuation of optical Fiber Cable of Various lengths.
6. Characteristics of Reflex Klystron.
7. Characteristics of Gunn diode oscillator.
8. Measurement of coupling coefficient, Directivity and insertion loss of a Directional coupler.
9. VSWR, isolation and insertion measurement of Isolators and Circulators
10. S-parameter and VSWR measurements of Tees

404212 ELECTIVE IV

Teaching Scheme
Lecture:3 hr/week

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

ROBOTICS

Course Objectives:

- Describe the history and early beginnings of automated manufacturing & Robotics.
- Aims to Develop understanding Robotics Components.
- To study path planning and robotic programming
- Apply creative approaches to practical applications, identify technological opportunities in robotics.

Course Outcomes:

After successfully completing the course students will be able to

1. Demonstrate use of engineering methods and problem solving towards design of the specified robot.
2. Identify prerequisites of Robotics for small industrial Applications.
3. Understand robotic programming.
4. Describe Robot control & its applications.

UNIT I: Introduction 6L

Robot anatomy, Definition, law of robotics, History and Terminology of Robotics, Accuracy and repeatability of robotics, Simple problems specification of robot, speed of robot, robot joints and links, robot classification, architecture of robotics systems, robot drive system, Hydraulic, pneumatic and electric system.

UNIT II: Robot Transformation, Sensors & End effectors 6L

Transformation types: 2D, 3D. Translation- Homogeneous coordinates multiple transformations, Simple problems. Sensors in robot, Touch sensors, tactile sensor, Proximity and range sensors. Robotic vision sensor, Force sensor, Light sensors, Pressure sensors End effectors: Mechanical grippers, Slider crank mechanism, Screw type, Rotary actuators, cam type, Magnetic grippers, Vacuum grippers, Air operated grippers, Gripper force analysis, Gripper design and simple problems

UNIT III: Kinematics 6L

Rigid body Kinematics, Inverse Kinematics, Rotation matrix, Homogenous transformation matrix, Denavit - Hartenberg convention, Euler angles, RPY representation, Direct and inverse Kinematics for industrial robots for position and orientation Redundancy, Manipulator, Jacobian Joint, End effector, velocity – direct andinverse velocity analysis. Control: Individual joint computed torque.

UNIT IV: Dynamic **6L**

Lagrangian Dynamics, link inertia tensor and manipulator inertia tensor, Newton-Euler Dynamics of Robot, Newton-Euler formulation for RR & RP manipulators, Dynamics of systems of Interacting Rigid Bodies, D-H Convention, Trajectory planning for Flexible Robot, Cubic polynomial linear segments with parabolic blending, static force and moment transformation,solvability, stiffness, Singularities.

UNIT V: Path planning & Programming **6L**

Trajectory planning and avoidance of obstacles, path planning, skew motion, joint integrated motion, straight line motion, Robot languages, computer control and Robot software.

UNIT VI: Robot Control & Applications **6L**

Control approaches: oscillatory based time varying control law, control law based on vector field orientation approach. Advanced strategies of control: conventional aerial vehicle, Bidirectional X4-flyer. Applications of Fuzzy Logic and Neural network in Robot Control, Neural controllers, Implementation of Fuzzy controllers: Trajectory tracking controller. Applications of Robotic system: complex control system, vision system in complex control system. Human Robot Interaction: Architecture.

Text Books:

1. Thomas R. Kurfess, Robotics And Automation Handbook, CRC Press, 2004
2. Robotics: Appin Knowledge Solutions (Firm), Infinity Science Press , 2007

Reference Books:

1. J. Norberto Pires, Altino Loureiro and Gunnar Bölmsjo, Welding Robots -Technology, System Issues and Applications, Springer-Verlag 2006.
2. Robot Motion and Control (Recent Developments) by M.Thoma& M. Morari
3. Ben-Zion Sandler, Robotics: Designing the Mechanisms for Automated Machinery, 2nd ed. 1999 by Academic Press.
4. Mikell P. Grooveret. al. "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008.

404212 ELECTIVE IV

Teaching Scheme
Lecture:3 hr/week

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

WIRELESS SENSOR NETWORKS

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

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

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.

404212 ELECTIVE IV

Teaching Scheme
Lecture:3 hr/week

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

RENEWABLE ENERGY SYSTEMS & DSM

Course Objectives:

- To explain the concepts of Non-renewable and renewable energy systems.
- To outline utilization of renewable energy sources for both domestic and industrial applications.
- To analyze the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

Course Outcomes:

After successful completion of this course students will be able to:

1. Develop fundamental understanding about Solar Thermal and Solar Photovoltaic systems.
2. Provide knowledge about development of Wind Power plant and various operational as well as performance parameter/characteristics.
3. Explain the contribution of Biomass Energy System in power generation.
4. Use various energy measurement and audit instruments.
5. Solve simple problems on cost benefit analysis.

Unit I: Solar Energy 6L

Solar energy system, Solar Radiation Availability, Measurement and Estimation, Types of PV system: Stand-alone PV systems, Grid connected PV systems. Solar Thermal Conversion Devices and Storage, System sizing: Power and energy estimates, battery sizing, PV array sizing and Applications Solar power system. Case study on installation of Solar power plant.

Unit II: Wind Energy 6L

Wind Energy Conversion, System component, Power vs speed and TSR, Maximum power operation , Types of wind turbines, Wind generators, Wind generator drives, Installation of wind power plant, Stand alone and Grid connected wind power system, Wind data and energy estimation, Safety and environmental aspects, Case study-Applications of wind power system.

Unit III: Biomass Energy System 6L

Biomass Classification, Biomass Resources and their Energy Potential, Biomass Conversion Technologies: Anaerobic Digestion, Ethanol Fermentation, Biomass Gasification: Gasifiers, Fluidized Bed Gasifier, Biogas Technologies and their factor affecting Biogas Production, Biogas Plants: Floating and Fixed Dome type, designing of biogas plant Power Generation from Municipal Solid Waste (MSW), Land Fill Gas and Liquid Waste

Unit IV: Introduction to Demand Side Management **6L**

India's Energy Scenario, Energy supply demand balancing, Traditional supply oriented power planning, need for integrated resource planning, DSM and its relevance, load shape objectives in context to DSM, Electricity Act & regulatory framework, Technology options for DSM in Lightning, Space cooling(Ceiling Fan, AC system), Refrigeration and Water cooling)

Unit V Introduction to Demand Response (DR) **6L**

Demand Response, classification of various DR options, architecture for DR implementation, Energy management system, DR strategies for various load categories, role of communication infrastructure, MDMS, DRAS (Server & client) DR for vertical building, Demand Response as an apart of smart grid initiative

Unit VI: Load research and Energy Auditing **6L**

Load research- understanding variation in demand and supply of electricity, load forecasting, determining sector wise and end use wise load pattern

Energy Auditing- need of energy audits, types of audit, procedures to follow, data and information analysis, energy audit instrumentation, energy consumption, Outcome of energy audit and energy saving potential, action plans for implementation of energy conservation options.

Text Books:

1. Mukund R. Patel, "Wind and Power Solar System", CRC Press
2. Godfrey Boyle, "Renewable Energy", Third edition, Oxford University Press.
3. Energy Auditing made simple by Balasubramanian, Bala Consultancy Services.

Reference Books:

1. D. P. Kothari, K. C. Singal, RakeshRajan," Renewable Energy Sources and Emerging Technologies", PHI Second Edition
2. Paul Gipe, "Wind Energy Comes of Age", John Wiley & Sons Inc.
3. Donald L. Klass, "Biomass for Renewable Energy, Fuels, and Chemicals, Elsevier, Academic Press
4. S. Rao, Dr. B. B. Parulekar, "Energy Technology –Non Conventional, Renewable and Conventional", Khanna Publication

404212 ELECTIVE IV

Teaching Scheme
Lecture:3 hr/week

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

TM4C123GH6PM Microcontroller

Course Objectives:

- To study ARM cortex based Microcontroller
- To study detail architecture of TM4C123GH6PM Microcontroller
- To study applications of TM4C123GH6PM Microcontroller

Course Outcomes:

After successfully completing the course students will be able to

- Understand basic concept of ARM cortex based microcontroller
- Understand architecture of TM4C123GH6PM Microcontroller
- Use TM4C123GH6PM Microcontroller for industrial applications

UNIT I: Architecture 6L

The Cortex-M4F Processor, Block Diagram, System-Level Interface, Integrated Configurable Debug, Trace Port Interface Unit (TPIU), Cortex-M4F System Component Details.

UNIT II: Programming Model 6L

Programming Model, Processor Mode and Privilege Levels for Software Execution, Stacks, Register Map, Register Descriptions, Exceptions and Interrupts, Data Types, Memory Model, Memory Regions, Types and Attributes, Memory System Ordering of Memory Accesses Behavior of Memory Accesses, Software Ordering of Memory Accesses , Bit-Banding.

UNIT III: Exception Model 6L

Exception States, Exception Types, Exception Handlers, Vector Table, Exception Priorities, Interrupt Priority Grouping, Exception Entry and Return, Fault Handling, Fault Types, Fault Escalation and Hard Faults, Fault Status Registers and Fault Address Registers Lockup, Power Management, Entering Sleep Modes, Wake Up from Sleep Mode.

UNIT IV: Functional Description 6L

System Timer (SysTick), Nested Vectored Interrupt Controller (NVIC), System Control Block (SCB), Memory Protection Unit (MPU), Floating-Point Unit (FPU), Register Map, System Timer (SysTick) Register Descriptions, NVIC Register Descriptions, System Control Block (SCB) Register Descriptions, Memory Protection Unit (MPU) Register, Floating-Point Unit (FPU) Register Descriptions. Internal Memory, Micro Direct Memory Access

(Mdma, General-Purpose Input/Outputs (GPIOs), General-Purpose Timers, Watchdog Timers, Analog-to-Digital Converter (ADC).

UNIT V: Peripherals **6L**

Universal Asynchronous Receivers/Transmitters (UARTs), Synchronous Serial Interface (SSI), Inter-Integrated Circuit (I2C) Interface, Controller Area Network (CAN) Module, Universal Serial Bus (USB) Controller, Analog Comparators, Pulse Width Modulator (PWM), Quadrature Encoder Interface (QEI).

Unit VI: Applications **6L**

Remote monitoring, electronic point-of-sale machines, test and measurement equipment, network appliances and switches, factory automation, HVAC and building control, gaming equipment, motion control, transportation, and fire and security applications of TM4C123GH6PM Microcontroller.

Reference: TM4C123GH6PM Data sheet : https://www.ti.com

404213 LAB PRACTICE – III

Teaching Scheme:
Practical: 4 Hrs/week

Examination Scheme:
TW:50 Marks
PR: 50 Marks

COMPUTER NETWORKS & SECURITY

(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)
2. Installation and configuration of Proxy Server.
3. Installation and configuration of FTP server for FTP communication.
4. Installation and configuration of Telnet server for Telnet Communication. (Teamviewer)
5. Write a program in „C" for Encryption and Decryption (RSA Algorithm).
6. Write a program in „C" for Shortest Path algorithm.
7. Connectivity of LAN computers to Internet using Dial-Up modem/leased line Modem /Mobile Handset. (Installation and configuration).
8. Installation of Suitable Protocol Analyzing software and Analysis of Intranet activities. (Wireshark)
9. Configure RIP using packet Tracer.
10. 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.

404214 LAB PRACTICE – IV

Teaching Scheme:
Practical: 2 Hrs/week

Examination Scheme:
Pr: 50 Marks

Experiments to be chosen based on Elective III.

404215 PROJECT PHASE-II

Teaching Scheme:
Tutorial: 6Hrs/week

Examination Scheme:
TW: 150 Marks
OR: 50 Marks

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

2. Selection and approval of topic
Topic should be related to real life application in the field of Electronics OR
Investigation of the latest development in a specific field of Electronics or Communication or Signal Processing
OR
The investigation of practical problem in manufacture and / or testing of electronics or communication equipment
OR
The Microprocessor / Microcontroller based applications project is preferable.
OR
Software development project related to VHDL, Communication, Instrumentation, Signal Processing and Agriculture Engineering with the justification for techniques used / implemented is accepted.
OR
Interdisciplinary projects should be encouraged. The examination will be conducted independently in respective departments.

3. Note:
The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by internal and external guides.
Project report must be submitted in the prescribed format only. No variation in the format will be accepted. One guide will be assigned at the most 3 project groups.

4. The assessment is based on Innovative Idea, Depth of understanding, Applications, Individual contributions, presentation, and the grade given by the internal guide based on the work carried out in a semester.

5. A certified copy of report is required to be presented to external examiner at the time of final examination.

6. The examination be conducted by two examiners (internal and external-from industry or teaching staff from other university) appointed by the university.

AUDIT COURSE 6

FOREIGN LANGUAGE (JAPANESE MODULE 4)

About Course: With changing times, the competitiveness has gotten into the nerves and Being the Best‘ at all times is only the proof of it. Nonetheless, being the best differs significantly from communicating the best. The best can merely be communicated whilst using the best suitable Language!

Foreign languages like Japanese are the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer‘s companion in current times with an assertion of a thriving future. Metro cities like Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market & find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the resume since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it. The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support
- To get introduced to Japanese society and culture through language.

Course Outcome:

- On completion of the course, learner will be able to–Possess ability of basic communication.
- Possess the knowledge of Japanese script.
- Get introduced to reading, writing and listening skills for language Japanese.
- Develop interest to pursue professional Japanese Language course

Course Contents:

1. Stating existence or a presence of thing (s), person (s), Relative positions, Counters

2. Expressing one's Desire & wants, Verb groups, Asking, Instructing a person to do something

3. Indicating an action or motion is in progress, Describing habitual action, describing a certain continuing state which resulted from a certain action in the past. Express permission & prohibition

References:

1. Minna No Nihongo, "Japanese for Everyone", Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.

2.http://www.tcs.com
(http://www.tcs.com/news_events/press_releases/Pages/TCSInaugurates-Japan-centric-Delivery-Center-Pune.aspx

AUDIT COURSE 6

Technologies, Disruptions and Entrepreneurial Opportunities

Course Objectives:

- To understand the process of growth of exponential technologies and the resultant disruptive scenarios in business, social, government sectors of economy.
- To understand the few exponentially growing technologies and few business scenarios where disruptions are expected.
- To understand where the entrepreneurial opportunities are emerging and how new engineers will be able to exploit these opportunities.

Course Outcomes

1. Students will have better understanding of the process of technology trends leading to Business Disruptions and entrepreneurial opportunities.
2.Students will appreciate the technologies that they need to learn independently to better achieve their entrepreneurial career goals.

Course Contents

Unit No.	Contents
Unit 1	**Introduction** The process of emerging new technologies with exponential growth potential, how these exponential technologies lead to business disruptions, opportunities created for new businesses, destruction caused of established players, evolution of new businesses, Unicorns.
Unit 2	**Emerging Exponential Technologies** Understand Technology trends worldwide and identify the potential emerging exponential technologies like, Social, Mobile, Analytics, Computing (SMAC), Genetics, AI, 3D, Solar/Wind/Renewable, block chain.
Unit 3	**Emerging Business Disruptions and Business models** Learn business trends worldwide and identify potential business disruptions in multiple sectors like, Healthcare, Transportation, Weapons, Governance, Space, Energy, Finance and Education. Learn the new innovative business models.
Unit 4	**Identify Entrepreneurial Opportunities and Conclusions** Identify use cases and jobs to be done, customer pains and gains, solution development, prototype, problem-solution fit, product–market fit, customer development and validation.

Reference Books:

1. Innovator's Dilemma
   by Clayton Christenson(http://hbx.hbs.edu/hbx-courses/disruptive-strategy.html)
2. Disruption: Emerging Technologies and the Future of Work
   by Victor del Rosal (Paperback)
3. Mastering the Hype Cycle: How to Choose the Right Innovation at the Right Time
   by Jackie Fenn, Mark Raskino (Hardcover)
4. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses
   by Eric Ries (Hardcover)
5. Exponential Organizations: Why new organizations are ten times better, faster, and cheaper than yours (and what to do about it)
   by Salim Ismail, Michael S. Malone, Yuri van Geest (Paperback)
6. Abundance: The Future Is Better Than You Think
   by Peter H. Diamandis, Steven Kotler (Paperback)
7. Wharton on Managing Emerging Technologies
   by George S. Day and Paul J. H. Schoemaker