Savitribai Phule Pune University, Pune

BE (Electronics)

(2012 course revised syllabus)

(w.e.f. June 2015)

BE (Electronics) Structure

2012 Course w.e.f. June 2015

SEMESTER I

Subject Code	Subject	Teaching Scheme			Examination Scheme					Marks
		Lect	Tut	Pr	In Semester Assessment Phase I	Pr	Oral	TW	End Semester Examination Phase II	Total
404201	VLSI Design	3			30				70	100
404202	Electronics system Design	3			30				70	100
404203	Advanced Power Electronics	4			30				70	100
404204	Elective I	3			30				70	100
404205	Elective II	3			30				70	100
404206	Lab Practice I			4			50	50		100
404207	Lab Practice II			4		50		50		100
404208	Project Phase I		2				50			50
	Total	**16**	**2**	**8**	150	150		100	350	**750**

Elective I

1. Image Processing and Machine Vision
2. Embedded systems and RTOS
3. Biomedical instrumentation
4. Advance Measurement Systems

Elective II

1. DSP Processors
2. Robotics and Automation
3. Electronics in Agriculture
4. Mobile Communication

SEMESTER II

Subject Code	Subject	Teaching Scheme			Examination Scheme					Marks
		Lect	Tut	Pr	In Semester Assessment Phase I	Pr	Oral	TW	End Semester Examination Phase II	Total
404209	Computer Network	4			30				70	100
404210	Process Automation	4			30				70	100
404211	Elective III	3			30				70	100
404212	Elective IV	3			30				70	100
404213	Lab Practice III			4			50	50		100
404214	Lab Practice IV (Elective III)			2		50		50		100
404215	Project Work		6				50	100		150
	Total →	**14**	**6**	**6**	120	50	100	200	280	**750**

Elective III

1. Speech & Audio Signal Processing
2. Audio and Video Engineering
3. Optical and Microwave communication
4. Soft Computing

Elective IV

1. Biomedical Signal Processing
2. Nano Electronics & MEMS
3. System on chip
4. Mechatronics
5. Open Elective (Note on repetition)

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VLSI Design (404201)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Prerequisite:

- Study of basic PLDs.
- Knowledge of VHDL.

Course Objectives:

- To understand CMOS and its application in VLSI Circuits.
- To design digital circuits using VHDL.
- To implement digital circuits using CPLD/FPGA.
- To detect faults in the design.

Course Outcomes:

After successfully completing the course students will be able to

- Understand VLSI Design Flow.
- Design any digital circuit using VHDL.
- Understand the importance of testability in chip design.

Unit I : Introduction to VLSI Circuits 7L

Introduction to MOSFETs**:** MOS Transistor Theory –Device Structure and Physical Operation, Current Voltage Characteristics, Fabrication, MOS Capacitor, Body Effect, Temperature Effects, Channel Length Modulation, Latch-up.
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.
MOS Layers Stick/Layout Diagrams; Layout Design Rules, Issues of Scaling, Scaling factor for device parameters. Combinational MOS Logic Circuits: Pass Transistors/Transmission Gates; Designing with transmission gates: Primitive Logic Gates.

Unit II : Digital Circuit Design using VHDL 7L

Design of sequential circuits, asynchronous and synchronous design issues, state machine modeling (Moore and mealy machines), packages, sub programs, attributes, test benches.

Unit III : Programmable Logic Devices 6L

Complex Programmable Logic Devices – Architecture of CPLD, Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable

Interconnects, Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, and Applications of FPGAs.

Unit IV : 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 V : Floor Planning and Placement 6L

Floor planning concepts, shape functions and floor plan sizing, Types of local routing problems Area routing, channel routing, global routing, algorithms for global routing.

Unit VI : Fault Tolerance and Testability 6L

Types of fault, stuck open, short, stuck at 1, 0 faults, Fault coverage, Need of Design for Testability (DFT), Controllability, predictability, testability, built in Self Test (BIST), Partial and full scan check, Need of boundary scan check, JTAG, Test Access Port (TAP) controller.

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. Charles Roth, Digital System Design using VHDL, McGraw Hill Publication.
3. Data Sheets of PLDs.
4. Sung-Mo (Steve) Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata McGraw Hill Publication.

Electronic System Design (404202)

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Assessment:
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

- After successfully completing the course students will be able to
- Understand various stages of hardware, software and PCB design.
- Importance of product test & test specifications.
- Special design considerations and importance of documentation.

Unit I : **Introduction** 7L

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.

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Unit II : **Hardware Design- Analog** 7L

Analog Signal Conditioning: Factors affecting choice of Op-Amps in signal conditioning, applications, Need for Instrumentation Amplifiers- Case study. Error budget analysis with Case study. ADCs: Interpretation of ADC specifications from design view point, considerations in selecting references (Vref for ADC). DACs: Interpretation of DAC specifications from design view point.

Unit III :**Hardware Design- Digital** 6L

Interface examples for LED, HB LED, LCD, Keyboard, Relays (Electromagnetic and Solid State). Microcontrollers: Comparative study of different Microcontroller architectures, Factors affecting choice of Microcontroller for particular application with case study of one application. Introduction to buses and protocols used in Electronic products- I2C, SPI, CAN, Lin, Flexray

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

Different approaches to 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

Unit VI : **Fault Finding and Testing** 7L

Analyses- DC/ Operating Point Analysis, AC (Frequency Response), Transient, Sensitivity, Monte Carlo. Debugging/ Fault finding- Features and limitations of Analog CRO, DSO, 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 Leenaerts , Johan van der Tang , Cicero S. Vaucher , Circuit Design for RF Transceivers, Kluwer Academic Publishers, 2003

Advanced Power Electronics (404203)

Teaching Scheme:
Lectures: 4 Hrs/ Week

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

Course Objectives:

- To understand the operation of Dual converters, Cycloconverters and Multilevel inverters.
- Describe the structure of Electric Drive systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology.
- Study and understand the different types of drives and selection of drive and power converter for particular application.
- Study and understand the operation of electric motor drives controlled from a power electronic converter and to introduce the design concepts of controllers for closed loop operation
- Study and understand special motor drives and their control.

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

- Understand the operation of modern power converters and multilevel inverters.
- Understand the basic principles of power electronics in drives and its control, types of drives and basic requirements placed by mechanical systems on electric drives.
- Understand the operation of 1ϕ & 3ϕ converter drives for separately excited & series DC motors.
- Learn speed control of induction motor drives in an energy efficient manner using power electronics.
- Learn and understand working of cylindrical rotor motor, salient pole motor, reluctance motor and permanent magnet brushless DC motor drives.

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

Single phase and three phase dual converters: Ideal and practical dual converter, Dual converter without circulating current operation, Dual converter with circulating current operation, control schemes for non-circulating current type dual converter.
Power factor improvement of single phase converters: Phase angle control, semi converter operation of full converters, asymmetric firing, forced commutation, sequence control of series converters, comparative evaluation of schemes.
Effect of source impedance on single-phase converters with analysis.

Unit II: Modern Rectifiers & Converters **8L**

12 pulse converters, Three phase IGBT based PWM rectifier, analysis, comparison with SCR based conventional converters with respect to harmonic content, Power factor conditioning of diode rectifiers, EMI and Line Power quality problems of thyristor converters, Double sided PWM converter systems.

Unit III: Cycloconverters and Multilevel Inverters **8L**

Cycloconverters: 1 phase to 1 phase step up and step down Cycloconverter: Mid-point and bridge type Cycloconverters, 3 phase to 1 phase cycloconverters, 3 ph to 3 ph cycloconverters.
Multilevel Inverters: Concept of multilevel inverter, Types of multilevel inverter, Diode clamped, Flying Capacitor and Cascade Multilevel inverters **,** Advanced modulation Techniques, Trapezoidal, staircase, stepped, harmonic injection and delta modulation.

Unit IV: 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 with transfer function , Microprocessor based control of dc drives, Dynamic and regenerative breaking of DC motors.

Unit V : Induction Motor Drives & Control **8L**

Induction motor characteristics, Control strategies like stator voltage control, Stator frequency control, Stator voltage & frequency control, rotor resistance control ,Variable frequency Square wave VSI Drives ,Variable frequency PWM VSI Drives, Variable frequency CSI Drives ,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 VI: Synchronous Motor Drives & Special Motor Drives **8L**

Cylindrical rotor motor Drive, Salient pole motor drives, Switched reluctance motor drive, Synchronous Reluctance motor drive, Stepper motor drives, Servo motor drive, Permanent magnet brushless DC motor drive, Universal motor drive.

Text Books

1**.** Power Electronics Circuit Devices & Applications, M.H Rashid, Pearson

2. Fundamental of Electrical Drives, Gopal K. Dubey, Narosa Publishing House

3. Power Electronics, Converters Applications and Design, N. Mohan, T. M. Undeland & W. P. Robbins, John Wiley and Sons,3rd Edition

Reference Books

1. Thyristor DC drives, P.C Sen, Jhon Wiely.

2. Modern Power Electronics and AC Drives, Bimal K. Bose, Pearson

3. Power Electronics, M.D. Singh & K.B.Khanchandani, TMH

4.Power Electronics, P.S.Bimbhra, Khanna Publication

5. Modern power Electronics by P.C.Sen, S.Chand & Company

Image Processing and Machine Vision (404204)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Objectives:

- To cover the basic analytical methods which are widely used in image processing; linear and nonlinear filtering; and image transformations for coding and restoration.
- To design and implement algorithms for advanced image analysis.
- To develop experience using computer to process images.

Course Outcomes:

After successfully completing the course students will be able to

- Apply principles and techniques of digital image processing in applications related to digital imaging system design and analysis.
- Analyze and implement image processing algorithms.
- Hands-on experience in using software tools for processing digital images.

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

Components of Image Processing System. , Elements of Visual Perception, MTF of Visual System, Image Sensing and Acquisition, Image formation model, Image Sampling & Quantization Spatial and Gray Level Resolution, Basic Relationships between Pixels. Statistical parameters, Measures and their significance, Mean, standard deviation, variance, SNR, PSNR etc.

Unit II : **Image Enhancement** 6L

Gray level transformations, histogram processing, equalization, Arithmetic and logical operations between images, Basics of spatial filtering, smoothening and sharpening spatial filters. Image Enhancement in frequency Domain: smoothening and sharpening frequency domain filters. Color Image processing: Intensity filtering, gray level to color transformation, Basics of full color image Processing.

Unit III : **Image Transforms** **6**L

FFT, DCT, the KL Transform, Walsh/Hadamard Transform, Haar Transform, Wavelet Transform.

Unit IV : **Image Segmentation** 6L

Point, line & Edge detection, Gradient operators, Canny edge detector, Edge linking & boundary detection, Hough transform, Thresholding, Use of boundary characteristic for histogram improvement & Local thresholding, Region based segmentation.

Unit V : **Image compression** 6L

Data redundancies, Variable length coding, Predictive coding, Transform coding, Image compression standards, subband coding, Lossless Predictive, Lossy Compression- Lossy Predictive. Fundamentals of JPEG, MPEG, fractals.

Unit VI : **Image restoration and Image Processing Applications** 6L

Image Degradation Mode, Noise Models, and Restoration in Presence of Noise in spatial Domain, Linear Filtering, Applications: Character Recognition, Fingerprint Recognition, Remote Sensing. Applications using different Imaging modalities such as acoustic Imaging, Medical imaging, electron microscopy etc.

Text Books

1. Gonzalez and Woods, "Digital Image Processing", Pearson Edu
2. Arthur Weeks Jr., "Fundamentals of Digital Intake Processing", PHI.

Reference Books

1. A. K. Jain, "Fundamentals of Digital Image Processing"; Pearson Education
2. Pratt William, "Digital Image Processing", John Wiley & Sons

List of Experiments

Note: Experiments are to be performed using preferably open source software or MATLAB or C

1. Study of BMP file format & conversion of 24 bit colour image 8 bit image.
2. Study of statistical properties- Mean, Standard deviation, Variance & histogram plotting.
3. Histogram equalization & Modification.
4. Gray level transformation.
5. Spatial domain filtering –Smoothing & sharpening filters.
6. DCT/IDCT of given image.
7. Edge detection using Sobel, Roberts operators.
8. Morphological operations –Erosion, Dilation, Opening, Closing.
9. Pseudo Coloring
10. Creating noisy image & filtering.

Embedded Systems & RTOS (404204)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Objectives:

- To understand the different design metrics of embedded system
- To learn real time operating system concepts.
- To understand the Embedded Linux environment
- To apply concept RTOS for different embedded system application

Course Outcomes:

After successfully completing the course students will be able to

- Consider the different constraints of embedded system
- Understand Real time systems concepts.
- Do the analysis Linux operating system as real time operating system.
- To use RTOS for different embedded systems

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. Embedded processor technology, IC technology, Design technology. Software development life cycle. Various models like waterfall, spiral, V , Rapid Prototyping models and Comparison, Embedded system such as vending machine, temperature Controller, automatic cruise control system, antilog braking system and traction control in vehicles.

Unit II : **RTOS Concepts** 6L

Foreground and background systems, Critical Session, Shared resources, Tasks, Multitasking, Context switching, Kernels, Pre-emptive and non-preemptive Schedulers, Static and Dynamic Priorities, Priority inversion, Mutual exclusion, Synchronization, Inter task communication mechanisms, Interrupts: Latency, Response and Recovery, Clock Tick, Memory requirements.

Unit III: **Structure of uCOS – II** 6L

Kernel Structure: Tasks, Task States, TCB, Ready list, Task Scheduling, Task Level Context Switching, Locking and unlocking of scheduler, Idle Task, Statistics Task, Interrupts, Clock Tick, Initialization, Starting the OS. Task Management: Creating/Deleting and Suspending/Resuming Task, Task Stacks and checking, Changing Task's Priority. Time Management: Delaying/Resuming task, System Time.

Unit IV: **Synchronization in µCOS- II** **6L**

Semaphore Management: Creation/Delation, Pending/Posting/Acceptance/Query. Mutual Exclusion Semaphores: Creation/Delation, ending/Posting/Acceptance/Query. Event Flag Management: Internals, Creation/ Delation of Event Flag groups, Waiting/Setting/Clearing/Looking for/Querying an Event Flag Group.

Unit V : **Communication in µCOS- II** 6L

Message Mailbox Management: Creating/Deleting a Mailbox, Waiting/ Sending /Getting without waiting a Message from Mailbox, Status of Mailbox, Alternate uses of Mailbox. Message Queue Management: Creating/Deleting/ Flushing a Message Queue, Waiting/Sending/Getting without waiting a Message from Queue, Status and Alternate use of Message Queue. Memory Management: MCB, Crating a partition, Obtaining /Returning/Waiting for a memory Block, Partition Status. Porting of µCOS- II: Development tools, Directories and Files, Configuration and testing of Port.

Unit VI : **Linux Kernel Construction** 6L

Need of Linux, Embedded Linux Today, Open Source and the GPL, BIOS Versus Boot loader Linux Kernel Background, Linux Kernel Construction, Kernel Build System, Kernel Configuration. Role of a Bootloader, Bootloader Challenges. A Universal Bootloader: Das U-Boot. Porting U-Boot. Device Driver Concepts, Module Utilities, Driver Methods. Linux File System & Concepts.

Text Books

1. Jean J. *Labrosse, "*MicroC OS II, The Real-Time Kernel", 2nd edition, CMP Books.
2. Christopher Hallinan, "Embedded Linux Primer -A Practical, Real-World Approach "2nd edition, Prentice Hall.
3. Raj Kamal, "Embedded Systems – Architecture, Programming and Design" 2nd edition, Mc Graw Hill

Reference Books

1. Dr. K.V.K.K. Prasad **"**Embedded / Real Time Systems Programming Black Book" Dreamtech Press
2. Frank Vahid and Tony Givargis, "Embedded System Design – A Unified hardware/ Software introduction" 3rd edition, Wiley.

List of Experiments

Perform any 5 from 1 to 7 and any 2 from 8 to 10.

1. RTOS porting on available micro controller board.
2. Interfacing of 4X4 Keyboard to a micro controller using μCOS- II task
3. Interfacing of 4X4 Keyboard, 16X2 LCD display and ADC to a micro controller using μCOS- II task
4. Implement a semaphore for any given task switching on a micro controller
5. Implementation of mutual exclusion in tasks as per 3.
6. Implementation of mailbox and message queue management in tasks as per 3.
7. Implementation of memory management in tasks as per 3.
8. Interfacing of LEDS and Keyboard using Linux OS
9. Interfacing of graphic LCD using Linux OS.
10. Interfacing ADC and DAC using Linux OS.

Biomedical Instrumentation (404204)

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In semester Assessment:
Phase I : 30 Marks
End semester Examination:
Phase II: 70 Marks

Course Objectives:

- To familiarize students with various medical equipments and their technical aspects and learn to design, build, and test biomedical instrumentation equipment.
- Analyze how noise from the environment, instruments and other physiologic systems can create artifacts in instrumentation.
- Learn operation of ECG, EEG, EMG and EOG measurement techniques and their applications in biomedical signal processing.
- To learn and understand principle of different clinical lab instrumentation and Radiology Instrumentation.

Course Outcomes:
Upon successful completion of this course, students will be able to:

- Have a clear knowledge about human physiology system.
- Have knowledge of the principle operation and design and the background knowledge of biomedical instruments and specific applications of biomedical engineering.
- Understand operation of the cardiac, respiratory and neural physiological systems. Study the designs of several instruments used to acquire signals from living systems. Examples of instruments studied include ECG, blood pressure monitors, EEG, MRI, and ultrasound.
- Understand working principle of Blood Pressure Measurement (Direct and Indirect Methods). Blood Flow Measurement, Finger Plethesmography, Echocardiography, Stress Testing System, Beside Monitors, Central Monitoring System, Life Saving Devices: Pacemakers, Defibrillators.
- Understand working principle of Clinical Lab Instruments
- Understand working principle and applications of Radiology Instrumentation.

Unit I: **Introduction:** **6L**

Introduction to Biomedical Instrumentation System: Overview of Bio Instrumentation, Sources of bioelectric potential, Types Bio- Signals, Biomedical Instrumentation System and its components.

Transducers and Sensors for Bio Signal Measurements: Sensors and Transducers, 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, O2, Skin contact impedance, Artifacts and noise in medical instrumentation.

Unit II: **Cardiovascular System** **6L**

Introduction to Heart System, 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, Electromyography (EMG), 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 Plethesmography, Echocardiography, Stress Testing System, Beside 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 (CT Scan), MRI Machine, Introduction to Ultrasonic Doppler Machine, Laser applications in Biomedical.

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.

List of Experiments:

Students are expected to perform Minimum 8 experiments from the list mentioned below.

1. To study ECG Machine (Single channel or Multichannel).

2. Interface of PC simulated waveform with ECG machine.

3. ECG \ QRS Detector + Counter to display heart rate

4. To study and measure pulse rate using finger plethesmography.

5. To study Defibrillator/pacemaker

6. To study and measure Blood Pressure using sphygmomanometer/ Digital BP Instrument

7. To study EEG/EMG Machine.

8. Measure body temperature using Digital Clinical Thermometer

9. Measurement of concentration using spectrophotometer

10. To study Blood cell counter.

11. Study of Bedside Monitor, Drip Rate Monitor (ICU Monitor)

12. Study of PH measurement System.

13. Study of Dialysis System

14. Study of Clinical Lab Instrumentation.

15. Study of Laser Treatments in Medicines.

ADVANCED MEASUREMENT SYSTEMS (404204)

Teaching Scheme
Lectures: 3 Hrs / week

Examination Scheme
In-semester Assessment:
Phase I: 30 Marks
End semester Examination:
Phase II: 70 Marks

Course Educational Objectives:

1. To learn about measurements and its relation with instrumentation system.
2. To familiarize with the concepts of design and measurement of electronic instrumentation.

Course Outcomes:

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

1. Illustrate the concepts of signal integrity design issues, limitations of various measurement equipments.
2. Analyze various measuring techniques for various digital and analog signals
3. Compare different types of Measurement protocols.
4. Illustrate the concepts of design and measurements of microwave, virtual and digital instrumentation.

Unit I: **Signal Integrity:** [6 hrs]

Signal Integrity design Issues, Signal Integrity Testing Challenges and solutions**,** Electrical Validation and Debug with DPO/MSO Series Oscilloscopes and Arbitrary Waveform Generators

Unit II: **Hardware design and testing methods:** [6 hrs]

Logic analyzer, its architecture & operation and Use of logic analyzer, Spectrum analyser, Network analyzer, Oscilloscope, DSO trigger modes Examples using MSO Use & limitations of different types of analysis

Unit III: **Role of electronic measurements in Embedded Systems:** [7 hrs]

Design issues and role of electronic measurements for debugging in Automotive Electronics (ECU), Serial bus decode Test instruments for a variety of standards, including: USB, PCI Express, CAN/, I2C, Need of interfacing, interfacing techniques, interfacing of different displays including Graphic LCD (320X240), interfacing of input devices including touch screen etc, interfacing of output devices like thermal printer etc., embedded communication using CAN and Ethernet, RF modules, GSM modem for AT command study etc.

Unit IV: **Microwave Measurements:** [7 hrs]

Fundamental test set up for advanced radar systems and EMI EMC measurements. Microwave Enclosures, Hazards and Microwave Measurements and Computations Electromagnetic Compatibility, Detection of microwave power: measurement of microwave power bridge circuit using thermister & barraters. Theory & operation of barraters, direct reading barraters bridges. Measurement of wavelengths: single line cavity coupling system, frequency pulling by reactive load, Transmission cavity wave meter & reaction wave meter, measurement of VSWR, measurements of attenuation, free space attenuation.

Unit V: **Virtual Instrumentation:** [6 hrs]

Virtual Instrumentation, VISA (GPIB, VXI, PXI), SCPI coding. Test system development using Virtual Instrumentation, Software role in virtual Instrumentation, Hardware role in virtual instrumentation. Virtual Instrumentation and its application, modulation techniques: TDM, FDM, ASK, PSK, application of the same in instrumentation, Distortion analyzer, Logic analyzers. Case study of Lab View based Data acquisition system design.

Unit VI: **Digital Instrumentation:** [6 hrs]

Universal counter and its mode _ totalizing, frequency, period, time interval, ratio, measurement errors, application of counters for frequency meter, capacitance meter and timers, automation in digital instruments, ADC and DAC techniques, types, and their specifications, V to F converter, Sample and hold, analog multiplexer, data loggers.

Text Books:

1. H.S.Kalsi, "Electronics Instrumentation", Tata McGraw-Hill Education,3rd Edition 2010.

2. Das, "Microwave Engineering", Tata McGraw-Hill Education, 2nd Edition 2009

3.Gupta, "Virtual Instrumentation Using Labview", Tata McGraw-Hill Education, 2nd Edition, 2010.

References:

1. http://vlab.co.in/ -
2. http://in.tek.com - Application Notes by Tektronix
3. http://www.agilent.co.in - Application Notes by Agilent
4. Coombs "Hand Book for Electronic Measurements" McGraw-Hill, Inc., 2nd Edition.

List of Experiments:

Perform any eight experiments from the given list.

(Equipments Required: DSO, MSO, Logic Analyzer , Power Scope, Arbitrary signal generator)

1. Study and application of Universal counters
2. Study of DSO _ measurement of response time of relay using DSO
3. Study of MSO
4. Study of logic Analyser
5. Study and application of ADC 0809
6. Study and application of DAC 0808
7. Study of Arbitrary waveform generator
8. Program to demonstrate I2C Protocol.
9. Program to demonstrate CAN Protocol.
10. System building and simulation on Virtual Instrumentation
11. VSWR Measurement (Using Vmax / Vmin Method)

DSP Processors (404205)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Outcomes:
The student will be able to

1. Write different digital processing algorithms.
2. Show skills to design of filters for real time application.
3. Exhibit the knowledge of DSP algorithms on DSP Platforms.
4. Demonstrate the ability to analyze filter structures

Unit I : **Introduction to real time digital signal processing** 6L

Basic elements of real time DSP, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation, Analysis and Design tool for DSP Systems, computational accuracy in DSP implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

Unit II: **Architectures for programmable DSP devices** 6L

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing. Execution control and pipelining: Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models.

Unit III**: Programmable digital signal processors** 6L

Selections of DSP processors, real time implementation considerations, Hardware interfacing, addressing modes and DSP processor architectures: TMS 320C54XX, TMS 320C67XX, Blackfin processor: Architecture overview, memory management, I/O management, On chip resources, programming considerations, Real time implementations, Code Optimization

Unit IV : **Implementations of DSP Algorithms** 6L

The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing.

Unit V: **Implementation of FFT algorithms** 6L

An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit-Reversed index generation, An 8-Point FFT implementation on the TMS320C54XX, Computation of the signal spectrum.

Unit VI: **Interfacing with programmable DSP devices** 6L

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, CODEC interface circuit, CODEC programming, A CODEC-DSP interface.

Text Books

1. Avtar Singh and S. Srinivasan "Digital Signal Processing ", Thomson Publications, 2004.
2. Sen M. Kuo and Woon-Seng Gan, " Digital Signal Procesors, architectures, implementations, and applications", Prentice-Hall, ISBN 0130352144.

Reference Books

1. Lapsley et al. "DSP Processor Fundamentals, Architectures & Features", S. Chand & Co, 2000.
2. B. Venkata Ramani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications –", TMH, 2004.
3. Jonathan Stein "Digital Signal Processing", John Wiley, 2005

Robotics & Automation (404205)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Objectives:

- Describe the history and early beginnings of automated manufacturing & Robotics.
- Ability to recognize industrial control problems.
- Aims to Develop understanding Robotics Components.
- Apply creative approaches to practical applications, identify technological opportunities in robotics.
- An over view of technology of advanced topics such as CNC Machines, Human Robot Interaction.
- The ability to provide Automation solution.

Course Outcomes:
After successfully completing the course students will be able to

- Understand Need of Automation.
- Demonstrate use of engineering methods and problem solving towards design of the specified robot.
- Compare and contrast various mechanical systems, and the industrial application of robotic and automation.
- Identify prerequisites of Robotics for small industrial Applications.
- Describe Robot control & its applications.

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

Types of Automation; Architecture of Industrial Automation Systems, Advantages and limitations of Automation, Effects of modern developments in automation on global competitiveness.
Introduction of CNC Machines: Basics and need of CNC machines, NC, CNC and DNC (Direct NC) systems, Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines.

Unit II : **Robotics** **6L**

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems Hydraulic, Pneumatic and Electric system.

Unit III : **Robot Transformation, Sensors & End effectors** **6L**

Transformation types: 2D, 3D. Translation- Homogeneous coordinates multiple transformation-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-Simple problems

Unit IV : **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 and inverse velocity analysis. Control: Individual joint computed torque.

Unit V : **Dynamics** **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 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, ISBN 0-8493-1804-1
2. Robotics: Appin Knowledge Solutions (Firm)_, Infinity Science Press , 2007, ISBN 978-1-934015-02-5
3. Robot Motion and Control (Recent Developments) by M.Thoma & M. Morari

Reference Books

1. J. Norberto Pires, Altino Loureiro and Gunnar Bölmsjo, _Welding Robots -Technology, System Issues and Applications_, Springer-Verlag 2006, ISBN-10:1852339535
2. Ben-Zion Sandler, _Robotics : Designing the Mechanisms for Automated Machinery_, 2nd ed. 1999 by Academic Press, ISBN 0-12-618520-4

Electronics in Agriculture (404205)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Objectives:

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

Course Outcomes:

After successfully completing the course students will be able to

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

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

Data loggers, Data acquisitions systems (DAS), Supervisory control and data acquisition (SCADA), Basics of PLC, Functional block diagram of computer control system, alarms, interrupts.

Virtual Instrumentation: Historical Perspective, advantages, Block diagram and architecture of virtual instrument, data flow techniques, graphical programming in data flow, comparison with conventional programming.

Unit II : **Communication Systems** **6L**

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

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

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

Unit IV : **Precision Farming** **6L**

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

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

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

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

Greenhouse: History of modeling and control of Greenhouse, Identification of control and manipulation variables for Greenhouse. Crop Preservation : Importance of Preservation of various commodities and parts of plants, Drying process for preservation, Variable identification for drying process, Electronic control system for grape drying process.

Agriculture & Electronics Governance: Governance products & services in agriculture sector, Role of Electronics Governance in Agricultural sector.

Text Books

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

Reference Books

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

Mobile Communication (404205)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Objectives:

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

Course Outcomes

By the end of the course, the student 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 wireless 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 : **Channel, Speech Coding & Multiple Access Techniques** 6L

Fundamentals of channel coding.
Speech coding: Characteristics of speech signal, Quantization Techniques, ADPCM, Frequency domain coding of speech, Vocoders, Linear Predictive Coders, Selection of Speech Coders for Mobile Communication, GSM codec, USDC codec.
Multiple Access: FDMA, TDMA, spread spectrum multiple access, SDMA, Packet Radio.

Unit V: **Wireless Networking** 6L

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

Unit VI: **GSM & IS-95** 6L

GSM: services & features, system architecture, radio subsystem, channel types, example of GSM call, frame structure, signal processing.
IS-95: frequency & channel specifications, forward & reverse CDMA channel, IS-95 with 14.4 kbps speech coder.

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.

Lab Practice - I (404206)

VLSI and Electronics System Design

Teaching Scheme: **Examination Scheme:** OR: 50Marks
Practical: 4 Hrs/week TW:50Marks

VLSI Design

List of the Experiments:

Group A: To write VHDL code and test bench, synthesis, simulate and down load in to PLD, for the following (Any four).

1. To design of ALU to Perform – ADD, SUB, AND, OR, 1's compliment, 2's Compliment, Multiplication and Division.
2. To design of Sequence Detector (Finite State Machine- Mealy and Moore Machines).
3. To generate ramp/square waveform using DAC.
4. To measure the period of a signal.
5. To design lift/traffic light controller.
6. To design of 4-bit binary, BCD counters (synchronous/ asynchronous reset).

Group B: To prepare CMOS layout in selected technology, simulate with and without capacitive load, comment on rise and fall times. (Any four)

1. CMOS Inverter and also observe VTC and calculate switching threshold.
2. CMOS 3-input NAND, 3-input NOR.
3. 2:1 MUX by conventional method and by using Transmission gates. Compare them.
4. CMOS Combinational logic for minimum 5 variables.
5. D/ T Flip flop.
6. Single bit SRAM cell.

Electronics System Design

List of Experiments: (Any 6 experiments)

1. Design and implement Power supply (Estimation of current requirement)
2. Design of SPAN ZERO circuit
3. Design and implement of Transducer interface using Whetstone Bridge
4. Study of Error budget analysis
5. ADC Interface with microcontroller for temp transducer

6. DAC interface to generate triangular/sine waveform
7. Interfaces- LED, HB LED, LCD, Relays with microcontroller
8. Case study for deciding appropriate Microcontroller for given application
9. PCB Design for Mixed Signal Circuit (Involving ADC and Signal Conditioning)
10. DC analysis of given circuit
11. AC analysis of given circuit
12. Sensitivity analysis for given circuit
13. Reliability calculations from given data

Lab Practice - II (404207)

Advanced Power Electronics and Elective I

Teaching Scheme:
Practical: 4 Hrs/week

Examination Scheme: PR: 50Marks
TW:50Marks

Advanced Power Electronics

Experiments:

1. Study of Dual converter (Single phase/ Three phase)
2. Power Factor improvement techniques for single phase converters (SAC/EAC/PWM)
3. Study of Cycloconverter
4. Feedback Controlled DC Motor Drive
5. Chopper fed 4-Quadrant reversible DC drive
6. V/F controlled AC induction motor drive
7. Speed Control of Universal Motor.
8. Simulation of closed loop controlled DC drive using PSIM/Matlab/MathCad/any open source software
9. Simulation of AC drive using PSIM / Matlab/MathCad
10. Case Study/ Industrial Visit.

Elective I

Experiments to be chosen based on Elective I.

Computer Networks (404209)

Teaching Scheme:
Lectures: 4 Hrs/ Week

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

Course Objectives:

- Build an understanding of the fundamental concepts of computer networking
- Preparing the student for entry Advanced courses in computer networking.
- Acquire the required skill to design simple computer networks.

Course Outcomes:

At the end of the course a student will be able to:

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

Unit I : **Introduction to Computer Networks** 7L

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** 8L

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** 8L

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** 8L

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** 8L

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** 8L

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

PROCESS AUTOMATION (404210)

Teaching Scheme:
Lectures: 4 Hrs/ Week

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

Course Objectives:

- To give the students a comprehension of Process Control Instrumentation Design.
- To give the students a comprehension of the relation between Instrumentation and controller design in industrial applications.
- To make the students able to analyze the control loops and to achieve the control actions with different Controllers

Course Outcomes:

After successfully completing the course students will be able to

- Describe process control principles.
- Solve issues related to efficient controller design.
- Understand Advance Process Automation Techniques.
- Utilize knowledge of PLC programming for Process Automation.
- Design GUI for process industry using LABVIEW Software.

Unit I : **Introduction** **8L**

Basic Principle of Process Automation, Block Diagram of process control. Process characteristics, Control system Parameters, Control system Evaluation, Evaluation Criteria, Analog and Digital Processing, Process Control Drawings, Comparison of Pneumatic & Electro pneumatic control system.

Unit II : **Process Controllers** **8L**

Controller modes, Electronic controllers, Pneumatic controllers, Hydraulic controllers, Realization of controllers using Operational amplifier circuits. Feed forward controller, Tuning of PID controllers: Ziegler Nichols Method, Frequency Response Method, Process reaction curve(PRC),Concept of adaptive and inferential control

Unit III : **Final Control Operation** **8L**

Signal conversion: Analog signals, Digital signals, Pneumatic signal, Actuators: Electrical actuators, Pneumatic actuators, Hydraulic actuators, Control element: Mechanical, Electrical, Fluid Valves, Principle of control valve, Characteristics of Valve, selection of control valve, Different types of control valves and their applications.

Unit IV : **Discrete state process control** **8L**

Definition, Characteristics of the system, Relay controllers and Ladder Diagram Elements & Examples, Programmable Logic controllers (PLCs): Functions of PLC, Advantages, Architecture, PLC Operation, Scan time, Types, selection of PLC, Interfacing Input and Output devices with PLC, Ladder Programming, and PLC based automated systems.

Unit V : **Advanced Process Automation Techniques** **8L**

Statistical Process Control, Fuzzy logic systems, Artificial Neural Network (ANN) based controllers, Model Predictive control, Linear Quadratic Gaussian control.
Instrumentation schemes for boiler, Heat exchanger, Distillation column control, Evaporator, Compressor.

Unit VI : **Computers in Instrumentation** **8L**

Direct digital control systems, Distributed control systems (DCS): Introduction, DCS flow sheet symbols, architecture of DCS controller, DCS communication, DCS supervisory computer tasks, Features and advantages of DCS. Supervisory control and Data acquisition (SCADA): SCADA introduction, elements of SCADA, Features of SCADA, and MTU- functions of MTU, RTU- Functions of RTU, and Applications of SCADA. Types of Recorders and their working, Introduction to Virtual Instrumentation (LABVIEW).

Text Books

1. Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education.
2. George J Clir, Bo Youn, "Fuzzy Sets and Fuzzy Logic Theory and Applications", Prentice Hall of India Pvt. Ltd.
3. S.K Singh, "Industrial Instrumentation and Control", Third Edition, McGraw Hill companies.

Reference Books

1. K. Krishna Swamy, "Process Control"; New Age International Publishers.
2. K. Astram, T Haggland, "PID Controllers, Theory, Design and Tuning";2nd Edition, ISA
3. Andrews, Applied Instrumentation in Process Industries

Speech and Audio signal Processing (404211)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Objectives:

- To understand the basic concepts of speech processing techniques and its applications.
- To teach about practical aspects of speech processing algorithms implementation.
- To provide good practical knowledge and signal processing concepts applied to various applications of speech.

Course Outcomes:

After successfully completing the course students will be able to

- Implement speech processing algorithms/techniques for speech signal analysis and various speech applications.
- Acquire skills to work in different domain of speech processing like ASR, Speech synthesis, speech enhancement, speech coding etc.

Unit I : **Speech Production and Acoustic Phonetics** 6L

Introduction, Anatomy and Physiology of speech organs, Articulatory phonetic, Acoustic Phonetics, Acoustic theory of speech production, LTI and LTV model, coarticulation, prosody.

Unit II : **Time and Frequency domain processing of speech** 8L

Time-domain processing of speech: Short-time energy, pitch estimation using autocorrelation and AMDF, formant estimation, voiced/unvoiced classification.
Frequency domain analysis: Short time analysis of speech, narrow and broad band spectrogram, cepstral domain analysis, mfcc, Homomorphic processing of speech signal, pitch detection and formant extraction.

Unit III : **Coding of speech signals** 6L

Introduction: Quantization: Quantization error, SNR, Non-uniform quantization, Measures to evaluate speech quality, Time domain waveform coding, spectral coders, Vocoders: Phase, channel, homomorphic, vector quantization coders.

Unit IV : **Linear Predictive coding of Speech** 6L

Basic principles of linear predictive analysis: Autocorrelation and covariance method, Solution

of LPC equation: Cholesky decomposition solution for covariance method and Durban's recursive solution for Autocorrelation equations. Applications of LPC parameters: Pitch detection, Formant analysis LPC Vocoders, voiced excited LPC Vocoders

Unit V : **Speech enhancement** 6L

Introduction, Nature of interfering signals, Speech enhancement techniques: spectral subtraction and filtering, harmonic filtering parametric resynthesis, filtering and adaptive noise cancellation

Unit VI : **Applications of speech and audio signal processing** 6L

Speech recognition, speech synthesis, speaker recognition and verification: Basic principles, specific features and state of the art systems. Fundamentals of Template matching, Pattern classification, statistical methods like DTW, GMM, HMM.

Text Books

3. L. R. Rabiner and R. W. Schaffer, "Digital Processing of Speech signals", Pearson
4. Thomas F. Quatieri, "Discrete-time Speech Signal Processing: Principles and Practice", Pearson Education Asia, 2003.
5. S.D. Apte, "Speech and Audio processing", Wiley India

Reference Books

1. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", John Wiley, 2002.
2. Douglas O'Shaughnessy, " Speech communication: Human and Machine, Universities Press

List of experiments:

1. Study of frame format for a .wav file. Record audio signal save as "wav" file format (16 bit, 16 kHz mono format using wave recorder interface (Audacity, Cool Edit Pro etc.). Write a program to read wave file in frame by frame manner and plot the speech segment.
2. Acoustic study of speech sounds using PRATT tool: Record and analyze speech sounds like consonants, vowels, semivowels, diphthongs, nasals, fricatives etc.
3. Classification and voiced and unvoiced part of signal using short time energy and zero crossing rate.
4. Pitch detection using Average Magnitude Difference Function method. Compare pitch with PRAAT pitch contour.
5. Pitch detection using Autocorrelation method. Compare pitch with PRAAT pitch contour.

6. Write a program to compute narrow band and wide band spectrogram and plot 2D and 3D spectrogram.
7. Write a program to draw a Cepstrum of speech segment from the speech utterance.
8. Write a program to find MFCC for a speech segment from the speech utterance.
9. Write a program to find LPC for a speech segment from the speech utterance. Use Levinson Durbin algorithm.
10. Write a program to find first 4 Formants for a speech segment from the speech utterance using a Cepstral domain window.

Group activity: Max. 3 to 4 students per group.

Application assignment: Implement small speech processing related application i.e. digit recognition, voice operated telephone dialing system, speech coding: Vocoders, spectral subtraction, vowel synthesis (using source filter model) etc.

Audio Video Engineering (404211)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Objectives:

The objective is to provide students with a strong understanding of the fundamental principles and practical applications of audio and video engineering with latest updates.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand the concept of basic television signal processing
2. Identify globally accepted colour TV standards
3. Demonstrate the need of audio and video compression techniques in real life
4. Acquire knowledge of latest digital TV systems and applications
5. Describe the attributes of acoustics, sound engineering and storage media.

Unit I : **Fundamentals of Colour Television:** 6L

Aspect, scanning, perception of brightness and colour, colour mixing, composite video signal, synchronisation details, digital TV camera, modulation of audio and video, terrestrial signal transmission, video displays: LCD vs LED.

Unit II : **Colour Standards and digital video** 8L

Standards: NTSC, PAL, SECAM colour system, generalized colour TV receiver block diagram, study of functionality of each block, alignment issues, sampling of video signal, colour sub sampling, composite vs component video, interlace vs progressive scan.

Unit III : **Digital TV** 6L

Digital video, resolution, notation, digital video formats, digital video quality measure, video restoration, video streaming, DTH, Video compression: MPEG 2, MPEG 4, comparison of SDTV, EDTV and HDTV.

Unit IV : **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, perspective of TV White spaces.

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 and Video Recording Systems** 6L

Digital sound, sound recording, CD/ DVD player, MP3 player, Blue Ray DVD Player, ITU-T(G) compression standards, multichannel/Dolby 5.1sound in DTV.

Text Books

1. A.M. Dhake, *Television and video Engineering*, TMH Publication, 2nd Edition,2001
2. Kelth jack, *Video Demystified: A Handbook for the Digital Engineer*, 5th Edition, Newnes, 2007.
3. 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

List of experiments:

1. Voltage waveform analysis of Digital TV Receiver.
2. Study of DTH and STB
3. Study of WC and color pattern generator with pattern analysis
4. Study of HDTV/UHDTV
5. Study of Wi-Fi TV system
6. Study of DVD/Blue ray player
7. Study of audio player: MP3 player
8. Study of audio and video coding scheme (soft)
9. Study of PA system
10. Directivity pattern of microphone/ speakers.
11. TV studio/station/relay station visit and report writing
12. Self study visit: summaries information obtained from dealers on UHD TVs and camcorders (optional)

Optical and Microwave Communication (404211)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

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** 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.

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

SOFT COMPUTING (404211)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Objectives:

- Introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real world problems.
- Insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systems Techniques.
- To create awareness of the application areas of soft computing technique
- Provide alternative solutions to the conventional problem solving techniques in image/signal processing, pattern recognition/classification, control system

Course Outcomes:

Having successfully completing the course students will be able to

- use a new tool /tools to solve a wide variety of real world problems
- find an alternate solution , which may offer more adaptability, resilience and optimization
- Identify the suitable antenna for a given communication system
- Gain knowledge of soft computing domain which opens up a whole new career option
- Tackle real world research problems

Unit I : Artificial Neural Network -I 8L

Biological neuron, Artificial neuron model, concept of bias and threshold , Mc Culloch-Pits Neuron Model , implementation of logical AND, OR, XOR functions Soft Topologies of neural networks, learning paradigms: supervised, unsupervised, reinforcement, Linear neuron model : concept of error energy , gradient descent algorithm and application of linear neuron for linear regression, Activation functions : binary , bipolar (linear, signup, log sigmoid, tan-sigmoid) Learning mechanisms: Hebbian, Delta Rule o Perceptron and its limitations Draft

Unit II : Artificial Neural Network-II 8L

Multilayer perceptron (MLP) and back propagation algorithm, Application of MLP for classification and regression, Self-organizing Feature Maps, k-means clustering, Learning vector quantization

Radial Basis Function networks: Cover's theorem, mapping functions (Gaussian, Multi-quadrics, Inverse multi quadrics), Application of RBFN for classification and regression, Hopfield network, associative memories.

Unit III : Fuzzy Logic -I 6L

Concept of Fuzzy number, fuzzy set theory (continuous, discrete), Operations on fuzzy sets, Fuzzy membership functions (core, boundary, support), primary and composite linguistic terms, Concept of fuzzy relation, composition operation (T-norm, T-conorm), Fuzzy if-then rules.

Unit IV : Fuzzy Logic -II 6L

Fuzzification, Membership Value Assignment techniques, De-fuzzification (Max membership principle, Centroid method, Weighted average method), Concept of fuzzy inference, Implication rules- Dienes-Rescher Implication, Mamdani Implication, Zadeh Implication, Fuzzy Inference systems -Mamdani fuzzy model, Sugeno fuzzy model, Tsukamoto fuzzy model, Implementation of a simple two-input single output FIS employing Mamdani model Computing.

Unit V : Fuzzy Control Systems 6L

CONTROL SYSTEM DESIGN PROBLEM 1.5, Control (Decision) Surface, Assumptions in a Fuzzy Control System Design V, Fuzzy Logic Controllers Soft o Comparison with traditional PID control, advantages of FLC, Architecture of a FLC: Mamdani Type, Example Aircraft landing control problem.

Unit VI : Adaptive Neuro-Fuzzy Inference Systems (ANFIS) 6L

ANFIS architecture, Hybrid Learning Algorithm, Advantages and Limitations of ANFIS Application of ANFIS/CANFIS for regression

Text Books

1. Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Laurene Fausett, Pearson Education, Inc, 2008 .
2. Fuzzy Logic With Engineering Applications, Third Edition Thomas, Timothy Ross, John Wiley & Sons,2010
3. Neuro- Fuzzy and Soft Computing, J.S. Jang, C.T. Sun, E. Mizutani, PHI Learning Private Limited.
4. Principles of Soft Computing , S. N. Sivanandam, S. N. Deepa, John Wiley & Sons, 2007

Reference Books

1. Introduction to the theory of neural computation, John Hertz, Anders Krogh, Richard Palmer, Addison –Wesley Publishing Company, 1991
2. Neural Networks A comprehensive foundation,, Simon Haykin,Prentice Hall International Inc-1999
3. Neural and Adaptive Systems: Fundamentals through Simulations, José C. Principe Neil R.

Euliano , W. Curt Lefebvre, John-Wiley & Sons, 2000
4. Pattern Classification, Peter E. Hart, David G. Stork Richard O.Duda,Second Edition,2000
5. Pattern Recognition, Sergios Theodoridis , Konstantinos Koutroumbas, Fourth Edition, Academic Press, 2008
6. A First Course in Fuzzy Logic, Third Edition, Hung T. Nguyen, Elbert A. Walker, Taylor & Francis Group, LLC, 2008
7. Introduction to Fuzzy Logic using MATLAB, S. N. Sivanandam , S.Sumathi, S. N. Deepa, Springer Verlag, 2007

Practical Sessions: (Use MATLAB/OCTAVE/SCILAB base code only)

1. Implement simple logic network using MP neuron model
2. Implement a simple linear regressor with a single neuron model
3. Implement and test MLP trained with backpropagation algorithm
4. Implement and test RBF network
5. Implement SOFM for character recognition
6. Implement fuzzy membership functions (triangular, trapezoidal, gbell, PI, Gamma, Gaussian)
7. Implement defuzzyfication (Max-membership principle, Centroid method, Weighted average method)
8. Implement FIS with Mamdaniinferencing mechanism
9. A small project: may include classification or regression problem , using any soft computing technique studied earlier

Biomedical Signal Processing (404212)

Teaching Scheme:
Lectures:3Hrs/ Week

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

Course Objectives:

1. To understand the basic signals in the field of biomedical.
2. To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, evoked potentials, and EMG.
3. To understand Sources and characteristics of noise and artifacts in bio signals.
4. To understand use of bio signals in diagnosis, patient monitoring and physiological investigation
5. To explore research domain in biomedical signal processing.
6. To explore application of established engineering methods to complex biomedical signals problems.

Course Outcomes:

After successfully completing the course students will be able to:

1. Model a biomedical system.
2. Understand various methods of acquiring bio signals.
3. Understand various sources of bio signal distortions and its remedial techniques.
4. Analyze ECG and EEG signal with characteristic feature points.
5. Have a basic understanding of diagnosing bio-signals and classifying them.

Unit I : Biomedical Instrumentation System **6L**

Bioelectric Signals and Electrodes: Bio-potentials and their origin: ECG, EEG, EMG, ENG, ERG, EOG, MEG. Biomedical Instrumentation System, biomedical transducers, electrodes and their characteristics. Origin of bio potentials. Sources and contamination of Noise in bio signals, Motion artifacts and skin Impedance.

Unit II : Cardio Vascular and Nervous System **6L**

Cardio Vascular System: Introduction to Heart System, Heart Structure, Functioning of Heart System, ECG Electrodes, Electrocardiograph, Lead Configurations to measure ECG, ECG Machine, Heart sounds.

Nervous System: Nervous System, Structure and functions of Neurons, Electrical activity of nerve cell, Synapse, Reflex action and Receptors.

Unit III: Cardiological Signal Processing **6L**

ECG signal parameters & their estimation - Use of multiscale analysis for ECG parameters estimation, Noise & Artifacts, ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection, Feature points of ECG and its classification for Normal and Abnormal state using Multilayer Perceptron.

Unit IV: Neurological Signal Processing **6L**

Structure of brain, EEG signal acquisition, 10-20 electrode placement, EEG rhythms & waveform - categorization of EEG activity - recording techniques - EEG applications- Epilepsy, sleep disorders, brain computer interface system and its component, EEG Signal Analysis -Use of Fourier Transform in EEG Signal Analysis.

Unit V: Analog Signal Processing **6L**

Basics of Instrumentation Amplifier, Isolation amplifier, Grounding and shielding techniques.
Design of Filters for Biomedical field. Basic design Concept, Low Pass and High Pass Filters, Band Pass, Band Stop and Band Reject Filters.
Adaptive Filters: Basic Concept, Principle noise cancellation model, removal of periodic events using adaptive cancellation, adaptive cancellation of maternal ECG from fetal ECG of Interest.

Unit VI : Digital signal Processing **6L**

Characteristics, frequency domain representation; Stationary and non-stationary bio-signals, waveform detection, Sampling Theory, Finite data considerations (Edge effects), Z Transform, FIR and IIR filters specific to event detection of ECG. Computation of diagnostic signal parameters of ECG like Heart rate and QRS detection using Multivariate analysis like PCA and ICA.

Text Books

1. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, 4th Edition, Prentice Hall, 2000.
2. R. Rangayan, “Biomedical Signal Analysis”, Wiley 2002.
3. John L Semmlow, “Bio-signal and Biomedical Image Processing”, Marcel Dekker.

Reference Books

1. R.S.Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003, Edition-II.
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, 4th Edition, Prentice Hall, 2000.
3. Bruce, “Biomedical Signal Processing & Signal Modeling,” Wiley, 2001
4. Sörnmo, “Bioelectrical Signal Processing in Cardiac & Neurological Applications”, Elsevier.
5. C.Reddy “Biomedical Signal Processing: Principles and techniques”, Tata McGraw Hill, New Delhi, 2005.
6. Willis J Tompkins, “Biomedical Signal Processing”, ED, Prentice – Hall, 1993

Nano Electronics & MEMS (404212)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Objectives:

- To understand the Nano-CMOS Devices.
- To learn the applications of nanotechnology in electronics.
- To understand the various MEMS controls.
- To learn different types of MEMS transducers.

Course Outcomes:

After successfully completing the course students will be able to

- Explain the properties of Nano particles and Nanotube with their applications in electronics.
- Identify the suitable MEMS transducer for a given electronic system

Unit I : **Introduction to Nano-CMOS Devices** 6L

Introduction to Nanotechnology: Fundamental science behind nanotechnology, tools for measuring nanostructures, tools to make nanostructures and imagine nano-behaviours Silicon Nanocrystal non volatile memories, Novel dielectric materials for future transistors, Nano-CMOS devices and applications. Tools for measuring nanostructures, scanning probe instrument, nanoscale lithography.

Unit II : **Nano particles and Nanotubes** 6L

Properties of Nano particles: Metal nanostructures and semiconducting nanoparticles, Carbon nanostructures: carbon molecules, clusters, nanotubes, properties of nanotubes-strength and elasticity, applications of carbon nanotubes.

Unit III : **Nanotechnology in Electronics** 6L

Use of Nanotechnology in Electronics: Application of nano structures in electronics, sensors, optics, energy capture, transformation and storage. Application of nanotechnology in biomedical electronics.

Unit IV : **Introduction to MEMS** 6L

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes.

Unit V : **Control and Materials of MEMS** 6L

Controls of MEMS: Analog control of MEMS, Sliding mode control of MEMS, Digital control of MEMS, Materials for MEMS: Substrate and wafers, Active substrate material, silicon, Silicon compound, Silicon piezoresisters, Gallium arsenide, Quartz, piezoelectric crystals, Polymers.

Unit VI : **Transducers** 6L

Mechanical Transducers: transduction methods, accelerometers, gyroscopes, pressure sensors, MEMS microphones, mechanical structures, actuators.
Chemical and Biological Transducers: basic concepts of cellular biology, chemical sensors, molecule-based biosensors, cell-based biosensors, chemical actuators, biological transducers.

Text Books

1. Nanotechnology: A Gentle Introduction to the Next Big Idea, Mark ratner,Daniel Rattner, ISBN-10:0-13-101400-5.
2. Kovacs, Gregory T. A. "Micromachined Transducers Sourcebook" McGraw-Hill
3. Charles P. Poole Jr., Frank J. Owens, "Introduction to Nanotechnology", John Wiley & Sons.
4. Jan G Korvinik and Oliver Paul, "MEMS Practical Guide to Design, analysis and Applications" William Andrew, Inc Springer

Reference Books

1. Springer Handbook of Nanotechnology ISBN: 978-3-540-35172-6
2. Nanotechnology :Principals &practices, Sulbha K.Kulkarni,Capital publishing company, ISBN:-81-85589-29-1

System on Chip (404212)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Objectives:

- The student will study SOC modeling and interfacing.
- The student will learn SOC system design.
- SOC design, SOC prototyping, verification, testing and physical design.
- The student will able to design , implement and test SOC.

Course Outcomes:

After successfully completing the course students will be able to

- Design the SOC prototype for real life applications.
- Analyze the various SOC design issues like clock domain crossing, power and timing analysis.

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

Design of system on chip, Microsystems technology and applications, core architecture for digital media and the associated compilation techniques.

Unit II : **RTL Simulation** 6L

RTL Designs, RTL based chip design flow, design challenges, Simulation race, simulation-synthesis mismatch.

Unit III : **Timing Analysis and Clock Domain Crossing** 6L

Timing parameters for digital logic, factors affecting delay and slew, sequential arcs, clock domain crossing, bus synchronization, preventing data loss through FIFO.

Unit IV : **Power Issues** 6L

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes.

Unit V : **Overview of Physical Design Automation** 6L

Physical design automation, behavioral synthesis, synthesis of FPGAs and testable ASICs micromachining processes: substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic process

Unit VI : **SOC Testing and Packaging** 6L

Hardware/software co-design, test and design of circuit to integrated systems, SOC prototyping, verification, testing and physical design.
Micro System Packaging: Over view of mechanical packaging of micro electronics micro system packaging.

Text Books

1. Sanjay Churiwala, Sapan Garg , "Principles of VLSI RTL Design A Practical Guide", Springer
2. Youn-Long Steve Lin, "Essential Issues in SOC Design, Designing Complex Systems-on-Chip", Springer

Reference Books

1. Kamaran Eshraghian, "Principles of CMOS VLSI Design", Pearson Education
2. Rabey, Chandrakasan, "Digital IC Design", Preason Publication.

Mechatronics (404212)

Teaching Scheme:
Lectures: 3 Hrs/ Week

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

Course Objectives:

- To provide multidisciplinary knowledge
- Expose Role of Controls in Mechatronics.
- Aims to develop understanding of Mechatronics Components.
- To make students aware about Logic system, Software & Data acquisition.
- Apply Mechatronics Engineering technical expertise to industry-related fields.
- Get awareness on advance technologies like MEMS.

Course Outcomes:
After successfully completing the course students will be able to

- Work in interdisciplinary field.
- Describe how to optimize Mechatronics system.
- Implement software for control of Mechatronics systems.
- Interpret and apply current or emerging knowledge from inside and outside Mechatronics Engineering.
- Use relevant mathematics and computer science concepts as tools.

Unit I : Overview of Mechatronics 6L

Key Elements, Mechatronics Design Approach, Functions of Mechatronics system, Division of functions between Mechanics and Electronics, Stepwise Design Procedure, Modeling Procedure. Mechanical Components and systems: Bearings and Bushings, Belts and Pulleys, Brakes and clutches, Chains and Sprockets, Couplings and joints, gears, Pulleys and Belts, Solenoids, springs, Switches.

Unit II : Self-Optimizing Mechatronic Systems 6L

Introduction ,Self-Optimization, Challenges during the development of self-optimizing systems, Specification of the principle solution, Partial models, Interrelations between the partial models, Particularities within the specification of self-optimizing systems,. Conceptual design of self-optimizing systems, The role of the principle solution during the concretization

Unit III : Systems and Control 6L

Role of controls in Mechatronics, Key elements of controlled Mechatronics system, Integrated Modeling, design and control implementation, Case study: Design of a mobile Robot, Modern examples of Mechatronics systems in action, Special Requirements of Mechatronics that

Differentiate from Classic Systems and Control Design, State space analysis controller examples.

Unit IV :Computers and Logic Systems 6L

The Mechatronics use of computers, concept of real time, System interfaces, Terminology and Definitions (Serial vs. Parallel, Bit Rate vs. Baud Rate, Synchronous 16 vs. Asynchronous, Data Flow-Control, Handshaking, Communication Protocol, Error Handling, Simplex, Half- Duplex, Full-Duplex, Unbalanced vs. Balanced Transmission, Point-to-Point vs. Multi-Point, Serial Asynchronous Communications, the Universal Asynchronous Receiver Transmitter (UART)), TIA/EIA Serial Interface Standards RS- 232 Serial Interface, Functional Description of Selected Interchange Circuits, IEEE 488- The General Purpose Interface Bus (GPIB) CNC machines, PLC.

Unit V: Software and Data Acquisition 6L

Data logging functional requirement: Acquisition, Sensors, Signal Connectivity, Signal Conditioning, Conversion, Online Analysis, Logging and Storage, Offline Analysis, Display, Report Generation, Data Sharing and Publishing; Data-Logging Systems Different applications of Mechatronics as Case study

Unit VI: Introduction to MEMS 6L

MEMS: Introduction and Fundamentals , mechanical properties of MEMS materials, modeling and simulation of MEMS, materials involved in designing and fabricating MEMS devices, various fabrication and manufacturing methods, including LIGA and macromolding, X-ray based fabrication.

Applications:-inertial sensors, micromachined pressure sensors, surface micromachined devices, microscale vacuum pumps, reactive control for skin-friction reduction, and microchannel heat sinks.

Text Books

1. Robert H. Bishop, 'The Mechatronics Handbook'_ CRC Press

2. D.G.Alciatore, M.B.Histand, 'Mechatronics'_2nd edition, TMH

3. Jurgen Gausemeier, Sascha Kahl, 'Architecture and Design of self –optimization Mechatronics System' InTech publication

Reference Books

1. Mohamed Gad-el-Hak, "The MEMS Handbook, Second Edition" - 3 Volume Set _CRC Press.

Lab Practice - III (404213)

Computer Networks and Process Automation

Teaching Scheme:
Practical: 4 Hrs/week

Examination Scheme: OR: 50Marks
TW:50Marks

Computer Networks

1. Study of network commands & IP address configurations.
2. Study of Cable tester for fault detection of UTP-CAT5 Cross / Straight LAN cable.
3. Implementation of LAN using star topology and connectivity between two computers using cross over UTP CAT5 cable. (Cisco Packet Tracer)
4. Installation and configuration of Web Server and hosting web page using HTML programming. (Cisco Packet Tracer)
5. Installation and configuration of Proxy Server.
6. Installation and configuration of FTP server for FTP communication.
7. Installation and configuration of Telnet server for Telnet Communication. (Teamviewer)
8. Write a program in 'C' for Encryption and Decryption (RSA Algorithm).
9. Write a program in 'C' for Shortest Path algorithm.
10. Connectivity of LAN computers to Internet using Dial-Up modem/leased line Modem /Mobile Handset. (Installation and configuration).
11. Installation of Suitable Protocol Analyzing software and Analysis of Intranet activities. (Wireshark)

Process Automation

1. Calibration of Electro pneumatic Converter.
2. Tuning of PID controllers for Different Control Actions.
3. To plot the control valve characteristics.
4. Study of Recorders.
5. Communication with smart Transmitter.
6. Microcontroller Based Instrumentation System.
7. & 8. Any two Experiments based on simulation of Instrumentation system/Process control.

Lab Practice - IV (404214)

Teaching Scheme:
Practical: 2 Hrs/week

Examination Scheme: PR: 50Marks
TW:50Marks

Elective III

Experiments to be chosen based on Elective III.