**STRUCTURE OF**

**B.E. (ELECTRONICS) 2008 COURSE**

**TERM - I**

| SUBJECT CODE | NAME OF SUBJECT | TH | PR | TUT | PP | TW | OR | PR | TOTAL MARKS |
|---|---|---|---|---|---|---|---|---|---|
| 404201 | ELECTRONICS SYSTEM DESIGN | 3 | | 1 | 100 | | 25 | | 125 |
| 404202 | VLSI DESIGN | 4 | 2 | | 100 | | | 50 | 150 |
| 404203 | EMBEDDED SYSTEM | 4 | 2 | | 100 | 25 | 25 | | 150 |
| 404204 | ELECTIVE-I | 4 | 2 | | 100 | 25 | | 50 | 175 |
| 404205 | ELECTIVE-II | 4 | | | 100 | | | | 100 |
| 404206 | PROJECT (PART-1) | | 2 | | | 50 | | | 50 |
| | | 19 | 8 | 1 | 500 | 100 | 50 | 100 | 750 |

**Elective –I**

1. Advanced Measurement Systems
2. Advanced Power electronics
3. Biomedical Instrumentation
4. Mechatronics

**Elective-II**

1. Advanced Computer Architecture
2. Entrepreneurship and Business Planning
3. SOC (System on Chip)
4. Robotics and Automation

**SEM-I**

## ELECTRONIC SYSTEM DESIGN (404201)

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| **Lectures/Week:** 3Hrs | **Paper:** 100 Marks |
| **Tutorial/Week:** 1Hrs. | **Oral:** 25 Marks |

### Unit 1: Introduction

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. Fundamentals of Communication System Design, criteria for selection of frequency bands, requirements of Voice and Multimedia Applications

### Unit 2: Hardware Designs- Analog

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 3: Hardware Design- Digital

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.

### Unit 4: Software Design and Testing for Electronic Product

Different approaches to development of application software for Electronic Product. Assemblers Factors affecting choice between Assembly language and High level language like C and C++. Documentation practices and templates for above software. Debugging tools and techniques for software- Features of Simulators, ICE, IDE.

**Unit 5: PCB Design and EMI/EMC**

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 6: Fault Finding and Testing**

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 Book**

1. Bernhard E. Bürdek, "History,Theory and Practice of Product Design", Springer Science, 2005
2. Paul Horowitz, "Art of Electronics", Cambridge University Press
3. Howard Johnson, Martin Graham, "High-speed Digital design- A Handbook of Black Magic", Prentice Hall Publication
4. G. Pahl andW. Beitz J. Feldhusen and K.-H. Grote, "Engineering Design - A Systematic Approach", Springer,2007
5. Tim Williams, "EMC for Product Designers", Elsevier, Fourth edition 2007

**Reference Books**

1. Jerry C Whitaker, "The Electronics Handbook", CRC Press, IEEE Press, ISBN 0-8493-8345-5
2. David Bailey, "Practical Radio Engineering and Telemetry for Industry", Elsevier, ISBN 07506 58037
3. Pressman , "Software Engineering - A Practitioner's Approach"
4. David Bailey, "Practical Radio Engineering & Telemetry for Industry", Elsevier, ISBN 07506 58037
5. Domine Leenaerts ,Johan van der Tang , Cicero S. Vaucher , "Circuit Design for RF Transceivers" , Kluwer Academic Publishers, 2003

**Tutorials**

1. Power supply sizing (Estimation of current requirement)
2. Design of SPAN ZERO circuit
3. Design of Transducer interface using Whetstone Bridge

4. Error budget analysis
5. ADC Interface example
6. DAC interface example
7. Interfaces- LED, HB LED, LCD, Relays
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

## VLSI DESIGN (404202)

| Teaching Scheme | Examination Scheme |
|---|---|
| **Lectures/Week:** 4Hrs | **Paper:** 100 Marks |
| **Practical/Week:** 2Hrs. | **Practical:** 50 Marks |

### Unit 1: Digital CMOS Design

CMOS Inverter, voltage transfer curve, body effect, hot electron effect, velocity saturation, Static and dynamic dissipations, Power delay product. Noise margin, Combinational logic design, W/L calculations, Transmission gate, design using TGs, λ parameter, layout, Design Rule Check, Technology scaling.

### Unit 2: CMOS Memories

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. Role of memories in PLD, chip area occupied by them.

### Unit 3: VHDL and Finite State Machines

VHDL design units, modeling styles, synthesizable and non synthesizable test benches, design flow, functions, procedures, attributes, test benches, configurations, packages, Synchronous and asynchronous machines, Finite State Machines (FSM), metastability, state diagrams and VHDL codes for FSMs.

### Unit 4: Programmable Logic Devices (PLDs)

Need of PLD, antifuse, SRAM and flash technologies, Comparison with ASIC, general purpose processor, DSP processor, microcontroller, memories etc, Features, specifications, detail architectures, application areas, limitations of Complex Programmable Logic Device (CPLD) and Field Programmable Logic Devices (FPGA).

### Unit 5: Fault tolerance and testability

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.

**Unit 6: Signal Integrity and System on Chip**

Clock skew, Clock distribution techniques, clock jitter, Supply and ground bounce, power distribution techniques, Power optimization, Interconnect routing techniques, wire parasitics. Design validation, Off chip connections, I/O architectures, Signal integrity issues, EMI immune chip design.

**Text books**

1. Neil H. Weste and Kamran, "Principles of CMOS VLSI Design", Pearson Publication.
2. Wyane Wolf, "Modern VLSI Design (System on Chip)", Pearson Publication.
3. John F. Wakerly, "Digital Design, Principles and Practices", Prentice Hall Publication.

**Reference Books**

1. Allen Holberg, "Analog CMOS Design", Oxford University Press.
2. Perry, "VHDL", McGraw Hill Publication.
3. Charles Roth, "Digital System Design using VHDL", McGraw Hill Publication.
4. Data Sheets of PLDs.
5. Sung-Mo (Steve) Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits", Tata McGraw Hill Publication.

**List of Practicals**

**Group A**: To write VHDL code and test bench, synthesis, simulate and down load in to PLD, for the following (Any four).
1. To sense physical parameter such as temperature/pressure/flow etc., convert in to digital using ADC, interface to PLD and display.
2. To write/read in to RAM.
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 programmable timer/counter.

**Group B**: To design following logic, calculate W/L ratios, prepare layout in multi metal layers and simulate (Any four).
Assume suitable technology, load capacitance, free running frequency, switching timings etc.
1. CMOS Inverter.

2. CMOS NAND, NOR.
3. 2:1 Mux by conventional method and by using Transmission gates. Comparison of them.
4. CMOS Combinational logic for minimum 4 variables.
5. Minimum 5 stage cascaded Inverter ring counter and understand technology limitations.
6. Clock skew generation and mitigation by any one method for synchronous machine.

## EMBEDDED SYSTEMS (404203)

| Teaching Scheme | Examination Scheme |
|---|---|
| **Lectures:** 4 Hrs/week | **Paper**: 100 Marks |
| **Practical:** 2 Hr/week | **Oral:** 25 Marks |
| | **Term work:** 25 Marks |

### Unit 1: Introduction

Introduction to embedded system, Definition of embedded systems, characteristics of embedded systems, design metrics, applications, embedded system operations, Software development, software architectures, IDE, Communication protocols: Blue tooth, Zig-bee, etc.

### Unit 2: Embedded Processor

Processor internal architecture, processor technology, processor types, embedded processor, RISC design philosophy, specifications of processor/s, memory organization, memory interfacing aspects, processor & memory selection for different applications, Interrupts.

### Unit 3: Arm Processor

ARM-7 processor LPC 2148 architecture, data flow model, memory organization, programming model, ISP & IAP, register banking, operating modes: ARM mode & Thumb mode, I/O port read/write operations, Status registers

### Unit 4: Programming

On chip communication protocols of LPC 2148, Programming concepts using embedded C, Programming ARM processor for implementing various communication protocols, keyboard Interface, LCD interface, on chip ADC/DAC interface.

### Unit 5: Real Time Operating Systems Concept

Real Time Operating Systems μCOS-II, Features, State diagram, comparison with traditional OS, Semaphore, shared data problem, scheduling algorithms, dead lock.

**Unit 6:Case Study**

Priority inversion problem, priority inheritance, interrupts management; inter task communication, memory management, Time delays. Case studies: Cruise control, digital Camera.

**Text Books**

1. Rajkamal " Embedded Sytems " TMH.
2. David Simon " Embedded systems software primer" pearson
3. Andrew sloss " Arm System Developer guide"
4. Christopher Hallinan " Embedded linux primer" Prenice Hall

**References Books**

1. Frank Vahid, " Embedded sytem design " , PHI
2. Steve Furber "Arm System on chip architecture", AddisonWesely
3. Alessandro Rubini and Jonathan Corbet, "LinuxDevice Drivers", 3rd Edition O'Reilly

**List of Experiments**

1. Write C code for implementation of four tasks using μCOS-II RTOS on LPC 2148 [ARM-7] processor.
2. Write C code for use of semaphore using μCOS-II RTOS on LPC 2148 [ARM-7] processor.
3. Write C code for message queue implementation using μCOS-II RTOS on LPC 2148 [ARM-7] processor.
4. Write C code for mail box implementation using μCOS-II RTOS on LPC 2148 [ARM-7] processor.
5. Write C code for message pipe implementation using μCOS-II RTOS on LPC 2148 [ARM-7] processor.
6. Write C code for demonstrating shared data problem using μCOS-II RTOS on LPC 2148 [ARM-7] processor.
7. Write C code for demonstrating priority inversion problem using μCOS-II RTOS on LPC 2148 [ARM-7] processor.
8. Write C code for implementing communication protocol on LPC 2148 [ARM-7] processor.

# Elective-I

## ADVANCED MEASUREMENT SYSTEMS (404204)

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| **Lectures**/week**:** 4 Hrs | **Paper:** 100 Marks |
| **Practical**/week: 2Hrs | **Practical**: 50 Marks |
| | **Term work:** 25 Marks |

**Unit 1: Signal Integrity:**

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

**Unit 2: Hardware design and testing methods:**

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

**Unit 3: Role of electronic measurements in Embedded Systems:**

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 4: Microwave Measurements:**

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 5: Virtual Instrumentation:**

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 6: Digital Instrumentation:**

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. Electronics Instrumentation by H.S.Kalsi
2. Microwave circuits and design by Samuel Liao
3. Handbook for I2C and CAN protocol
4. Process Handbook by Liptac

**References:**

1. Application Notes by Tekteronics
2. Application Notes by Agilent
3. Hand Book for Electronic Measurements by Coombs

**List of Practicals**

(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 and application of ADC 0809
4. Study and application of DAC 0808
5. Study of Arbitrary waveform generator
6. Program to demonstrate I2C Protocol.
7. Program to demonstrate CAN Protocol.
8. System building and simulation on Virtual Instrumentation
9. VSWR Measurement (Using Vmax / Vmin Method)

## ADVANCED POWER ELECTRONICS (404204)

| Teaching scheme | Examination scheme |
|---|---|
| **Lectures/week:** 04 Hrs | **Paper:** 100 marks |
| **Practical's/week:** 02 Hrs | **Practical:** 50 marks |
| | **Term work:** 25 marks |

### Unit 1: 3 Phase Converter drives

3 phase converter drives for dc motors ( HCC/FCC) ,wave form analysis with RL load.. Harmonic analysis for above covertres.numericals based on above. Dynamic & regenerative braking techniques. Protection circuit for motors .

### Unit 2:Variable DC drives

Concept of reversible drives .3 phase dual converters with & without circulating current. Dual mode dual converters, waveform analysis.numericals on above. Study of 4 quadrant chopper drives with highly inductive load, operation analysis & application, regenarative braking techniques. Microcontroller based variable dc drives**.**

### Unit 3:Power Supplies and Resonant Converter

DC-DC power converters, limitations of linear power supplies switched mode power supplies (buck, buckboost.boost, cuk, flyback & forward converters. Concept of soft switching, close loop control. Resonant converters .Transfer functions of these converters. Resonant converters analysis & design of series & parallel resonant converters, zero voltage switching, zero current switching analysis with applications.

### Unit 4: 3 Phase IM Motor drives

Principle of operation & speed control techniques of 3 phase induction motor,characteristics,study & comparison between various types of (P,PI,P+D), Z-Sourse inverters, Stepper motor control, mode of excitation, different power circuit configuration for stepper motor drive, microstepping of stepper motor**.**

### Unit 5: Renewable Energy Sources

Role of power electronics in renewable energy, variable wind energy conversion system with dc to dc converter followed by 3 phase VSI, Photo voltaic energy conversion system, solar battery powered drives traction drives, energy conversion in electrical drives. Battery chargers

**Unit 6: Power Conditioning**

Power quality, power line disturbances & its remedies, energy audit, solar power conditioning, power transmission-facts technology HVDC**.**

**Text books**

1. by P.C.Sen, “Modern power electronics”; S Chand & co
2. M.H. Rashid, “Power electronics”; PHI 4TH edition New Delhi
3. Ned Mohan, “Power electronics”, TMH Publication

**Reference Books**

1. P.C sen, “Thyrister d.c drives”,Jhon Wiely
2. Bimal K Bose, “Modern power electronics & ac drives”, Pearson publication
3. Burlon,d.Sharp,n Jenkins Bossanji, “Wind energy hand book”, Jhon Wiely & Sonst.

**List of Practicals**

1. Dc motor control using semi/full single or three phase controlled converter.
2. Dual converter single phase/three phase controlled dc drives.
3. Microprocessor/microcontroller based single phase/three phase controlled dc drives.
4. Four quadrant chopper reversible dc drives.
5. Three phase induction motor control using square wave/PWM invertors.
6. Microprocessor/microcontroller based single phase/three phase control AC drive.
7. simulation of DC drives using power SIM/simulink in mat lab
8. Simulation of AC drives using power SIM/simulink in mat lab.
9. Case study on drive application (Industrial visit).

## BIO-MEDICAL INSTRUMENTATION (404204)

| Teaching Scheme | Examination Scheme |
|---|---|
| **Lectures/Week:** 4Hrs | **Paper:** 100 Marks |
| **Practical/Week:** 2Hrs. | **Practical:** 50 Marks |
| | **Term work:** 25 Marks |

**Unit 1: Introduction**

Introduction to Biomedical System**,** Cell structure, Functions of Cell, Bio- Signals, Types of Electrodes to Measure Bio-signals**.** Transducers and Sensors for Bio Signal Measurements: EEG, ECG, EMG, PCG, Respiration, Skin contact impedance, Motion artifacts. Fiber Optic sensor for Temperature. Chemical Sensors to measure PH, PO2, Glucose, O2.

**Unit 2: Nervous System-Anatomy**

Introduction to Nervous System-Anatomy, 10-20 electrode for EEG, Evoked- Potential, Types and significance of EEG Signals ($\alpha$, $\beta$, $\gamma$, $\delta$, $\theta$) EEG machine, Analysis of Diseases using EEG, EMG Machine.

**Unit 3: Heart System**

Introduction to Heart System. Functioning of Heart System, Anatomy of Heart, Lead Configuration to measure ECG, ECG Amplifiers, ECG Machine. Introduction to Heart Sound, Phonocardiography.

**Unit 4: Medical Instruments and Measurment**

Introduction to Blood Pressure Measurement (Direct and Indirect Methods). Blood Flow Measurement. Finger Plethesmography, Echocardiography, Stress Testing System, Beside Monitors, Central Monitoring System, Life Saving Device: Pacemakers, Defibrillators,

**Unit 5: Clinical Lab Instruments**

Introduction to Clinical Lab Instruments. Blood Cell Counter, Electron Microscope, Colorimeter, Autoanalyser, Flame photometer, PH/Blood Gas Analyzer, Pulse Oximeter, Vivo Oximetry Vitro-Oximetry. Introduction to Dialysis System. Electronic Stethoscope (Advantages and Disadvantages of Electronic Stethoscope). Issues of Noise Pollution around Hospitals. Electrical Safety of Instruments: Grounding and Shielding.

**Unit 6: Radiology Instrumentation**

Introduction to Radiology Instrumentation such as X-Ray Machine, Computer Tomography (CT Scan), MRI Machine, Introduction to Ultrasonic Doppler Machine, Lasers in Medicine- Vision Correction, Dermatological. Principles, types, applications Dermatology, vision correction information to be collected from net ASL (American Society for lasers), Medical laser book: Selection of lasers type, powers, wavelength, Depth of penetration, Ximer Laser. Introduction to Dental Instruments on following topics: Aerator, Amalgamator, Shadow Less Light, Ortho Pentamo Graph.

**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 Practical / Assignments**

Students are expected to perform Minimum 8 practical from the list mentioned below.
1. To study ECG Machine (Single channel or Multichannel).
2. PC based ECG machine – waveform simulation C based
OR
EGC waveform generation using microcontroller.
3. Interface of PC simulated waveform with ECG machine
4. To study and measure Blood Pressure using sphygmomanometer/ Digital BP Instrument
5. To study Defibrillator/pacemaker
6. Measure body temperature using Digital Clinical Thermometer
7. ECG \ QRS Detector + Counter to display heart rate
8. To study and measure pulse rate using finger plethesmography.
9. measurement of concentration using spectrophotometer
10. To study EEG/EMG Machine.
11. To study Blood cell counter.
12. Study of Bedside Monitor, Drip Rate Monitor (ICU Monitor)
13. Study of Dialysis System
14. Study of Clinical Lab Instrumentation.
15. Study of Laser Treatments in Medicines.

## MECHATRONICS (404204)

| Teaching Scheme | Examination Scheme |
|---|---|
| **Lectures/Week:** 4Hrs | **Paper:** 100 Marks |
| **Practical/Week:** 2Hrs. | **Practical:** 50 Marks |
| | **Term work:** 25 Marks |

### Unit 1: Overview of Mechatronics

Key Elements, Mechatronics Design Approach, Functions of Mechatronics system, Division of functions between Mechanics and Electronics, Stepwise Design Procedure, Modelling 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 2: Physical System Modelling

Modelling Electromechanical Systems, Simple dynamic models, Elastic system modelling, Structures and Materials, Common structures in Mechatronics: Beams, Springs, Thin Plates, Vibration and analysis,

### Unit 3: Sensors and actuators Sensors and transducers:

Principle of operation, Specifications, Selection criterion (Design aspects) for Force, pressure, temperature, motion (Rotary and Linear), position, flow, Level Sensors
**Actuators:**Classification, Specifications, Selection criterion and application areas for:
Mechanical actuators: Pneumatic, Hydraulic, programmable electro hydraulic valves
Electrical actuators: Relays and Solenoids, Stepper Motors, DC brushed motors, DC brushless motors, DC servo motors, 4-quadrant servo drives , PWM's, Pulse Width Modulation, Variable Frequency Drives, Vector Drives, Drive System load calculation

### Unit 4: Systems and Control

Role of controls in Mechatronics, Key elements of controlled Mechatronics system, Integrated Modelling, 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, Design optimisation of Mechatronics system, controller examples

### Unit 5: Computers and Logic Systems

The Mechatronics use of computers, concept of real time, System interfaces, Terminology and Definitions (Serial vs. Parallel, Bit Rate vs. Baud Rate, Synchronous

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 6: Software and Data Acquisition**

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

**Text Books**

1. Robert H. Bishop, "The Mechatronics Handbook", CRC Press
2. W. Bolton, "Mechatronics", 2nd Edition, Pearson Education

**Reference Books**

1. D.G.Alciatore, M.B.Histand, "Mechatronics", 2nd edition, TMH
2. Christopher Kilian, "Modern control technology", 2nd edition, Thomson

**List of Practicals**

1. Study of various mechanical components used in Mechatronics applications
2. Study of different switches and relays with their applications in Mechatronics
3. Study of Flip Flops, Timers, ADC, DAC and Op – Amp circuits as Mechatronics system elements
4. Calibration of flow meters/ Thermocouple /RTD
5. Study of Load Cells for Mechatronics applications
6. Vibration measurement /Displacement measurement/ level measurement
7. Verification of P, P+I, P+D, P+I+D control actions
8. Study of linear conveyor control system
9. Study of rotary table positioning systems 10. Analysis of control system using software like MATLAB/SIMULINK or equivalent.
11. Development of ladder diagram/programming PLC for level control, position control or any other mechanical engineering application
12. Study of Data acquisition system
13. Study of Microcontrollers applications for Mechatronics systems
14. Case study of any Mechatronics system

# Elective-II

## ADVANCED COMPUTER ARCHITECTURE (404205)

**Teaching Scheme** **Examination Scheme**

**Lectures/Week:** 4Hrs **Paper:** 100 Marks

### Unit 1: Overview of Parallel Processing and Pipelining Processing

Necessity of high performance, Constraints of conventional architecture, Parallelism in uni processor system, Evolution of parallel processors, future trends, Architectural Classification Principles of scalable performance : Performance Metrics and Measures, Speedup Performance Laws, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Introduction to Parallel Programming Languages : Fortan 90, Occam and C-Linda, Introduction to cluster, Neuro Computing and grid computing

### Unit 2: Pipeline Architecture

Principles and implementation of Pipelining, Classification of pipelining processors, General pipelining reservation table, Design aspect of Arithmetic and Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering techniques, Job sequencing and Collision, Advanced pipelining techniques, loop unrolling techniques, out of order execution, software scheduling, trace scheduling, Predicated execution, Speculative loading, Register Stack Engine, Software pipelining, VLIW (Very Long Instruction Word) processor, Superscalar Architecture- Pentium, Ultra SPARC, Explicitly Parallel Instruction Computing (EPIC) Architecture, Case study of Intel Itanium Processor

### Unit 3: Vector and Array Processor

Basic vector architecture, Issues in Vector Processing, vectorization, Vector performance modeling, vectorizers and optimizers, pipeline chaining and vector loops, Case study: Cray Architecture.

### Unit 4: SIMD Computer Organization

Masking and Data network mechanism, Inter PE Communication, Interconnection networks of SIMD, Static Vs Dynamic network, cube hyper cube and Mesh Interconnection network.
Parallel Algorithms for Array Processors: Matrix Multiplication. Sorting, FFT

### Unit 5: Multiprocessor Architecture:

Loosely and Tightly coupled multiprocessors, Processor characteristics of multiprocessors, Inter Processor communication network, Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping, Massively Parallel Processors (MPP), COW's and NOW's Cluster and Network of Work Stations), Chip Multiprocessing (CMP), Inter Processor Communication and Synchronization, Case Study of IBM Power4 Processor

**Unit 6: Parallel Programming and Multithreaded Architecture**

Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Message passing parallel programming, Shared Memory Programming, Data Parallel Programming Multithreaded Architecture: Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions, case study-JVM

**Textbooks**

1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGrawhill international Edition
2. Kai Hwang, "Advanced Computer Architecture", Tata McGrawhill Edition

**References**

1. V.Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI.
2. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition
3. Kai Hwang, "Scalable Parallel Computing"
4. Richard Y. Kain, "Advanced Computer Architecture"

## ENTREPRENEURSHIP AND BUSINESS PLANNING (404205)

**Teaching Scheme** **Examination Scheme**

**Lectures/Week:** 4Hrs **Paper:** 100 Marks

### Unit 1: Introduction

Entrepreneur: Present and Past, Entrepreneurship for an Engineer, Identify Business Opportunities and Set Goals. Entrepreneurs Skills: Communication Skills, Math Skills, Problem-Solving Skills

### Unit 2: Entrepreneurs in a Market Economy and Ownership

Entrepreneurs in a Market Economy: An Economy, The Concept of Cost, Government in a Market Economy. Select a Type of Ownership: Run an Existing Business, Own a Franchise or start a Business, Choose the legal form business

### Unit 3: Business Plan

Develop a Business Plan: Necessity a business plan, What goes into a business Plan?, Create an effective business plan. Identity and Meet a Market Need: The value of market research, How to perform market research, Identify your competition. Finance, Protect, and Insure Business: Put together a financial plan, Obtain financing for business, Theft proof business, Insure business Choose Location & Setup for Business: Choose a retail business location, Choose a location for a non-retail business, Obtain space and design the physical layout, Purchase equipment, supplies and inventory. Market Business: The Marketing mix-product, distribution, price, The Marketing mix-promotion, Set marketing goals

### Unit 4: Hire and Manage a Staff: Record keeping and Accounting

Hire and Manage a Staff: Hire Employees, Create a compensation package, Manage staff , Record Keeping and Accounting: Set up a record keeping system, Understand basic accounting, Tracking inventory

### Unit 5: Financial Management, Use Technology

Financial Management: Manage cash flow, Analyze financial performance, Hire experts, Use of Technology: Technology and business, Learning about the internet, Purchase technology

**Unit 6: Meeting Legal, Ethical, and Social Obligation Growth in Today's Marketplace**

Meeting Legal, Ethical, and Social Obligation: Understanding legal requirements, Ethical issues in business, meeting social responsibilities. Growth in Today's Marketplace: Developing a strategy for growth, Global Trends and opportunities, Culture and business

**Text books**

1. Cynthia L. Greene, "Entrepreneurship Ideas in Action", South Western Publishing Company (A Division of Thomson Learning Inc.,), First Edition.2000.
2. G.S. Batra, "Entrepreneurship Development", Deep & Deep Publications : 1st Edition.

## ROBOTICS AND AUTOMATION (404205)

**Teaching Scheme** **Examination Scheme**

**Lectures: 4 Hrs/week** **Paper: 100 Marks**

### Unit 1: Introduction to Robotics and Automation

**Robotics:** History of Robotics, Applications of Robotics, Current Research in Robotics, General Structure of Robotic Mechanical Systems, Classification of Robots based on co-ordinate system, Classification of Robotics, Overview of robot subsystems, Components of Robot system-Manipulator, Controller, Power conversion unit etc, Specifications of robot. Commercially available Software Packages for Robot Simulation.

### Unit 2: Kinematics and Dynamics

**Kinematics:** Homogeneous co-ordinate vector operations, matrix operations, co-ordinate reference frames, Homogeneous transformation and manipulator orientation relative points reference frames, Workspace , Forward Kinematics - forward solutions- Link co-ordinate frames, D-H matrix, Inverse Kinematics - Existence and Uniqueness of Solutions, Analytical Approaches - Reduction of Inverse Kinematics to Sub-problems, Pieper's Solution, Numerical Techniques, techniques of using direct & geometric approach

**Dynamics:** Newton's equation, Euler equations, Dynamic Modeling of Robotic Manipulators - Force and Torque Balance on an Isolated Link, Two-Link Robot Example, Closed-Form Equations. Kane's Method in Robotics - Two DOF Planar Robot with Two Revolute Joints, Generalized Coordinates and Speeds, Velocities, Partial Velocities, Accelerations, Generalized Inertia Forces, Generalized Active Forces, Equations of Motion**,** Special Issues in Kane's Method

### Unit 3: Mechanisms Actuators and Sensors

Some Popular **Mechanisms** - Four-bar Mechanism, Slider-crank Mechanism, Rack and Pinion, Cams and Cranks, Gear and Gear Trains, Synthesis of Mechanisms , Kinematic Analysis of Mechanisms, System Features, Kinematics and Kinetics, Serial Robots, Parallel Robots, Mechanical Structure, Joint Mechanisms. **Actuators:** Electromagnetic Actuators, Fluid Power Actuators. Different types of grippers - Compressed Air, Vacuum, Hydraulic Fluid Power, Electrical Power & other methods of gripping. DC Motors, Stepper Motors, Servo Motor, Controlling of these motors. **Sensors**: Encoders - Rotary and Linear Incremental Encoders, Tachometer, Quadrature Encoders, Absolute Encoders. Analog Displacement Sensors, Force and Tactile Sensors, Ultrasonic Transponder, Accelerometers, Gyroscopes , proximity sensors, Infrared Sensors, touch slip sensor, laser range finder, Vision-based Sensors, Color-tracking Sensors, Sensor Mounting Arrangement, Reading the Pulses in a Computer, Design of the Circuitry

**Unit 4: Motion Planning and Motion Control**

On-off trajectory, relocking and acceleration profile, Cartesian motion of manipulator, joint interpolated control, Jacobian in terms of D-H matrix, Trajectory Planning: Command 2 Generation, Pick-and-Place Operations, Obstacle avoidance, Basic control system, control loops of robotic system, Feed-forward Control Action, Fuzzy controllers, Error Budgeting.

**Unit 5: Robot Vision Systems**

Hardware Considerations for Vision Systems: Sensors, Interconnects to Sensors, Image Operations, Hardware Components, Processing Board Organization. Design Methodology for Vision Systems: Algorithms Architectures Interfaces Modeling and Specification Partitioning and Mapping Scheduling Design Space Exploration, Code Generation and Verification
Video Analytics: Segmentation, Classification and Recognition, Tracking, Architecture, Algorithmic Components, Camera Calibration, Object recognition.

**Unit 6: Automation**

Structure of Automatic Industrial Systems, Relationship between the Robot Intelligence and the Product, Productivity of a Manufacturing Process, Kinematics and Control of Automatic Machines, Feedback Sensors, Transporting Devices, Feeding and Orientation Devices, Automatic Assembling, Inspection Systems, Welding – Automation.

**Text Books**

1. Bruno Siciliano, Oussama Khatib (Eds.), "Springer Handbook of Robotics", 2008, ISBN: 978-3-540-23957-4
2. Jorge Angeles, "Fundamentals of Robotic Mechanical Systems Theory, Methods, and Algorithms" Second Edition, 2003, Springer-Verlag New York, Inc.,ISBN 0-387-95368-X
3. Edwin Wise, "Robotics Demystified", 2005, The McGraw-Hill Companies, ISBN 0-07-143678-2
4. Thomas R. Kurfess, "Robotics And Automation Handbook", CRC Press, 2004, ISBN 0-8493-1804-1
5. "Robotics: Appin Knowledge Solutions (Firm)", Infinity Science Press , 2007, ISBN 978-1-934015-02-5

**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
3. Branislav Kisa˘canin, Shuvra S. Bhattacharyya, "Embedded Computer Vision", Sek Chai-Editors, Springer-Verlag London Limited 2009, ISBN 978-1-84800-303-3

## SYSTEM ON CHIP (404205)

**Teaching Scheme** **Examination Scheme**

**Lectures:** 4 Hrs/week **Paper:** 100 Marks

### Unit 1: Introduction to MEMS and SoC

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.
Mechanical Transducers : transduction methods, accelerometers, gyroscopes ,pressure sensors, MEMS microphones, mechanical structures, actuators.

### Unit 2: Control and Materials of MEMS

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 pezoresisters, Gallium arsenide, Quartz, piezoelectric crystals, Polymers.

### Unit 3: Transducers

Chemical and Biological Transducers: basic concepts of cellular biology, chemical sensors, molecule-based biosensors, cell-based biosensors, chemical actuators, biological transducers, electrophoresis: optical transducers, thermal transducers, magnetic transducers, RF transducers.

### Unit 4: Introduction to SOC

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

### Unit 5: Overview of Physical Design Automation

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

**Unit 6: SOC Testing and Packaging**

Hardware/software co-design, test and design of circuit to integrated systems, testable design and testing of Microsystems, embedded core based system on chip test strategies Micro System Packaging: Over view of mechanical packaging of micro electronics micro system packaging

**Text Books:**

1. Kovacs, Gregory T. A. "Micromachined Transducers Sourcebook" McGraw-Hill
2. Max J. Madou, "Fundamentals Of Micro Fabrication", The science of miniaturization, Nanogen corporation, USA, CRC press, March 2002.
3. Sergey Edward Lyshevski, "Nano-And Micro Electro Mechanical Systems"; Second edition, CRC press, Boca Ratron London.

**Reference Books:**

1. Jan G Korvinik and Oliver Paul, "MEMS Practical Guide to Design, analysis and Applications" William Andrew, Inc Springer
2. G.K. Anantsuresh, K.J. Vinoy, S. Gopalkrishnan, K.N. Bhat, V.K. Atare, " Micro and Smart Systems" Wiley

## Project Part I (404206)

| Teaching Scheme | Examination Scheme |
|---|---|
| **Tutorial: 2 Hrs/Week** | **Term Work: 50 Marks** |

**Note:**

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

TERM-II

| SUBJECT CODE | NAME OF SUBJECT | TH | PR | TUT | PP | TW | OR | PR | TOTAL MARKS |
|---|---|---|---|---|---|---|---|---|---|
| 404207 | COMPUTER NETWORK & SECURITY | 4 | 2 | | 100 | | 50 | | 150 |
| 404208 | PROCESS AUTOMATION | 4 | 2 | | 100 | 25 | 50 | | 175 |
| 404209 | ELECTIVE-III | 4 | 2 | | 100 | 25 | | 50 | 175 |
| 404210 | ELECTIVE-IV | 4 | | | 100 | | | | 100 |
| 404211 | PROJECT (PART-II)*** | | 6 | | | 100 | 50 | | 150 |
| | | 16 | 12 | 0 | 400 | 150 | 150 | 50 | 750 |

**Elective-III**

1. Audio and Video Engineering
2. Image Processing and Machine Vision
3. Optical and Microwave Communication
4. Soft Computing tools

**Elective-IV**

1**.** Advanced Communication System
2. Automotive Electronic Systems
3. Artificial Intelligence
4. Nanotechnology in Electronics
5. Any one subject from the list of Elective IV of Computer/IT/Electrical/Instrumentation OR institute can offer an elective-IV based on any industry need with prior approval of BOS (Electronics)

**Note:**

1) All Theory papers are three hours duration

2) Practical/Oral shall be based on term-work

3) Term-work of Project Part I consist of project report based on project

4) ** * Exam at the end of II term

**SEM-II**

**COMPUTER NETWORK AND SECURITY (404207)**

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| **Lectures:** 4 Hrs/week | **Paper:** 100 Marks |
| **Practical**: 2Hrs/week | **Oral**: 50 Marks |

**Unit 1: Introduction to Computer Networks**

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 addres, Example of networks-X.25, Frame Relay & ATM, Protocols and Standards.

**Unit 2: Application Layer**

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 programming, Introduction to HTML programming.

**Unit 3: Transport Layer and Network Layer**

Transport layer-Process to process delivery, Connection oriented & Connectionless Transport, UDP, TCP, congestion control and Quality of Service. 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.

**Unit 4: Data link layer**

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 5: Physical Layer**

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

**Unit 6: Basics of Network Security and Network administration**.

Network security: Introduction to Cryptography, Secret key algorithm, public key algorithm, Hash Functions, basic ITU-T Recommendation - X.805 Security Architecture, 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.
3. Kurose & Ross, "Computer Networking" A top Down Approach featuring the Internet. 3rd 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.

**List of the Experiments**

1. Implementation of LAN using star topology and connectivity between two computers using cross over UTP CAT5 cable.
2. Installation and configuration of Web Server and hosting web page using HTML programming.
3. Installation and configuration of Proxy Server.

4. Installation and configuration of FTP server for FTP communication.
5. Installation and configuration of Telnet server for Telnet communication.
6. Write a program in “c” for Encryption and Decryption
7. Write a program in “c” for Shortest Path algorithm.
8. Connectivity of LAN computers to Internet using Dial-Up modem/leased line modem/Mobile Handset. (Installation and configuration).
9. Installation of Suitable Network Monitoring software and Analysis of Intranet activities.
10. Installation of Suitable Protocol Analyzing software and Analysis of Intranet activities.
11. Assignment of LAN or WAN simulation using Suitable network Simulating software.
12. Study of Cable tester for fault detection of UTP-CAT5 Cross / Straight LAN cable.

## PROCESS AUTOMATION (404208)

| Teaching Scheme | Examination Scheme |
|---|---|
| **Lectures/Week:** 4Hrs | **Paper:** 100 Marks |
| **Practical/Week:** 2Hrs. | **Oral:** 50 Marks |
| | **Term work:** 25 Marks |

**Unit 1: Introduction**

Block Diagram of process control system, process control principles, Instrumentation standard signals.

**Unit 2: Controllers**

Closed loop control system, process characteristics, control system parameters, degree of freedom. Controller modes: Discontinuous, continuous and composite controller modes. Electronic controllers: Realization of controllers using operational amplifiers circuits. Pneumatic controllers, Hydraulic controllers, Tuning of PID controller.

**Unit 3: Control Elements**

Comparison of electronic, pneumatic, hydraulic systems. Control Valves: Principle of control valve, different parts of control valve, flow characteristics, selection of control valve, control valve sizing, different types of control valve and their applications, control valve noise, valve positioner, cavitations and flashing.

**Unit 4: Advanced process control**

Feedback and feed forward control systems, cascade, ratio, selective and adaptive control systems, applications of these systems in process industry. Statistical process control, self tuning controller. Internal Model Control [IMC], Model Predictive control [MPC], Process Model Based Control [PMBC].

**Unit 5:**

Instrumentation schemes for boiler, Heat exchanger, Distillation column control, Evaporator, Compressor. Introduction to Robotics: Definition, Need of robot, Robot components, Classification and applications.

**Unit 6: Computers in Instrumentation**

Supervisory control systems, direct digital control systems, Distributed control systems, SCADA. Auxiliary process components: Square root extractor, flow tantalizer, recorders, alarm annunciators, Control Panels.

**Text Books**

1. B G Liptak "Instrument Engineers Handbook "Volume I & II, Chilton Book Co.
2. C D Johnson, "Process Control Instrumentation Technology", PHI

**Reference Books**

1. Andrews, "Applied Instrumentation in Process Industries"
2. Considine, "Process Instrumentation and Control Handbook"

**List of Practicals**

1. Calibration of electro pneumatic converter.
2. Tuning of PID controller for different control actions.
3. To plot the control valve characteristics.
4. Study of Recorders.
5. Communication with SMART TX.
6. Microcontroller based instrumentation system.
7. Any one experiment based on simulation of instrumentation system/Process control.

## Elective-III

## AUDIO AND VIDEO ENGINEERING (404209)

| Teaching Scheme | Examination Scheme |
|---|---|
| **Lectures/week:** 4 Hrs | **Paper:** 100 Marks |
| **Practical/week**: 2Hrs | **Practical**: 50 Marks |
| | **Term work:** 25 Marks |

### Unit 1:Fundamentals of Television and Displays

Color TV systems, Television basics, color fundamentals, mixing of colors, color perception, chromaticity diagram, Digital TV cameras. Display devices: LCD, TFT, LED, Plasma, and HDTV.

### Unit 2: Television Standards

NTSC, PAL, SECAM systems, color TV transmitter, high level, low level transmitters, color TV receivers, remote control, antennas for transmission. TV alignment and fault finding with Wobbuloscope and TV pattern generation, field strength meter.

### Unit 3:Digital TV

Introduction to Digital TV, Principle of Digital TV, Digital TV signals and parameters, Digital TV Transmitters, MAC signals, advanced MAC signal transmission, Digital TV receivers, Basic principles of Digital Video compression techniques, MPEG1, MPEG2, MPEG4, Video compression ITU-Standards(H.). Digital TV recording techniques.

### Unit 4:HDTV Systems

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

### Unit 5:Audio Systems

Overview of Digital Sound Recording, Digital sound recording, CD recording, CD/ DVD player, MP3 player, Blue Ray DVD Players, Audio Compression Standards, MPEG,MP3,Audio Compression ITU-T Standards( G.)

**Unit 6: Acoustics**

Studio Acoustics, reverberation, PA system for auditorium, Acoustic chamber, Graphic Equalizers and Digital Filters, chord less microphone systems, special type of speakers, Satellite radio reception.

**Text Books**

1. A. M. Dhake, “Television and video Engineering”, TMH Publication.
2. Kelth jack, “Video Demisified”, Penram International Publication.
3. R.G. Gupta, “Audio Video Systems”, Technical Education.

**Reference Books**

1. S. P. Bali, “Color TV Theory and Practice”
2. Bernard Grobb, Charles E, “Basic TV and Video Systems”
3. Gulathi, “Monochrome & Color TV”

**List of Practical Assignments**

1. Voltage and waveform analysis for color TV.
2. Alignment and fault finding for color TV
3. Study of Wobbulosocpe and Pattern Generator.
4. Study of direct to home TV and set top box.
5. Simulation of video compressing techniques.(Software Assignments)
6. Practical visit to TV transmitter/studio.
7. Study of PA system with chord less microphone.
8. Study of Audio system: CD players and MP3 player.
9. Study of HDTV.
10. Study of Digital TV.

## IMAGE PROCESSING AND MACHINE VISION (404209)

| Teaching Scheme | Examination Scheme |
|---|---|
| **Lectures/week:** 4 Hrs | **Paper:** 100 Marks |
| **Practical/week**: 2Hrs | **Practical**: 50 Marks |
| | **Term work:** 25 Marks |

### Unit 1: Introduction to image processing

Image Processing Applications, Fundamentalsteps in Digital image processing, Elements of visual perception, Image sensing and acquisition, Basic Concepts in Sampling and Quantization, representing digital images.

### Unit 2: Image Enhancement

Some basic gray level transformations, Histogram Processing, Arithmetic Operations, Spatial filtering, Smoothing and Sharpening Spatial filters, Image Enhancement in the Frequency Domain, Gaussian filters, Homomorphic filtering.

### Unit 3: Image Segmentation

Some Basic Relationships between pixels, point, line and edge detection, Gradient operators, Canny edge detection, pyramid edge detection. Edge linking and boundarydetection, Hough transform, Chain codes, boundary segments, skeletons, Boundary descriptors, Fourier descriptors.Thresholding, global thresholding, adaptive thresholding, use of boundary characteristics for histogram improvement and local thresholding, Region based segmentation, Region growing, region splitting and merging.

### Unit 4: Image Compression

Data redundancies Elements of information, variable-length coding, predictive coding, Transform coding, Image compression standards, Wavelets and Multiresolution processing Image pyramids, subband coding.

### Unit 5: Representation and Description

Shape Representation and Description, Region Identification, Contour based shape representation and description, Region based representation and description, Shape classes

**Unit 6: Object Recognition and 3 D vision**

Statistical pattern recognition and Syntactic pattern recognition, Graph Matching, 3 D vision and Geometry, Single perspective camera , scene reconstruction from multiple views.

**Text Books**

1. Gonzalez & Woods, "Digital Image Processing", Second Edition, Pearson Education, 2003
2. Milan Sonka et al, " Digital Image Processing and Computer Vision, Third Reprint, Cengage Learning, 2008

**Reference Books**

1. B. Chanda & D. Dutta Majumder, " Digital Image Processing and Analysis", 2001.
2. Pratt W.K, "Digital Image Processing", Third Edition, John Wiley & Sons, 2001

**List of Practical Assignments**

1. Study of different File Formats BMP, TIFF
2. Study of statistical Properties: mean standard Deviation, Profile, Variance and Histogram Plotting
3. Histogram Equalization and modification
4. Gray Level transformation : contrast Stretching negative, power law transformation
5. Spatial Domain Filtering: Smoothing and sharpening Filters
6. DCT/IDCT of given Image
7. Shape Description and Object Recognition
8. Assignment on 3D vision

## OPTICAL AND MICROWAVE COMMUNICATION (404209)

| Teaching Scheme | Examination Scheme |
|---|---|
| **Lectures/Week:** 4Hrs | **Paper:** 100 Marks |
| **Practical/Week:** 2Hrs. | **Practical:** 50 Marks |
| | **Term work:** 25 Marks |

### Unit 1: Fundamentals of FOC

Basic block diagram of Optical Fiber Communication system, Principles of light propagation through a fibre, Different types of fibres and their characteristics, Connectors & splicers, Fibre termination, Optical sources and Optical detectors. Fibre optic sensors, Different types of modulators

### Unit 2: Dispersion, Modulation and Optical Networks

Attenuation, Distortion, Pulse broadening in GI fibers, Mode coupling, Coupling losses, Material dispersion, Dispersion in single-mode and multimode fibers, Principle of Wavelength Division Multiplexing, Passive components, Optical amplifiers - EDFA, Raman amplifier, and WDM systems. Concept of self-phase modulation optical networks: SONET/SDH.

### Unit 3: Industrial and Medical Applications

Interferometric method of measurement of length, Moire fringes, Measurement of pressure, temperature, current, voltage, liquid level and strain. Laser heating, welding, melting and trimming of material, Removal and vaporization, Medical applications of lasers, Laser instruments for surgery, removal of tumours of vocal cards and brain surgery.

### Unit 4: Microwave Ddevices and Components

Basic concepts and properties of wave guides, Scattering Matrix of Microwave passive Network and Smith Chart, Properties of S matrix, S matrix formulation of two-port junction, T junctions- H plane, E plane and EH plane Tee junctions, its S matrix and properties, Applications of Hybrid junction. Directional coupler, Gyrator, Isolator, Circulator, Phase changer, Attenuator and matched terminations

### Unit 5: High Power Microwave Sources

Two cavity klystron amplifier, Mechanism and mode of operation, Power output and efficiency ,Mode curve, Equivalent circuit and voltage gain, Beam loading ,Applications, Multi cavity Klystron, Reflex Klystron, Traveling Wave Tube and Magnetron - Principle

of Mechanism and mode of operation, Power output, Efficiency, Mode curve, Equivalent circuit

**Unit 6: Microwave Solid State Devices and Circuits**

Crystal diode, Schottky diode, PIN diode, IMPATT diodes, Mechanism of operation, Application as oscillator and amplifier, Tunnel diode as oscillator / amplifiers, Varactor diode, Parametric amplifier, Unipolar and bipolar Microwave transistors, Gunn diode, Mode of operation, Gunn diode as an Oscillator and an amplifier, Terrestrial and satellite based microwave communication systems

**Text Books**

1. G.P. Agrawal, "Fiber optic communication systems", 3rd Ed, John Wiley & Sons New York, 2002
2. G. Keiser, "Optical fiber communication systems", McGraw-Hill, 3rd Edition, New York, 2000
3. John F. Read, "Industrial Applications of Lasers", Academic Press

**Reference Books**

1. Monte Ross, "Laser Applications", McGraw Hill
2. Samuel Liao, "Microwave devices and circuit", PHI.
3. A K Maini, "Microwave and radar", Khanna Publishers.

**Practicals**

1. V-I & I-P characteristics of LED.
2. Characteristics of light detector.
3. Measurement of Numerical Aperture.
4. Study of transmission of analog / Digital signals through Fiber optic Cable.
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 TOOLS (404209)

| Teaching Scheme | Examination Scheme |
|---|---|
| **Lectures/week:** 4 Hrs | **Paper:** 100 Marks |
| **Practical/week**: 2Hrs | **Practical**: 50 Marks |
| | **Term work:** 25 Marks |

**Unit 1: Introduction to Neuro-Fuzzy and soft computing**

Introduction, Soft computing constituents and conventional artificial intelligence, from conventional AI to computational intelligence, neural networks, Fuzzy set theory, Evolutionary computation, Neuro-Fuzzy and Soft Computing Characteristics

**Unit 2: Fuzzy Set Theory**

Fuzzy logic, Fuzzy sets, Fuzzy set operations, Fuzzy rules, Fuzzy algorithms, the fuzzy algorithm with linear constituents, determining the fuzzy algorithm

**Unit 3: Fuzzy Contro**l

Systematic approach for the design of fuzzy control system, Synthesis and validation of a fuzzy controller, determining the control laws, determining the fuzzy controller, validating the fuzzy controller

**Unit 4: Artificial Neural Network**

Artificial neural network theory, Topologies, Multilayer perceptron, unsupervising neural network, Radial basis function, Learning algorithm, Numerical Examples regarding MLP's and RBF.

**Unit 5: Neural Network Application**

Neural network applications for identifying non-linear dynamic system and for complex system control, Image processing, and communication.

**Unit 6: Neuro Fuzzy Modelling**

Introduction, ANFIS architecture, Hybrid learning algorithm Learning methods that cross-fertilize ANFIS and RBFN, Use of ANN for process control.

**Text Books**

1. J.S. Jang, C.T. Sun, E. Mizutani, “Neuro-Fuzzy and Soft Computing”, By PHI Learning Private Limited.
2. L-Fortuna, G. Rizzotto, M. Lavorgna, G. Nunnari, M. G. Xibilia and R.Caponetto, “Soft Computing”, Springer.

**Reference Books**

1. James A. Freeman, David M. Skapura, “Neural Networks Algorithms, Applications and Programming Techniques”, Pearson Education.
2. S. N. Sivanandam, S. N. Deepa,” Principals of soft Computing”, Wiley India.

**List of practicals**

1. Design and implement ANN to compute OR, AND, NOT gate for the two input using MP model .
2. Implement perceptron algorithm for solving EX-OR problem.
3. Implement Back Propogation algorithm to solve classification problem
4. Implementation of various learning learning laws
5. Implement Kohonen algorithm for character recognition
6. Implement various membership functions
7. Implement primary and composite linguistic fuzzy variables
8. Implementation of defuzzification using various method
9. Implement fuzzy controller to control simple process (Mamdani / Sugeno / Tsukamoto)

# Elective-IV

## ADVANCED COMMUNICATION SYSTEMS (404210)

**Teaching Scheme** **Examination Scheme**

**Lectures/week:** 4 Hrs **Paper:** 100 Marks

### Unit 1: Introduction to Cellular Mobile System

Uniqueness of Cellular Mobile Environment, Severe Fading, Model of Transmission Medium, delay spread & coherence bandwidth, direct wave path, line of sight path& obstructive path, Operations of cellular systems,Max. no. of frequency channels per cell, frequency reuse schemes, co channel interference reduction factor, handoff mechanism, cell splitting Cell coverage for signal and traffic, Ground incident angle, elevation angle, reflection angle &reflection point, mobile point to point Lee model, phase difference between direct path & a ground reflected path, Formula for mobile radio propagation over water,, flat open area, between fixed stations, land to mobile over water, foliage loss,1 mile intercept near field , long distance propagation, Finding antenna height gain in obstructive/ non obstructive condition, Point to point model cell sight antenna heights & signal coverage cell

### Unit 2: Cell Site Antennas and Mobile Antennas

Free space path loss formula, EIRP, gain & pattern relationship, Relationship between gain & beam width, antennas at cell site, interference reducing directional antennas,. space diversity antennas, mobile antennas Co-channel and non-co channel interference, Design of Omni directional & directional antenna system, lowering antenna height, neighboring channel interference, near end far end interference, Effect on coverage & interference by decreasing power, antenna height & beam tilting, interference between systems, UHF-TV interference, long distance interference, Frequency Management & channel assignment Numbering the channels, grouping into subsets, frequency spectrum utilization, set up channels, access channel spacing channels ,self location schemes, autonomous registration, fixed/non fixed channel assignment, channel sharing &borrowing, sectorisation,underlay-overlay, Handoffs & dropped calls, Two types of handoffs, initiation of a handoff , delaying handoff, forced handoff, power difference handoffs, mobile assisted & soft handoffs, intersystem handoffs

### Unit 3: Operational Techniques

Adjusting parameters of a system, increasing coverage, transmitted power, cell site antenna height, received signal strength threshold, diversity receiver, reducing interference, increasing traffic capacity, diversity, cell splitting techniques, microcells, narrow beam concept, separation between highway cell sites, Digital Cellular systems GSM, system architecture, radio interface, protocols, handover, security, authentication, HSCSD, GPRS

**Unit 4: Introduction to Satellite Communication Systems**

Satellite Communication overview, Orbital Mechanics, Look Angles, Attitude and Orbit Control System, Telemetry; Tracking Commands and Monitoring System, Power System, Communication systems, Transponders, Different types of Antennas and relationships, Antennas used in practical systems.

**Unit 5:**

Analog FM Transmission by Satellite for FM, FDM, telephony & TV signals, Signal to Noise Ratio, Data transmission using Analog FM channels, Digital Transmission on Satellite Channels; RRC filter signal shaping for digital signals, Bit and Symbol Error Rates, Bit error rate & C/N relations for BPSK & QPSK modulation, SNR for Digital Voice Systems. Satellite Link Design Basic Transmission Theory, System Noise Temperature and G/T Ratio, Down / Up link Budgets, Link design procedures in C and Ku Band

**Unit 6: Multiple Access and VSAT Systems**

FDMA, TDMA and CDMA Multiple Access Systems, VSAT Systems, Network Architectures, VSAT-Earth Stations Engineering,

**Text Books**

1. William C.Y. Lee, "Mobile Cellular Telecommunications (Analog and Digital Systems)2nd Edition McGraw Hill Editions
2. Jochen Schillar, "Mobile Communications" 2nd Edition, Pearson Education
3. Timothy Pratt, Charles Bostian, Jeremy Allunut "Satellite Communications" Second Edition, John Wiley & Sons.

## ARTIFICIAL INTELLIGENCE (404210)

**Teaching Scheme** **Examination Scheme**

**Lectures/week:** 4 Hrs **Paper:** 100 Marks

**Unit1: Foundation**

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

**Unit 2: Searching**

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

**Unit 3: Knowledge Representation**

First order logic, representation revisited, Syntax and semantics for first order logic, Using first order logic, Knowledge engineering in first order logic, Inference in First order logic, prepositional versus first order logic, unification and lifting, forward chaining, backward chaining-Resolution, Knowledge representation, Ontological Engineering, Categories and objects, Actions-Simulation and events, Mental events and mental objects

**Unit 4: Learning**

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

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**Unit 5: Perception and Expert System**

Visual perception-Waltz's algorithm, Introduction to Expert System, Architecture and functionality, Example Expert system

**Unit 6: Natural Language Understanding**

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

**Text Books**

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", 2nd Edition, Pearson Education / Prentice Hall of India, 2004.

**References**

1. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000. Elaine Rich and Kevin Knight, "Artificial Intelligence", 2nd Edition, Tata McGraw-Hill, 2003.
2. George F. Luger, "Artificial Intelligence-Structures and Strategies For Complex Problem Solving", Pearson Education / PHI, 2002.

## AUTOMOTIVE ELECTRONIC SYSTEMS (404210)

**Teaching Scheme** **Examination Scheme**

**Lectures/Week:** 4Hrs **Paper:** 100 Marks

**Unit 1: Power Train Engineering and fundamentals of Automotive.**

Fundamentals of Petrol, diesel and gas engines, electric motors and control systems. Basic Automotive System, System Components. Evolution of Electronics in Automotive. Alternators and charging, battery technology, Ignition systems. Working principles of various electronic components and accessories used in Automotive. Emission control. Developments in existing engine forms and alternatives, Hybrid designs (solar power, electric/gasoline, LPG, fuel cells). Basic Transmission systems, Different forms and developments.

**Unit 2: Sensor technologies in Automotive**

In-vehicle sensors: Working principles, Characteristics, limitations and use within the automotive context of the following: Temperature sensing e.g. coolant, air intake, Position sensing e.g. crankshaft, throttle plate. Pressure sensing e.g. manifold, exhaust differential, tyre. Distance sensing e.g. anti-collision, Velocity sensing e.g. speedometer, anti-skid, Torque sensing e.g. automatic transmission, Vibration sensing e.g. Airbags, Flow sensing and measurement e.g. Fuel injection. Interfacing principles: Operation, topologies and limitations of all sensors covered in the above to in-vehicle processing or communications nodes. Interfacing electronics, Operational amplifier circuits, Instrumentation amplifiers, Comparators. Level shifting, Wave-shaping, Filters. Noise mechanisms and reduction. ADCs and DACs. Use of Actuators: Types, Working principle, Characteristics, limitations and use within the automotive context of each type

**Unit 3: Automotive Control Systems.**

Control system approach in Automotive: Analog and Digital control methods, stability augmentation, control augmentation, Transmission control, System components and functions. Cruise control, traction control, actuator limiting, wind-up, gain scheduling, adaptive control. Special Control Schemes: Vehicle braking fundamentals, Antilock systems, Variable assist steering and steering control, Controls for Lighting, Wipers, Air-conditions/Heating, Remote keyless Entry and Anti-theft System, Emission sub-system control, Control techniques used in hybrid system. Electronic Engine control: Motion equations, modeling of linear and non-linear systems, numerical methods, system responses Objective of Electronic Engine control, Spark Ignition and Compression Ignition Engines and their electronic controls. Engine management testing: Engine management system strategies and implementation, Simulation and implementation methods, Methods of improving engine performance and efficiency.

**Unit 4: Electronic Control Unit Design.**

Critical review of microprocessor, microcontroller and digital signal processor development (overview of development within the automotive context). Architecture of 8 /16 bit microcontrollers with emphasis on Ports, Timer/Counters, Interrupts, Watch-dog timers, PWM, Memory requirement and Usage. High-level language programming: Effective use of „C" programming with particular reference to: Operators- including bit wise, Control constructs, Pointers. Real-Time Program Design: Pointers to physical addresses and linking, Input and Output device programming, Timers and interrupts, latency. Program Development: Software development strategies, Compiling and linking, Software testing and debugging, Use of a professional development system (Use of Embedded C).

**Unit 5: Automotive Communication Systems**

Communication interface with ECUs: Interfacing techniques and interfacing with infotainment gadgets. Relevance of internet protocols, such as TCP/IP for automotive applications. Wireless LANs standards, such as Bluetooth, IEEE802.11x. Communication protocols for automotive applications. Automotive Buses: Use of various buses such as CAN, LIN, FlexRay, Recent trends in Automotive buses (Such as OBDII, MOST, IE, IELLI, D2B, and DSI). Application of Telematics in Automotive: Global Positioning Systems (GPS) and General Packet Radio Service (GPRS), for use in an automotive environment. Higher End Technology: Comparative study and applications of ARM Cortex:-A series/M-series, ARM 9 and ARM11.Current developments and issues.

**Unit 6: Diagnostics and Safety in Automotive**

Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system. Preliminary checks and adjustments. Self Diagnostic system. Fault finding and corrective measures. Electronic transmission checks and Diagnosis. Diagnostic procedures and sequence. On board and off board diagnostics in Automotive. Safety in Automotive: Safety norms and standards. Passenger comfort and security systems. Electromagnetic environment and Automotive EMC Standards. SAE and IEEE Standards. Future trends in Automotive Electronics.

**Text Books**

1. Williams. B.Ribbens, "Understanding Automotive Electronics", 6th Edition, 2003, Elsevier Science, Newness Publication.
2. Robert Bosch, "Automotive Electronics Handbook", John Wiley and Sons, 2004.
3. Nitaigour Mahalik, "Mechatronics: Principles", Concepts and Applications, TMH, 2003.
4. K.P.Ramchandran, G.K.Vijayraghavan, M.S. Balsundaram, "Mechatronics: Integrated Mechanical and Electronic System", Wiley India, 2010.

**Reference Books**

1. Ronald K Jurgen, “Automotive Electronics Handbook 2nd Edition”, McGraw-Hill, 1999.
2. James D Halderman, “Automotive Electricity and Electronics”, PHI Publication 2005.
3. Terence Rybak, Mark Steffka, “Automotive Electromagnetic Compatibility (EMC)”, Springer, 2004.
4. Allan Bonnick, “Automotive Computer Controlled Systems: Diagnostic Tools and Techniques”, Elsevier Science, 2001.
5. Uwe Kiencke and Lars Nielsen, “Automotive Control Systems: Engine, Driveline and Vehicle”, 2nd Edition, Springer Verlag, 2005.
6. David Alciatore, Michael Histand, “Introduction to Mechatronics and Measurement Systems (SIE)”, TMH, 2007.
7. Iqbal Husain, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.
8. Tom Denton, “Advanced Automotive Diagnosis”, 2nd Edition, Elsevier, 2006.
9. G. Meyer, J. Valldorf and W. Gessner, “Advanced Microsystems for Automotive Applications”, Springer, 2009.
10. Tracy Martin, “How to Diagnose And Repair Automotive Electrical Systems Motor Books”, MBI Publishing Company, 2005.
11. Mehrdad Ehsani, Ali Emadi, Yimin Gao, “Modern Electronic, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, 2nd Edition, CRC Press, 2009.

## NANOTECHNOLOGY IN ELECTRONICS (404210)

**Teaching Scheme** **Examination Scheme**

**Lectures:** 4 Hrs/week **Paper:** 100 Marks

### Unit 1: Introduction

Introduction to Nanotechnology: Fundamental science behind nanotechnology, tools for measuring nanostructures, tools to make nanostructures and imagine nano-behaviours

### Unit 2:Nano-CMOS Devices

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 3: Nano particles and Nanotubes

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 4: Nanomachines and Nanodevices

Nanomachines and Nanodevices, NEMS and MEMS and their fabrication, molecular and super molecular switches. Lithography.

### Unit 5: Nanoelectronics

Introduction, the tools of manufacturing of micro and nano fabrication optical lithography, electron beam lithography, atomic lithography. Nano-Electronics for advanced computation and communication.

### Unit 6: Nanotechnology in Electronics:

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

### Reference Books

1. Anatoli Korkin, Jan Labanowski, Evgeni Gusev, Serge Luryi, “Nanotechnology for Electronic Materials and Devices”, Springer.
2. Mark Ratner, Daniel Ratner, “Nanotechnology: A Gentle introduction to a next big Idea”, Pearson Education.

3. Gregory Timp, “Nanotechnology”, Springer-Verlag NY.
4. Charles P. Poole Jr., Frank J. Owens, “Introduction to Nanotechnology”, John Wiley & Sons.

## PROJECT(404211)

| Teaching Scheme | Examination Scheme |
|---|---|
| **Practical: 2 Hrs/Week (Sem –I)** | **Term work: 100 Marks** |
| **Practical: 6 Hrs/Week (Sem-II)** | **Oral: 50 Marks** |

1. **Group Size**

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

**2. Selection and approval of topic**

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

**Note:**

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