**ADVANCED CONTROL SYSTEMS**

<table>
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<tbody>
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**Module-I**

**Describing function analysis of non-linear control systems:** Introduction to non-linear control systems, Describing function analysis and Stability of Non-linear control systems.  

12 Hours

**Module-II**

**Discrete- time systems & the z- transform method:** Introduction to discrete systems, Review of Z- Transforms, Pulse Transfer Function, Stability analysis in the Z- plane.  

10 Hours

**Module-III**

**State-space analysis of control systems:** State-space representation of systems, solving the time-invariant state equations, Transfer matrix, Linear Time Invariant systems, State-space representation of Discrete-time systems, solving discrete-time state equation.  

10 Hours

**Module-IV**

**Optimal and adaptive control systems:** Controllability, observability for continuous system, optimal control system based on Quadratic performance index.  

8 Hours

**Module-V**

**Compensation techniques:** lead, lag, lead lag network, and compensator design using Bode and Root Locus Techniques.  

12 Hours

---

**TEXT BOOKS:**

1. K. OGATA Modern Control Engineering, 1996, PHI  
2. K. OGATA Discrete Time Control Systems, 1996, PHI

**REFERENCE BOOK:**

1. MADANGOPAL Digital control and state variables methods 1997, PHI  
## MICROPROCESSORS

<table>
<thead>
<tr>
<th>Contact Hours/ Week</th>
<th>Credits</th>
<th>Total Lecture Hours</th>
<th>CIE Marks</th>
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**Sub. Code**: IT52

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### Module-I

Introduction, Microprocessor based computer system, Architecture of 8086 Microprocessor, Pin functions, Clock generator, Minimum/Maximum mode of operation. Read/Write Timing diagrams, 8086 instruction set, Instruction template for data transfer instruction. **08+06 Hours**

### Module-II

Addressing modes, Assembler directives, linking and relocation, Stacks, Procedures, Interrupt and Interrupt routines, Macros, Programming examples. **08+05 Hours**

### Module-III

DOS interrupt 21H function to read a character from keyboard, Write character to console, Creation of a new file, read/write from/to file, Serial/parallel communication. Interfacing devices, Memory devices and Interfacing. **08+05 Hours**

### Module-IV

8255 PPI device and interfacing, Keyboard, display, ADC, DAC, Stepper motor and Printer interfacing using 8255. 8279 programmable keyboard/display controller and interfacing, 8253 and interfacing. **8+05 Hours**

### Module-V

8259 programmable interrupt controller and interfacing, 8257 DMA controller and interfacing, serial communication using 8251 & RS 232 serial communication standards. **07+05 Hours**

**TEXT BOOKS:**

<table>
<thead>
<tr>
<th>No.</th>
<th>Author(s)</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>DOUGLAS V HALL (TMH)</td>
<td>Microprocessor and Interfacing, Programming &amp; Hardware.</td>
</tr>
<tr>
<td>3</td>
<td>A.K.RAY &amp; K.M.BHURCHANDI</td>
<td>Advanced Microprocessor and Peripherals, Tata McGraw Hill</td>
</tr>
</tbody>
</table>

**REFERENCE BOOKS:**

<table>
<thead>
<tr>
<th>No.</th>
<th>Author(s)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MOHAMED RAFIQUZZAMAN</td>
<td>Microprocessors and Microcomputer based system design Universal Book Stall, New Delhi.</td>
</tr>
<tr>
<td>2</td>
<td>Berry Brey</td>
<td>The Intel Microprocessors, 8085/8088, 80186/80188, 80286,</td>
</tr>
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</table>
DATA CONVERTERS

Contact Hours/ Week : 4+0+0 (L+T+P)  
Credits : 4.0
Total Lecture Hours : 52  
CIE Marks : 50
Total Tutorial Hours : 0  
SEE Marks : 50
Sub. Code : IT53

Module-I

Data Acquisition Systems: Introductory concepts, Block diagram, Analog switches and multiplexers, fundamentals Sampling and Quantization, Sample and hold architecture: open loop and closed loop, multiplexed input switched capacitor, current mode architecture, Specifications and accuracy considerations, Examples of typical data acquisition systems, Data Loggers, PGA, MUX & DEMUX.

10 Hours

Module –II


12 Hours

Module –III

Analog to Digital Converters (ADCs): Introduction, Timing Accuracy, Metastability error, Full-Flash Converters: Reference Voltages, Offset of Comparators, Offset Auto-zeroing, Practical Limits, Sub-Ranging and Two-Step Converters: Accuracy Requirements, Two-step Converter as a Non-linear Process, Folding and Interpolation: Double Folding Interpolation, Use of Interpolation in Flash Converters, Use of Interpolation in folding Architectures,
Interpolation for Improving Linearity, Time-Interleaved Converters: Accuracy requirements, **Successive Approximation Converter**: Errors and Error Correction, Charge Redistribution, Pipeline Converters: Accuracy Requirement, Digital Correction, Dynamic Performances, Sampled-data Residue Generator, Other Architectures: Cyclic (or Algorithmic) Converter, Integrating Converter Voltage-to-Frequency Converter, Delta-Sigma Converters.

**12 Hours**

**Module -IV**

**Data Converters Specifications:** Type Of Converter, Typical Converter Connections, Conditions Of Operation, General Converter Specifications, Static Converter Specifications, Dynamic Converter Specifications, Selection Criteria For Converters.

Precision Techniques: Comparator offset cancellation, Op amp offset cancellation, Calibration techniques for DAC and ADC.  

**10 Hours**

**Module -V**

**Functional Design:** Error models for RTD and Strain gauge circuits, Discussions on 0816 and ICL 7109 ADCs, Concepts of Direct Digital Synthesis (DDS), Discussions on DAC 0800 chip, interfacing converters to microprocessors, Case study of high-speed computer based data acquisition systems.  

**08 Hours**

**TEXT BOOKS**

<table>
<thead>
<tr>
<th>No.</th>
<th>Author</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>FRANCO MALOBERTI</td>
<td>Data Converters</td>
</tr>
<tr>
<td>2</td>
<td>BEHZAVI RAZAVI</td>
<td>Principles of Data Conversion system Design</td>
</tr>
<tr>
<td>3</td>
<td>HNATEK</td>
<td>Handbook of A/D and D/A converters, John Wiley</td>
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**REFERENCE BOOK**

<table>
<thead>
<tr>
<th>No.</th>
<th>Author</th>
<th>Title</th>
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<tbody>
<tr>
<td>1</td>
<td>H. SCHMID</td>
<td>Electronic analog-digital conversion,</td>
</tr>
<tr>
<td>2</td>
<td>SERGIO FRANCO</td>
<td>Design with op-amps and Analog IC’s, Tata McGraw Hill</td>
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MICROPROCESSOR LAB

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PART – A

Software Experiments:
- Average of N-16 bit unsigned numbers.
- GCD of two 16-bit unsigned numbers.
- BCD to Seven segment code using look up table.
- Sorting of N 16-bit unsigned numbers.
- Read Hexadecimal numbers from keyboard and display on the screen.
- Multiplication of 16-bit numbers.
- Solving of Equations.
- Checking the validity of code.
- Conditional code assembly.
- Binary search algorithm.
- Factorial of a number using Recursive procedure.

PART – B

Interfacing Experiments:
- BSR mode of operation of 8255.
- Stepper motor.
- Keyboard.
- 8-bit DAC.
- 8-bit ADC.
- Realization of 8:1 Multiplexer using PPID.
- Realization of 4-bit Binary and Decimal counters.
- 7-segment display.
- Printer.
- Realization of ALU- Addition, Subtraction, AND & EXOR.

Note:
1) Include one experiment from part A and one experiment from part B during setting of questions for Semester End Examination.
DATA CONVERTERS & CONTROL SYSTEM LAB

<table>
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1. Sample and Hold circuits using discrete components and IC. Analyze using LABVIEW
2. Analog multiplexer & programmable gain amplifier using analog mux.
3. 4 Bit Binary weighted & R-2R DAC (using Discrete components)
4. 8 Bit DAC using IC (DAC 0800)
5. 8 Bit ADC using IC (Successive approximation method)
6. To determine the step response of 1st and 2nd order system using RC circuit and to measure the Time constant for different values of R & C. Analyze using LABVIEW
7. To determine the response of lead, lag & lead-lag circuits using LABVIEW.
8. To design relay driving circuits using photo devices (LDR & Opto-couplers).
9. To study Synchro as a position controller.
10. Stability analysis for a given transfer function & specifications using Bode-plot, Nyquist diagram & Root locus with and without compensation and Verification using MATLAB/LABVIEW.
11. Design of signal conditioning circuits to measure the temperature using RTD and convert into digital using LABVIEW.
12. Design of signal conditioning circuits to measure the load using load cell and convert into digital using LABVIEW.

Experiments 1 to 9 - for both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE).
Experiment 10 - 12 for only Continuous Internal Evaluation (CIE).

Note: Students have to do
a) Simulation of some of the above experiments.
b) Preparation of Electronic Board including PCB design and fabrication for one of the experiments or any other application using basic Electronic and Electromechanical components.
**Professional Electives**

**ANALYTICAL INSTRUMENTATION**

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**Module-I**

**Introduction:** Classification of analytical methods and Instrumental Techniques, Considerations in analytical methods, Electromagnetic Radiation, EM spectrum, Atomic Energy Levels, Molecular Energy Levels, Vibrational Energy levels, Electromagnetic radiation properties and interaction with matter, Emission of radiation, Absorption of Radiation.

**UV and Visible Spectroscopy:** Fundamental Laws of Photometry, Radiation Sources, Wavelength selection, cells and sampling Devices, Detectors, Readout modules, Instruments for absorption Photometry.

**Module-II**

**Flame Emission and Atomic Absorption Spectroscopy:** Introduction, Instrumentation for Flame Spectroscopic Methods, Flame Emission Spectrometry and Atomic absorption spectrometry.

**Atomic Emission Spectroscopy:** Principle and Instrumentation.

**Module-III**

**X-Ray Methods:** Production of X-Rays and X-rays spectra, Instrumentation, Direct X-ray methods, X-ray Absorption method, X-ray Fluorescence method, dispersive instruments, non-dispersive instruments, X-ray diffraction and its applications.

**Module-IV**

**Infrared Spectroscopy:** Correlation of Infrared Spectra with Molecular Structure, Instrumentation, Sample Handling, Near infrared spectroscopy: Principles and applications.

**Mass spectrometry:** Sample Flow in a Mass Spectrometer, Inlet sample systems Mass Analyzers.

**Module-V**

**Chromatography:** Classification of chromatographic Methods, Gas Chromatographs, Gas chromatographic Columns, Liquid Phases and Column Selection, Detectors for Gas chromatography Gas-solid chromatography.

**TEXT BOOKS**

<table>
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<tr>
<th></th>
<th>Instrumental Methods of Analysis: Seventh Edition</th>
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<tbody>
<tr>
<td>1</td>
<td>Willard H.W Merritt, L.L Dean J A Settie FA</td>
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<td>Skoog ,Holler, Nieman</td>
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8 Hours

8 Hours

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8 Hours

8 Hours

7 Hours
THIN FILM INSTRUMENTATION

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</table>

Module-I

**Kinetic Theory of gases and Vacuum Terminology:** Ideal gas equations, Mean free path, Conduction of gas flow, Molecular flow, molecular velocity or speeds, Gas impingement on surfaces, Gas flow Regimes, adsorption, outgasing & throughput. **7 Hours**

Module-II

**Rotary, Roots and sorption Pumps:** Introduction, Rotary Vacuum pumps, Roots Pumps & Sorption pumps

**High Vacuum Pumps:** Principles, Selection of backing Pumps, Selection of vapour fluid, Diffusion pump fluids, Magnifications to the Diffusion pumps, Turbo molecular pumps, cryopumps, sputter ion pump & integrated vapour pumps. **8 Hours**

Module-III

**Measurement of Vacuum:** Introduction, Different types of Vacuum gauges: Hydrostatic gauges, Thermal conductivity gauges, Ionization gauges, capacitance gauge and Spinning rotor gauge.

**Leak Detection Techniques:** Introduction, Leak rate & units, Rate Rise measurement, Leak Detector: Tesla Coil, Halogen leak Detector, Thermal Conductivity gauge, Helium leak detector **8 Hours**

Module-IV

**Thin Film Deposition Techniques**: Introduction, Different techniques of deposition Physical vapor Deposition (PVD): Introduction, Resistive Evaporation, flash Evaporation, E-beam Evaporation, Sputter deposition- DC diode bias, Triode, Magnetron, RF sputtering, Chemical Deposition Methods: Introduction, overview and history-Electro deposition (Electrolytic, Electro less, Anodization), Chemical Vapour deposition: Plasma CVD, PE CVD and LP CVD. **8 Hours**

Module-V

**Thin film Characterization:** Overview of thin film characterization, Imaging techniques: Scanning electron microscopy (SEM), AFM, Structural properties: X-ray diffraction (XRD), Electrical properties: Resistance/resistivity – four point probe, Vander Pauw, Mechanical properties: Stress-curvature measurements. **8 Hours**

TEXT BOOK:

Module-I

Overview of Optical Fiber Communications: Historical perspective, Motivations for Light wave Communications, Optical Spectral Bands, The basic Communications system, measurement of information and capacity of a communication channel, advantages of optical fiber communications, Ray theory & applications, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Applications of Fiber optic Communications, communication super highway architecture.

7 Hours

Module-II

Optic Fiber Waveguides: Step Index Fiber, Graded –Index Fiber, Modes and fields in Step Index and graded index Fibers, Fiber materials — Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers, Photonic crystal fibers, Fiber manufacturing techniques, Fiber optic cables.

8 Hours

Module-III


8 Hours

Module-IV

Optical sources: Direct and indirect Band gap materials, Light Emitting Diodes, LED operating characteristics, Laser principles, Laser Diode, Laser Diode operating characteristics, Narrow spectral width and tunable laser diodes, Optical amplifiers.

Couplers and connectors: Connector Principles, Fiber-End preparation, Splices, Connectors, Source Coupling

8 Hours

Module-V

Optical Detectors: PIN and APD diodes: Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise, Structures for InGaAs APDs, Temperature Effect on Avalanche Gain, Comparison of Photo detectors, Fundamental Receiver Operation, preamplifiers, Error Sources Receiver Configuration Probability of Error Quantum limit.

8 Hours
TEXT BOOKS:

<table>
<thead>
<tr>
<th></th>
<th>Author(s)</th>
<th>Title</th>
<th>Publisher</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Gerd Keiser</td>
<td>Optical Fiber Communication</td>
<td>McGraw-Hill International</td>
</tr>
<tr>
<td>2</td>
<td>Joseph C. Palais</td>
<td>Fiber Optic Communications</td>
<td>Pearson Education</td>
</tr>
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</table>

SMART SENSORS

Contact Hours/ Week: 3+0+0(L+T+P)  
Credits: 3.0
Total Lecture Hours: 39  
CIE Marks: 50
Total Tutorial Hours: 0  
SEE Marks: 50
Sub. Code: ITPE4

Module I

BASICS OF SMART SENSORS & MICROMACHINING: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining, LIGA process, laser micromaching, micromilling, Dry etching processes:- plasma and reactive ion etching.

10 Hours

Module II

MCUS AND DSPS TO INCREASE SENSOR IQ: Introduction, amplification and signal conditioning, separate versus integrated signal conditioning, digital conversion, MCU control, MCUs for sensor interface, DSP control, Techniques and Systems Considerations, sensor integration.

10 Hours

Module III

COMMUNICATIONS FOR SMART SENSORS: Introduction: Definitions and Background, Sources (Organizations) and Standards, Automotive Protocols, Industrial Networks, Office/Building Automation, Home Automation, Protocols in Silicon, Other Aspects of Network Communications.

10 Hours

Module IV


12 Hours

Module V

PACKAGING, TESTING AND RELIABILITY OF SMART SENSORS: Introduction, Semiconductor packaging applied to sensors, hybrid packaging, packaging for monolithic sensors, reliability implications, testing smart
sensors, Unit Standards for Smart Sensors: Introduction, setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE 1451.4, extending the systems to network.

**TEXT BOOK:**


**REFERENCE BOOKS:**

| 1 | Paul W. Chapman | Smart Sensors– ISA Press. |

**AIR CRAFT INSTRUMENTATION**

Contact Hours/ Week: 3+0+0 (L+T+P)  
Total Lecture Hours: 39  
Total Tutorial Hours: 0  
Sub. Code: ITPE5

**Module I**

**Aircraft instruments:** Introduction, instruments grouping, instruments display, quantitative and qualitative displays, director displays, cockpit layout, standard atmosphere, basic air data system, pitot static probe, heating circuit arrangements.  
8 Hours

**Module II**

**Air data instruments:** Air speed indicator, square law characteristics, match/air speed indicator, altimeters, affects of atmospheric temperatures, vertical air speed indicators, air temperature indicator, air data alternating system, match warning system, altitude alert system  
8 Hours

**Module III**

**Gyroscopic flight instruments:** The gyroscope and its properties, determining direction of precession, limitations of gyroscopes, operating gyroscopic instruments, gyro horizons, erection systems for gyro horizons, errors due to acceleration and turning, direction indicator, turn and bank indicator.  
8 Hours

**Module IV**

**Fuel quantity indicating systems:** capacitance type system, indicating system, affects of fuel temperature changes, measurement of fuel quantity by weight, construction of probes, and location of probes.  
7 Hours

**Module V**

**Engine power and control instruments:** RPM measurement, generator and indicating system, tacho probe and indicator system, torque monitoring, exhaust gas temperature, engine pressure ratio measurement, fuel flow measurement, integrated flow meter system.  
8 Hours

**TEXT BOOK:**
INDUSTRIAL INSTRUMENTATION

Contact Hours/ Week : 3+0+0 (L+T+P)  Credits : 3
Total Lecture Hours :  39   CIE Marks : 50
Total Tutorial Hours : 0   SEE Marks : 50
Sub. Code : ITPE6

Module-I
**Definition, Classification of Variables & Measurement:** Classification of variables, Classification by measurement signals, measurement signals for variables, Types of measurement, Definition & Sources of Error, Classification of errors, Evaluation of Data.  

**Module-II**
**Measuring & Transmission methods:** True Significance of the Measurement, Significance of the measurement on the Process, Factors to be accomplished as a result of Measurement, Factors involved in obtaining this measurement, Measuring methods, Transmission (Telemetering) methods, Hydraulic & Magnetic types, Pneumatic types, Electric & Electronic types.  

**Module-III**
**Steam power plant instrumentation:** Instrument selection, primary and secondary plant measurement, Automatic Control systems: Feed water Control of all types, Steam –temperature control , Auxiliary System Controls, Control room trends, Data logging and computing equipment.  

**Module-IV**
**Food industry instrumentation:** Instrumentation in Brewing, Canning industry, Baking industry, Dairy industries.  

**Module-V**
**Paper and Pulp Instrumentation:** Different types of pulping, Pulp bleaching, Pulp blending, wet end and drier instrumentation.  
**Nuclear Reactor Instrumentation:** Nuclear reactor dynamics, reactor instrumentation, reliability aspects of protective systems.  

**TEXT BOOK:**

<table>
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<tr>
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<th>Considine and Ross</th>
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<td>Reference Book</td>
<td>Hand book of applied instrumentation, Publisher McGraw-Hill.</td>
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<tr>
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<th>C A Williams</th>
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<td>Aircraft Instruments</td>
<td>Golgotia Publications, New Delhi.</td>
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<tr>
<td>1</td>
<td>Donald P. Eckman</td>
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<tr>
<td>2</td>
<td>K. Krishna Murthy, S. Vijayachitra</td>
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<td>3</td>
<td>J. S. Smith</td>
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BIOMEDICAL INSTRUMENTATION

Contact Hours/ Week : 3+0+0 (L+T+P)  
Credits : 3

Total Lecture Hours : 39  
CIE Marks : 50

Total Tutorial Hours : 0  
SEE Marks: 50

Sub. Code : ITPE7

Module-I

Fundamentals: Sources of biomedical signals, Basic instrumentation system, General constraints in design of biomedical instrumentation systems

Bioelectric Signals and Electrodes: Origin of bioelectric signals, Types of bioelectric signals. Recording electrodes, Electrode-Tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.

7 Hours

Module-II

Electrocardiography: Electrical activity of the heart, Genesis & characteristics of Electrocardiogram (ECG), Block diagram description of an Electrocardiograph, ECG lead system, Multi-channel ECG machine.

Electroencephalography: Genesis of Electroencephalogram (EEG), Block diagram description of an Electroencephalograph, 10-20 electrode systems, and computerized analysis of EEG.

Electromyography: Genesis of Electromyogram (EMG), Block diagram description of an Electromyography.

8 Hours

Module-III


8 Hours

Module-IV

Cardiac Pacemakers and Defibrillators: Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemaker, Rate-responsive pacemakers, AC & DC defibrillators, Dual peak DC defibrillator, Square wave defibrillator.

8 Hours

Module-V


8 Hours

TEXT BOOKS
1 R. S. Khandpur  

2 C. Raja Rao & S.K. Guha  
Principles of Biomedical Instrumentation, Universities press (India) Ltd.

REFERENCE BOOKS:

1 Lesely Cromwell  
Principles of applied biomedical instrumentation, John Wiley and sons

2 J. G. Webster  
Encyclopedia of medical devices and instrumentation, John Wiley

MEDICAL IMAGING

Contact Hours/ Week : 3+0+0 (L+T+P)  
Credits : 3

Total Lecture Hours : 39  
CIE Marks : 50

Total Tutorial Hours : 0  
SEE Marks : 50

Sub. Code : ITPE8

Module-I

Introduction: Imaging Modalities- X Ray, Ultrasound and MRI.


7 Hours

Module-II


8 Hours

Module-III

X-Ray Computed Tomography: Basic Principle, components.

Module-IV

Thermal Imaging: Medical thermography, Infrared detectors, Thermographic equipment.

8 Hours

Module-V

Ultrasound Imaging: Attenuation, Absorption and Scattering Generation and Detection of Ultrasound Ultrasonic transducers, Arrays, Pulse Echo systems: A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flow imaging.

8 Hours

Module-V

Radionuclide Imaging: Interaction of nuclear particles and matter, nuclear sources, Radionuclide generators, nuclear radiation detectors, rectilinear scanner, scintillation camera, SPECT, PET scanning technique.

8 Hours

TEXT BOOK:

1 Kirk  
Principles of Medical Imaging-, Academic Press.
BIO MEDICAL DIGITAL SIGNAL PROCESSING

Contact Hours/ Week : 3+0+0(L+T+P) Credits : 3
Total Lecture Hours : 39 CIE Marks : 50
Total Tutorial Hours : 0 SEE Marks : 50
Sub. Code : ITPE9

Module-I
INTRODUCTION TO BIOMEDICAL SIGNALS: The nature of biomedical signals, The action potential, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis, Introduction to Real Time Signal Processing.

NEUROLOGICAL SIGNAL PROCESSING: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis. 7 Hours

Module-II
LINEAR PREDICTION THEORY: The Autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination- the case of epileptic patients, overall performance. 8 Hours

Module-III
SLEEP EEG: Data acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of sleep-wake transitions, Hypnogram model parameters, Event history analysis for modeling sleep. CARDIOLOGICAL SIGNAL PROCESSING: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG parameters and their estimation: ECG QRS detection techniques, estimation of RR interval: Finite first difference method, the use of multi-scale analysis for parameter estimation of ECG waveforms, Arrhythmia analysis monitoring, long term continuous ECG recording. 8 Hours

Module-IV
ECG DATA REDUCTION TECHNIQUES: Direct data compression techniques, Direct ECG data compression techniques: Turing point algorithm, AZTEC algorithm, CORTES and FAN algorithm, other data compression techniques: data compression by DPCM, Data compression method comparison. 8 Hours

Module-V
ADAPTIVE INTERFERENCE/NOISE CANCELLATION : A review of Wiener filtering problem, Principle of an Adaptive filter, The steepest descent algorithm, the Widrow-Hoff least mean square adaptive algorithm, Adaptive noise canceller, Cancellation of 50Hz interference in ECG, Canceling Donor-
heart interference in Heart-transplant electrocardiography, Cancellation of ECG signal from the electrical activity of the chest muscles, canceling of maternal ECG in fetal ECG, Cancellation of High frequency noise in Electrosurgery.  

**TEXT BOOK:**

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<tr>
<td>2</td>
<td>Rangaraj M. Rangayyan</td>
<td>Biomedical Signal Analysis a case study approaches, The John Wiley publications.</td>
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**REFERENCE BOOKS:**

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<tr>
<td>1</td>
<td>Willis J. Tompkins</td>
<td>Biomedical Digital Signal Processing, The Prentice Hall of India publications</td>
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**DIGITAL IMAGE PROCESSING**

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**Module-I**

**FUNDAMENTALS:** Introduction, Fundamental steps in digital image processing (DIP), components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, Color image processing: color fundamentals, Color models: RGB, CMY and CMYK, HIS.  

**Module-II**

**IMAGE ENHANCEMENT IN SPATIAL DOMAIN:** Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Local enhancement, Arithmetic/Logic operations – Image subtraction, Image averaging, SPATIAL FILTERING: Smoothing spatial filters – Smoothing linear filters, order statistics filters, Sharpening spatial filters – Foundation, Laplacian and gradient.  

**Module-III**

**IMAGE ENHANCEMENT IN FREQUENCY DOMAIN:** Introduction to the Fourier Transform and the frequency domain, Basic filtering in the frequency domain, Basic filters and their properties, Smoothing frequency domain filters – Ideal low-pass filters, Butterworth low-pass filters, Gaussian lowpass filters, Sharpening frequency domain filters – Ideal high-pass filters, Butterworth high-pass filters, Gaussian high-pass filters, Homomorphic filtering.  

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8 Hours
Module-IV

**IMAGE COMPRESSION:** Fundamentals: Coding redundancy, interpixel redundancy, psychovisual redundancy, Image Compression models: Source encoder and decoder, Channel encoder and decoder, Error Free compression: Variable length coding, LZW coding, Bit plane coding, Lossless predictive coding, Lossy Compression: Lossy predictive coding, transform coding fundamentals, image compression standards: basics, JPEG.

**8 Hours**

Module-V

**IMAGE SEGMENTATION:** Detection of discontinuities: point detection, Line detection, edge detection, Edge Linking and boundary Detection: Local Processing, Global processing via the Hough transform, Introduction, Global processing via Graph theoretic Techniques, Thresholding: Foundation, Role of illumination, Basic Global thresholding, Basic Adaptive thresholding, Optimal global and adaptive thresholding, Region-based segmentation: Basic Formulation, region growing, Region splitting & merging.

**8 Hours**

**TEXT BOOK:**


**REFERENCE BOOKS:**


**ANALOG AND DIGITAL COMMUNICATION**

| Contact Hours/ Week | 3+0+0 (L+T+P) | Credits : 3.0 |
| Total Lecture Hours | 39 | CIE Marks : 50 |
| Total Tutorial Hours | 0 | SEE Marks : 50 |
| Sub. Code | ITPE11 |

**Module-I**

**Introduction:** Need & Importance of modulation.

**Amplitude Modulation:** Principle, AM generation, modulation index, bandwidth, power in sidebands, frequency translation, Problems.

**7 Hours**

**Module-II**

**Amplitude Modulation Techniques:** AM/DSB, AM-SSB/SC generation, bandwidth & power, Demodulation of AM waves, coherent & non coherent detection, effect of noise, threshold effect, FDM.

**8 Hours**

**Module-III**

**Angle Modulation:** Principle of FM & PM, NBFM, WBFM, bandwidth, modulation index, generation, demodulation -frequency discriminator, phase
locked loop (1st order), threshold effect in FM, pre-emphasis & de-emphasis, comparison of AM and FM.

**Module IV**

**Pulse Modulation:** Sampling theorem for low pass and band pass signal, statement and proof, practical aspects of sampling, reconstruction of signal from sampled signal, PAM, PDM and PPM generation and detection, PCM, DPCM, delta modulation, adaptive delta modulation and TDM.

**Module V**

**Digital Communication:** Methods of binary data transmission, RZ, NRZ (L) NRZ (M) NRZ(S) BiO(L) BiO(S), PSK, QPSK, DPSK, FSK, probability error for PSK & QPSK, Coding: Huffman coding, error control coding, block code.

**TEXT BOOKS**

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<tr>
<th>No.</th>
<th>Author</th>
<th>Title</th>
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<tbody>
<tr>
<td>1</td>
<td>Simon Haykin</td>
<td>Analog and Digital Communication, John Wiley</td>
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<tr>
<td>2</td>
<td>Taub and Schilling</td>
<td>Principles of Communication systems, TMH</td>
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<th>No.</th>
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<tr>
<td>1</td>
<td>George Kennedy</td>
<td>Electronic Communication System</td>
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<tr>
<td>2</td>
<td>Sam Shanmugam</td>
<td>Communication System</td>
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<td>3</td>
<td>Proakis</td>
<td>Electronic Communication System</td>
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**COMPUTER NETWORKS**

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**Module I**

**Introduction:** Network Hardware, Network Software, OSI Reference Model, TCP/IP reference model.

**Physical Layer:**


**Module II**

**Data Link Layer:** Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols, Protocol Verification, HDLC, The data link layer in the internet, point to point protocol.

**Module III**

**Network Layer:** Network Layer Design Issues, Routing Algorithms: optimality principle, shortest path routing, Distance vector routing, flooding, link state routing.

**Module IV**
TRANSPORT LAYER: The transport service, Elements of transport protocols, Simple transport protocol, the internet transport protocols: UDP, TCP.

8 Hours

Module V

APPLICATION LAYER: Domain Name System (DNS), electronic mail, worldwide web.

7 Hours

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<tr>
<td>1</td>
<td>HONDEL AND FLUBER</td>
<td>ATM Protocol concepts, Addison Wesley.</td>
</tr>
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</table>
REMOTE SENSING AND TELEMETRY

Contact Hours/ Week : 3+0+0(L+T+P)    Credits : 3.0
Total Lecture Hours : 39    CIE Marks : 50
Total Tutorial Hours : 0    SEE Marks : 50
Sub. Code : ITPE13

Module I

7 Hours

Module II

8 Hours

Module III

9 Hours

Module IV

8 Hours

Module V

8 Hours

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<td>1</td>
<td>Paul J Curran, Longman</td>
<td>Principles of remote sensing</td>
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<td>2</td>
<td>Floyd F Sabns</td>
<td>Remote sensing principles and interpretation</td>
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</tbody>
</table>
**ELECTRICAL ENGINEERING MATERIALS**

Contact Hours/ Week : 3+0+0 (L+T+P)  
Credits : 3.0  
Total Lecture Hours : 39  
CIE Marks : 50  
Total Tutorial Hours : 0  
SEE Marks : 50  
Sub. Code : ITPE14

**Module-I**

8 Hours

**Module-II**

**Dielectric Properties of Insulators:** Static fields: Introduction, Polarization and dielectric constant, Dielectric constant of polyatomic molecules, Internal field and static dielectric constant of solids. Ferroelectric materials, Spontaneous polarization, Piezoelectricity, Alternating fields: Frequency dependence of electronic and ionic polarizabilities, Complex dielectric constant of non-dipolar solids, Overview of dipolar relaxation and dielectric loss.  
8 Hours

**Module-III**

8 Hours

**Module-IV**

**Conduction Mechanisms:** Metals: Overview of electron theory of metals, Electron scattering and receptivity of metals, Heat developed in current carrying conductors, Superconductivity.  
Semiconductors: Review of classification, Carrier densities in n-type and p-type semiconductors, Hall effect, Drift and diffusion currents, p-n junction and n-p-n junction transistors, Overview of physics of power-semiconductor devices.  
8 Hours

**Module-V**

**Applications:** Properties and application of electrical conducting, semiconducting, insulating and magnetic materials, soft and hard magnetic materials, permanent magnetic materials, Thermal conductivity of metals, optical properties of solids, Materials for semiconductor industries, Advancements.  
7 Hours

**TEXT BOOKS**

<table>
<thead>
<tr>
<th></th>
<th>A.J. DEKKER</th>
<th>Electrical engineering materials, PHI</th>
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<tr>
<td>1</td>
<td>C.S. INDULKAR AND S.TRIRUVAGDAN</td>
<td>An Introduction to Electrical Engg. Materials S.Chand &amp; Co</td>
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<td>1</td>
<td>The Feynman, Lectures on Physics, Volume-2, Narosa</td>
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<tr>
<td>2</td>
<td>IAN P. HONES Material Science for Electrical and Electronic Engineering Oxford University Press.</td>
</tr>
<tr>
<td>3</td>
<td>NARULA Material Science, Tata McGraw Hill</td>
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**INDUSTRIAL DRIVES**

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**Module-I**

**Electric Drives:** Concept and Classification, Dynamics of Electric Drives, Types of Loads, Torque Characteristics of Load, Characteristics of Motor-Load Combination, Dynamics of Motor-Load Combination, Steady-state and Transient stability of Electric Drive. Characteristics of Electric Drives: Modified Speed-Torque Characteristics of DC Shunt motors, DC Series motor and Induction Motors. **8 Hours**

**Module-II**

**Starting of Electric Motors:** Methods of Starting Electric Motors, Acceleration time, Energy relation during starting, DC Shunt & Series motors and Induction motors, Methods to reduce the energy loss during starting. Electric Braking: Types of Braking, Braking of DC and AC motors, Energy relation and Dynamics of Braking. Rating of Motors: Heating effects, Load conditions and Classes of duty, Determination of power rating, Effect of load inertia and load equalization. **8 Hours**

**Module-III**

**D.C motor control:** Single-phase controlled rectifier and Chopper circuit arrangement for continuous armature current operation., Circulating current and non-circulating current modes of operation, Principles of closed loop control for DC drives. **8 Hours**

**Module-IV**

**Induction motor control:** Speed control of 3-phase Induction motor with AC voltage regulators, Voltage source inverters and Cyclo-converters, Static rotor resistance control, Slip power recovery schemes: Static Krammer drive and Scherbius drive. **8 Hours**

**Module-V**

**Synchronous motor control:** Self controlled and Separately controlled, synchronous motors, Brushless D.C motors, Switched reluctance motors. **7 Hours**
EMBEDDED SYSTEMS and RTOS

Contact Hours/ Week : 3+0+0(L+T+P)  
Credits : 3.0

Total Lecture Hours : 39  
CIE Marks : 50

Total Tutorial Hours : 0  
SEE Marks : 50

Sub. Code : ITPE16

Module I


Real Time Systems: Definition, Basic model of a Real Time systems, Types of Real Time systems.

ARM Processor: The ARM Architecture, The ARM programmer’s model.

ARM Assembly Level Programming: The ARM Instruction set(32-bit) - Data transfer and Data processing Instructions

Module II


Module III

Memory Organization: Introduction, Classification of Memory on the basis of location and the way of data storage, Memory Access and Memory specifications, Memory Hierarchy, Cache design, Memory management unit (MMU), Memory organization of ARM processor.

Module IV

Input/Output Devices in Embedded Systems: Timers and Counters, Pulse Width Modulator (PWM), Watchdog timer.

Communication in Embedded Systems: Parallel and serial communication, RS232 for Asynchronous Serial communication, Network communication – I²C bus, CAN bus, USB.

Interrupt Handling: Polling and Interrupts, Types of Interrupts, Context and the period of context switching, Interrupt latency and Deadline.
Computing Platforms and Design Analysis: Development and Debugging – Program design – Model of Programs – Assembly and Linking, Basic Compilation Techniques.  

8 Hours

Module V

8 Hours

TEXT BOOK:

1. Steve Furber  

2. Wayn Wolf  


4. Frank Vahid, Tony Givargis  
   Embedded systems design: A unified hardware/software introduction, John Wiley and sons, Inc,2002

REFERENCE BOOKS:

1. Rajkamal  
   Embedded systems: Architecture programming and design TMH 2008.

2. Jonathan W Valvano  

3. Tim Wilmhurst  
   An Introduction to the design of small scale Embedded systems, Palgrave Mcmillan

4. KVKK Prasad  
COMPUTER ARCHITECTURE

Contact Hours/ Week  : 3+0+0(L+T+P)  Credits :  3.0
Total Lecture Hours  : 39  CIE Marks :  50
Total Tutorial Hours  : 0  SEE Marks :  50
Sub. Code  : ITPE17

Module-I
Introduction: Introduction to Computer Architecture, Quantitative principles of computer design, basics of How to Flow chart for hardware

Pipelining Basic and Intermediate Concepts: Basics of Pipelining, Basics of RISC instruction set and its Implementation.  \(9\) Hours

Module-II
Pipelining Basic and Intermediate Concepts: Classic 5-stage pipelining for a RISC processor, Basic performance issues in pipelining, Pipelining Hazards, A simple Implementation of MIPS pipeline.  \(7\) Hours

Module-III
Pipelining: Pipelining implementation difficulties, Extending MIPS pipeline to Handle Multi-cycle Operations.
Instruction level Parallelism: ILP Concepts, Basic Compiler Techniques for exposing ILP, Reducing Branch Costs with prediction, Overcoming Data Hazards with Dynamic Scheduling, Hardware threading.  \(8\) Hours

Module-IV
Instruction level Parallelism: Hardware based speculation, Static Branch prediction, Static Multiple issue: The VLIW approach, limitations of ILP.  \(8\) Hours

Module-V
Memory Hierarchy Design: Introduction, Review of the ABCs of Cache, Cache Performance, Reducing Cache miss Penalty and miss rate, Reducing Hit rate, Memory Technology and Optimization, Virtual Memory  \(7\) Hours

TEXT BOOK:


REFERENCE BOOKS:

2  John L. Hennessy and David A.  Computer Organization.
| Patterson. |                                                                 |