Department of Instrument Technology

SCHEME OF INSTRUCTION & SYLLABUS

FOR

M.Tech Instrumentation And Control

(With effect from 2019-20 Admitted Batch)

Department of Instrument Technology

AU College of Engineering

Andhra University

Visakhapatnam

M.Tech (InstrumentationAnd Control), Two Year (Four Semesters)

Scheme to be valid with effect from the admitted batch of 2019 – 2020

SEMESTER-I

Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTIE-1.1	Advanced Transducers and Measurement Technique	3	-	70	30	100	3
MTIE-1.2	Digital Signal Processing	3	-	70	30	100	3
MTIE-1.3	Elective I Advanced Process Control / Analytical Instrumentation / Computer Control of Process	3	-	70	30	100	3
MTIE-1.4	Elective II Bio-Medical Instrumentation / Electronic Instrumentation / Digital Instrumentation	3	-	70	30	100	3
MTIE-1.5	Research Methodology & IPR	3	-	70	30	100	2
MTIE-1.6	Audit Course	3	-	70	30	100	0
MTIE-1.7	Industrial Instrumentation Lab	-	3	-	100	100	2
MTIE-1.8	Microprocessors Lab	-	3	-	100	100	2
	Total	18	06	420	380	800	18

SEMESTER-II

Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTIE-2.1	Microcontrollers and Embedded Systems	3	-	70	30	100	3
MTIE-2.2	Virtual Instrumentation	3	-	70	30	100	3
MTIE-2.3	Elective – III a) Industrial Communication Systems b) Robotics and Automation c) Power Plant Instrumentation		-	70	30	100	3
MTIE-2.4	Elective – IV a) Advanced Sensors b) Piping and Instrumentation c) Steel Plant Instrumentation	3	-	70	30	100	3
MTIE-2.5	Audit Course	3	-	70	30	100	0
MTIE-2.6	Process Control Lab	-	3	-	100	100	2
MTIE-2.7	Virtual Instrumentation Lab	-	3	-	100	100	2
MTIE-2.8	Mini Project With Seminar	-	3	-	100	100	2
	Total	15	9	350	450	800	18

SEMESTER-III

Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTIE-3.1	Elective V a) Fiber Optics and Laser Instrumentation b) Fuzzy Logic and Neural Networks and Control / Environmental Analysis Instrumentation	3	-	70	30	100	3
MTIE-3.2	Open Elective VLSI Design	3	-	70	30	100	3
MTIE-3.3	Dissertation- I / Industrial Project	-	-	-	100	100	10
	Total	6		140	160	300	16

SEMESTER-IV

Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTIE-4.1	Dissertation- II	-	-	70	30	100	16
	Total			70	30	100	16

Note:

1. **At the end of 3rd semester project review is conducted by HOD with the committee consisting of the HOD, Chair Person of BOS and the Guide. In the Affiliated Colleges, Project (Preliminary) will be evaluated by concerned HOD and the thesis Guide of their respective colleges.**
2. **At the end of the 4th semester there will be a final viva voce for the project work conducted by the HOD with the committee consisting of HOD, Chair Person of BOS, the Guide and an External examiner nominated by the university.**

Audit Course 1 & 2

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

Program Outcomes (POs)For Post Graduate (PG) Program M.Tech Instrumentation Engineering

The M.Tech Instrumentation Engineering graduates will be able

PO1. To independently carry out research /investigation and development work to solve practical problems.

PO2. To write and present a substantial technical reports/documents.

PO3. To demonstrate a degree of masterly over the area as per the specialization of the program. The masterly should be at a level higher than the requirements in the appropriate bachelor program.

PO4. To identify suitable sensors and transducers for real time applications.

PO5. To Acquire knowledge of Instrumentation Engineering with ability to evaluate, analyze and synthesize problems related to process oriented industries.

Programme Educational Objectives (PEOs) For Post Graduate (PG) ProgramM.Tech Instrumentation Engineering

The following Programme Educational Objectives are designed based on the department mission. The post-graduates of Instrumentation and Control Engineering should be able to:

PEO1. Extract knowledge through literature survey, experimentation, expertise in research methodology, technique and tools.

PEO2. Utilize, expertise in designing and analysing complex and real life problems that are techno-economically and socially sustainable.

PEO3. Demonstrate professional ethics and commitment to organizational goals.

PEO4. DemonstrateLeadership and team work while working with diverse multi-disciplinary/interdisciplinarygroups.

PEO5. Exhibit sustained learning and adaptation to modern engineering tools, techniques and practices through instruction, group activity and self-study.

Program Specific Outcomes (PSOs) For PGProgram In Instrumentation and Control Engineering

PSO1.Apply knowledge to design, analyze and synthesize problems related to Instrumentation and Control Engineering.

PSO2. To evolve innovative solutions for real-time and industrial problems using skills, modern tools and recent technologies.

MTIE-1.1Advanced Transducers and Measurement Technique

CEOs (Course Educational Objectives)

1. To understand about measurement systems and their classification
2. To understand about errors in measurement systems and calibration of measurement systems
3. To enable the students to select and design suitable instruments to meet the requirements of industrial applications and various transducers used for the measurement of various physical quantities
4. To understand about Various types of Sensors & Transducers and their working principle.
5. This course provides adequate knowledge of various instruments for measuring electrical quantities.
6. To understand basic laws governing the operation and working of instruments and their equivalent circuits used for the measurement of voltage, current, power, energy.

Transducer fundamentals, Classification of transducers, General transducer characteristics, Resistance- Capacitance, Inductance- reluctance- Piezoelectric Magnetostrictive- Hall effect- Photo electric type of transducers and their applications. Smart Transducers- Transducers for Bio-Medical applications- tactile sensors-MEMS and their applications.

Measurement ofForce, Acceleration, Strain and Torque. Design of Electrical, Optical, & MEMS Accelerometers. Design of Gyroscopes.

Pressure measurement: Elastic types-Resistive- Capacitive and Inductive pressure pickups. Piezoelectric- Piezoresistive types. Vacuum measurement: McLeod gauges-Ionization gauges-Alphatron gauge. High Pressure measurement. Force balance and Motion balance type transmitters – P/I and I/P converters. IC pressure sensors and calibration of pressure measuring devices.

Temperature measurement: Filled-in thermal systems- Bimetallic thermometers - RTD, Thermistor, Thermocouple - Radiation and Optical pyrometers - Digital IC thermometers - Accuracy, errors and compensation.

Flow measurement: Head flow meters- types, Area flow meters– Rotameter bypass rotameter-Turbine meter. Electromagnetic flowmeter – Principle – DC AC and pulsed type. Ultrasonic flow meters – Principles – transit time – Doppler shift – beam deflection– Cross correlation flowmeters. Vortex flowmeters -Coriolis flowmeters- Solid flow measurement-conveyor belt type. Installation and Calibration procedures of various flowmeters

Level Measurement: Conductive and Capacitive methods –Ultrasonic, Microwave and RADAR level sensors - Solid level measurement by Paddlers method. Capacitance method for powder level measurement. Density, Viscosity and PH measurement.

REFERENCE BOOKS

1. Patranabis.D., “Principles of Industrial Instrumentation,” McGraw-Hill PublishingCompany, 1984.
2. D. V.S.Murthy, Transducers in instrumentation, Prentice Hall, 1995.

3. Ernest. O. E. Doebelin, “Measurement Systems”, McGraw-Hill publishing company, 1990.
4. James.W.Dally, “Instrumentation for Engineering Measurement”, John Wiley &Sons, Inc., 1993.
5. Bela G. Liptak, Process measurement and Analysis-Instrument Engineers’ Handbook-Vol. I Third edition- Butterworth Heinemann publishing company

COs (Course outcomes)

After completion of the course the students will be able to

1. Deep understanding in measurement systems including static and dynamic characteristics, type of errors, and error manipulation using statistical analysis.
2. Understand the concepts and principles of different types of transducers and their associated signal conditioning circuits
3. Design signal conditioning circuit
4. Understand the basic principles of multi-sensor data fusion and their associated techniques
5. Conduct research in measurement and sensor field to contribute in knowledge

MTIE-1.2 Digital Signal Processing

CEOs (Course Educational Objectives):

1. To understand the basic Discrete time signals and system types,convolution sum,impulse and frequency response concepts
2. To understand the realization of LTI systems and basic properties of these
3. To understand the DFT and relation between DFT and other transforms.To understand convolution and its types
4. To understand the FFT. Differences between DIT and DIF algorithms
5. To understand the concept of Frequency selective filters
6. To understand the concept of architecture of DSP processor

Linear Shift Invariant Systems : Signals, systems and signal processing, discrete time signals, discrete time systems, analysis of linear time invariant systems, classification of discrete time systems, block diagram and signal flow graphs, structures for realization for IIR systems, structures for realization of FIR systems.

Discrete Fourier Transforms: Introduction, Circular shift and circular symmetries of a sequence, properties of DFT, linear convolution, circular convolution, performing linear convolution using DFT, sectioned convolution, Fast Fourier Transforms, Decimation – in time FFT, Decimation –in- frequency FFT, computation of IDFT through FFT.

FIR Filters: LTI systems as frequency selective filters, FIR filters, characteristics of FIR filters with linear phase, frequency response of linear phase FIR filters, Design techniques for linear phase FIR filters, Fourier series method of FIR filter design, windows, FIR filter design using windows, Design of FIR filters by frequency sampling technique.

IIR Filters: Introduction, Impulse Invariant transformation, Bilinear Transformation, specifications of the low pass filter, design of low pass digital Butterworth filter, Design ofloa pass digital Chebyshev filter, Frequency transformation.

Finite Word Length Effects in Digital Filters: Introduction, representation of numbers in Digital system, Types of arithmetic in digital systems, quantization by truncation and rounding, quantization of input data, quantization of filter coefficients, product quantization error, limit cycles in recursive systems.

Text Books

1. John G Proakis," Digital Signal Processing: Principles, Algorithms and Applications," Pearson Education, 4th Edition 2007.
2. Alan V Openhiem, Ronald W Schafer , "Digital Signal Processing," PHI learning Pvt. Ltd, 1975

References

1. Manson H Hayes," Digital Signal Processing," TMH Publications, 2004.
2. P.RameshBabu," Digital Signal Processing ," Scitech Publications.

COs (Course outcomes):

After completion of the course the students will be able to

1. Explain digital signal,sampling, convolution
2. Explain Discrete Fourier transform in DIT and DIF
3. Explain programmable DSPs

MTIE-1.3 Elective I (A) Advanced Process Control

CEOs (Course Educational Objectives)

1. To study and review of Process Control Principles.
2. To study basic Servo mechanisms and discrete state control systems.
3. To learn Process control block diagram and identification of elements.
4. To study about various evaluation-stability.
5. To learn about steady state regulation, transient regulation, evaluation criteria.
6. To study about Process control (P&I) drawings.

Review of systems: Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances.

Design aspects: Process characteristics-process equation, process load, process lag, self-regulation; Control system parameters- Error, variable range, Control parameter range, control lag, dead time, cycling.
Control valve types-linear, equal percentage and quick operating valves. Flow equation through valves-viscosity correction, rangeability, turn down, cavitation and flashing of valves, Design of valves.

Optimum controller settings: evaluation criteria-1/4 decay ratio, IAE, ISE,ITAE; Controller tuning and process identification--open loop and closed loop tuning methods--Ziegler-Nichols and Cohen –coon tuning methods.

Special control techniques: Advanced control techniques, cascade, ratio, feed forward, adaptive control, selective controls, smith predictor, internal model control.

Multivariable control – examples of distillation column and boiler control systems.

Intelligent control: Model based controllers- adaptive controller-model reference adaptive control-self tuning regulator -adaptive controllers-optimal control-predictive control

Expert systems- expert controller-Fuzzy logic systems-fuzzy controller-Fuzzy logic tools-Artificial neural networks-perceptron-neural controllers.

REFERENCE BOOKS

1. D.R.Coughnour,'Process Systems analysis and Control', McGraw Hill,II Edition, 1991.
2. Curtis.D.Jhonson: Process control instrument Technology, Pearson education**.**
3. D.E.Seborg,T.F.Edger and D.A.MillixhMP, 'Process Dynamics and control', Hohn Wiley and Sons, II Edition, 2004
4. C.A.Smith and A.B.Corripio,'Principle and Practice of Automatic Process Control' John Wiley and Sons, 1985
5. W.L.Luyben, 'Process Modelling simulation and Control for Chemical Engineers', McGraw Hill, II Edition,1990
6. Stephanopoulos., 'Chemical Process Control-Theory and Practice', Prentice Hall of India Ltc., 1984.
7. Krishna Kant., 'Computer based Industrial Control', Prentice Hall of India Pvt., Ltd., 2002

COs (Course outcomes)

After completion of the course the students will be able to

1. Describe control systems- process control principles.
2. Can use various Controller Principles.
3. Classify Evaluation criteria-1/4 decay ratio.
4. Able to Explain various Multi loop control systems.
5. Categories variouscontrol elements.
6. Can explain Control valve characteristics and sizing.
7. Able to know the Implementation of Fuzzy and Neural networks.

MTIE-1.3 Elective I(B) Analytical Instrumentation

CEOs (Course Educational Objectives)

1. To study the electromagnetic radiation, the Beer Lambert law.
2. To study the concepts related to spectroscopy computerized NMR. Electro spin resonance spectrometer (ESR).
3. To study the X-ray absorption meters X-ray fluorescence spectrometers.
4. To Demonstrate the functions of chromatographic system.
5. To study Measuring circuits. electro-chemical cell.
6. To study Hydrogen gas analyzers-IR gas analyzers.
7. To study the ozone automated wet chemical analyzers water pollution monitoring.

Design, construction and application of UV, Visible and IR spectroscopy, X-ray absorption and fluorescence spectrometry- X-ray diffraction methods of analysis – energy dispersion analysis —

Radiation sources - α, β, γ, sources – detectors –Geiger Mueller counter – proportional counters – Ionization chamber, scintillation counter and Solid-State Detectors.

Nuclear Magnetic Resonance (NMR) spectroscopy – Principles of operation and constructional details of NMR spectrophotometer – Broad band spectrometer – Applications. Principles andapplicationsof Electron Spin Resonance (ESR) spectrometer. Mass spectrometry – principle of operation – Co-analyzer – Commercial mass spectrometer.

Flue Gas and Water Analyzers: Flue gas analysis is using thermal conductivity principle – Cathetometer – Oxygen analyzer using paramagnetic, depolarization principles – Zirconium oxide cells – CO_X,SO_X, NO_X Measurement-combustibles analyzer – Different types of Dust and Smoke meters – Visible Emission Monitor – Remote sensing laser instruments

Water purity meter – Conductivity meters – Steam purity measurement – Dissolved oxygen meter using polarographic principle – Sodium analyzer – Silica analyzer.

Gas Chromatography: Basic Principle and construction –Different types of columns – Detectors – Recorders and associated equipment. Industrial and laboratory applications of gas Chromatography.

Liquid Chromatography: Salient features of liquid chromatography Ionizing electrodes - pH and ion sensitive electrodes, ISFET and chemical sensors. Applications of high precision liquid chromatography. Current trends in analysis instrumentation.

REFERENCE BOOKS

1. D.A. Skoog and D.M. West, Principles of Instrumental Analysis, Holt Saunders's publication, Philadelphian, 1980.
2. C.K. Mann, T.J. Vichers and W.H. Gulick, Instrumental Analysis, Harper and Row Publishers, New York, 1974.
3. H.A. Willard, L LMerrit and J.A. Dean, Instrumental Method of Analysis D. Van Nostrand Co., New York, 1958.
4. E.B.Jones, Instrument Technology, Vol.II, Instruments, Butterworth Scientific Pub., London, 1956.
5. B.G. Liptak, Instrumentation in Process Industries Suppl. To Vol.I& III Chilton Book Co., 1974.

COs (Course outcomes)

After completion of the course the students will be able to

1. Able to implement and Colorimeters & Spectrophotometers.
2. Able to describe Nuclear magnetic resonance spectrophotometer (NMR).
3. Able to describe Gas & liquid chromatographic systems.
4. Able to implement X-ray spectrometer: X-ray spectrum.
5. Able to analyzeSystems working on thermal conductivity.
6. Able to analyzeindustrial gas analyzers.
7. Able to describe ozone automated wet chemical analyzers water pollution monitoring.

MTIE-1.3 Elective I (C) Computer Control of Process

CEOs (Course Educational Objectives)

1. To study and review of current trends in computer control of process plants.
2. To study basics of automatic process control and basic building blocks.
3. To learn DDC Structure and algorithms.
4. To study about Distributed Digital Control systems and its architectures.
5. To study Personal Computers in real time environment.
6. To study Industrial control applications.

Introduction: objective of automation-basic functions- Historical developments of control systems-current trends in computer control of process plants-centralized-distributed and hierarchical control systems-intelligent control.

Supervisory control and data acquisition systems: -channel scanning-conversion to engineering units-Data Processing-Distributed SCADA system-Remote terminal UJIT-communication module- special software facilities

Direct Digital control:DDC structure- DDC software-position algorithm-velocity algorithm-position vs. velocity algorithm- cascade control-ratio control-multivariable control
Programmable controllers:advantages-principles of operation-architecture of programmable controllers-input/output system-programming devices.

Programming of PLCs: ladder diagrams-special functions-data transfer and data manipulation operations-arithmetic operations-flow control operations.Booleanmnemonics-functional blocks-English like statement-applications.

Distributed Digital Control: introduction-distributed vs. centralized-advantages of distributed control-Functional requirements of DCS-System architecture-distributed control sub systems-local field station-library of functions-continuous process displays-atch/sequence operating displays-process upset displays- communication options in distributed control systems-configuration- some popular distributed control systems.

Modeling and simulation for plant automation: definitions-need of modeling-uses- model building-model evaluation-applications and future perspectives

REFERENCE BOOKS

1. Krishna kant-Computuer based industrial control, PHI
2. Instrument engineer's handbook B.G. Liptak 3rd edition.
3. Curtis.D.Johnson: Process control instrumentation technology
4. Patrinabis,D, Principles of process control.

COs (Course outcomes)

After completion of the course the students will be able to

1. Describe historical developments and current trends in computer control of process.

2. Explain about various controllers.
3. Describe various DDC algorithms.
4. Explain distributed process control systems.
5. Describe Personal Computers applications in real time environment.
6. Design Industrial control applications.

MTIE-1.4 Elective II(A) Bio-Medical Instrumentation

CEOs (Course Educational Objectives):

1. To introduce the fundamentals of bio electric potentials, resting and action potentials
2. To understand the anatomy of heart and physiological measurements of cardio vascular system
3. To understand anatomy of respiratory system and its diagnostic and therapeutic equipment
4. To provide the insight into the of nervous system and its physiological measurements
5. To understand the working of X Ray, CT scan and MRI Scanning equipment.
6. To know the shock hazards and electrical safety in hospitals.
7. To train the students to measure temperature and Oxygen saturation in blood

Basic Concepts of Bio-Medical Instrumentation: Terminology – Generalized medical instrumentation system – Measurement constrains – Classification – Interfacing and modifying inputs – Bio statistics – Static and dynamic characteristic – Regulation of medical devices – Electrical safety in medical environment.

Basic Sensors and Signal Processing: Displacement measurements – Resistive sensors – Bridge circuits – Inductance, capacitance and piezo electric sensor – Temperature measurements – Thermocouples – Radiation thermometry – Fiber optic temperature sensors – Optical measurements – Op-amp circuits – Phase sensitive demodulation – Oscillographic, galvanometric and potentiometric recorders – Microcomputers in bio medical instrumentation.

Bio-potentials and Measurements: Electric activity and excitable cells – Functional organization of peripheral nervous system. ENG, EMG, ECG, EEG & MEG – Bio-potential electrodes – Electrolyte interface. Polarization – Body surface recording electrodes – Electrodes for electric simulation of tissues – Practical hints for using electrodes – Bio potential amplifiers.

Blood pressure, Flow and Sound Measurement: Direct and indirect blood pressure measurement and analysis – Bandwidth requirement – Typical waveforms – Phonocardiography – Electromagnetic and ultrasonic flow meters – Photo plethysmography.

Clinical Measurement and Imaging Systems: Respiratory instruments – Transducers, Spiro meters, pulmonary measurements and instruments – Oxymeter – Laser application in medicines – Pulsed ruby, NdYag, Argon and Carbon-dioxide lasers – X-ray machines – Fluoroscopic machines, thermogram equipments – Ultrasonic imaging – Scanning methods and applications – Image evaluation and processing in medical field – Artificial assist devices.

REFERENCE BOOKS

1. Khandpur R.S., “Handbook of Bio-medical Instrumentation”, Tata McGraw-HillPublication Company, 1989.

2. Dean D.E. Marre A., “Bio electronic Measurements”, Prentice Hall, 1983.
3. All Evans, “The Evaluation of Medical Images, “Adam Hilger publication, 1981.
4. John G.Webster, “Medical Instrumentation application and design”, John Wileyand Sons, 1999.
5. Cromwell. L.FredJ.Webbell, “Bio medical Instrumentation and measurements”, Prentice Hall, 1995.

Course Outcomes: At the end of the course the students will be able to

1. Understand the physiology of Cardiovascular system, Respiratory system and Nervous system
2. Measure, detect and analyze the bio-electric potentials
3. Select and apply the appropriate medical instruments for measurement
4. Design medical devices for diagnosis and therapeutic applications
5. Analyze simple bio-sensing and transduction problems.
6. Apply safety standards and select disposal method and procedures for electrical diagnostic equipment
7. Learn to measure the Oxygen Saturation in blood

MTIE-1.4 Elective II(B) Electronic Instrumentation

CEOs (Course Educational Objectives):

1. To introduce the fundamentals about the basic Instrumentation system and the units of measurement.
2. To equip the students with the design details of Conventional CRO and Special purpose CRO's.
3. To explore the various signal generators, Wave analyzers, Spectrum analyzers and Q Meters.
4. To provide the insight into the design of AC and DC Electronic Volt Meters.
5. To understand the design aspects of various types of Digital Instruments
6. To familiarize the students about the overall design of Electronic Instruments

ANALOG INSTRUMENTATION: Electronic voltmeters VTVM, TVM, FETVM Voltmeters, electronic – multimeters differential voltmeters.

CATHODE RAY OSCILLOSCOPE: Block diagram vertical and horizontal amplifiers, sweep circuits delay line, dual trace oscilloscopes. Q-meters, vector – voltmeters, instruments for generating and analyzing wave forms, square wave, pulse, standard-signal, random noise and function generators wave analysers spectrum analysers, wave-meters.

DIGITAL INSTRUMETNS: Digital voltmeters, digital frequency meters, digital display method and units, digital read out oscilloscopes, data acquisition system.

REFERENCE BOOKS

1. Modern electronic instrumentation measurements techniques by Helfrick and cooper.
2. A course in electrical and electronic measurement and instrumentation by A.K.Shawney.
3. Electronic measurements and instrumentation by Rajendra Prasad.

Course Outcomes: At the end of the course the students will be able to

1. Compare and analyze the performance of Mechanical, Electrical and Electronic Instruments.
2. Apply the theoretical design aspects to develop Cathode Ray Oscilloscope
3. Obtain the knowledge on the different signal generators.
4. Analyze and compare the working of AC and DC voltmeters
5. Evaluate the performances of Digital Instruments.
6. Develop the Electronic Instruments by applying the theoretical concepts

MTIE-1.4 Elective II(C) Digital Instrumentation

CEOs (Course Educational Objectives):

1. To introduce the fundamentals of digital devices and discrete data handling.
2. To explain the functionality of various digital methods of measurements.
3. To understand the working of Digital display and recording devices.
4. To provide the insight on current trends in digital instrumentation.

Introduction: Digital codes – Memory devices – Basic building blocks – Gates, FF and counters – Discrete data handling – Sampling – Sampling theorem – Aliasing errors – Reconstruction – Extrapolation – Synchronous and asynchronous sampling.

Digital methods of measurements Review of A/D, D/A techniques – F/V and V/F conversion techniques – Digital voltmeters and multimeters – Automation and accuracy of digital voltmeters and multimeters – Digital phase meters – Digital tachometers – Digital frequency, period and time measurements – Low frequency measurements – Automatic time and frequency scaling – Sources of error – Noise – Inherent error in digital meters, hidden errors in conventional ac measurements – RMS detector in digital multimeters – Mathematical aspects of RMS.

Digital display & recording devices: Digital storage oscilloscopes – Digital printers and plotters – CDROMS – Digital magnetic tapes, dot matrix and LCD display CROs, colour monitor, digital signal analyzer and digital data acquisition.

Current trends in digital instrumentation: Introduction to special function add on cards – Resistance card – Input and output cards – Counter, test and time of card and digital equipment construction with modular designing; interfacing to microprocessor, micro controllers and computers - Computer aided software engineering tools (CASE) – Use of CASE tools in design and development of automated measuring systems – Interfacing IEEE cards – Intelligent and programmable instruments using computers.

REFERENCE BOOKS

1. Digital Instrumentation: Bouwens, A.J., McGraw Hill, 1984.
2. Handbook ofMicrocomputer based Instrumentation and Control John Lenk, D., PHI, 1984.
3. Measurement System, Application & Design: Doebelin, IV Ed, McGraw-Hill, 1990.
4. ‘Product catalogue’, Hewlett Packard, 1996.

Course Outcomes:

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

1. Understand the various digital devices and discrete data handling methods.
2. Measure, detect and analyzedifferent digital methods of measurements.
3. Select and apply the appropriate digital display and recording instruments.
4. Analyzethe current trends in digital instrumentation.

MTIE-1.5 Research Methodology & IPR

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Effective literature studies approach, analysis
Plagiarism, Research ethics,

Effective technical writing, how to write report, Paper
Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Nature of Intellectual Property: Patents, Designs, Trade and Copyright.
Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.
Traditional knowledge Case Studies, IPR and IITs.

REFERENCE BOOKS

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

MTIE-1.6 Audit Course

MTIE-2.1 Microcontrollers and Embedded Systems

CEOs (Course Educational Objectives)

1. Differentiate between microprocessors and microcontrollers.
2. Explain the architecture of ARM processor with its instruction set.
3. Identify the applicability of the embedded system.
4. Comprehend the real time operating system used for the embedded system

Architecture of 8/16 bit microcontrollers**:**8748 micro controller architecture: program memory – data memory – I/O ports – BUS Ports, Test and interrupt inputs- instruction set and programming.

8051 Microcontroller family - architecture, parallel and serial I/O - instruction set – programming and hardware interfacing techniques

8096 Microcontroller – CPU, RAM space, memory space, high speed input & outputs, analog inputs - serial I/O ports - parallel I/O ports and watch dog timer.

The concept of embedded systems design. Embedded microcontroller cores, embedded memories. Examples of embedded systems.

Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing. Sub-system interfacing, interfacing with external systems, user interfacing.

Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Texts/References

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newnes, 1999.
3. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
4. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.
5. B.P.Singh ., Microprocessors and Microcontrollers-Golgotia publications-2003

COs (Course outcomes)

After completion of the course the students will be able to

1. Describe the architectural features and instructions of ARM microcontroller
2. Apply the knowledge gained for Programming ARM for different applications.
3. Interface external devices and I/O with ARM microcontroller.
4. Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
5. Develop the hardware /software co-design and firmware design approaches.
6. Demonstrate the need of real time operating system for embedded system applications.

MTIE-2.2 Virtual Instrumentation

CEOs (Course Educational Objectives)

1. To know the History of Instrumentation systems.
2. To understand software Environment.
3. To describe Virtual Instrumentation &sub–Virtual Instrumentation.
4. To know the Analog inputs, Analog outputs.
5. Describe input and output files.

Introduction to Virtual Instrumentation

History of Instrumentation systems, Evolution of Virtual Instrumentation, premature challenges, programming requirements, Drawbacks of recent approaches, conventional Virtual Instrumentation, Distributed Virtual Instrumentation, Virtual Instrumentation versus Traditional Instruments, Advantages.

Introduction to LabVIEW

Introduction, Advantages of LabVIEW, software Environment, Front panel, Block diagram, Data flow programming.

Programming Concepts of Virtual Instrumentation

VI & sub VI, loops, shift registers, feedback node, formula node, case and sequence structures, arrays, clusters.

Output Verification Tools

Waveform Graphs, Waveform charts, files I/O, local and global variables.

Data Acquisition

Introduction, transducers, Signals, Signal conditioning, DAQ Hardware configuration, DAQ Hardware, Analog inputs, Analog outputs, counters, Digital I/O, DAQ software architecture, DAQ assistant.

IMAQ Vision

Vision basics, Image processing and analysis, particle analysis, Machine vision, Machine vision hardware and software, building a complete Machine Vision system, Acquired and displaying images with NI-IMAQ driver software, Image processing tools and functions in IMAQ vision, Machine Vision applications.

Textbooks

1. S. Sumathi, P. Surekha, “Virtual Instrumentation with LabVIEW,” ACME Learning Pvt. Ltd 2007.

References

1. Jovitha Jerome, “Virtual Instrumentation Using LabVIEW,” PHI learning Pvt. Ltd 2006.
2. Jeffrey Travis,” LabVIEW for everyone,” Pearson Education 2009.

COs (Course outcomes)

After completion of the course the students will be able to

1. Describe Virtual Instrumentation versus Traditional Instruments

2. Explain concept of LabVIEW.
3. Classify output verification Tools Waveform Graphs.
4. Appraise the DAQ Hardware configuration.
5. Explore output verification waveform charts.

MTIE-2.3 Elective – III(A) Industrial Communication Systems

CEOs (Course Educational Objectives)

1. To give an overview of the Industrial data communications systems.
2. To provide a fundamental understanding of common principles, various standards, protocols.
3. To provide insight into some of the new principles those are evolving for future industrial datanetworks.

Introduction: importance of communication in industry, hierarchy of factory automation, evolution of technology in control systems.Local area networks-network topologies-Metropolitan area networks-Wide area networks-Wireless networks

Network software: Reference models-The OSI reference model-TCP/IP reference model-comparison of models- Critiques of OSI and TCP/IP models regarding implementation and success.

Transmission media: magnetic media- twisted pair-base band coaxial cable-broadband coaxial cable-Fiber optic networks: multi-mode and single mode fibers-Transmission of light through fiber-fiber cables. Fiber optic networks- comparison of fiber optics and copper wire.

Physical layer options: Network topologies, interface standards, RS232,RS 422,RS 485,IEEE 488(GPIB): Talkers, Listeners and controllers, Connector and signal lines, Data bus, Handshake lines, Handshaking, Control bus, Data bus transfer timing, Physical connection, Electrical characteristics, IEEE 488.2, IEEE 488.2 control sequences and protocols, HS 488, Handshake, HS 488 data transfer flow control, System configuration effects on HS 488, HS 488 configuration messages.

HART Communications: HART communication technique, Cable specifications, HART commands, Benefits ofHART,Token buses and rings: IBM token ring protocol, Function of a bridge, Function of a repeater and splitter.Ethernet or CSMA/CD: MAC protocol, Different ways of implementation, Vital statistics. Moving up the layers: Function of a router, Gateways, Remote file request, FDDI, Typical enterprise network.

Field bus and device networks: Introduction, The CIM pyramid, Field bus characteristics, Field bus configuration, Advantages of Field bus, Connecting Field bus to PLC and other devices, Connection with analog signals, Intelligent/ smart hybrid signals, pure digital communication, open system and interoperability, Field bus requirements, types of Field buses.

Foundation field bus: Architecture, Physical layer, wire media characteristics, communication, data link layer, Field bus media access control, Data Link Control, Objective oriented design, Application layer, System and Network management, Function block application process, field bus benefits.

REFERENCE BOOKS

1. M.M.S. Anand , "Electronic Instruments and Instrumentation Technology", Prentice Hall of India Private Limited.
2. Krishna kant-Computuer based industrial control, PHI.

3. Noltingk B.E., "*Instrumentation Reference Book*", 2nd Edition, Butterworth Heinemann, 1995.
4. B.G. Liptak, Process software and digital networks, 3rd Edition, CRC press, Florida.

Course Outcomes:

After completing the course, the students will gain ability to

1. Ability to differentiate various types of industrial data network standards and the associatedprotocols based on their specifications and applications.
2. Ability to analyze the various characteristics of each layer of the protocol stack pertaining todifferent Industrial data network standards.
3. Ability to compare the performance of the standards and infer the advantages and drawbacksof each for a given industrial application.
4. Ability to select and use the most appropriate networking technologies and standards for agiven application.
5. Ability to identify procedures for fault-free operations in the data communications links.
6. Ability to infer the requirements of an industry and select a wired or wireless solution forinstalling Industrial data network.

MTIE-2.3 Elective – III(B) Robotics and Automation

COURSE EDUCATIONAL OBJECTIVES:

1)To introduce the basics of Robotics their principles and their classification.
2)To understand the concept of Robot kinematics, dynamics, and their control.
3)To provide adequate knowledge in Robot programming languages and computers that control manufacturing automation.
4)To describe various automation techniques and methods in the design and selection of a Robot.
5)To familiarize the basics of machine vision and its applications in the field of Robotics.
6) To impart fundamental knowledge of the latest technologies in the area of Robotics and Automation.

Introduction: Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors – End effectors – Control systems – Robot programming languages and applications – Introduction to robotic vision.

Robot arm kinematics : Direct and inverse kinematics – Rotation matrices – Composite rotation matrices – Euler angle representation – Homogenous transformation – DenavitHattenberg representation and various arm configurations.

Robot arm dynamics**:** Lagrange – Euler formulation, joint velocities – Kinetic energy – Potential energy and motion equations –GeneralizedD'Alembert equations of motion.
Planning of manipulator trajectories**:** General consideration on trajectory planning- joint interpolation & Cartesian path trajectories.

Control of robot manipulators:PID control - Computed torque technique – Near minimum time control – Variable structure control – Non-linear decoupled feedback control – Resolved motion control and adaptive control.

Industrial robots: Industrial robots for welding, painting and assembling-Remote controlled robots- robots for nuclear, chemical and thermal plants- industrial automation-typical examples of automated industries.

REFERENCE BOOKS

1. Fu, K.S. Gonazlez, R.C. and Lee, C.S.G., "Robotics (Control, Sensing, Vision and Intelligence), McGraw-Hill, 1968 (II printing).
2. Wesley, E. Sryda, "Industrial Robots: Computer interfacing and Control" PHI, 1985.
3. Asada and Slotine, "Robot Analysis and Control", John Wiley and Sons, 1986.
4. Philippe Coiffet, "Robot Technology" Vol. II (Modelling and Control), Prentice Hall INC, 1981.
5. Groover M. P. Mitchell Wesis., 'Industrial Robotics Technology Programming and Applications', Tata McGraw-Hill, 1986.

LEARNING OUTCOMES:

1. Explain the Laws and history of robots.
2. Identify different sensors and transmission elements in robotic applications.
3. Describe the basic components of machine vision.

4. Comprehend the concept of three-dimensional transformation of matrices and manipulator dynamics.
5. Learn PLC programming using ladder logic for simple applications like pick and place.
6. Identify and analyze different case studies of robots in manufacturing and non-manufacturing applications.
7. Describe several considerations in selecting a Robot.

MTIE-2.3 Elective – III(C) Power Plant Instrumentation

Course Educational Objectives:

1. To introduce the fundamentals about different types of energy sources.
2. To understand the different methods of power generation and performanceparameters of power plants.
3. To explore the various controls in a thermal power plant.
4. To know the details of operations of thermal power plant.
5. To understand the basic operations of turbines and governers.
6. To train the students to work in Industries

Basics of power plant operation- major input variables, major control variables
Automation strategy: Distributed system structure, automatic boiler control, diagnostic function and protection.

Automatic boiler control- basic boiler operation- block diagram, ID,FD fans, Unit type boilers

Combustion controls; series-parallel operation, hardware schemes, optimizing control for air-flow, loss-efficiency curves, oxygen/CO trimming control, comparison,

Drum level control: feed water control, drum level control, steam flow control, two-element control, and three-element control

Furnace pressure control, steam temperature control, super heater control, Advanced control aspects: Adaptive variable pressure control, combined plant control

Digital electrohydraulic governor: block diagram, basic functions, turbine speed control, valve actuation.Automatic startup systems- block diagram, steps in turbine speed control, thermal stress control.

Man-Machine interface: types of displays, Software system-online functions, graphic display, Application functions

Reference Books

1. D. Patranabis: Principles of process control, TMH, New Delhi, second edition.
2. Krishna Kant: Computer based industrial control, Prentice Hall India Pvt Ltd.
3. George Stephanopoulos: Chemical process control; Prentice Hall India Pvt Ltd.
4. Bela.G.Liptak: Instrumentation Engineers Hand book

Course Outcomes:

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

1. Compare and analyze the performance of various power plants

2. Develop the control loops for any control actions in power plant
3. Obtain the detailed knowledge on the operations of thermal power plant
4. Design the control loops for turbine speed control
5. Apply the theoretical aspects of power plants to design the entire control system.
6. Install and commission the power plant

MTIE-2.4 Elective – IV(A) Advanced Sensors

Course Educational Objectives:

1. To provide in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterised, and analysed.
2. To introduce the students to sources and detectors of various semiconductor sensors and provide in-depth understanding of the principle of measurement, and theory of instruments and sensors.
3. An understanding of the principles of silicon sensors.
4. To give a fundamental knowledge on the basic laws and phenomena on which operation of Chemical and biomedical sensors.
5. To impart a reasonable level of competence in the design, construction, and execution of micro sensors.

Chemical Sensors: Amperometry-Potentiometry-Conductivity sensors- Semi conductive sensors-MEMSsensors. Materials for Sensors-Electrical conducting materials- Ionic conductors-zirconia-alumina-NASICON. Semiconductor materials-titania-tinoxide-zinc oxide. Insulating materials- Ferroelectric Materials-Negative temperature ceramic thermistors.

Thin and Thick film sensors: Thick film Processes-Thin film processes- Thin film deposition methods- thin film characterization methods-thin film delineation techniques-compatibility issues- Longmuir-Blodgett films for sensor materials-film forming apparatus-dipping-ion sensors-gas sensors. Applications of thin and thick film sensors.

Biosensors:Colorimetric- Optical- Potentiometric- Amperometic- Conductometric-Semiconductor- Mechanical and Molecular electronic based sensors. Chemiluminescence based biosensors. Applications of biosensors in medical and health care- food and agricultural-Industrial process and environmental monitoring.

Integrated Magnetic Sensors: Overview of magnetic field sensor Technology-AMR-GMR-SQUIDS-Optoelectronic MFS- Semiconductor magnetic effects-materials and figure of merit-Standard MFS technologies-limitations and applications.

Sensor Applications: Automotive Sensors-Environmental Sensors-Sensors for Medical Diagnosis and patient monitoring-Aerospace sensors.

REFERENCE BOOKS

1. Sensors- A Comprehensive study-W.Gopal, J Hesse, J N Zemel –VHC Press, 1989.
2. Sensors Handbook-SabreeSoloman—McGraw Hill Publishers-1998
3. Electro Optical Instrumentation- SilvanoDonati, Pearson Education 2005.
4. Introduction to Medical Equipment Technology: Carr and Brown- Addison Weseley-2001.

Course Outcomes:

1. Explain the various principles employed in transducers.
2. Examine the methods of fabricating a sensor.

3. Apply knowledge in designing smart sensors.
4. Discuss the techniques of fabrication and application of MEMS.
5. Describe the various applications of smart sensors.
6. Discuss advanced sensing technology.

MTIE-2.4 Elective – IV(B) Piping and Instrumentation

Course Educational Objectives:

1. Identify the symbology used in P&IDs.
2. Explain P&ID symbol labeling, positioning and size as related to the physical control system.
3. Develop and utilize Process Flow Diagrams (PFDs) and Identify structured control concepts.
4. Describe, identify and discuss engineering flow diagrams, loop diagrams, logic diagrams and wiring diagrams.
5. Use a P&ID on a human machine interface (HMI) unit and be capable of navigating between the various screens.

Types of flow sheets, Flow sheet Presentation, Flow Sheet Symbols, Process flow diagram- Synthesis of steady state flow sheet - Flow sheeting software.

P & I D objectives, guide rules, Symbols, Line numbering, Line schedule, P & I D development, typical stages of P & I D.

P & I D for rotating equipment and static pressure vessels, Process vessels, absorber, evaporator.

Control System for Heater, Heat exchangers, reactors, dryers, Distillation column, Expander.

Applications of P & I D in design stage - Construction stage - Commissioning stage -Operating stage - Revamping stage - Applications of P & I D in HAZOPS and Risk analysis.

REFERENCEBOOKS

1. Applied Process Design for Chemical and Petrochemical Plants: Ernest E. Ludwig, Vol.-I Gulf Publishing Company, Houston, 1989.
2. Plant Design and Economics for Chemical Engineer: Max. S. Peters and K.D.TimmerhausMcGraw Hill, Inc., New York, 1991.
3. Chemical Process Synthesis and Engineering Design: Anil Kumar, "", Tata Mc-GrawHill publishing Company Limited, New Delhi - 1981.
4. Process Flow sheeting: N. Westerberg, et al. Cambridge University Press, 1979.

Course Outcomes:

1. Explain the various symbols used in P&IDs.
2. Examine the methods of designing physical control system.
3. Apply knowledge in analysing the process flow diagrams.
4. Identify and Discuss the various engineering flow diagrams and wiring diagrams.
5. Integrate P&ID on a Human Machine Interface.

MTIE-2.4 Elective – IV(C) Steel Plant Instrumentation

Course educational objectives:

1. To learn about the process of making steel from the raw materials.
2. To know the role of instrumentation in a steel industry
3. To deal with the control operations carries out at various stages
4. To know the role of various utilities

Basics of steel production; mill zones: iron zone, steel zone, mill zone, utility zone
Automation strategy: different levels, input, output data.

Iron zone: supervisory control, direct digital control; instrumentation for-raw material handling, coke oven, sinter plant, Blast furnace; input/output data, control architecture.

Steel zone: Automation for- LD converters, continuous casting, soaking pit control, blooming mill controls.

Utility zone: instrumentation for-Gas distribution, liquid fuel distribution, power generation, steam generation, compressed air generation

Instrumentation for water management system. Pollution control and monitoring for steel plant environment.

REFERENCE BOOKS

1. D. Patranabis: Principles of process control., TMH, New Delhi, second edition.
2. Krishna Kant: Computer based industrial control, Prentice Hall India Pvt Ltd.
3. George Stephanopoulos: Chemical process control; Prentice Hall India Pvt Ltd.
4. Bela.G.Liptak: Instrumentation Engineers Hand book

COs (Course outcomes):

After completion of the course the students will be able to

1. Describe various process in Iron and Steel industry
2. Indicate the use of instruments in steel making and Suggest suitable sensor for a typical measurement
3. Develop control systems for the various operations in Steel Industries
4. Evaluate the usefulness of Instrumentation in monitoring and control in the Steel industry

MTIE-2.5 Audit Course

MTIE-3.1 Elective V (A) Fiber Optics and Laser Instrumentation

CEOs (Course Educational Objectives)

1. To know the principles of light propagation theory.
2. To learn different types of fibers and their individual properties, characteristics.
3. To study about various fiber optic sensors.
4. To learn about various fiber optic communication systems.
5. To study about fundamentals of lasers and their types.
6. To study about applications of various lasers.

Principles of light propagation through fiber- Different types of fibers and their properties– transmission characteristics of optical fibers - absorption losses-scattering losses-dispersion. Fabrication of fiber components- Optical fiber as cylindrical waveguide, fiber-optic polarizer.

Fiber optic sensors – Fiber optic communication and instrument system – Advantages of optical communications – Different types of Modulators – Detectors – Fiber optic communication setup – Applications in instrumentation.Distributed fiber-optic sensors-OTDR and OFDR principles in temperature measurement.

Characteristics and fundamentals of lasers – Laser emission and light amplification – Properties of laser beams – Laser modes – Resonator configuration – Q-switching mode locking – Single frequency operation. Types of lasers – Gas lasers – Solid lasers – liquid lasers – semiconductors lasers.

Lasers for Analysis – Laser application in holographic microscopy – holographic interferometer and applications-Holography for non-destructive testing – Medical applications of lasers.

Industrial application of Lasers – Measurement of distance and length, velocity, acceleration, atmospheric effects, sonic boom, pollutants, Material processing, laser heating, melting, scribing, splicing, material removal, calculation of power requirement of laser for material processing.

REFERENCE BOOKS

1. H.C. Allen, An Introduction to Optical Fibers, McGraw-Hill International Book Co., 1983.
2. John and Harry, Industrial lasers and their applications, McGraw Hill publications,1974
3. Gerd Kaiser, Optical fiber communications, McGraw Hill International Edition,2000
4. D.C. Oshea and W.Russel Callen, Introduction to lasers and their Applications, AddisonWesley, 1978.
5. BS. Wherrelt, Laser Advances and Applications, John Wiley, 1979.
6. W.O.N. Guimarass and A.Mooradian, Lasers and Application Springer Verlag, 1981.

COs (Course outcomes)

After completion of the course the students will be able to

1. Describe the properties and characteristics of optical fibers.

2. Estimate the losses due to attenuation, absorption, scattering.
3. Construct the various fiber optics communication systems.
4. Classify the various types of lasers and its properties.
5. Illustrate various laser applications with laser instruments for medical field.
6. Design systems for Industrial application of Lasers.

MTIE-3.1 Elective V(B) Fuzzy Logic and Neural Networks and Control

CEOs (Course Educational Objectives)

1. To understand the basic concept of fuzzy sets, fuzzy logic &defuzzification.
2. To learn basics of Artificial Neural of theory and programming ofMicroprocessors.
3. To analyze various techniques in feedback and feed forward Neural Networks.
4. To Understand the principle of competitive neural networks andAdaptive resonance theory.
5. To learn the architecture and algorithm of Cognitron, Neo cognitronThe concepts of fuzzy associative memory and fuzzy systems.

Neural Networks: Introduction - Biological neurons and their artificial models – Learning, adaptation and neural networks learning rules types of neural networks – Single layer, multiplayer – Feed forward, feedback networks; back propagation – Learning and training – Hop field network.

Neural Networks in Control: Neural network for non-linear systems – Schemes of neuro control – System identification forward model and inverse model – Indirect learning neural network control applications – Case studies.

Fuzzy Logic**:** Fuzzy sets – Fuzzy operation – Fuzzy arithmetic – Fuzzy relations – Fuzzy relational equations – Fuzzy measure – Fuzzy functions – Approximate reasoning – Fuzzy propositions – Fuzzy quantifiers – If–then rules.

Fuzzy Logic Based Control: Fuzzy Controllers: Preliminaries Fuzzy sets in commercial products basic construction of fuzzy controller Analysis of static properties of fuzzy controller Analysis of dynamic properties of fuzzy controller simulation studies case studies fuzzy control for smart cars.

Neuro Fuzzy and Fuzzy Neural Controllers: Neuro fuzzy systems: A unified approximate reasoning approach Construction of role bases by self-learning: System structure and learning algorithm. A hybrid neural network based Fuzzy controller with self-learning teacher. Fuzzified CMAC and RBF network based self-learning controllers.

REFERENCE BOOKS

1. Jacek. M. Zurada, “Introduction to Artificial Neural Systems”, Jaico Publishing House, 1999.
2. Kosko, B. “Neural Networks and Fuzzy Systems”, Prentice Hall of India Pvt. Ltd., 1994.
3. Klir G.J. & Folger T.A. “Fuzzy sets, uncertainty and information”, Prentice Hall of India Pvt. Ltd., 1993.
4. Zimmerman H.J., “Fuzzy set theory – and its application” – Kluwer Academic Publishers, 1994.
5. Driankov, Hellendroon, “Introduction to Fuzzy Control”, Narosa Publishers.
6. Farin Wah S.S., Filev, D. Langari, R. “Fuzzy control synthesis and analysis”, John Wiley and Sons, 2000.

COs (Course outcomes)

After completion of the course the students will be able to

1. Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines
2. Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.
3. Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem

MTIE-3.1 Elective V(C) Environmental Analysis Instrumentation

CEOs (Course Educational Objectives)

1. To understand the fundamental characteristics, terminologies, sensing and transduction principles of sensors and transducers used for environment monitoring.
2. Justifythe use of an analytical instrument in monitoring and maintaining the quality of water and air for solving real world environmental problem.
3. Summarizeand classify capabilities and limitations of analytical instruments.
4. Preparea report on various cases of environmental parameters monitoring and control.
5. To work as an individual and as a team-member to design and implement analytical instrument using embedded systems.

Electromagnetic radiation, Characteristics - Interaction ofe.m. radiation with matter - Spectral methods of analysis - absorption spectroscopy – Beer's law - radiation sources - monochromators and filters - diffraction grating - ultraviolet spectrometer - single beam and double beam instruments.

Particles emitted in radioactive decay - nuclear radiation detectors - injection chamber - Geiger - Muller counter - proportional counter - scintillation counter - Semiconductor detectors.

Measurement techniques for water quality parameters - conductivity - temperature - turbidity. Measurement techniques for chemical pollutants - chloride - sulphides - nitrates and nitrites - phosphates - fluoride - phenolic compounds.

Measurement techniques for particulate matter in air. Measurement of oxides of Sulphur, oxides of nitrogen unburnt hydrocarbons, carbon-monoxide, dust mist and fog.

Noise pollution measurement of sound, tolerable levels of sound. Measurement of sound level. Measurement techniques for soil pollution.

REFERENCEBOOKS

1. H.H. Willard, Merrit and Dean, Instrumental Methods of Analysis, 5thEdn., 1974.
2. R.K. Jain, Fundamentals of Mechanical and Industrial Instrumentation. 1985.
3. S.P. Mahajan, Pollution Control in Process Industries, Tata McGraw Hill, 1985.
4. G. N. Pandey and G.C. Carney, Environmental Engineering, Tata McGraw-Hill, 1989.

CO's (Course Outcomes):

After completion of the course the students will be able to

1. Understand the fundamentals of environmental analysis.
2. Know role of sample preparation in environmental analysis.
3. Understand theory and techniques for their measurements of pollutants.
4. Demonstrate a broad and coherent knowledge and understanding of analytical chemistry and instrumental methods of analysis.
5. Use spectroscopic techniques to determine analyze various pollutants in environment.

MTIE-3.2 Open Elective VLSI Design

CEO's (Course Educational Objectives)

1.To understand the concept of different IC technologies and analyse basic electrical properties of Bi-polar, MOS, CMOS, NMOS, PMOS, Bi-CMOS devices.

2. Analyse the concepts of alternate gate circuits, interconnect delays,fan-in and fan-out relationship.

3. Acquire knowledge of Semi-custom and full custom ASICS, standard cell design, PLA, PAL, Programmable gate Arrays-CPLD, FPGAs.

4. Outline the concepts and Methodologies for chip design using circuit design flow in VHDL synthesis, design verification tools, validation & testing techniques.

5. To understand the different types of VLSI packages and VLSI design rules.

6. To analyze the Electrical, Mechanical, Thermal design considerations of IC packages.

Introduction: Introduction to IC technology-MOS, PMOS, NMOS, CMOS, BiCMOS Technologies. Fabrication, Fabrication sequence - Oxidation, Lithography. Diffusion, Ion implantation, Metallization, Encapsulations. Basic Electrical Properties of MOS and BiCMOS circuits -I_{ds}-V_{ds} relationships, MOS transistor Threshold voltages, figure of merit, NMOS inverter, and CMOS inverter analysis and design-BiCMOS inverters.

VLSI circuit Design Processes: VLSI design flow, MOS layers, Stick diagrams, Design rules and layout, 2µm CMOS Design rules for wires, contacts and transistors-Layout diagrams for NMOS and CMOS inverters and gates- Scaling of MOS circuits- Limitations of scaling.

Gate level Design: Logic gates and other complex gates, switching logic-alternate gate circuits-Basic circuit concepts-sheet resistance Rs and its concept to MOS- Area capacitance units-calculations-δ delays- Driving large capacitance loads- Wiring capacitive loads- wiring capacitances- Fan-in and fan-out- choice of layers.

Semi-custom Integrated circuit Design: Design approach of semi-custom and Full-custom ASICS, Standard Cell design, Programmable Logic Array, Programmable Array Logic, programmable gate arrays- CPLDs, FPGAs - etc.

VHDL Synthesis: Circuit Design flow- Circuit synthesis- Simulation-Layout-Design capture tools- Design verification tools- Test principles- Test vector generation, scan based techniques, Boundary scan test(BST), Built-in-self Test(BST) techniques, Testing and qualification.

REFERENCE BOOKS

1. Essentials of VLSI circuits and Systems: Kamran Eshraghian, Eshraghian Douglas and A.Pucknell—PHI-2005 Edition.
2. Principles of CMOS VLSI Design: Weste and Eshranghian—Pearson Education-1999.
3. Introduction to VLSI circuits and systems-John P.Uyemura-JohnWiley-2003
4. Modern VLSI Design- Wayne Wolf, Pearson Education, 3rd Edition, 1997.
5. Digital Integrated Circuits: A Design Perspective- J. Rabaey-Prentice Hall India, 1997.

CO's (Course Outcomes):

After completion of the course the students will be able to

1.Understanding the characteristics of MOS, CMOS, NMOS, PMOS, Bi-CMOS devices and the comparison between different MOS technologies and processes.
2. Able to design CMOS combinational and sequential logic at the transistor level.
3. Design of different functional units using Programmable gate Arrays.
4. Getting the idea of VHDL synthesis, verification tools, validation & testing.
5. Identify the various VLSI packages and design rules.
6. Be able to complete a significant VLSI design project having a set of objective criteria and design constraints.

Audit Course

ENGLISH FOR RESEARCH PAPER WRITING

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Reference Books

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

DISASTER MANAGEMENT

Introduction Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War And Conflicts.

Disaster Prone Areas in India Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global CoOperationIn Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Reference Books

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

SANSKRIT FOR TECHNICAL KNOWLEDGE

- Alphabets in Sanskrit.
- Past/Present/Future Tense.
- Simple Sentences

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

- Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Reference Books

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

VALUE EDUCATION

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

- Importance of cultivation of values.
- Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity. Power of faith, National Unity.
- Patriotism. Love for nature, Discipline.

- Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity oflabour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature.

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence,Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively.

Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

CONSTITUTION OF INDIA

- History of Making of the Indian Constitution:
    - History
    - Drafting Committee, (Composition & Working)

- Philosophy of the Indian Constitution:
    - Preamble
    - Salient Features

- Contours of Constitutional Rights & Duties:
    - Fundamental Rights
    - Right to Equality
    - Right to Freedom
    - Right against Exploitation
    - Right to Freedom of Religion
    - Cultural and Educational Rights
    - Right to Constitutional Remedies
    - Directive Principles of State Policy
    - Fundamental Duties.

- Organs of Governance:
    - Parliament
    - Composition
    - Qualifications and Disqualifications
    - Powers and Functions
    - Executive
    - President
    - Governor
    - Council of Ministers
    - Judiciary, Appointment and Transfer of Judges, Qualifications
    - Powers and Functions

- Local Administration:
    - District's Administration head: Role and Importance,
    - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
    - Pachayati raj: Introduction, PRI: ZilaPachayat.
    - Elected officials and their roles, CEO ZilaPachayat: Position and role.
    - Block level: Organizational Hierarchy (Different departments),
    - Village level: Role of Elected and Appointed officials,
    - Importance of grass root democracy

- Election Commission:
    - Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners.
    - State Election Commission: Role and Functioning.

- Institute and Bodies for the welfare of SC/ST/OBC and women

Reference Books

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

PEDAGOGY STUDIES

- Introduction and Methodology:
- Aims and rationale, Policy background, Conceptual framework and terminology.
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions.
- Overview of methodology and Searching.

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

- Evidence on the effectiveness of pedagogical practices.
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

- Professional development: alignment with classroom practices and followup support.
- Peer support.
- Support from the head teacher and the community.
- Curriculum and assessment.
- Barriers to learning: limited resources and large class sizes.

- Research gaps and future directions.
- Research design.
- Contexts.
- Pedagogy.
- Teacher education.
- Curriculum and assessment.
- Dissemination and research impact.

Reference Books

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

STRESS MANAGEMENT BY YOGA

- Definitions of Eight parts ofyog. (Ashtanga)

- Yam and Niyam.
  Do`s and Don't's in life.
  i) Ahinsa, satya, astheya, bramhacharya and aparigraha
  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

- Asan and Pranayam
  i) Various yog poses and their benefits for mind & body
  ii) Regularization of breathing techniques and its effects-Types ofpranayam

Reference Books

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

- Approach to day to day work and duties.
- Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Reference Books

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
3. Rashtriya Sanskrit Sansthanam, New Delhi.