SCHEME FOR MASTER OF ENGINEERING (INDUSTRY ORIENTED AND PRACTICE BASED) PROGRAMME REGULAR AND MODULAR ELECTRICAL ENGINEERING IN INSTRUMENTATION AND CONTROL

AIM

To offer Master of Engineering (industry oriented and practice based) Regular & Modular Programmes Electrical Engineering in Instrumentation and Control, for technical teachers and professionals working in industries.

RATIONALE

The rapid pace at which changes and advancements are taking place in technology pose a great challenge to training and supplying the right kind and quality of technical manpower. The training of technical personnel is largely influenced by the nature of curriculum, quality of instructional processes, management of instructional system and the role played by industry in their training.

In order to increase the relevance of technical personnel to the world of work, it has all along been felt that the nature of programmes offered by the technical institutes should be oriented towards technology applications and practices. These programmes should focus on learning of industrial practices, practical and generic skills of problem solving, learning to learn skill and entrepreneurship skill.

As per the latest recommendations of the AICTE regarding pay scales and qualifications for technical teachers, the minimum qualification for lecturers is prescribed as degree in Engineering or Technology or equivalent and they have to acquire Master's degree or such higher qualifications for promotions to higher grades. Majority of these teachers are fresh graduates and lack the knowledge of industrial practices and related practical skills, which in turn affects, the quality of technician engineers produced by the Polytechnics/ Engineering Colleges. They, therefore, need a strong orientation in technological and field practices in the areas of fabrication, erection, construction, installation, operation, production, testing, maintenance and quality control.

The practice-based M.E. degree programme in Instrumentation and Control will provide the above education and training to the Polytechnic/ Engineering College teachers specially to equip them with the necessary knowledge and skills related to industry and field practices. They will be in a position to transfer such knowledge and training to the students of Polytechnics, so that their effective contribution in the world of work is increased.

In order to meet the above long felt need for higher education of polytechnic/ Engineering College teachers, it is necessary to offer practice based Masters degree programmes specially designed to incorporate credit based system of evaluation. The system will have all the inbuilt flexibility to allow for self pacing, taking up study of courses in the sequence and at the time convenient to in-service graduate personnel and obtaining specialization in the areas specific to their profession and carrier development.

In view of the above, NITTTR (earlier known as TTTI) Chandigarh have started offering a practice based M.E Electrical Engineering programme (Regular) in Instrumentation and Control for technical teachers having a B.E. degree or an A.M.I.E qualification in Electrical/ Electronics/ Instrumentation & Control Engineering or equivalent, since August, 1998. The course aims to provide an in-depth knowledge of field practices and ability to innovate and conduct research in technology areas. This will not only change the orientation of technician programmes but
will also reduce the widening gap between technician courses and field practices and will greatly improve the performance of industries. Limited numbers of seats are also available to professionals working in industries and field organizations.

An acute problem faced by technical institutions both for degree and diploma level is that they are not able to spare their teachers for two long years for higher studies away from their institutes. In order to face the above situation, the institute is also offering another **M.E. Electrical Engineering programme (Modular) in Instrumentation & Control** for technical teachers and professionals working in Industries. This programme has been structured modular in nature where the teachers could be relieved from their institute to this institute for attending classes during summer and winter vacations. They will however also have to undertake follow up study when they return to their institutions so as to prepare themselves for University examinations before the beginning of subsequent modules. The contact type ME programme which is of two years duration has been made modular without any dilution with respect to rigour of teaching learning practices as also University examinations. However, the duration of the programme has been increased to 3 years. Classes will begin from first week of June and second week of December having a contact period of 5 weeks each where the students will study two subjects simultaneously.

**Objectives**

The specific objective of this course is Continuing Education and Training and Retraining of:

- in service technical teachers.
- industry personnel
- any other sponsored candidate desirous of pursuing a career in teaching.

**Target Population**

The envisaged target group includes:

- teachers with a B.E degree or an equivalent qualification such as A.M.I.E. etc, in Electrical/Electronics/Instrumentation and Control Engineering.
- working professionals from Industries and other organizations having a B.E. degree in Electrical/Electronics/Instrumentation and Control Engineering or an equivalent qualification such as A.M.I.E. etc. in Electrical/ Electronics/ Instrumentation and Control Engineering.

**SPECIAL FEATURES OF THE PROGRAMMES**

i) Both the programmes are flexible, and allow self-pacing and taking up course of study in the sequence and at times convenient to the students:

ii) The courses focus on the mastery of minimum essential competencies and development of capabilities such as learning to learn, problem solving, human relations and management skills in addition to learning of Instrumentation Control Engineering subjects.

iii) These make use of a combination of instructional techniques such as group discussions, home assignments, individual and group projects, independent study, seminars etc.

iv) Assessment of student's performance will be based on both continuous evaluation using variety of assessment techniques matching the learning objectives of the different courses of study and end of term University evaluation.

v) Completion of the course work is followed by Thesis work
## STUDY & EVALUATION SCHEME
### OF
#### M.E.ELECTRICAL ENGINEERING(INSTRUMENTATION & CONTROL) – REGULAR PROGRAMME

### Semester – I CORE SUBJECTS (COMPULSORY)

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Subject</th>
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<th>Theory</th>
<th>Sessional</th>
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**ELECTIVE SUBJECT II (ANY ONE)**

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(iv) The Quality of paper published can be graded as in table below.

<table>
<thead>
<tr>
<th>Requirement</th>
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<tr>
<td>Publication in Scopus Indexed Journal</td>
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### STUDY & EVALUATION SCHEME
OF M.E. ELECTRICAL ENGINEERING (INSTRUMENTATION & CONTROL) – MODULAR PROGRAMME

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**SPELL – VII**

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INSTRUCTIONS TO PAPER SETTERS

The instructions for the paper setters for all the subjects of M.E. Electrical Engineering (Instrumentation & Control) are as follows:

1. The paper must be set by taking into consideration the total syllabus.
2. There should be in all 8 questions covering the total syllabus.
3. The examinees are supposed to attempt any five out of the 8 questions.
4. The paper should be set by following the principle of simple to complex approach.
5. The paper must be set in such a pattern that it examines knowledge, analytical power and the reasoning power of the examinee.
6. Wherever appropriate, proper numerical problems should be included.
7. Maximum marks for the paper should be 50 and time allotted should be three hours.
DETAILED SYLLABUS OF SUBJECTS

MEI 6101 MEASUREMENT SCIENCES AND TECHNIQUES

CONTENTS

Introduction

Signal Conditioning
Amplification, Operational Amplifiers, Typical OP-Amp Applications: Inversion, Addition, Subtraction, Multiplication and Division, Integration, Differentiation, Voltage to Current Conversion, Current to Voltage Conversion, Voltage Follower, Modulation, Demodulation, Filters- Low pass RC filter, High Pass RC Filter, Band-pass filter, Band-reject Filter, Phase Locked Loop, Sample and Hold circuit, Analog to Digital Conversion, Digital to Analog Conversion, Designing a Signal Conditioning Circuit

Measurement of Non-Electrical Quantities
Review of conventional and recent measurement techniques for measurement of Displacement, Strain, Pressure, Temperature, Flow, Level, Humidity.

LABORATORY/FIELD EXPERIENCES
1. Experimental determination of system parameters.
2. Study and verification of transducer characteristics.
3. Study of signal conditioning techniques.
4. Simulation of signal conditioning circuits using MULTISIM software
5. Case study of a real life measuring system in an industry.

BOOKS RECOMMENDED
2. Operational Amplifiers and Linear Circuits, Robert F. Coughlin, Pearson Education

COURSE OUTCOMES
Completion of this course will enable the students to
- Classify and analyse various types of errors.
- Interpret static and dynamics performance characteristics.
- Demonstrate various types of signal conditioning systems
- Illustrate latest techniques for measurement of non-electrical quantities
- Develop proficiency in handling MULTISIM for simulation and analysis of signal conditioning circuits.
CONTENTS

Review of Process and Control systems

Design aspects of Process Control System

Dynamic Behaviour of Feedback Controlled Process

LABORATORY/FIELD EXPERIENCES
1. Study and analysis of a feedback controller
2. Simulation of control schemes
3. Verification of desired characteristics of P,I,D, and PID controllers
4. Design fabrication and testing of an electronic controller
5. Case study of digital computer controlled system in industry

BOOKS RECOMMENDED
1. Techniques of Process Control, P.S. Buckley, John Wiley and Sons. N.Y.
COURSE OUTCOMES

Completion of this course will enable the students to
- Evaluate a process control system on the basis of different criteria.
- Identify functioning of different elements of Process Control System.
- Analyse the characteristics of various final control elements.
- Classify and compare various types of controllers.
- Experiment with different feedback controllers
- Recommend a controller for various types of process control applications.

MEI 6103 DIGITAL SIGNAL PROCESSING

CONTENTS


Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT): Discrete Fourier Transform and its Properties, Efficient Computation of DFT using FFT algorithms: Direct computation of the DFT, Divide and Conquer Approach, Radix-2 and Radix-4 FFT algorithms, Linear Filtering Approach to Computation of DFT.

The z-transforms: Introduction, z-transform, Properties of z-transform, Inverse z-transform, System function and Pole-zero plots from z-transform, Causality and Stability in terms of z-transform, Bilateral z-transform, Computation of z-transform

Structures for the Realization of Discrete-time System: Structures for FIR systems-Direct from I and II, cascade and parallel form, structures for IIR systems.


LABORATORY / FIELD EXPERIENCES

Implement the following programs in MATLAB
2. Circular Convolution.
3. DFT and FFT of Discrete time sequences.
4. Design of FIR Filters.
5. Design of IIR Filters.

BOOKS RECOMMENDED

5. Digital Signal Processors, Venkataramani, Bhaskar, PHI
**COURSE OUTCOMES**

Completion of this course will enable the students to
- Classify different discrete time signals and systems
- Apply different FFT algorithms to compute DFT
- Make use of Z-transforms to find causality and stability of systems
- Realize different types of structures for FIR and IIR system
- Design different types of digital IIR and FIR filter systems.

**MEI 6104 POWER ELECTRONICS DEVICES AND CIRCUITS**

**CONTENTS**

**Semiconductor Devices**
Power Diodes, Bipolar Junction Transistor (BJT), Thyristors, MOSFET, Gate Turn-off Thyristor (GTO) and Insulated Gate Bipolar Transistors (IGBT) – Basic Structure, Physics of Device Operation, V-I Characteristics and Switching Characteristics.

**Line-Frequency Diode Rectifiers (Line Frequency ac to Uncontrolled dc)**

**Line-Frequency Phase Controlled Rectifiers (Line Frequency ac to Controlled dc)**
Thyristor Circuit and their Control, Single-Phase Converters, Three-Phase Converters

**Chopper**
Control of dc-dc Converters Buck Converters, Boost Converters, Buck-Boost converters, Cuk dc-dc Converters, Full Bridge dc-dc Converter, dc – dc Converter Comparison

**Inverters**
Basic Concepts of Switch Mode Inverters, Single-Phase Inverters, Three-Phase Inverters, Effect of Blanking Time on Output Voltage in PWM Inverters, other Inverter Switching Schemes, Rectifier Mode of Operation, Concept of Muti-Level Inverter.

**Cycloconverters**
Single Phase Mid-point and Bridge type Cycloconverters. Three Phase Half-Wave Cycloconverters, Output Voltage Equation, Load Commutated Cycloconverters.

**Power Conditioners and Uninterrupted Power Supplies**
Power Line Disturbances, Power Conditioners and UPS

**Solid State Control of Motors**
Single-Phase and Three-Phase dc Drives, Chopper Drives, ac Drives, Induction Motor Drives, Speed Control of Three-Phase Induction Motors, Synchronous Motor Drives, Microcontroller based ac and dc Drives.

**LABORATORY / FIELD EXPERIENCES**
1. MATLAB/SIMULINK based simulation of (i) rectifier (ii) chopper and (iii) inverter.
2. MATLAB/SIMULINK based simulation of (i) cycloconverter and (ii) dc chopper drive
3. Fabrication, testing and trouble shooting of Illumination Control using Thyristor.
4. Fabrication, testing and trouble shooting of three phase diode bridge rectifier.
5. Fabrication, testing and trouble shooting of dc chopper drive.
6. MPPT of PV array using buck converter with MATLAB/SIMULINK and D-space interface.

**BOOKS RECOMMENDED**
COURSE OUTCOMES
Completion of this course will enable the students to
- Explain the physics of various power devices and discuss their characteristics.
- Analyze and design ac-to-dc, dc-to-dc, dc-to-ac and ac-to-ac converters.
- Apply power electronic based controllers in ac drives, power conditioners, UPS and dc drives.
- Develop proficiency in handling MATLAB for simulation analysis and design of power electronics based controllers.
- Develop skill for testing, trouble shooting and repair the thyristorised control circuits.

MEI 6105 INDUSTRIAL INSTRUMENTATION

CONTENTS

Industrial Automation and Control Schemes
Field bus concept, Data acquisition system, Data loggers, Supervisory control, DDC, DCS, SCADA, Instrumentation in hazardous situations, Robotics and Automation.

Introduction to PLC and its Working

PLC Programming
Instruction set used in PLC programming, Basic Instructions, Program Flow Control Instruction, Timer Instructions, Counter, Sequencers-Sequencing Instructions, Comparison Instructions, Arithmetic Instructions in Ladder Logic, Math Instructions/Functions in PLC.

Ladder Logic Programming
Rung in a Ladder Logic Program, Program Execution Sequence in Ladder Logic, Rung Condition, Role of Instructions in Ladder Diagram Programming, Ladder Diagram Programs Based on Basic Instructions, Program Flow Control Instruction, Timer Instructions, Counter, Sequencing Instructions, Comparison Instructions, Arithmetic Instructions in Ladder Logic, Math Instructions/Functions

Applications of Industrial Instrumentation
Study of Instrumentation Schemes for Thermal (Boiler, Chiller), Hydro power stations (Governor Control), Cement plant (temperature loop) industry.

LABORATORY/FIELD EXPERIENCES
1. PLC Programming practices based on ladder diagrams using relays, timers, counters, sequencers.
2. Case study of a PLC based instrumentation scheme in a process industry.

BOOKS RECOMMENDED
1. Principles of Industrial Instrumentation; D. Patranabis, T.M.H.
2. Computer Based Industrial Control, Krishna Kant, PHI, New Delhi, 1997.
5. Basic Instrumentation System & Programmable Logic Controller, UmeshRathore, Katson Books,
COURSE OUTCOMES
Completion of this course will enable the students to

- Illustrate different control schemes used for Industrial Automation.
- Explain PLC operation and make use of basic ladder logic programming.
- Create ladder logic programs for various industrial automation process.
- Applying various ladder logic programs on real time physical system.
- Analyze various process control automation schemes used in process industry.
CONTENTS

Introduction
Differences between Microprocessor and Microcontroller, Microcontrollers and their Applications,
An Overview of 8051, AVR, PIC Microcontrollers,

PIC Microcontroller
Introduction to PIC Microcontroller: History and Features, Architecture, Pin Diagram of PIC18F458,
I/O port pins and their functions, PIC18 Configuration Registers

PIC Programming in C
Data types and time delays in C, I/O Programming in C, Logic operations in C, Data conversion
programs in C, Data serialization in C, Program ROM allocation in C18, Data RAM allocation in
C18, PIC18 timer programming in C, PIC18 serial port programming in C

Real World Interfacing with PIC18
LCD and keyboard Interfacing, ADC, DAC and Sensor Interfacing

Communication Protocols
Communication protocols such as UART, SPI, I2C, CAN, Internet of Things

Programmable DSP Processors
Introduction, Signal processing in Embedded systems, Commercial Digital Signal Processing
Devices, Architecture of TMS320 series chips

LABORATORY/FIELD EXPERIENCES
1. Performing experiments on microcontroller kits
2. Simulation of PIC using Proteus Software
3. Design and development of Arduino based projects
4. Simulation of Arduino using simulation software
5. Programming Raspberry Pi with MATLAB and Simulink
6. Programming DSP chips using Code Compose Studio software

BOOKS RECOMMENDED
1. PIC Microcontroller and Embedded systems using assembly and C for PIC18,
   Muhammad Ali Mazidi, Rolin D and Danny Causey, Pearson Education,
2. PIC Microcontroller: An Introduction to Software & Hardware Interfacing, Han-Way Huang,
   Course Technology
3. Programming and customizing the PIC Microcontroller, MykePredko, Tata McGraw
   HillEducation Pvt Ltd.
   Hen Hu, CRC Press

COURSE OUTCOMES
- Completion of this course will enable the students to
- Understand the difference between various microcontrollers.
- Explain the architecture of PIC microcontroller.
- Implement C programming for interfacing PIC microcontroller with various peripherals.
• Design application circuits using Arduino
• Develop proficiency in softwares such as MATLAB/SIMULINK, Proteus and Code Composer Studio for simulation of different microcontrollers.

MEI 6202 ADVANCE CONTROL THEORY

CONTENTS

Control System Analysis using State Variable Methods
State variable representation, Conversion of state variable models to transfer function and of transfer function to canonical state variable models, Eigen values and Eigen vectors, Solution of state difference equations, Controllability and Observability, Multivariable system.

Pole-Placement Design and State Observers

Lyapunov stability analysis
Basic concepts, Stability definitions and theorems, Lyapunov functions for linear and non linear systems, A model reference adaptive system.

Linear Quadratic Optimal Control
Parameter optimization and optimal control, Quadratic performance index, control configurations, State regulator design through the Lyapunov equation, Optimal state regulator through the Matrix Riccati equation for digital control systems.

BOOKS RECOMMENDED
2. Digital Control Systems; B.C. Kuo, Prentice Hall of India.

COURSE OUTCOMES
Completion of this course will enable the students to
• Analyze and design control systems using state variable methods.
• Design the state regulator, state observer, compensator, servo system, state feedback with integral control and dead beat control.
• Examine the stability of linear and non-linear system.
• Conceptualize parameter optimization and optimal control.
• Develop proficiency in MATLAB for simulation, analysis and design of advance control circuits.

MEI 6203 OPTO-ELECTRONIC INSTRUMENTATION

CONTENTS

Introduction
PN junction, Electrostatics of PN junction, Schottky Barrier and Ohmic contacts, Semiconductor Heterojunction, Metal Semiconductor (Schottky Barrier) Photo Diode, Metal Semiconductor Metal (MSM) Photodiode, Microcavity Photodiode, PIN Photo-Diodes.

**Photo Sensitive Devices**

**Lasers**

**Optical Fibers**
Introduction to fiber communication, Optical fiber materials, their properties, Optical fiber based sensors eg. strain and temperature, Optical fiber communication schemes, Comparison of optical fiber communication with the conventional communication. Different instrumentation schemes using optical sensor.

**LABORATORY / FIELD EXPERIENCES**
1. Study and verification of characteristics of a light emitting diode.
2. Experiments on laser beam production and their control
3. Study and verification of Characteristics of a photo conductor device.
4. Study and verification of characteristics of an avalanche photo diode.
5. Study of an opto-electronic integrating circuit used in industries.

**BOOKS RECOMMENDED**

**COURSE OUTCOMES**
Completion of this course will enable the students to
- Explain the physics of various opto-electronic devices.
- Analyze the characteristics of photo sensitive devices and various optical sensors for different applications.
- Apply the knowledge and skill of laser based measuring techniques
- Apply the knowledge of optical fibre materials in communication schemes.

**MEI 6204 SOFT COMPUTING TECHNIQUES**

**CONTENTS**

**Artificial Neural Networks**
Biological Neural Network-structure of human brain, Characteristics of ANN, Artificial neurons, Types of ANN-single layer and multilayer, Hopkinsons, counter propagation, back propagation,
feedforward etc., Non Linear activation functions, Training of ANN and different training algorithms, bidirectional associative memories, various applications of ANN in the field of engineering in general and electrical engineering in particular, programming methods using ANN Techniques.

**Fuzzy Logic**
Introduction, Comparison of Fuzzy logic with digital logic, Fuzzy set theory, Fuzzification process, Defuzzification methods, Fuzzy logic controllers, Fuzzy associated memories, Application of fuzzy logic techniques in various fields of engineering, Programming methods using fuzzy logic techniques, Concepts and Applications of Neuro-fuzzy systems.

**Bio-Inspired Optimisation**
Concept of optimization, Evolutionary-Inspired Methods: Genetic algorithms, Behavior-Inspired Methods: Ant colony optimization, Particle Swarm Optimization.

**LABORATORY / FIELD EXPERIENCES**
Implementation of the following using MTLAB toolboxes
1. Design and train NN for AND or gate using perceptron
2. Design and train perceptron to classify odd and even numbers
3. Design and train NN for alphabet recognition using back propagation
4. Design and train Hopfield network for recognizing patterns such as „+“ and „−“, 
5. Design and train NN for E-XOR classification using back propagation

**BOOKS RECOMMENDED**

**COURSE OUTCOMES**
Completion of this course will enable the students to
- Illustrate the concepts of Artificial Neural Networks and Fuzzy Logic.
- Make use of different types of artificial neural networks, training algorithms in various applications.
- Build fuzzy logic controllers using various techniques such as fuzzification and de-fuzzification methods.
- Explain different bio inspired optimisation algorithms.
- Develop proficiency in handling MATLAB Toolboxes of Neural Networks, Fuzzy Logic and optimisation.
MEI 6205  INSTRUMENTATION AND COMPUTATION LABORATORY

L T P       - - 4

CONTENTS

2. Data Acquisition Practices with the help of various transducers and backup software.
3. Various practices using MATLAB toolboxes.
   (i) SIMULINK
   (ii) Sim power system
   (iii) Optimization
   (iv) Control System

COURSE OUTCOMES
Completion of this course will enable the students to
- Demonstrate the hardware interface of various controllers with MATLAB.
- Apply various MATLAB toolbox for electrical applications.
- Develop real time projects on applications of transducers.

MEI 6206  POWER SYSTEM ANALYSIS

L T P C
3 2 4

Basic Principles
Power in Single-phase AC Circuits, Complex Power Balance, Power Factor Correction, Balanced Three-Phase Circuits, Star Connected Loads, Delta connected loads, Star-Delta Transformation, Per Phase Analysis, Balanced three-phase power

Power System Analysis

Power Flow Analysis

Short Circuit Analysis
Symmetrical Components, Sequence Networks, Short Circuit Calculations (L-G, L-L, L-L-G and 3-phase Faults), Bus Impedance Matrix Formulation, Short Circuit Calculation Using Bus Impedance Matrix,

Transient Stability Analysis
Swing Equation, Synchronous Machine models for stability studies, Steady state stability, Transient stability, Equal Area Criterion, Multi-machine transient stability

FACTS Controllers
Basic Principles and Applications of SVC, TCSC, STATCOM, SSSC, UPFC

LABORATORY/FIELD EXPERIENCES
1. Modeling of multi-machine 9-bus system using MATLAB/SIMULINK
2. Real time simulation of multi-machine 9-bus system using RT LAB
3. Fault analysis of multi-machine 9-bus system using MATLAB/SIMULINK
4. Real time Fault analysis of multi-machine 9-bus system using Opal RT simulator
5. Hardware-in-Loop application with Opal RT simulator
6. Real time simulation of FACTS devices using Opal RT simulator

BOOKS RECOMMENDED
COURSE OUTCOMES
On completion of this module, the student will be able to:

- Demonstrate an understanding of the nature of the modern power system.
- Describe the modeling of transmission lines, three-phase transformers, Generators and Loads.
- Apply load flow analysis to an electrical power network and interpret the results of the analysis.
- Analyse a network under both balanced and unbalanced fault conditions and interpret the results.
- Demonstrate an understanding of the factors which determine transient stability in both single machine and multi-machine systems.
- Analyse the transient stability of a single machine/infinite bus system using both analytical and real-time simulation methods.
CONTENTS

Air pollution measurement
Impact of man on the environment: An overview, Air pollution sources, Air pollution effects, Air quality standards, Air pollution detection methods, Air sampling techniques, gas analyzers, Chromatography, Gas chromatography, Management of air pollutants, measurement of automobile pollution; Orsat gas apparatus, CO/HC analyzer.

Water pollution measurement

Measurement of other pollutants
Radioactive pollutants, Cause and effects, Measurement of radioactive pollutants, Geiger counter, Sources of noise pollution, effects of noise pollution, Sound level measurement techniques, Noise Level Standards, Control of noise pollution.

LABORATORY / FIELD EXPERIENCES
1. Experimental analysis of air pollution of a given sample
2. Study of air pollution control techniques used in a given industry
3. Sampling and analysis of pollution level of a given water sample
4. Case study of air pollution control in an industry
5. Case study of flue gas handling in a thermal power station
6. Case study of water pollution control.

BOOKS RECOMMENDED
1. Environmental Pollution Control Engineering, C.S. Rao; Wiley Eastern LTD, New Delhi,1996.

COURSE OUTCOMES
Completion of this course will enable the students to
- Explain and apply the knowledge of sources of air, water, noise and radioactive pollution and their effects, quality standards of air, water, waste and noise pollution.
- Apply the concept, principle and theory for various instrumentation techniques for measurement of different types of environmental pollution.
- Explain the techniques of pollution management for air, water and noise, as well as solid waste management.
- Demonstrate various methods for measurement of various parameters related to air, water and noise pollution.
Analytical Methods of Measurements
Physical methods of chemical analysis, special methods of analysis, basic techniques, terminologies, units, Interaction of electromagnetic radiations with matter, emission, absorption and scattering techniques. Instrumentation related to X-Ray, Ultraviolet and Infrared techniques.

Spectral Analysis
Various light sources, spectrometer, detectors and data processing, comparison of various spectral analytical techniques, refractometry, nuclear magnetic resonance spectrometry. Analytical techniques based on separation method: Basics of chromatography liquid, gas and HPLC Mass Spectrometry and related instrumentation.

Electrometric Methods of Analysis

LABORATORY / FIELD EXPERIENCES
1. Study of operation and maintenance of mass-spectrometry related instruments
2. Study of operation and maintenance of pH and selective potentiometry related instruments.
3. Study of operation and maintenance of voltmetry related instruments
4. Study of operation and maintenance of colorimetry related instruments
5. Study of operation and maintenance of conductometry
6. Case study of operation and maintenance of an analytical instrumentation laboratory.

BOOKS RECOMMENDED

COURSE OUTCOMES
Completion of this course will enable the students to
- Illustrate the interaction of electromagnetic radiation with matter at atomic and molecular level.
- Demonstrate different instrumentation techniques related to UV-visible, IR and X-Rays.
- Classify and explain different chromatographic techniques.
• List mass spectrometry, and related mass analysers.
• Define and elaborate instrumentation related to different electrometric methods of analysis

MEI 6209 MODELLING OF ELECTRICAL MACHINES

CONTENTS

Principles of Electromagnetic Energy Conversion
Magnetic circuits, permanent magnet, stored magnetic energy, co-energy force and torque in singly and doubly excited systems –machine windings and air gap mmf - winding inductances and voltage equations.

DC Machines
Elementary DC machine and analysis of steady state operation -Voltage and torque equations – dynamic characteristics of permanent magnet and shunt d.c. motors –Time domain block diagrams - solution of dynamic characteristic by Laplace transformation –digital computer simulation of permanent magnet and shunt d.c. machines.

Reference Frame Theory
Historical background –phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame –variables observed from several frames of reference.

Induction Machines

Synchronous Machines

BOOKS RECOMMENDED


COURSE OUTCOMES
Completion of this course will enable the students to
• Explain the concept of electromagnetic energy conversion.
• Analyse the steady state and dynamic characteristics of dc machines
• Illustrate the concept of phase transformation of poly phase machines
• Utilise the concept of reference frame theory to evaluate performance characteristic of induction machine
• Apply the analysis of steady state operation and dynamic performance of synchronous machine.
MEI 7101 VIRTUAL INSTRUMENTATION

CONTENTS

Introduction to Virtual Instrumentation
Historical perspective, advantages, block diagram and architecture of a virtual instrument, conventional vs virtual instrumentation.

Learning LabVIEW
Introduction to LabVIEW, Front panel, Block diagram, Data acquisition, Instrument Control, Signal Generation and Signal Processing Examples.

Elements of Data acquisition
Selection of hardware for data acquisition, ADC, DAC, DIO, Counters and timers, PC Hardware structure, Timing, Interrupts; RS232C/ RS485, GPIB.

System buses, Interface buses
Ethernet based controllers USB, PXI, etc., networking basics for office and industrial applications, remote logging storage and control, VISA and IVI, LABVIEW tool kits such as : Motion Control and Fuzzy Logic.

Machine Vision
Digital images, definition, types, files, borders ad masks, Image display, Pallets, Region of Interest, Non-Destructive overlays, Convolution kernels, Spatial filters, Gray scale morphology, Thresholding, Particle measurement, Edge detection, Pattern matching.

LABORATORY / FIELD EXPERIENCES
1. Graphical programming using Menus, Palettes, Sub VI, Structures, Arrays, Clusters, Charts and Graphs LabVIEW
2. Development of projects using LabVIEW

BOOKS RECOMMENDED

COURSE OUTCOMES
Completion of this course will enable the students to

- Compare conventional instruments with virtual instruments.
- Build virtual instruments using various programming concepts like structures, arrays, clusters, strings, subVI, express VI using LabVIEW.
- Apply LabVIEW for data acquisition, instrument control, signal generation, signal processing etc.
- Make use of various LabVIEW toolkit for real time applications
- Apply Machine Vision toolkit to solve industrial and medical problems.

MEI 7102 POWER QUALITY ISSUES AND THEIR MITIGATION
**INTRODUCTION TO POWER QUALITY**

Terms and definitions, Total harmonic distortion, Power quality standards: CBEMA curve, IEC-61000-4-11/34

**POWER QUALITY PROBLEMS**

Voltage Sags and Interruptions -Sources of sags and interruptions, estimating voltage sag performance, Motor starting sags, estimating the sag severity, mitigation of voltage sags, Active series compensators, static transfer switches and fast transfer switches. Over Voltages-Sources of over voltages: Capacitor switching, lightning, ferro resonance, Harmonics-Harmonic distortion: Voltage and current distortion, harmonic indices, harmonics from commercial and industrial loads, locating harmonic sources

**POWER CONDITIONING**

Multi pulse methods for harmonic elimination- delta/wye, delta zigzag/Fork, Delta Polygon, Delta/delta/Double Polygon, Delta/Hexagon. Auto Wound Transformers, Interphase and Current Balancing Transformers. Active Power Line Conditioners- Passive filters and limitations, active filters for harmonic and reactive power compensation in two wire, three wire and four wire ac systems, Shunt Active Filter, Hybrid and Series Active Filters, Combined Series and Shunt Power Conditioners(UPFC, UPQC, UPLC).

**POWER QUALITY MONITORING**

Considerations and requirements, power quality measurement equipment: Power line disturbance analyzer, Harmonic / spectrum analyzer, flicker meters, disturbance analyzer, Applications of expert system in power quality monitoring

**LABORATORY/FIELD EXPERIENCES**

1. Study of power quality monitor / analyzer
2. Design of active/passive harmonic filter using MATLAB/SIMULINK
3. Simulation studies of Power Conditioning devices using MATLAB/SIMULINK
4. Power quality audit of institute

**BOOKS RECOMMENDED**


**COURSE OUTCOMES**

Completion of this course will enable the students to

- Know the significance of power quality and related problems that have to be overcome to maintain this quantity.
- Review various standards for power quality and apply intelligent systems for conforming to these standards.
- Define the voltage sag, identify its sources and estimate it.
• Classify sources of transient over voltages and employ devices for protection against these over voltages.
• Analyse use of active and passive filters for mitigating harmonic distortion.
• Propose power quality measurement systems for monitoring the quality.

MIC 7103  BIO-MEDICAL INSTRUMENTATION  L  T  P  C  3  -  2  4

CONTENTS

Sensors and Transducers for Biological Applications
Types, properties, characteristics and selection of transducers for biological instrumentation.

Measurement of Bio-Signals
Leads and electrodes, electrocardiography, electrical activity of the heart, equivalent cardiac generator. Einthoven lead system, standardization of recording and display of ECT (Electrocardiogram), EEG (Electroencephalogram), EMG (Electromyogram), EOG (Electroocculogram), ERG (Electroretinogram), EGG (Electrogastogram).

Measurement of Physical parameters
Bloodflow, droprecorder, electromagnetic flow meter, measurement of systolic and distolic pressures, blood pressure instruments, intraocular pressure, lung air pressure, audiometers. Measurement of body temperature, thermography. Cardiac tachometer, respiration rate phonocardiogram, heart sounds, electrical stethoscope, pulmonary function analysers. CO₂ -O₂ - Concentration in exhaled air, blood and lungs, pH value of blood, impedance plethysmography, blood gas analysers, blood cell counters.

Medical Imaging Systems
Medical display systems, medical thermography, X-Ray, diathermy equipment. Ultrasonics in biomedical application for diagnostic and therapeutic, CAT, MRI, Laser applications in biomedical field.

Patient safety
Electrical Safety of Medical Equipments, Shock Hazards from Electrical Equipment, Methods of Accident Prevention, Test Instruments for checking Safety parameters of biomedical equipments.

LABORATORY / FIELD EXPERIENCES
1. Study of sensors and transducers used in Bio-medical applications
2. Study of Bio Medical instruments used in Heart-care system
3. Study of operation and maintenance of ECG instrument
4. Study of operation and maintenance of instruments used for thermography
5. Study of operation and maintenance of instruments used for blood analysis
6. Case study of operation and maintenance of an ultrasonic machine

BOOKS RECOMMENDED

COURSE OUTCOMES
Completion of this course will enable the students to

- Outline the properties and characteristic of different transducers used for Biomedical Application.
- Classify methods of acquisition and display of bio signals like, ECG, EOG, EMG, etc.
- Summarize methods for measurement of biophysical diagnostics.
• Compare different imaging modalities used in Medical Imaging.
• List parameters for Electrical Safety of patients and biomedical equipment and methods of their testing and calibration.

MEI 7104 ADVANCED DIGITAL SIGNAL PROCESSING

CONTENTS

Transformations

Digital Filters

Multi-rate Digital Signal Processing
Sampling Rate Alteration Devices, Multi-rate Structures for sampling rate conversion, Multistage design of Decimator and Interpolator, The Poly-phase Decomposition, Arbitrary Rate Sampling Rate Converter, Filter Banks, QMF banks, Multilevel Filter Banks, Sub-band Coding, Discrete Wavelet Transform.

Linear Prediction and Optimum Linear Filters
Forward and Backward Linear Prediction, Properties of Linear Prediction-Error Filters, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Adaptive Digital Filters

Power Spectrum Estimation

DSP Chips
Introduction to fixed point and floating point processors, ADSP21xx and TMS320Cxx- Architecture, Memory, Addressing Modes, Interrupts, Applications. Comparison of ADSP21xx and TMS320Cxx series.

LABORATORY / FIELD EXPERIENCES

Implement the following programs in MATLAB
1. Simulation of Digital Filters.
3. Decimation and Interpolation of Discrete time sequences.
4. Implementation of an Arbitrary rate Sampling Rate Converter.
5. Illustrate Adaptive Filtering using LMS Algorithm and RLS Algorithm.
8. System Design based on ADSP 21XX DSP chip.

BOOKS RECOMMENDED
4. Discrete Time Signal Processing, Oppenheim & Schafer. PHI.

COURSE OUTCOMES
- Apply the different transforms such as DCT, Watch, Hadamard, Wavelet.
- Design different types of IIR and FIR digital filters and realize the corresponding structures.
- Development and analyze algorithm for multirate digital signal processing.
- Design adaptive filters for a given Application
- Be able to implement power spectrum estimation.
- Make use of DSP chips such as ADSP 21XX.
CONTENTS

Introduction Research Methodology
Definition of Research, Need of Research, Concept and steps of Research Methodology, Uses of Research Methodology, Research Techniques.

Reviewing Literature
Need, Sources-Primary and Secondary, Purposes of Review, Scope of Review, Steps in conducting review.

Identifying and defining research problem
Locating, Analyzing stating and evaluating problem, Generating different types of hypotheses and evaluating them.

Method of Research
Descriptive research design-survey, case study, content analysis, Ex-post Facto Research, Correlational and Experimental Research.

Sampling Techniques
Concept of population and sample'sampling techniques-simple random sampling, stratified random sampling, systematic sampling and cluster sampling, quota sampling techniques determining size of sample.

Procedure of data collection
Aspects of data collection, Techniques of data Collection

Statistical Methods of Analysis
Descriptive statistics: Meaning, graphical representations, mean, range and standard deviation, characteristics and uses of normal curve.

Inferential statistics
t-test. Chi-square tests. Correlation (rank difference and product moment), ANOVA (one way).

Procedure for writing a research proposal and report
Purpose, types and components of research proposal, Audiences and types of research reports, Format of Research report and journal.

Case Studies on Software tools used for research work.

BOOKS RECOMMENDED
2. Statistical Methods, S.P Gupta, Sultan Chand & Sons, 2006
COURSE OUTCOMES

Completion of this course will enable the students to

- Discuss about research, need of research, research methodology and research techniques and methods of research.
- Explain the importance of literature review, literature sources, apply the methodology for conducting literature review and identifying research problem.
- Explain the method of conducting survey and apply the concept of sampling techniques and procedure for data collection.
- Discuss and apply the descriptive and inferential statistical methods for data analysis.
- Explain and analyse the purpose and procedure for writing research proposal and research report.
CONTENTS

Introduction to Human Resource Development
Evolution, Mission and Purpose, Components of HRD, HRD problems and issues related to Indian Industry and technical education, HRD in the context of new Industrial Policy

Staff Development, Professional Development and Career Development
Stages of HRD, Initial or Induction Training, Training for job-related/professional development, Training for horizontal and vertical mobility of employees

Concept of Training
Assumptions for prevailing and alternative concept of training, Action through training or action through force.

Training Strategy
Strategic issues, Basic phases, Modalities in training, Formulating a coherent strategy

Training Methods
Learning on the job-training in the fields, Simulating real life-role playing and games, Incidents and cases-individualized training, Seminars and syndicates, Lecture method

Developing Group and the Climate
The Social process, Indicators of group development, Training climate

Evaluation of Training
Issues for evaluations, Role of the Training System with evaluators from other constituencies

Systems Approach to HRD
Definition and importance of needs assessment, Methods employed in needs assessment (Interviews, Questionnaire, Tests, Records and Reports Study, Job Analysis and Performance Review. Strategies for HRD : on the job, off the job, Programme Planning
Design, Implementation and Evaluation

BOOKS RECOMMENDED

COURSE OUTCOMES
Completion of this course will enable the students to
- Understand the evolution of HRD, its mission, purpose and components and Identify HRD problems and issues related to Indian Industry and technical education
- Understand stages of HRD as Initial or Induction Training, Training for job-related/professional development and Training for horizontal and vertical mobility of employees
- Understand concept of Training and formulate a coherent training strategy by knowing the strategic issues and modalities in training
- Employ different training methods suiting to trainee and training requirements and develop a Group and promote a healthy training climate
- Design a training programme through systems approach to HRD.
Introduction
Energy consumption and its impact on environment, Load management, Energy scenario-in context of India and world, conventional and non-conventional sources of energy, their merits and limitations.

Renewable energy
Generation of electrical energy using non-conventional sources- Solar, Wind, Magnetohydro, Tidal, Geo-thermal, Ocean etc., their advantages and disadvantages.

Energy Storage
Energy storage methods, their advantages and limitations, Secondary batteries, Fuel cells, Hydrogen energy system.

Energy Efficient Technology
Technology for efficient utilization of electrical energy, Energy efficient lighting devices, motors, transformers, Instrumentation schemes for measuring and controlling electrical energy for implementation of energy efficient systems, Impact of power factor on electrical power systems, Improvement of power factor.

Energy Conservation

Energy Audit

BOOKS RECOMMENDED
1. ECBC code, Bureau of Energy Efficiency, Government of India, New Delhi

COURSE OUTCOMES
Completion of this course will enable the students to
- Explain about energy consumption and environment, load management, energy management and its standards, differentiate between conventional and non-conventional renewable energy sources.
- Apply the concept and principle for generation of electrical energy using various non-conventional renewable energy sources.
- Discuss and apply the concept, principle of various energy storage methods.
- Examine, apply and analyze different energy efficient technologies, various methods of energy conservation and energy audit.

MMT 6109 OPTIMIZATION TECHNIQUES CONTENTS
C Numerical Techniques
4
Introduction to numerical techniques, Numerical differentiation and numerical integration, Eigen value problems, Newton-Raphson's method, Computer based numerical analysis.

**Introduction to optimization**
Introduction and Engineering applications of optimization, Optimal Problem Formulation; Design-variables, Constraints, Objective function, Variable bounds.

**Single-variable Optimization**

**Multivariable Optimization**

**Constrained Optimization**

**Integer Programming**

**Geometric Programming**

**BOOKS RECOMMENDED**

**COURSE OUTCOMES**
Completion of this course will enable the students to
- Formulate optimization problems
- Understand and apply the concept of optimality criteria for various type of optimization problems
- Solve various constrained and unconstrained problems in single variable as well as multivariable
- Apply the methods of optimization in real life situation.