BATCH 2021 - 2023

SCHEME FOR MASTER OF ENGINEERING (INDUSTRY ORIENTED AND

MEI 6208	Analytical Instrumentation	3	-	2	3	-	1	4	50	50	50	150
MEI 6209												

STUDY & EVALUATION SCHEME

S. No.	SUBJECT	SCHEME OF TEACHING			CREDITS	MARKS		
		L	P	TOTAL		THEORY	SESSIONAL	TOTAL
13	Subject ï 2	4	---	4	**4**	50	50	**100**
14	Preliminary Thesis	---	20	20	**10**	---	---	**---**
TOTAL					**18**			**200**

SPELL – VII

L P TOTAL

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 whole 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. Where ever 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

L	T	P	C
3	-	2	4

CONTENTS

Introduction

Review of measurement and measuring systems. Functional elements of a measuring system. Errors and uncertainty in measurements, Statistical analysis of errors. Loading effects, Generalized impedance and stiffness, Static and Dynamic performance characteristics.

Signal Conditioning

Amplification, Operational Amplifiers, Typical OP-Amp Applications: Inversion, Addition,

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.
Analyze 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**

L	T	P	C
3	-	2	4

CONTENTS

Review of Discrete Time Signals and Systems: Introduction, Discrete time signals as array of values, Classification of discrete time signals, Linear Time Invariant (LTI) Systems, Non-Recursive Systems and Recursive Systems and representation of discrete time systems via difference equations, Correlation: Cross-correlation and Auto-correlation and their properties, Analog to Digital (A/D) Conversion: Sampling, Frequency Relationships, Aliasing, Quantization, Encoding, Sampling Theorem and Anti-Aliasing Filter.

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.

Design of Digital Filters: Filter approximation ï Butterworth, Chebyshev, Bessel and Elliptic functions, Design of FIR filters ï using window, frequency sampling method. Design of IIR filters ï Impulse invariance, Bilinear transformation, Magnitude squared functions, Multirate sampling of DSP systems. Signal processing algorithms and applications in instrumentation engineering.

LABORATORY / FIELD EXPERIENCES

Implement the following programs in MATLAB

1. Convolution of Causal and Non Causal Sequences.
2. Circular Convolution.
3. DFT and FFT of Discrete time sequences.
4. Design of FIR Filters.
5. Design of IIR Filters.
6. Simulation of Digital Filters.

BOOKS RECOMMENDED

1. Discrete-time Signal Processing, A.V. Oppenheim and RW Schieffer, PHI, 1975.
2. Digital Signal Processing ï A Practical Approach, E.C. Ifeachor, B.W. Jervis, Pearson Education, Delhi, 2nd Edition, 2002.
3. Digital Signal Processing- Principles, Algorithm and Applications, John G. Proakis, Dimitris G. Monalakis, PHI, 4th Edition, 2007
4. Digital Signal Processing: Theory, Analysis and Digital-Filter Design, B.Somanathan Nair, PHI
5. Digital Signal Processors, Venkataramani, Bhaskar, PHI

COURSE OUTCOMES

Completion of this course will enable the students to

Classify different discreet 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

L	T	P	C
3	-	2	4

CONTENTS

Semiconductor Devices

MEI 6105 IoT ENABLED INDUSTRIAL AUTOMATION

L	T	P	C
3	-	2	4

CONTENTS

Introduction to Internet of Things

Internet of Things ï Definition, Structure of IoT, Sensors for IoT Applications, Recent Trends in the Adoption of IoT, Societal Benefits of IoT: Health Care ï ï Machine to Machine (M2M) - Smart Transportation ï Smart Living ï Smart Cities- Smart Grid

Implementation of IoT using Arduino

Arduino Uno Architecture, Basics of Embedded C programming for Arduino, Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino Interfacing of Actuators with Arduino. Interfacing of Relay Switch and Servo Motor with Arduino

Basic Networking with ESP8266 WiFi module

Introduction to Node MCU/ESP 32 and its interfacings- Temperature Sensor Interfacing (LM35) - Bluetooth Interfacing (HC05)- Motor driver Interfacing (L298) -LCD Interfacing (HD44780), Posting sensor(s) data to web server

Implementation of IoT using Raspberry Pi & Python Programming

Introduction to Raspberry Pi board, Basics of Linux and Python programming language for R-Pi implementation, Setting up the pins, applying digital voltages, and generating Pulse Width Modulated signals, Interfacing R-Pi with sensors, actuators and transmitting data to webserver

IoT Enabled Programmable Logic Controllers

Introduction about Programmable Logic Controller, History of PLC, Architecture of PLC, CPU, I/O Modules, Power Supply and Communications, Need of PLC for Industrial Automation, Introduction to PLC Programming, Types of Programming Languages, Ladder Logic Programming for PLC, Applications of IoT Enabled Programmable Logic Controllers, Introduction to Industry 4.0 and Industrial Internet of Things

LABORATORY/FIELD EXPERIENCES

1. Create a major project of IoT implementation using Arduino/R-pi and ESP8266 WiFi module.
2. PLC Programming practices based on ladder diagrams using relays, timers, counters, sequencers.
3. Case study of a PLC based instrumentation scheme in a process industry.

BOOKS RECOMMENDED

1. The Internet of Things, Samuel Greengard, Cambridge, MA: MIT Press, 2015.
2. The Fourth Industrial Revolution, Klaus Schwab, World Economic Forum
3. Building Internet of Things with the Arduino, Charalampos Doukas, Createspace Independent Pub.
4. Internet of Things with ESP8266: Build amazing Internet of Things projects using the ESP8266 Wi-Fi chip, Marco Schwartz, Packt Publishing House.
5. Ladder Logic Programming Fundamentals: Learn Ladder Logic Concepts Step By Step to Program PLC's on the RS Logix 5000 Platform, A J Wright, 2019.

COURSE OUTCOMES

After the completion of the course, the students will be able to:

Understand the concept of IoT and its various applications

Implement C programming for interfacing Arduino with various peripherals.

Design application circuits using Arduino

Apply the knowledge of Networking with ESP8266 WiFi module for IoT Applications

Implement IoT using R-pi and python programming

Create ladder logic programs for various industrial automation process.

Applying various ladder logic programs on real time physical system.

MEI 6201 **SMART GRID TECHNOLOGIES**

L	T	P	C
3	-	2	4

CONTENTS

Communication Technologies for Power System

Fiber Optical Networks, WAN based on Fiber Optical Networks, IP based Real Time data Transmission, Substation communication network, Zigbee.

Information System for Control Centers (ICCS)

ICCS Configuration, ICCS communication Network, ICCS Time Synchronization, E-Commerce of Electricity, GIS, GPS.

Integration, Control and Operation of Distributed Generation

Distributed Generation Technologies and its benefits, Distributed Generation Utilization Barriers, Distributed Generation integration to power grid.

Monitoring the Smart Grid

Load dispatch centers, wide-

COURSE OUTCOMES

After the completion of the course, the students will be able to:

Explain various aspects of the smart grid, including, Technologies, Components, Architectures and Applications.

Explain communication infrastructure of smart grid.

Explain various integration aspects of conventional and non-conventional energy sources.

Explain distributed generation coordination including monitoring of smart grid using modern communication infrastructure.

MEI 6202 **ADVANCED CONTROL THEORY**

L	T	P	C
3	1	-	4

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

Stability improvement by state feedback, Necessary and sufficient conditions for arbitrary pole-placement. State regulator design, Design of state observer. Compensator design by separation principle. Servo design. State feedback with integral control, Deadbeat control by state feedback and deadbeat 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

1. Digital Control & State Variable Methods, M Gopal, McGraw Hill Education, 4th Edition,2012.
2. Digital Control Systems; B.C. Kuo, Prentice Hall of India.
3. th

MEI 6203 OPTO-ELECTRONIC INSTRUMENTATION

L	T	P	C
3	-	2	4

CONTENTS

MEI 6204 **SOFT COMPUTING TECHNIQUES**

L	T	P	C
3	-	2	4

MEI 6206 **POWER SYSTEM ANALYSIS**

L	T	P	C
3	-	2	4

CONTENTS

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
Single Line Diagram and Per Unit System, Transmission line Parameters, Modeling of Transmission Lines, Steady State Operation of Transmission Lines, Modeling of Transformers, Modeling of Generators and Loads (Steady State Operation),

Power Flow Analysis
Bus Admittance Matrix Formulation, Gauss-Seidel Iterative Solution, Newton-Raphson Method for Power Flow, Decoupled and Fast Decoupled Load Flow Solution Methods, Gauss elimination and Sparsity Techniques

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

BOOKS RECOMMENDED

1. Power System Analysis, Hadi Saadat, Tata McGraw Hill, New Delhi, 21st reprint, 2010.
2. Modern Power System Analysis, Nagrath I.J., Kothari D.P., Tata McGraw-Hill, 4th Edition, 2011.
3. Power System Analysis, T K Nagssarkar and M S Sukhija, Oxford Higher Education.
4. Power System Analysis, John J. Grainger, W.D. Stevenson Jr., Tata McGraw-Hill, 6th reprint, 2010.
5. Electrical Power Systems Analysis, Security and Deregulation, P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan, PHI Learning Private Limited, New Delhi, 2012.
6. Power System Stability and Control, Kundur P., Tata McGraw Hill, New Delhi, 10th reprint, 2010.
7. Power System Analysis & Design, J. DueTf1 0 .

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

COURSE OUTCOMES

Completion of this course will enable the students 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.

MEI 6208 ANALYTICAL INSTRUMENTATION

L	T	P	C
3	-	2	4

CONTENTS

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

MEI 7102 POWER QUALITY ISSUES AND THEIR MITIGATION

L	T	P	C
3	-	2	4

CONTENTS

Introduction to Power Quality

Terms and definitions, Total harmonic distortion, Power quality standards: CBEMA curve, IEC-6100-4-11/34

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

1. Electrical Power Systems Quality, Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.WayneBeaty, McGraw Hill, 2003
2. Power Electronic Converter Harmonics (Multi-pulse methods for Clean Power), Derek A Paice, IEEE Press 1995, ISBN
3. Instantaneous power Theory and applications to Power Conditioning, H Akagi, E.H. Watanabe and M Aredes, IEEE Press, John Wiley and sons Incorporate, 2007.
4. Power System Harmonics, J Arrilaga, D.A Bradley and P.S Bodger, John Wiley and Sons Ltd, 1995.

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.

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 distollic 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. CO_2 -O_2 - 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 Equipment, Shock Hazards from Electrical Equipment, Methods of Accident Prevention, Test Instruments for checking Safety parameters of biomedical equipment.

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

1. Biomedical Instrumentation and Measurements; L.C. Cronwell F.J. Weibell. E.A. Pfeiffer, PHI, 1980.
2. Principles of applied instrumentation: Gaddes and Baker, John Wiley & Sons,1989.
3. Handbook of Bio-medical Instrumentation; R.S. Khandpur, Mc Graw Hill, 2003.
4. Medical Instrumentation ï Application & Design, John G. Webster, Editor, John Wiley & Sons, 2010.

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.

MEI 7104 **ADVANCED DIGITAL SIGNAL PROCESSING**

L	T	P	C
3	-		

MEI 7105 **ENERGY MANAGEMENT**

L	T	P	C
3	-	2	4

CONTENTS

Energy Sources

Types of Energy, Conventional Sources of Energy, Non-Conventional Sources of Energy, Commercial Energy Production, Current Scenario of Energy in India and World, Need for Energy Conservation.

Energy Audit

Definition, Need, Types of Audit, Preparing an Energy Audit Report, Benchmarking, Sankey Diagram, Calculation of Payback Period.

Energy Management

Definition, Need, Standards for Energy Management, ISO Standards 14001, 50001, Energy Conservation Act 2003, Designated Consumers, Energy Substitution.

Instrumentation

Instruments used for Energy Audit: Power Analyzer, Thermal Analyzer, General Instruments and their use, SCADA, Maximum Demand Controllers, Automatic Power Factor Controllers, Energy Efficient Motors, Soft Starters with Energy Saver, Variable Speed Drives, Energy EfficiN

COURSE OUTCOMES

After the completion of the course, the students will be able to:

Understand the need, comparison and use of various type of electrical energy resources.
Understand and compare the basic energy audit report
Comprehend various energy management standards and justify its implementation
Acquire the knowledge to use various instruments for energy audit
Understand the environmental effects and various international protocols
Analyze the pollution situation and understand clean development mechanism.

MMT 6109 **OPTIMIZATION TECHNIQUES**

L	T	P	C
4	-	-	4

CONTENTS

Numerical Techniques
Introduction to numerical techniques, Numerical differentiation and numerical integration, Eigen value problems, Newton-Raphsonôs method, Computer based numerical analysis.

Introduction to optimization
Introduction and Engineering applications of optimization, Optimal Problem Formulation; Design-variables, Constraints, Ob