Flexible Scheme & Syllabus

2021 Admitted Batch

B.Tech.

in

Electrical Engineering

(VI Semester)

Madhav Institute of Technology & Science

Gwalior-474005

Course Objectives:

- To familiarize the students with the learn standard terms and definitions
- To expose the student to the need for protection and various protective devices, their construction, operating principle, torque equation, characteristics and field of application for different types of equipment to identify reasons for mal operation and their remedies

Unit I. Arc Interruption: Arc properties, Formation and extinction of arc, Restriking and recovery voltage RRRV, different methods and control devices for arc extinction, Current chopping, Interruption of capacitive currents, Resistance switching. Type and classification of circuit breakers. Oil circuit breaker.

Unit II. Air blast and SF6 circuit breakers: Vacuum circuit breakers, duties and rating Maintenance and testing of OCB 's. Isolators, HRC fuse. Protective Relays: introduction, Definition of terms associated with protective relaying. Construction and characteristics of electromagnetic relays.

Unit III. Elements of static relays: Comparator, induction, distances and differential relays, microprocessor based relays. Modern trends in power system protection, Auto reclosure, under and over frequency relays and their applications. Digital Protection. Numerical protection Introduction, block diagram of numerical relay, numerical over current protection.

Unit IV. Protection schemes: Protection of generators and transformers, percentage differential relay, Buchholz relay, different protections provided for generator and transformer, transmission line protection using over current relays, distance relays and carrier current protection, protection of motors and bus bars.

Unit V. Protection against Over Voltages: Power System transients, over voltage in transmission lines, fault clearance and lightning and switching surges, ground wire, lightning arrestors, basic impulse insulation level(BIL), insulation coordination, grounding of P.S. current limiting reactors, their uses and location protection against traveling waves.

Recommended Books:

1. Switchgear protection and power systems by Sunil S. Rao, Khanna publication, 13th edition, 2008.
2. Power system protection & Switchgear by Badriram, TMH publication, 2nd edition, 2011.
3. Switchgear and protection by Ravindranath and Chander, Newage publication, 2nd edition, 2012
4. Switchgear and protection by Deshpande , TMH Publication, 2004
5. Digital Protection by L.P. Singh New Age Publication, 2nd edition, 1997.

Course outcomes focused on employability/entrepreneurship and skill development
Course Outcomes:

S No.	Course Outcome (CO)	Mapping
1	**Explain** the concepts, theories and features associated with protective relays and circuit breakers	Skill Development
2	**Classify** relays and circuit breakers based on criteria such as construction, type of supply, working principle, actuating quantities	Skill Development
3	**Select** relays and circuit breakers for specific equipment and applications	Employability
4	**Design** protection schemes for generators, motors, transformers and transmission lines	Skill Development
5	**Analyze** the behavior and performance of relays under different loading levels and faults	Skill Development
6	**Select** the protective devices and their locations for protecting power systems against over voltages	Employability

Switch Gear & Protection Lab- 130615

Course outcomes focused on employability/entrepreneurship and skill development
Course Outcomes:

S No.	Course Outcome (CO)	Mapping
1	**Operat**e the Over/Under voltage & over current relays and observe the performance for different setting**s**	Skill Development
2	**Analyze** the effect of time and current settings on the operating characteristics of an Inverse Definite Minimum Time (IDMT) relay	Skill Development
3	**Validate** the characteristics of percentage biased differential relay for different bias settings	Skill Development
4	**Prepare** an organized written report.	Skill Development
5	**Develop** the ability to work is team and learns professional ethics.	Skill Development

List of Experiments

1. To plot the characteristics & analyze the performance of under voltage relay
2. To plot the characteristics & analyze the performance of microprocessor based over voltage relay
3. To plot the characteristics & analyze the performance of electromechanical over current relay
4. To plot the characteristics of percentage biased differential relay (Static) at different biasing
5. To plot the characteristics of percentage biased differential relay (Electro-mechanical) at different biasing
6. To test the over current relay using the relay test bench
7. To operate Motor protection simulation panel
8. To operate Feeder protection simulation panel
9. To simulate distance relay and plot the characteristic by using MATLAB
10. To simulate IDMT relay and plot the characteristic using MATLAB

Control Systems: 130616

Course Objective:

- To familiarize the students with the fundamental concepts of control system problems and their solution possibilities,
- To expose the students to the mathematical modeling of the various physical systems,the concept of time-domain response (transient and steady-state response) and frequency-domain analysis of the systems, stability analysis of the systems, specifications of controller and compensator design and its implementations.

Unit-I Modeling of Physical Systems: Translational & Rotational Transfer Function of Electrical and Mechanical systems. Feedback characteristics of control systems, Open loop and closed loop systems, effect of feedback sensitivity to parameter variations, Block diagram representation and reduction techniques, Signal flow graphs, Mason's rule. Control systems and its components, error sensing devices: Potentiometers, Tacho generators and Synchros, A.C. & D.C. servomotor.

Unit-II Time Response Analysis: Transient Response Analysis: Transient and steady-state response analysis for first and second order systems and their qualitative analysis; error analysis and error constants., Derivative and Integral error compensation, P, PI, PD, PID Controller.

Unit-III Frequency Response Analysis: Frequency domain specifications of second order system, Polar plot, Bode plots, M Circles, N Circles. Compensator Design: Lead, lag and lag-lead compensation using frequency response methods.

Unit-IV State Variable Analysis: Concept of state, state variables and state models, state equations and state transition matrix, relationship between transfer function and state equations, control system with state variable feedback, controllability & observability.

Unit-V Stability: Stability, Absolute and relative stability, Routh Hurwitz stability criteria, Root Locus Analysis: Development of root loci, effects of pole/zero on loci, Nyquist plot & Nyquist stability criterion

Recommended Books:

1. Control System Engineering by I.J. Nagrath and M. Gopal, New Age International Publication.
2. Control Systems by U. A. Bakkshi, Technical Publication, Pune.
3. Linear Control Systems by B. S. Manke, Khanna Publishers
4. Automatic Control System by S.C. Gupta, New Age International Publication.
5. Control System Engineering by Norman Wiley Publication.
6. Automatic Control System by B.C. Kuo, Oxford University Press & Pearson Education.
7. Modern Control Engineering by K. Ogata, Pearson Education, Asia.

Course outcomes focused on employability/entrepreneurship and skill development
Course Outcomes:

S No.	Course Outcome (CO)	Mapping
1	**Develop** mathematical models of mechanical, electrical and	Skill Development

	electromechanical systems	
2	**Represent** the complex system into standard canonical form by signal flow graph and block diagrams reduction rules	Skill Development
3	**Compute** the time and frequency-domain responses of first and second-order systems to standard inputs.	Skill Development
4	**Formulate** control engineering problems in state-variable form	Skill Development
5	**Evaluate** the stability of a closed-loop control system in time-domain as well as in frequency-domain	Skill Development
6	**Predict** the nature of response for the given input	Skill Development

Industrial Automation 130660

Course Objective:

- To familiarize the students with the Industrial aspects of automation, planning and model making
- To provide the understanding of the control of a different PLCs and their applications in various low ,medium and high power drives

Unit I: Introduction: Overview of industry environment, Different type of switches & their operation, Architecture of industrial automation system, Relay and contactor logic, AC and DC relays and their role for load control. Review of starters: Power and Auxiliary contactors and their usage for load control. Overview of standards (BIS, ISO) & star and delta starters and their rating.

Unit II:Sensors: Temperature& speed Measurement, Humidity,Pressure, Force and Torque Sensors, Motion Sensing(speed sensor), proximity sensor, Signal Conditioning, Data Acquisition Systems,Characteristics of Sensors and control logic, control using potential free output sensors, linear potentiometer timer hardware architecture, Controlling industrial system using timers and counters (case study)

Unit III:Industrial Drives: AC & DC Drive basics, Electrical specifications and hardware architecture .AC drive and AC motor specification matching (sizing of drive),Load characteristics and its types, Servo Drives Stepper motor drive and VFD(Variable frequency drives) drives.AC drive power wiring and Interfacing input and output signals. Energy Savings with Variable Speed & multi motor Drives. Braking motoring and regenerative operation of drives Selection of power, motor and signal cables for AC drive application. Heat management of Drives, Drives protection

Unit IV: Programmable Logic Controllers: Programmable controllers, Programmable logic controllers, Analog/Digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, , Advantage of using PLC for Industrial automation, Application of PLC to process control industries.Different types of Network Communication Protocol, DH-485, Ethernet, Device Net, Control Net, Modbus, Profibus Proprietary Protocol, open Protocol.

Unit V: Automatic Control: Introduction to P-I-D Control, manual and auto PID Control Tuning, Feed forward Control Ratio Control, Time Delay Systems and Inverse Response Systems, PWM control in drives.

Recommended Books:

1. Lingefeng Wang, Kay Chen Tan,"Modern Industrial Automation and Software Design" John Wiley & Sons Inc.
2. K. L.S. Sharma, “Overview of Industrial Process Automation”, Elsevier
3. KokKiong“Drives and Control for Industrial Automation”, Springer
4. John Webb**,** “Programmable Logic Controllers Principles & Applications”, PHI
5. John G. Webster,“The Measurement, Instrumentation and Sensors Handbook”, CRC Press.

S No.	Course Outcome (CO)	Mapping
1	**Analyse** architecture of industrial automation system	Skill Development
2	**Select** appropriate sensors	Skill Development
3	**Acquire** PLC knowledge	Employability
4	**Acquire** the knowledge of PID control technique	Employability
5	**Develop** small application using PLC & transducer,	Skill Development
6	**Compare** AC and DC drives for particular applications	Skill Development

Energy Conservation &Management: 910104

Course Objectives:

To familiarize the students to the concepts of Energy Audit, various terminology, rules and regulations, policy, energy economics, energy tariff, analysis techniques and energy conservation.

Unit I: Energy Scenario: Classification of Energy, Indian energy scenario, energy needs of growing economy, long term energy scenario, energy conservation and its importance, Energy conservation Act 2001 and its features, Schemes of Bureau of Energy Efficiency (BEE) including Designated consumers, Electricity Acts, National action plan on climate change.

Unit II: Energy Sources & conservation: Conventional &Non-Conventional sources of energy, Renewable &non-renewable source of energy, Various methods of energy Conservation, Generation of Electrical Energy using non-conventional Sources.

Unit III: Energy Audit: Introduction, Energy Audit- Need, Scope, Methodology, Types of Energy Audit, Energy Flow Diagram, Baseline data for energy audit, Instruments for energy auditing. Sankey Diagram, Questionnaire for energy audit, Preparations & presentations of energy audit reports, Functions of Energy Auditor

Unit IV: Energy Management: Definition and objective of energy management, General Principles of energy Management, Energy Management Approach, Energy supply side Management, Management of energy distribution, Functions of energy management team.

Unit V: Energy Economics: Introduction, Parameters for energy economics, Energy Tariff, Economic Analysis Technique- Simple payback period, Discounted Cash Flow Method or Time Audited Technique (Net present value NPV, Present value index method PI, Internal rate of return Method IRR), Return on Investment (ROI).

Recommended Books:

1. Energy Management by W. R. Murphy, G. A. Mckay, Butterworth, 2nd ed., 2009.
2. Energy Management Principles by C.B. Smith, Pergamon Press, 2nd ed., 2015.
3. Electrical Energy Conservation & Utilization by S.C. Tripati, McGraw Hill Edu. India, 1st ed., 1980.
4. Non-Conventional Energy Resources by N. K. Bansal, Laxmi Publication, 1st ed., 2014.
5. Energy Management Hand book by W.C. Turner, John Wikey& Sons, 6th ed., 2006.
6. Energy Conservation guide book by Pattrick, Prentice Hall, 1st ed. 1993.

S No.	Course Outcome (CO)	Mapping
1	**Explain** the basic concepts of Energy Audit & its various terminologies, rules and regulations, policy and how to write reports.	Skill Development
2	**Discuss** the conventional and non-conventional energy technologies	Skill Development
3	**Describe** different energy auditing methods and the	Employability

	implementation procedures	
4	**Identify** present scenario of energy utilization, management and corresponding ACT of regulatory commission	Employability
5	**Apply** energy tariff and power factor improvements to achieve energy efficient systems	Employability

Biomedical Instrumentation: 910105

Course Objectives:

- The objective of this course is to introduce student to basic biomedical engineering technology and introduce different biological signals, their acquisition, measurements and related constraints.

S No.	Course Outcome (CO)	Mapping
1	Identify bio systems and medical systems from an engineering perspective	Skill Development
2	Describe the techniques to acquiring and recording the physiological activity of the human body through cell potential	Skill Development
3	Analyze ECG, EEG, EMG signals for abnormality detection	Employability
4	Familiarize with the patient safety issues related to biomedical instrumentation	Employability
5	Describe different ultrasonic scanning & medical imaging systems.	Skill Development

UNIT – I: Bio-Potential Signals and Electrodes

Bio-signals and their characteristics, Organization of cell, Nernst equation of membrane, Resting and Action potentials. Bio-amplifiers, characteristics of medical instruments, problems encountered with measurements from living systems. Bio-potential electrodes – Body surface recording electrodes, Internal electrodes, micro electrodes.Bio-chemical transducers – reference electrode, the pH electrodes, Blood gas electrodes.

UNIT – II:Cardiovascular Instrumentation

Heart and cardiovascular system, Heart electrical activity, blood pressure and heart sounds. Cardiovascular measurements electro cardiography – electrocardiogram, ECG Amplifier, Electrodes and leads, ECG recorder principles. Types of ECG recorders. Principles of blood pressure and blood flow measurement.

UNIT – III:Neurological Instrumentation

Neuronal communication, electro encephalogram (EEG), EEG Measurements EEG electrode-placement system, interpretation of EEG, EEG system Block diagram, preamplifiers and amplifiers. EMG block diagram and Stimulators

UNIT – IV:Equipment for Critical Care

Therapeutic equipment – Pacemaker, Defibrillator, Shortwave diathermy, Hemodialysis machine. Respiratory Instrumentation – Mechanism of respiration, Spirometry, Ventilators.Elements of intensive care, Monitoring, Electrical safety of patients & medical equipment, physiological effects of electric current, shock hazards from equipment. Introduction to Telemedicine.

UNIT – V:Non-invasive Diagnostic Instrumentation

Ultrasonic Waves and Ultrasonic Vibrations , Propagation, Acoustic Intensity, Applications, Super Imposition, Potential Health Hazard, Measurement of Velocity, Ultrasonic Scanning techniques for bone fracture detection, Applications, Comparison between X-rays and ultrasonic scanning, Applications, Ultrasonic Cleaning, Principle of Medical Imaging, computed Radiography, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear Medicine, Single Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET).

Reference Books

1. R. S. Khandpur, Biomedical Instrumentation Technology and Applications, McGraw-Hill Professional, 2004.

2. Leslie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd Edition, PHI, 2003.
3. John G. Webster, Medical Instrumentation: Application and Design, 3rd edition, John Wiley & Sons, New York, 1998.
4. Raja Rao, C, Guha, S.K, Principles of Medical Electronics and Biomedical Instrumentation, Orient Longman Publishers (2000)
5. Raghbir Singh, Biomedical Instrumentation: Technology and Applications, McGraw-Hill Education, 1st ed., 2004.

Industrial Automation: 910106

Course Objective:

- To familiarize the students with the Industrial aspects of automation, planning and model making
- To provide the understanding of the control of a different PLCs and their applications in various low ,medium and high power drives

S No.	Course Outcome (CO)	Mapping
1	**Analyse** architecture of industrial automation system	Skill Development
2	**Select** appropriate sensors	Skill Development
3	**Acquire** PLC knowledge	Employability
4	**Acquire** the knowledge of PID control technique	Employability
5	**Develop** small application using PLC & transducer,	Skill Development
6	**Compare** AC and DC drives for particular applications	Skill Development

Unit I: Introduction: Overview of industry environment, Different type of switches & their operation, Architecture of industrial automation system, Relay and contactor logic, AC and DC relays and their role for load control. Review of starters: Power and Auxiliary contactors and their usage for load control. Overview of standards (BIS, ISO) & star and delta starters and their rating.

Unit II:Sensors: Temperature& speed Measurement, Humidity,Pressure, Force and Torque Sensors, Motion Sensing(speed sensor), proximity sensor, Signal Conditioning, Data Acquisition Systems,Characteristics of Sensors and control logic, control using potential free output sensors, linear potentiometer timer hardware architecture, Controlling industrial system using timers and counters (case study)

Unit III:Industrial Drives: AC & DC Drive basics, Electrical specifications and hardware architecture .AC drive and AC motor specification matching (sizing of drive),Load characteristics and its types, Servo Drives Stepper motor drive and VFD(Variable frequency drives) drives.AC drive power wiring and Interfacing input and output signals. Energy Savings with Variable Speed & multi motor Drives. Braking motoring and regenerative operation of drives Selection of power, motor and signal cables for AC drive application. Heat management of Drives, Drives protection

Unit IV: Programmable Logic Controllers: Programmable controllers, Programmable logic controllers, Analog/Digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, , Advantage of using PLC for Industrial automation, Application of PLC to process control industries.Different types of Network Communication Protocol, DH-485, Ethernet, Device Net, Control Net, Modbus, Profibus Proprietary Protocol, open Protocol.

Unit V: Automatic Control: Introduction to P-I-D Control, manual and auto PID Control Tuning, Feed forward Control Ratio Control, Time Delay Systems and Inverse Response Systems, PWM control in drives.

Recommended Books:

6. Lingefeng Wang, Kay Chen Tan,"Modern Industrial Automation and Software Design" John Wiley & Sons Inc.
7. K. L.S. Sharma, “Overview of Industrial Process Automation”, Elsevier
8. KokKiong“Drives and Control for Industrial Automation”, Springer

9. John Webb**,** "Programmable Logic Controllers Principles & Applications", PHI
10. John G. Webster,"The Measurement, Instrumentation and Sensors Handbook", CRC Press.

Solar PV System: Design& Economics: 910107

Course Objective: To impart the industry-oriented knowledge of solar photovoltaic (PV) systems to the students and develop their understanding for economic &planning of PV plant.

S No.	Course Outcome (CO)	Mapping
1	**Recognize** the principles and the performance characteristics of solar photovoltaic systems.	Skill Development
2	**Derive** the electrical equivalent circuits of solar PV system.	Skill Development
3	**Differentiate** thedifferent types of solar PV based power plants.	Employability
4	**Apply**the knowledge of solar PV technology for finding its impact on associated electrical appliances.	Employability
5	**Apply**the energy & economic analysisfor Solar PV system planning	Skill Development

Unit I: Solar PV technology: Basics& performance parameters

Introduction to solar energy scenario, Solar cell material selection and working, concept of fill factor and I-V Curve, Solarmodules and its types, Series and parallel connections of solar modules,SolarPV array, Solar PV performance parameters as per IEC 61724 standards: array yield, reference yield, final yield, performance ratio, array capture loss, system loss, cell temperature losses, PV module efficiency, system efficiency, inverter efficiency, capacity factor.

Unit II: Solar PV power plant: Components, design& types

Solar PV power plant components & their size selection as per load requirements: DC/ AC cables, junction box, solar converter, charge controller and battery system; concept of MPPT;Single line diagram representation and working of different types of solar plants: Grid connected PVplant, offgridPVplant, Building integrated PV plant and their Comparison; net metering and gross metering.

Unit III: Solar PV power quality and its impact on transformer performance

Power and power quality parameters produced by solar PV plant: measurement, analysis &Instruments used; impact of solar plant on power/ distribution transformer performance: effect on transformer sizing (IEEE C57.91-1995), impact of harmonics on transformer performance (IEEE C57.110-2018), Hot spot temperature & ageing of transformer, impact on OLTC operationand single/ three phase transformer.

Unit IV: Energy metrics of solar PV system

Embodied energy: material production energy, system installation energy, maintenance energy, administration energy; hourly energy production curve, matching of energy production with load curve, energy gap; seasonal variation of energy production & concept of clear days; Energy payback time (EPBT), Electricity production factor (EPF), Life cycle conversion efficiency (LCCE).

Unit V: Economics of solarPVsystems

Basic terminology of economics: capital cost, cost of operation, cost of maintenance & replacement, incremental cost (property)- tax; Concept of benefit, cost &Cash flow diagram; Time value of money, Salvage value;Profit cost analysis, Simple &discounted payback period; Net present value; Internal rate of return (IRR); Unit cost analysis of solar PVplant&Levelized cost of electricity (LCOE).

Recommended Books:

1. Renewal Energy ResourcesbyJohnTwidell and Tony Weir, BSP Publications, 3rd Edition, 2015.
2. Solar Photovoltaics; Fundamentals, Technologies and Applications by C.S. Solanki, PHI Learning, 3rd Revised Edition, 2015.
3. Financial Evaluation of Renewable Energy TechnologiesbyT.C.Kandpal and H.P. Garg, Macmillan publishers India limited, 1stEdition, 2003.
4. Solar Energy: Fundamental, Economic and Energy Analysis by S.K. Rajput, NITRA publication, 1st Edition, 2017.
5. IEEE standards: IEEE C57.110-2018&IEEE C57.91-1995.

Course Objectives:

- To provide the fundamental knowledge of Artificial Intelligence, Neural Network and Machine Learning.
- To present the basic representation and reasoning paradigms used in AI &ML.
- To understand the working of techniques used in AI &ML.

Unit – I: Introducing Artificial Intelligence: Definition, Goals of AI, Task of AI, Computation, Psychology and Cognitive Science. Perception, Understanding, and Action. Artificial intelligence vs machine learning vs deep learning and other related fields. Applications of Artificial intelligence and Machine Learning in the real world.

Unit – II: Problem, Problem Space and Search: Production System, Blind Search: BFS & DFS, Heuristic Search, Hill Climbing, Best First Search
Introduction to Neural Networks: History, Biological Neuron, Artificial Neural Network, Neural Network Architectures, Classification, & Clustering

Unit – III: Introduction to Machine Learning: Traditional Programming vs Machine learning. Key Elements of Machine Learning: Representation, process (Data Collection, Data Preparation, Model selection, Model Training, Model Evaluation and Prediction), Evaluation and Optimization. Typesof Learning: Supervised, Unsupervised and reinforcement learning. Regression vs classification problems.

Unit – IV: Supervised Machine Learning: Linear regression: implementation, applications & performance parameters. Decision tree classifier, terminology, classification vs regression trees, tree creation with Gini index and information gain, IDE3 algorithms, applications and performance parameters. Random forest classifier. Case study on regression and classification for solving real world problems.

Unit –V: Unsupervised Machine Learning: Introduction, types: Partitioning, density based, DBSCAN, distribution model-based, hierarchical, Agglomerative and Divisive, Common Distance measures, K-means clustering algorithm. Case study on clustering for solving real world problems.

RECOMMENDED BOOKS:

1. Artificial Intelligence: A Modern Approach by Stuart J. Russell and Peter Norvig, PrenticeHall.
2. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-GrawHill.
3. Introduction to AI & Expert System: Dan W. Patterson,PHI.
4. Pattern Recognition and Machine Learning, Christopher M.Bishop
5. Introduction to Machine Learning using Python: Sarah Guido
6. Machine Learning in Action: Peter Harrington

S No.	Course Outcome (CO)	Mapping
1	Define basic concepts of Artificial Intelligence & Machine Learning.	Skill Development
2	Illustrate various techniques for search and processing.	Skill Development
3	Identify various types of machine learning problems and techniques.	Skill Development
4	Analysis various techniques in Artificial Intelligence, ANN& Machine Learning.	Skill Development
5	Apply AI and ML techniques to solve real world problems.	Skill Development
6	Build AI enabled intelligent systems for solving real world problems.	Skill Development