EE301U – AC MACHINES

Teaching Scheme: 03L + 00T, Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

The course explores on understanding of construction, basic principles underlying the operation of electrical machines, performance and characteristics of three phase and single phase ac machines. This course also covers the applications of ac machines.

DESIRABLE AWARENESS/SKILLS:

Knowledge of basic electrical engineering and basics of dc machines

COURSE OBJECTIVES:

The objectives of the course are to:
1. know the fundamentals and working principles of ac machines.
2. understand characteristics of ac machines.
3. analyze ac machines.
4. understand various speed control methods

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:
1. describe the construction and working of synchronous machines.
2. analyze the performance of synchronous machines under different operating conditions.
3. apply starting and speed control methods of three phase IM
4. select suitable fractional watt motors for industrial applications
5. illustrate the use of special motors

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of correlation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2									3		
2					3									2	
3					2									2	
4						2								2	
5						2								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Synchronous Generator: Construction, types, winding factors, emf equation, armature reaction, phasor diagrams, load characteristics, voltage regulation by synchronous impedance method, MMF method, Zero Power Factor method, two reaction theory, slip test. Parallel operation of synchronous generators, methods of synchronization, synchronization power, synchronizing torque, operation of synchronous generator on infinite bus bar, effect of load on synchronization power, effect of unequal voltage, effect of change in excitation and steam supply, Short Circuit Ratio and its importance, power angle characteristics, efficiency and losses, applications.

Synchronous Motor: Principle of operation, phasor diagrams, methods of starting, operation at constant power and fixed excitation, equivalent circuit, power and torque developed in cylindrical rotor and salient pole rotor, effect of change in load and effect of change in excitation, V and inverted V-curves, hunting and methods of suppression, synchronous condenser.

Three Phase Induction Motor: Rotating magnetic field, principle of operation, torque equation, torque-slip characteristics, losses and efficiency, phasor diagram and equivalent circuit, no load test, blocked rotor test, circle diagram, speed control, starting and their types. Double Cage Induction Motor-construction, working principle and torque-slip characteristics. Induction Generator-principle of working and equivalent circuit.

Fractional Kilowatt Motors: Single phase induction motors, double field revolving theory, equivalent circuit, torque-slip characteristics, starting methods and types. Universal motor-principle of working and applications.

Special Machines: constructional details and working of single phase synchronous motors, reluctance motors, brushless DC motors, stepper motors, permanent magnet DC motors

Text Books:

1. Electrical Machines, Nagrath and Kothari, 4th Edtion,Tata McGraw Hill, 2010
2. Electrical Machines by S. K. Bhattacharya, 3rd edition, McGraw Hill, 2009
3. Electrical Machines by A. Chakrabarti and S. Debnath, McGraw Hill, 2015

Reference Books:

1. Performance and Design of A.C. Machines M.G. Say, 6th Edition, ELBS, 2006
2. Theory and performance of Electrical Machines, J. B. Gupta and S. K. Kataria Publications, 2003
3. Electrical Machines, Samarjit Ghosh Pearson Publication, 2001
4. Electrical Machinary and Transformer, Bhag S. Guru and Huseyin R. Hiziroglu, 3rd edition, Oxford University Press, 2006
5. Special Electrical Machines, E G Janardanan, Prentice Hall of India, 2011

EE302U - MICROCONTROLLER AND ITS APPLICATIONS

Teaching Scheme: 03L + 00T, Total: 03 **Credits:** 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

The course explores knowledge of microcontroller and its applications. The course comprises of architecture of microcontroller, assembly language programming and interfacing of peripherals and their applications.

DESIRABLE AWARENESS/SKILLS:

Knowledge of digital electronics and microprocessor fundamentals

COURSE OBJECTIVES:

The objectives of the course are to:

1. know the pin configuration of a typical microcontroller
2. understand memory organization of microcontroller
3. compile and debug the program
4. interfacing various peripherals for different industrial applications

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. describe architecture and basic concepts of 8051 Microcontroller
2. write assembly language programs using arithmetic and logical instructions
3. configure various sensors and peripherals with 8051.
4. use compiler and debugger

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				1									1		
2					2									2	
3						3							1		
4						2								2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Contents

Introduction to Microcontroller: Evolution of microcontrollers. Comparison of different microcontrollers such as Intel 8051/PIC/At mega 16 etc, internal block diagram of 8051, CPU, ALU, address bus, data bus, control signals, working registers, SFRs, clock and reset circuits, stack and use of stack pointer, program counter. I/O ports, memory structure, data memory, program memory, memory expansion techniques, different addressing modes

Microcontroller Programming Interfacing, instruction set. Illustrative applications and programming techniques, tutorial programs should include programming using: arithmetic instructions, jump, loop and call instructions, I/O programming, logical instructions, single bit instructions, timer/counter programming, UART programming, Programming interrupts, priority, interrupt handling, power off and power on-reset situations, self check and recoveries.

Peripherals and Interfacing: Digital input and output pin of PWM, ADC, I/O pins, timers, counters, interrupts, I2C, SPI, flash programming. Interfacing A to D, D to A, LCD/ LED and keyboard interfacing, I/O expansion techniques, etc. Stepper motor interfacing, dc motor interfacing, interfacing of sensors, relays. CAN protocol and its interfacing, RS232, USB protocol and its interfacing, blue-tooth, zig-bee protocol and its interfacing.

Integrated Development Environment (IDE) for Microcontrollers: 8051/ 89C51/XX micro controllers. Study of datasheets, programming using assembly language and Cross "C" compiler, programming tools such as simulator, assembler, cross "C" compiler, emulator and debugger.

Text Books:

1. PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18 by Muhammad Ali Mazidi, Rolind D. Mckinlay, Danny Causey, Pearson Education
2. Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC by Ramesh Gaonkar,Thomson and Delmar learning, 1st Edition
3. Embedded Systems Architecture, Programming and Design by Raj Kamal, TATA McGraw Hill
4. Programming And Customizing the PIC Microcontroller by Myke Predko, TATA McGraw Hill

PIC microcontroller: An introduction to software and Hardware interfacing by Han-WayHuang, Thomson Delmar Learning

Reference Books:

1. Programming and Customizing the 8051 microcontroller by Myke Predko, TMH, 1st edition
2. Embedded System by Raj Kamal, TMH, 3rd edition
3. MICROCHIP Technical Reference Manual of 18F4520 Embedded Design with PIC 18F452 Microcontroller by John.B.Peatman, Prentice Hall

EE303U - POWER SYSTEM II

Teaching Scheme: 03L + 01T, Total: 04 **Credits:** 04

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks:** 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course imparts knowledge about power system analysis. This course provides the knowledge of power flow through transmission lines, symmetrical faults and unsymmetrical faults and load flow study.

DESIRABLE AWARENESS/SKILLS:

Knowledge of power system, power plant, generation, transmission and distribution

COURSE OBJECTIVES:

The objectives of this course are to:

1. analyze sending end voltage, receiving end voltage, transmission efficiency and regulation of transmission line.
3. develop and solve the positive, negative and zero sequence networks for a given system.
4. recognise the common causes of faults in the power system.
5. formulate the power flow problems using load flow methods

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. analyse the performance of long transmission line
2. construct the sequence networks for fault analysis
3. analyse power system under symmetrical and unsymmetrical faults
4. apply Gauss-Seidal and Newton-Rapson method for power flow analysis
5. differentiate the feeders in ac distribution

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1			2											2	
2				3										2	
3					3									2	
4					2									3	
5						1								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Characteristics of Transmission Line: Surge impedance loading and its derivation, characteristics and performance of short, medium and long transmission line, power flow through transmission line, voltage regulators, synchronous phase modifiers or compensators.

Representation of Power System Components: Representation of synchronous machines and power transformers, transmission lines, motors, one line diagram, impedance and reactance diagrams of a power system, per unit system.

Symmetrical Fault and Unsymmetrical Analysis: Transients on transmission line, short circuit current and reactance of synchronous machine on no load and loaded condition, bus impedance matrix in fault calculations, algorithm for short circuit studies. Synthesis of unsymmetrical phasors from their symmetrical components, symmetrical components of unsymmetrical phasors, power in terms of symmetrical components, positive, negative and zero sequence representation of electrical components. Single line to ground fault (LG), line to line fault (LL), double line to ground fault (LLG) on an unloaded generator. Single line to ground fault (LG), line to line fault (LL), double line to ground fault (LLG) on a power system, faults through impedance.

Load Flow Study: Introduction, bus classifications, network equations: graph theory and its applications for formation of primitive networks, Y matrices, incidence matrices, Y-bus matrices, development of load flow equations, load flow solution using Gauss - Seidel and Newton- Raphson method, approximation to Newton- Raphson method.

AC distribution Systems: primary distribution systems: radial feeders, parallel feeders, loop feeders, secondary distribution systems: 3-phase, 4-wire distribution, 1-phase, 2-wire distribution, AC distribution with concentrated loads, AC interconnected systems, 3-phase-4-wire-star-connected unbalanced load circuits, consequences of disconnecting neutral in a 3-phase, 4-wire system.

Text Books:

1. Elements of Power System Analysis by William Stevenson, TMH, 6th edition, 2006
2. Modern Power System Analysis by J. Nagrath and D. P. Kothari, TMH, 3rd edition, reprint 2010
3. Power System Analysis by Hadi Saadat, McGraw Hill, 2003

Reference Books:

1. A course in Electrical Power by J. B. Gupta, S. K. Kataria and Sons, 1st edition, 2009
2. Electrical power by Soni, Gupta, Bhatnagar, Dhanpat Rai, 4th, 1997

Professional Elective - I

EE304U A – WIND AND SOLAR POWER TECHNOLOGIES

Teaching Scheme: 03L + 00T, Total: 03 **Credits**: 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks**: 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains a brief introduction to wind and solar power generation. Also, it includes practical approach such as design of solar and wind power plant for various applications.

DESIRABLE AWARENESS/SKILLS:

Knowledge of solar cells, asynchronous machines, transmission and distribution, grid systems

COURSE OBJECTIVES:

The objectives of the course are to:

1. understand the limitations of conventional energy resources
2. know about distributed generation.
3. understand the interconnection of wind and solar generation.
4. study and make aware about photovoltaic power systems.

COURSE OUTCOMES:

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

1. know the basic concepts of wind plants
2. select various wind turbines to various applications and power quality issues related to power generation
3. connect wind farm to grid system
4. analyze the basic requirement of solar power generation
5. design rooftop solar power systems

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1			1										3		
2			2										2		
3				2									2		
4					2									2	
5					3									2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Physics of Wind Power: History of wind power, Indian and Global statistics, wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power - cumulative distribution functions.

Wind Generator Topologies: Fixed and Variable speed wind turbines, power electronics converters, wind generator topologies, voltage and reactive power control, power quality standards for wind turbines, review of modern wind turbine technologies.

Network Integration Issues: Overview of grid code technical requirements for wind farms - real and reactive power regulation, voltage and frequency operating limits, wind farm behavior during grid disturbances, power system interconnection experience in the world, economic aspects, hybrid and isolated operations of wind farms.

Solar Energy: Introduction, solar radiation spectra, solar geometry, earth Sun angles, observer Sun angles, solar day length, estimation of solar energy availability.

Solar Photovoltaic: Technologies-Amorphous, mono-crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, series and parallel connection, blocking and bypass diode, Maximum Power Point Tracking (MPPT) algorithms. Solar Thermal Power Generation: Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis, design and develop a solar rooftop system.

Text Books:

1. Wind Power in Power Systems by Thomas Ackermann, John Willy and Sons ltd., 2005, ISBN 0-470-85508-8, 1st edition, 2005
2. Renewable and Efficient Electric Power Systems by Gilbert M. Masters, John Willy and Sons, 2004, ISBN0-471-28060-7, 2004
3. Solar Energy by S.P. Sukhatme, Tata McGrew Hill, 2nd edition, 1996, ISBN 0-07-462453-9

Reference Books:

1. Grid integration of wind energy conversion systems by Siegfried Heier, John Willy Ltd., 2006
2. Renewable Energy Applications by Mullic and G. N. Tiwari, Pearson Publications
3. Solar Engineering of Thermal Processes by John A. Duffie, William A. Beckman, Wiley Inter science Publication, 1991
5. Solar Photovoltaic: Fundamentals, Technology and Application, C. S. Solanki, PHI Learning, 2010.

Professional Elective - I

EE304U B – DIGITAL SIGNAL PROCESSING

Teaching Scheme: 03L + 00T, Total: 03 **Credits**: 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks**: 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course digital signal processing makes the students aware about discrete signals. The course explores on understanding discrete data systems and its analysis using Z-transform, Fourier Transform and sample data systems. Further, DSP Processors like TMS are introduced.

DESIRABLE AWARENESS/SKILLS:

Knowledge of digital electronics, control system and microprocessor

COURSE OBJECTIVES:

The objectives of the course are to:

1. introduce the basic concepts and techniques for processing signals on a computer.
2. be familiar with the most important methods in DSP including digital filter design
3. write the assembly language in DSP kit
4. apply DSP to various electrical fields

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:

1. apply Fourier Transforms to various discrete-time signals
2. sample signals in frequency domain
3. model the discrete time signals by Z-transform
4. write the assembly code and model discrete time signals by Fourier-transform
5. apply knowledge of DSP to various electrical fields

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		2											1		
2			2										1		
3				2										2	
4					2									1	
						3								2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Discrete-Time Signals and Systems: Discrete time signals, sequences, time domain and frequency domain representation of discrete time signals, linear time invariant systems, properties of LTI systems. Representation of sequences by Fourier transforms, linear constant, coefficient of different equations.

Sampled data systems and sampling of continuous-time signals: Sampled data systems, multiplexers, sample and hold circuit, DAC and ADC, sampling of continuous signals, periodic sampling, frequency domain representation of sampling, reconstruction of samples. Discrete time processing of continuous time signals, continuous time processing of discrete time signals

Z-transform and realization of discrete-time systems: Z Transform, definition, convergence. Properties of Z Transform, inverse Z Transform. System function for discrete time systems characterized by linear constant, coefficient differential equations. Recursive and non recursive structure, block diagram and signal flow graph representation of discrete time systems. Basic structure for FIR and IIR systems.

Discrete Fourier Transform and the Fast Fourier Transform: Derivation of DFT from DTFT, inverse DFT, convolution using DFT. Computational complexity of the DFT, decimation in time FFT algorithm, decimation in-frequency FFT algorithm, comparison of DIT and DIF algorithms. Digital Signal Processors: DSP architecture: Harvard architecture, pipelining, hardware multiplier, accumulator, special instructions, On-Chip memory, parallelism. General purpose DSP: fixed point and floating point arithmetic. Comparison of some common digital processor. Architecture of TMS320 DSP: fixed point and floating point precision, instruction set/assembly code, algorithm design, mathematical, structure and numerical constraints.

DSP Programming and Applications of DSP: TMS320 assembly language programming and C Language Programming. Application of DSP in power systems: measurement of electrical quantities, power system protection, state estimation etc. Application of DSP for data compression, array processing and in control system.

Text Books:

1. DSP: Principles, Algorithms and Application by Proakis and Manolakis, PHI, 3rd edition, 2000
2. Digital Signal Processing by E. C. Ifeacher and B. W. Jervis, Adison,Wesley, 1993
3. Introduction to Digital Signal Processing by Johnny Johnson, PHI, 1th edition, 1989

Reference Books:

1. Digital Signal Processing by H. Hayes by Schaum's, McGraw-Hill, 1999
2. Small DSP laboratory using MATLAB S. K. Mitra, McGraw-Hill, 1999
3. Digital Signal Processing by A. V. Oppenheim and R. W. Schafer, PHI, 1st edition 1975

Professional Elective - I

EE304U C - POWER QUALITY

Teaching Scheme: 03L + 00T, Total: 03 **Credits**: 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks**: 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course provides information about the power quality in electrical field and different terms related to it. This course also provides the information about various techniques to mitigate the poor power quality.

DESIRABLE AWARENESS/SKILLS:

Knowledge of power system, electrical machines and their operating characteristics

COURSE OBJECTIVES:

The objectives of the course are to:

1. develop ability to identify various power quality issues
2. understand relevant IEEE standards
3. illustrate various PQ monitoring techniques and instruments
4. learn and characterize various PQ problems
5. identify different mitigation techniques

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. characterize power quality events.
2. reproduce causes of voltage sag and estimate magnitude of voltage sag.
3. analyse the causes of transients occurring in power system
4. calculate harmonics in pure sign wave
5. design the circuits for harmonic reduction

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1			2										2		
2			3											1	
3				3										2	
4					3									2	
5						2								3	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Contents

Basics of Power Quality and Standards: Introduction and importance of Power Quality, symptoms of poor power quality. Various power quality issues such as transients, short duration voltage variations, long duration voltage variations, voltage imbalance, voltage fluctuations, voltage flicker and waveform distortion. Relevant power quality standards such as IEEE 1159- 2009 and IEEE 519- 2014. Grounding and power quality issues.

Voltage Sag: Origin of voltage sags and interruptions, voltage sag characteristics- magnitude, duration, phase angle jump, point on wave initiation and recovery, missing voltage. Area of vulnerability, equipment behavior under voltage sag, ITIC curve, voltage sag monitoring and mitigation techniques.

Transient Over-Voltages and Flickers: Classification of transients, sources of transient over voltages, computer tools for transient analysis, techniques for over voltage protection. Voltage flickers – sources of flickers, quantifying flickers and mitigation techniques.

Fundamentals of Harmonics: Harmonic distortion – voltage and current distortion, power system quantities under non sinusoidal condition – active, reactive and apparent power, power factor – displacement and true power factor, harmonic phase sequences and triple harmonics, harmonic indices, sources of harmonics, effect of harmonic distortion

Measuring and Control of Harmonics: Concept of point of common coupling and harmonic evaluation, principles of controlling harmonics, Harmonic study procedures and computer tools for harmonic analysis, Devices for controlling harmonic distortion design of filters for harmonic reduction. Measuring and solving power quality problems. Introduction, power quality measurement devices – harmonic analyzer, transient disturbance analyzer, oscilloscopes, data loggers and chart recorders, true rms meters, power quality measurements, number of test location, test duration, instrument setup and guidelines.

Text Books:

1. Power System Quality Assessment by J. Arrillaga, M. R. Watson, S. Chan, John Wiley and Sons
2. Understanding Power Quality Problems, Voltage Sag and Interruptions by M. H. J. Bollen, New York: IEEE Press, 2000, Series on Power Engineering.
3. Electrical Power System Quality by R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, 2nd Edition, McGraw Hill Publication.

Reference Books:

1. Power System Harmonics: Computer Modeling and Analysis by Enriques Acha, Manuel Madrigal, John Wiley and Sons Ltd.
2. Power Quality in Power Systems and Electrical Machines by Ewald F. Fuchs, Mohammad A. S. Masoum, Elsevier Publication
3. Electric Power Quality by G. J. Heydt, Stars in Circle Publications

Open Elective - I

EE305U A - RENEWABLE ENERGY TECHNOLOGIES

Teaching Scheme: 03L + 00T, Total: 03 **Credits**: 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks**: 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course explores about the new techniques for electrical power generation. This course explore about the different energy sources, its storage, transportation, distribution and supply of secondary forms of energy.

DESIRABLE AWARENESS/SKILLS:

Knowledge of power generation and grid system, PV cells

COURSE OBJECTIVES:

The objectives of the course are to:

1. understand problems and limitations of fossil fuels for electrical power generation.
2. know the various renewable energy sources, their conversion technology and application.
3. know gap between energy demand and energy generation.
4. learn opportunities in field of energy conversion.
5. create awareness about renewable energy sources.

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. explain the concept solar energy and choose solar collectors for different use
2. differentiate solar panels for various applications
3. identify geothermal energy resources
4. analyze the wind energy generation and its connection to grid system
5. use the biomass energy processes from different wastes

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1					2									2	
2						2								2	
3						2								2	
4							2							2	
5							3								3

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Contents

Solar Energy: Introduction to energy technology and energy sciences, energy and environment, laws of conservation of energy. essential subsystem in solar energy plant, phenomena of light and energy, energy from sun, power density for various wavelength of sun light, clarity index , angle of latitude and solar insolation at different geographical locations, Solar thermal collectors and its types.

Solar Photovoltaic: Introduction to solar photovoltaic system, merit and limitations, economic consideration of solar PV system, principal and characteristics of solar cell, efficiency of solar cell, configuration of solar PV panel, solar PV cell technology and small solar PV system for residence and rural areas.

Geothermal Energy: Introduction to geothermal energy, geothermal energy resources, origin of geothermal resources, geothermal gradient, hydro geothermal resources, geo-pressure geothermal resources, geothermal fluid for electric power plant and classification and type of geothermal power plant.

Wind Energy: Introduction to wind energy, nature of wind energy conversion system, wind power density, forces on the blades of a propeller, wind turbine efficiency, wind velocity, characteristics, type of wind turbine – generator unit, planning of wind farm and grid connection.

Biomass Energy: Introduction to biomass energy resources, biomass conversion process, direct combustion of biomass, gaseous fuels from biomass. Introduction to urban solid waste-to-energy by incineration process, generating plant, its location, wood and wood waste as primary energy sources and cogeneration plant.

Text books:

1. Wind Power in Power Systems by Thomas Ackermann, John Willy and sons Ltd., 2005
2. Renewable and Efficient Electric Power Systems by Gilbert M. Masters, John Willy and sons, 2004
3. Solar Energy by S.P. Sukhatme, Tata McGrew Hill, 2nd edition, 1996

Reference Books:

1. Grid integration of wind energy conversion systems by Siegfried Heier, John Willy Ltd, 2006
2. Renewable Energy Applications by Mullic and G. N. Tiwari, Pearson Publications, 1st edition, 2007
3. Energy Technology by S. Rao and B. B. Parulekar, Khanna Publishers, 3rd edition, 2009
Solar Engineering of Thermal Processes by John A. Duffie, William A. Beckman, Wiley Inter science Publication, 2nd edition, 1991
4. Understanding Clean Energy and fuel From Biomass by Dr. H. S. Mukunda, Wiley India, 1st edition, 2011

Open Elective - I

EE305U B – WIND AND SOLAR POWER SYSTEMS

Teaching Scheme: 03L + 00T, Total: 03 **Credits**: 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks**: 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course contains a brief introduction to wind and solar power generation. Also, it includes practical approach such as design of solar and wind power plant for various applications.

DESIRABLE AWARENESS/SKILLS:

Knowledge of renewable energy sources, power generation, transmission and distribution

COURSE OBJECTIVES:

The objectives of the course are to:

1. appreciate problems and limitations of fossil fuels for electrical power generation.
2. know about distributed generation.
3. understand the interconnection of wind and solar generation.
4. study and make aware about photovoltaic power systems.
5. create awareness about wind energy sources.

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. explain the importance of energy crises and non-conventional energy sources.
2. estimate solar radiation at a given location.
3. select components for stand-alone and grid tied solar PV system.
4. use appropriate solar thermal technology for specific applications.
5. explain the operation of various components used in isolated and grid-tied wind farms.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1					2								2		
2					2									3	
3						3								2	
4						2								2	
5							3							2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Basics of Energy: Energy and power, estimation of energy bill, conventional energy sources, environmental impact of fossil fuels, non-conventional energy sources, global energy scenario and energy scenario of India, current energy situation.

Solar Radiation: Solar spectrum, radiation on Earth surface, global, direct and diffuse solar radiation, solar radiation at a given location, daily radiation pattern, annual variation in solar radiation, optimal tilt.

Solar Photovoltaic Technologies: Advantages and limitations of solar PV technologies. Types of solar PV modules, rating of module and actual power from a module, protection of solar cells. Solar PV system components: rating and cost of solar PV module, charge controller, battery, inverter, Maximum Power Point Tracking. Stand alone and grid tied solar PV system. Solar PV water pumping system.

Solar Thermal Technologies: Absorption and radiation, heat gain and loss. Solar cooking systems – box type, dish type, heat transfer type solar cooker. Solar distillation system – components and specifications, solar water heating systems – types and operation of solar water heaters.

Wind Energy: Wind flow – motion of wind, vertical wind speed variation, distribution of wind speeds, wind turbine, efficiency of wind power conversion. Wind Generator Topologies: Fixed and Variable speed wind turbines, power electronic converters, wind generator topologies, technical requirements for wind farms, real and reactive power regulation, voltage and frequency operating limits, hybrid and isolated operations of wind farms.

Text Books:

1. Renewable Energy Technologies: A Practical Guide for Beginners, C. S. Solanki, PHI Learning Pvt. Ltd., 2009
2. Solar Energy by S. P. Sukhatme, Tata McGrew Hill, 2nd edition, 1996, ISBN 0-07-462453-9

Reference Books:

1. Grid integration of wind energy conversion systems by Siegfried Heier, John Willy Ltd., 2006
2. Renewable Energy Applications by Mullic and G. N. Tiwari, Pearson Publications
3. Solar Engineering of Thermal Processes by John A. Duffie, William A. Beckman, Wiley Inter science Publication, 1991
5. Solar Photovoltaic: Fundamentals, Technology and Application, C. S. Solanki, PHI Learning, 2010

EE306U – AC MACHINES LAB

Teaching Scheme: 02 Pr; Total: 02 **Credits**: 01
Evaluation Scheme: 25 ICA + 25 ESE **Total marks**: 50
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course of AC Machines explores understanding, construction, basic principles underlying the operation of ac machines. Performance, characteristic, voltage regulation of synchronous alternator, its parallel operation and characteristic of synchronous motor. It also gives the platform to understand construction, working, performance and application of three phase and single phase motors.

DESIRABLE AWARENESS/SKILLS:

Knowledge of basic electrical engineering and its concepts

COURSE OBJECTIVES:

The objective of the course are to:

1. understand construction, concepts, principles of operation and application of ac machines.
2. know the behavior of AC motors and analyze data to determine characteristics of machines by performing practical.
3. perform duties in industry, operation and maintenance with the sense of safety precautions
4. apply knowledge for technological subjects such as utilization of electrical energy, switchgear and machine design for economical and sustainable developments

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. understand the construction, concepts, principles of operation and application of ac machines.
2. know the behavior of AC motors and analyze data to determine characteristics of machines by performing practical.
3. perform duties in industry, operation and maintenance with the sense of safety precautions.
4. apply knowledge for technological subjects such as utilization of electrical energy, switch gear and machine design for economical and sustainable developments.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				3									2		
2					3								2		
3					2									2	
4						2								2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work should consist of experiments based on theory syllabus of EE301U. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of Experiments:

1. Determination of voltage regulation and efficiency of three phase alternator by direct load test.
2. Open and short circuit test on three phase alternator: determination of its regulation by EMF method and MMF method
3. Zero power factor test on three phase alternator: determination of regulation by Potier triangle method.
4. Determination of direct axis and quadrature axis reactance by slip test on synchronous machine
5. Synchronizing alternators: lamp methods and use of synchroscope
6. Synchronous alternator on infinite bus, behavior of machine under change in mechanical power and excitation
7. Characteristic of synchronous motor at constant load and variable excitation
8. Characteristic of synchronous motor at constant excitation and variable load
9. Determination of performance of three phase induction motor by direct load test
10. Determination of performance of three phase induction motor by no load, blocked rotor test and construction of circle diagram
11. No load and blocked rotor tests on capacitor start single phase induction motor and determination of parameters of equivalent circuit
12. Load test on single phase induction motor
13. Speed control of three phase Slip Ring Induction Motor

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical's performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guide lines for ESE: The End Semester Examination (ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE307 U - MICROCONTROLLERS AND ITS APPLICATIONS LAB

Teaching Scheme: 02P; Total 02 **Credits**: 01
Examination Scheme: 25 ICA + 25 ESE **Total Marks**: 50
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

The course explores knowledge of microcontroller and applications. The course comprises of architecture of microcontroller, assemble language programming and interfacing of peripherals and their applications. To meet the challenges of growing technology, student will be conversant with the programmable aspect of microcontroller. The objective of course is to understand microcontroller principles, concept and develop skill in both hardware and programming.

DESIRABLE AWARENESS/SKILLS:

Knowledge of digital electronics and microprocessor fundamentals

COURSE OBJECTIVES:

The objectives of the course are to:

1. know the pin configuration of a typical microcontroller
2. understand memory organization of microcontroller
3. develop assemble language programming skills
4. design any given system with automation

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:

1. outline architecture and basic concepts of 8051 microcontroller
2. draw flowchart and write ALP for archithmetic and logical operation using 8051
3. justify importance and relevance of interrupt and memory system
4. analyse the timing diagram and its sequence for different instruction
5. compare microprocessor and microcontrollers

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1					2									2	
2					3									2	
3					3									2	
4						2								2	
5							2							3	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work should consist of experiments based on theory syllabus of EE302U. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of Experiments:

1-4 Programs of 8051 based on its Instruction set.
5. Interrupts of 8051 suitable Simulator
6. Relay control using 8051
7. Timer of 8051
8. SFR application
9. Stepper motor control using 8051/xx
10. I/O operations of 8051
11. ADC Interfacing and Programming with 8051
12. DAC Interfacing and Programming with 8051
13. Interfacing with LCD/ LED display
14. Applications of 8051

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guide lines for ESE: The End Semester Examination (ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE308 U - POWER SYSTEM - II LAB

Teaching Scheme: 02P; Total: 02 **Credits:** 01

Evaluation Scheme: 25 ICA + 25 ESE **Total marks:** 50

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course imparts knowledge about power system analysis. This course also provides information of line parameters, performance of transmission line parameters. Course also provides knowledge of symmetrical faults and unsymmetrical faults and load flow Desirable awareness/skills: Knowledge of basic electrical and electronics engineering and their concepts.

COURSE OBJECTIVES:

The objectives of course are to:

1. understand the factors to be consider in site selection for different power plants in view of social, environmental and safety.
2. understand hydrology, load factor, load duration curves
3. familiarize with different transmission systems and their components.
4. write programs for load flow and simulate the circuits

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:

1. understand the factors to be consider in site selection for different power plants in view of social, environmental and safety.
2. understand hydrology, load factor, load duration curves
3. familiarize with different transmission systems and their components.
4. write the program for load flow and simulate the circuits using any relevant software

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1					2								2		
2					2									2	
3					3									3	
4						3								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work consists of experiments based on theory syllabus of EE303U. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of Experiments:

1. Study of the effect of VAR compensation on the profile of receiving end voltage using capacitor bank.
2. Static measurement of sub-transient reactance of a salient-pole alternator.
3. Measurement of sequence reactance of a synchronous machine.
4. Unsymmetrical fault analysis for LL, LG, LLG FAULT ON AC / DC network analyzer
5. Solution of a load flow problem using Gauss-Seidal method using software
6. Solution of a load flow problem using Newton-Raphson method using software
7. Unsymmetrical fault analysis of a 3-bus system using software
8. Calculation of inductance and capacitance for symmetrical and unsymmetrical configuration of transmission line using software
9. Determination of steady state power limit of a transmission line
10. To convert unsymmetrical components into symmetrical components using software
11. Formulation and calculation of Y-bus matrix of a system using software
12. Visit to any substation

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practicals and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practicals performed by student. The performance shall be assessed experiment wise using internal continuous assessment format.

Guide lines for ESE: The End Semester Examination (ESE) for the laboratory course of three hours duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

Professional Elective – I Lab

EE309U A – WIND AND SOLAR POWER TECHNOLOGIES LAB

Teaching Scheme: 02 P; Total: 02 **Credits:** 01

Evaluation Scheme: 50 ICA + 00 ESE **Total marks:** 50

Duration of ESE: 00 Hrs

COURSE DESCRIPTION:

This course contains a practical knowledge about the wind and solar power generation by doing practicals in laboratory and/or visit to actual site. Also, it includes approach to design of solar and wind power plant for various applications.

DESIRABLE AWARENESS/SKILLS:

Knowledge of renewable energy sources, power generation, transmission and distribution

COURSE OBJECTIVES:

The objectives of the course are to:

1. appreciate problems and limitations of fossil fuels for electrical power generation.
2. know about distributed generation.
3. understand the interconnection of wind and solar generation.
4. study and make aware about photovoltaic power systems.
5. create awareness about wind energy sources.

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:

1. understand the importance of energy crises.
2. understand the growth of the power generation from the renewable energy sources.
3. learn the physics of wind power generation and all associated issues.
4. understand the physics of solar power generation and the associated issues.
5. solve the problems of energy crises using wind and solar power technologies.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						2								3	
2						2								3	
3						2								2	
4						3								2	
5							3							1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work should consist of experiments based on theory syllabus of EE304U A. Experiments should involve simulation/performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of Experiments:

1. To demonstrate the I-V and P-V characteristics of PV module with varying radiations and temperature levels
2. To demonstrate the I-V and P-V characteristics of series and parallel combination of PV module
3. To show the effect of variations in the tilt angle of PV module
4. To demonstrate the effect of shading on module output power
5. To demonstrate the working of diode as bypass diode and blocking diode
6. Workout power flow calculation of standalone PV system with DC load and battery
7. Visit to Solar Power plant
8. Visit to Wind Power Plant
9. Case study of any Solar Power plant
10. Case study of any Wind Power Plant
11. Design Solar Power Plant for any institute/sector/mall/apartment/rooftop building

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practicals and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practicals performed by student. The performance shall be assessed experiment wise using internal continuous assessment format.

Professional Elective – I Lab

EE309U B – DIGITAL SIGNAL PROCESSING LAB

Teaching Scheme: 02 P; Total: 02 **Credits:** 01

Evaluation Scheme: 50 ICA + 00 ESE **Total marks:** 50

Duration of ESE: 00 Hrs

COURSE DESCRIPTION:

The laboratory course of digital signal processing make the students aware about performing experiments on discrete signals. The experiments are to be performed on any (eg. TMS) processor or using simulation. It explores on understanding discrete data systems and its analysis using Z-transform, Fourier transform, and sample data systems.

COURSE OBJECTIVES:

The objectives of course are to:

1. know discrete-time signals analytically and visualize them in the time domain.
2. learn the meaning and implications of the properties of systems and signals.
3. learn the Transform domain and its significance and problems related to computational complexity
4. suggest a particular filter for specific application
5. design any digital filters using MATLAB

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:

1. perform experiment to represent discrete-time signals analytically and visualize them in the time domain.
2. understand the meaning and implications of the properties of systems and signals.
3. understand the Transform domain and its significance and problems related to computational complexity.
4. specify and design any digital filters using MATLAB

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1					2								1		
2					3									2	
3					2									2	
4						2								3	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work should consist of experiments based on theory syllabus of EE304U B. Experiments should involve simulation/performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of Experiments:

1. To study the shifting and folding of digital signal
2. To study the linear convolution
3. To study the discrete Fourier transforms
4. To study the fast Fourier transforms
5. To study the design and implement FIR filter using windowing method
6. To study the design and implement IIR filter using butterworth approximation
7. To study the design and implement IIR filter using Chebeshev approximation
8. To study the sine/square wave generation using TMS320C67XX
9. To study the FIR filter implementation using TMS320C67XX
10. To study the IIR filter implementation using TMS320C67XX
11. To study the filtering using discrete wavelet transforms

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practicals and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Professional Elective – I Lab

EE309U C - POWER QUALITY LAB

Teaching Scheme: 02 P; Total: 02 **Credit:** 01
Evaluation Scheme: 50 ICA + 00 ESE **Total Marks:** 50
Duration of ESE: 00 Hrs

COURSE DESCRIPTION:

This course imparts about the aspects power quality in distribution system and various indices to estimate power quality. To get familiarize with the power conditioning standards, this course in introduced.

COURSE OBJECTIVES:

The objectives of the course are to:

1. develop ability to identify various power quality issues
2. understand relevant IEEE standards
3. illustrate various PQ monitoring techniques and instruments
4. learn and characterize various PQ problems
5. identify different mitigation techniques

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. characterize power quality events
2. reproduce causes of voltage sag and estimate magnitude of voltage sag
3. carry out harmonic analysis and calculate total harmonic distortion
4. calculate parameters for passive harmonic filter.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						3							2		
2						3								3	
3						2									2
4							2								1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work should consist of experiments based on theory syllabus of EE304U C. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of Experiments:

1. Study of power quality monitor / analyzer
2. Measurement of harmonic distortion of Desktop / computer and allied equipment
3. Measurement of harmonic distortion of CFL or FTL with electronic ballast and magnetic ballast.
4. Harmonic analysis of no load current of a single phase transformer
5. Analysis of performance of three phase induction motor operated with sinusoidal supply and under distorted supply conditions supplied by 3 phase inverter
6. Analysis of performance of single phase transformer operated with sinusoidal supply and under distorted supply conditions supplied by 1 phase inverter.
7. Measurement of sag magnitude and duration by using digital storage oscilloscope
8. Design of passive harmonic filter – computer simulation for power electronic application
9. Design of active harmonic filter – computer simulation for power electronic application
10. Simulation studies of harmonic generation sources such as VFD, SVC, STATCOM and FACTS devices and harmonic measurement (THD) by using MATLAB 2019b.
11. Power quality audit of institute or department

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practicals and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

EE310U – NUMERICAL METHODS AND COMPUTER PROGRAMMING LAB

Teaching Scheme: 01L+ 02P, Total: 03 **Credits:** 02

Evaluation Scheme: 25 ICA + 25 ESE **Total marks:** 50

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

The course explores role of mathematical modeling in engineering problem solving, approximation and round - off errors, accuracy and precision, truncation errors and the Taylor series, using any software or programming language like MATLAB. It also helps to study curve fitting, numerical integration and differential equations for electrical engineering applications.

DESIRABLE AWARENESS/SKILLS:

Knowledge of basic electrical, basics of computer programming

COURSE OBJECTIVES:

The objectives of course are to:

1. identify various mathematical problems and select a suitable numerical method for numerical treatment of the given problem
2. motivate the choice of a method by describing its advantages and limitations
3. select an algorithm leading to efficient computation language, suitable for scientific computing, e.g. MABLAB
4. utilize standard functions from e.g. MATLAB library for calculation, visualization and efficient programming

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:

1. understand various mathematical problems and select a suitable numerical method for numerical treatment of the given problem
2. distinguish method by describing its advantages and limitations
3. learn an algorithm leading to efficient computation language, suitable for scientific computing, e.g. MATLAB
4. use standard functions from e.g. MATLAB library for calculation, visualization and efficient programming

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1					2								2		
2					2								2		
3						3							3		
4						3								1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

The laboratory work should consist of experiments based on above syllabus. Experiments should involve programs on C/C++/MATLAB etc, result and conclusion based on it. The sample list given below is just a guide line.

List of Experiments:

1. Find Roots of Polynomial Equation Using

i. Bisection Method
ii. Secant Method
iii. Newton Raphson Method
iv. Regula-Falsi Method

2. Solve Linear Simultaneous Equation Using

i. Gauss Elimination Method
ii. Gauss Siedal Method
iii. Gauss Jordan Method

3. Curve Fitting Using Various Interpolation Techniques

i. Newton's Forward / Backward /Divided Difference
ii. Stirling Bessel's Interpolation
iii. Least Square ,Lagrange's ,Inverse Interpolation

4. Numerical Differentiation Using

i. Newton –Gregory
ii. Lagrange's

5. Numerical Integration Using

i. Trapezoidal
ii. Simpson's Rule(1/3, 3/8)

6. Ordinary Differential Equation Using Euler's Method

i. Taylor's Series
ii. Runge: Kutta (2nd ,3rd , 4th Order)
iii. Predictor Corrector Method

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guide lines for ESE: The End Semester Examination (ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

SH386U:INDUSTRIAL ORGANIZATION AND MANAGEMENT

Teaching Scheme: 02L **Credit:** 02
Evaluation Scheme: 30 MSE +10 ISA + 60 ESE **Total marks:** 100

Course Description

The course focuses on awareness of industrial organization and management and its different aspects. This course will cover details about management. It gives overview of industrial organization and functions of it.

Course Objectives

The objectives of offering this course are to

1. make students aware general management and functions of management
2. understand the basic concept of organizational structure
3. enable students to identifyformation of company and its legal aspects
4. acquire the different knowledge of economics

Course Outcomes

On successful completion of this course the students will be able to

1. apply the knowledge of entrepreneurship.
2. prepare project report to start own enterprise.
3. run and enhance their own family business.
4. utilize the new policies of entrepreneurship.

Contents:

Principles of Management: Basic concepts, definitions, nature, importance and functions of management, management vs administration, effectiveness of management, introduction to scientific management by Taylor, administrative management by Fayol, contribution of Peter Drucker, levels of management, span of management.

Organization Structures:

Introduction, organisation structure, types of organisation structure: line organisation, functional organisation, line and staff organisation, designing organization structure, multi-plant organization, small organization, multi-product organisation.

Managerial Economics: Meaning and scope of economics, basic theories, law of demandand supply, elasticity of demand and supply, consumer theories, meaning of utility and law ofdiminishing utility, cost concepts, opportunity costs, sunk costs, marginal cost, total andvariable costs, fixed costs, contribution, law of diminishing return, present value, net presentvalue, project cost

Operational Management: Plant location and layout, factors affecting plant location, different type of plant layout, CPM and PERT, Material handling: Functions, Factors to be consider in material handling problems, principles, devices.

Human Resource Management: Basicconcept, recruitment, selection,placement and induction, performance appraisal and development, employee training,fringe benefits & incentives payments, collective bargaining, Workmen's compensation act 1923, Factories Act 1947, attritionand Retention strategies

Marketing Management & Financial Management: concept of market, types of market,definition, nature and scope of marketing, marketing approaches, marketing process,functions of marketing, 4P's of marketing,green marketing, nature and scope of financial management, capital structure, types and sources offinance, role of financial institutions in industry.

Text books:

1. Industrial Engineering Managementsby O P Khanna
2. Principles of Management by L. M. Prasad, Himalaya Publications Ltd
3. Industrial Organization and Management by S. K. Basu, K. C. Sahu, B. Rajiv
4. Industrial Engineering and production Management by M S Mahajan, DhanpatRai and Co.

Reference Books:

1. Essentials of HRM & IR (Text, Cases & Games), P. SubbaRao, Himalaya PublishingHouse
2. Marketing Management by Philip Kotler, Tata McGraw Hill
3. Managerial Economics by D. N. Dwivedi, Vikas Publications
4. Human resource Management (Text & Cases) by S. Chand,S. S. Khanka

EE351 U - CONTROL SYSTEM

Teaching Scheme: 03L + 00T; Total 03 **Credits**: 03
Examination Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course explores about the automation systems with various sensors, error detectors. This course also elaborates mathematical modeling, block diagram, signal flow graph. It also discusses time domain analysis, Routh's stability, frequency domain analysis. Finally in state space approach modern control system is introduced.

DESIRABLE AWARENESS/SKILLS:

Knowledge of basic electrical engineering, dc machines, ac machines, mechanical engineering and their basic concepts.

COURSE OBJECTIVES:

The objectives of the course are to:

1. explain mathematical model of linear time invariant systems.
2. introduce basic control system components and their characteristics.
3. introduce the design of sampled data system using discrete system analysis.
4. specify control System performance in Frequency domain and time domain analysis

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:

1. derive the transfer function for single input single output system
2. derive system input output relations using signal flow graph and block diagram reduction
3. evaluate time domain response to known test signals
4. apply R-H criterion to determine stability of LTI system
5. construct bode and polar, root locus plots for various transfer functions
6. use various industrial controllers such as P, PI, PID

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						2								2	
2							2								3
3					1										2
4						2									2
5						1								1	
6								3						2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Transfer Functions and Block Diagrams: Basic components and classifications of general control systems, physical and non-physical, linear and nonlinear, continuous on-off, open loop and closed-loop systems, mathematical models of physical systems, electrical analogy of non-electrical systems, force-current and force-voltages analogies. Definition of transfer function, block diagram representation of physical systems, block diagram reduction techniques, signal flow graphs and Mason's gain formula, transfer function of electrical, mechanical and electromechanical systems, reduction of parameter variation and effects of disturbance, sensitivity, $S^T G$, $S^T H$

Control System Components: Working principle and torque-speed characteristics of synchros, dc and ac servomotors, ac and dc tacho-generators. Working principle of potentiometers, applications.

Time-Domain Analysis: Time response of second order systems, time domain specifications, steady state error and error coefficients, design specifications of second order systems, proportional, integral and derivative controllers, PID compensations, design considerations for higher order systems, nature of system response from the location of roots in the s-plane of characteristic equation

Root Locus: Concepts of stability, Routh-Herwitz criterion, definition of root-locus, rules and procedure for plotting root-loci, stability analysis using root locus, effect of addition of poles and zeros

Frequency-Domain Analysis: Frequency-domain specifications, correlation between time-and frequency-domain responses, Polar plot, Nyquist plot, Nyquist stability criterion, effect of addition of poles and zeros on the shape of the Nyquist plot, Bode plot, determination of gain and phase margin from Bode plot, effect of gain variation and addition of poles and zeros on Bode plot, determinations of transfer function from Bode plots

State Space Analysis: Concept of state and state variable, state equations of linear time invariant and continuous data system. Matrix representation of state equation, conversion of state variable model to transfer function, canonical form, Jordan canonical form, solution of state equations.

Text Books:

1. Modern Control Engineering by Katsuhiko Ogata, PHI, 5th edition, 2009
2. Control system Engineering by Norman Nise, John-Willey, 3rd edition, 2000
3. Control System Engineering by I. J. Nagrath and M. Gopal, Wiley Eastern Ltd, 3rd edition, 2000

Reference Books:

1. Control systems-Principles and Design by M.Gopal, 2nd edition, TMH, 2002
2. Linear Control System Analysis and Design by John J. D'Azzo, C. H. Houpis, McGraw Hill International, ISE edition, 1988
3. Automatic Control System by Farid Golnaraghi Benjamin and C. Kuo, PHI, 10th edition, 2017

EE352 U - POWER ELECTRONICS

Teaching Scheme: 03L + 00T, Total: 03 **Credits**: 03
Examination Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
Duration of ESE : 03 Hrs

COURSE DESCRIPTION:

This course gives electronic control of appliances, dc machines and ac machines. It explores various semiconductor devices SUC as SCR, GTO, MCT, etc with their characteristics, operation, triggering methods, etc. Further ac to dc converters, dc to dc converters and dc to ac inverters are discussed.

DESIRABLE AWARENESS/SKILLS:

Knowledge of basic electrical engineering, dc machines, ac machines, transformer and their concepts, semiconductors

COURSE OBJECTIVES:

The objectives of course are to:

1. describe power semiconductor devices in Thyristor family.
2. present triggering methods, commutation methods etc. of Thyristor.
3. classify controlled rectifiers and dual converters.
4. demonstrate dc-dc converters and their control techniques.

COURSE OUTCOMES:

After completing the course the student will be able to:

1. compare characteristics of different power semiconductor devices
2. design controlled rectifiers
3. recommend inverters for various applications.
4. select different types of choppers.
5. design protection schemes for power semiconductor devices.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						1								2	
2						2								2	
3							3								3
4							2								1
5								3						2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Contents

Power Semiconductor Devices: Power semiconductor devices structure, principle of operation, V/I characteristics, switching actions, trigger requirements of power semiconductor devices such as SCR, TRIAC, DIAC, Power MOSFET, IGBT

Performance of Thyristor: Triggering methods, turn on-turn off characteristics of SCR, types of commutation, ratings, protection, series and parallel operation, gate drive IC's ratings, protections and their areas of application.

AC-DC Converters: Single phase half wave and full wave converters with different types of load, circuit configurations, working, performance parameters and input-output waveforms for R, R-L and RLE loads. Comparison with uncontrolled rectifiers. Three phase half and full wave converters, performance parameters, use of freewheeling diode, effect of source inductance, comparison of diode rectifiers, dual converter in circulating and non-circulating current modes

DC-DC Converters: Operation of chopper, types of choppers, step-up and step-down configurations, various commutation methods, CLC and TRC techniques, PWM and FM techniques. Practical thyristerised chopper circuits: working, control, output waveforms, continuous and discontinuous current conduction.

DC-AC Converters: Series and parallel inverters, single phase centre tapped and bridge inverter with R, RL load, Three phase bridge inverters and three-phase thyristorised bridge circuits, output waveforms for R and R-L loads. PWM techniques-single, multiple and sinusoidal PWM. PWM Inverters: principle of operation, performance parameters, current source inverter

Text Books:

1. Power Electronics: Circuit, devices and applications by M.H. Rashid, PHI, 2nd edition, 1994
2. Fundamentals of Power Electronics by Robert W Erickson and Dragan Maksimovic, 2nd edition 2001
3. Power Electronics by B. W. Williams, John Willey, 1975.

Reference Books:

1. Power Electronics by C. W. Lander, Tata McGraw-Hill Publications India 1993.
2. An Introduction to Thyristors and Their Applications by M. Ramamoorthy, East-West Press Pvt. Ltd., New Delhi
3. Thyristorised Power Controllers by G. K. Dubey, S. R. Doradla, A. Joshi, M. K. Sinha, Wiley Eastern Ltd. 1987.

EE353 U - SWITCHGEAR AND PROTECTION

Teaching Scheme: 03L+00T, Total: 03 **Credits**: 03
Examination Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

The course of switch gear and protection is covering various protection systems for various equipments/appliances. The course explores on understanding of various circuit breakers, their types and operation. It also discusses fault current protection methods for transformer, generator. With advances in protective relaying, numerical relays are also introduced.

DESIRABLE AWARENESS/SKILLS:

Knowledge of basic electrical engineering, dc machines, ac machines, transformer and their concepts.

COURSE OBJECTIVES:

The objectives of the course are to:

1. impart knowledge related to the function of switchgear in power system and the function of different types of circuit breaker.
2. demonstrate the relay time grading scheme, current grading Scheme for relay operation.
3. explain the application of carrier current protection to transmission line.
4. deliver knowledge related to system protection against transients and surges.
5. know about the recent technology in protection.

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:

1. apply various circuit breakers to various applications
2. illustrate various protection schemes
3. explain arc interruption phenomenon
4. recognize the appropriate relay
5. implement recent technology for protection of power system equipment

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1				2										3	
2					2									2	
3						3								1	
4							3							2	
5							2								3

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Fundamentals of Power System Protection: Principle of circuit interruption arc phenomenon, ac and dc circuit breaking, arc interruption theories, transient recovery voltage, restriking voltage, factors affecting TRV, Rate of Rise of Re-striking voltage, resistance switching, damping of TRV, current chopping, capacitive current breaking, auto reclosing protection principles, protection paradigms, apparatus protection and system protection, desirable attributes of protection.

Circuit Breakers: Arc voltage, arc interruption, resistance switching, interruption of capacitive and inductive current, circuit breaker ratings, classification and working principle and applications of C.B: HT CB: Air Break, Air Blast, Vacuum, Minimum Oil and Bulk Oil, SF6 C.B. L.T. CB: MCB, MCCB, HRC fuses

Fault Analysis and Over Current Protection: Fuse protection, fundamental of over current protection, PSM setting and phase relay coordination, earth fault protection using over current relays, introduction to directional over-current relays

Transmission System Protection Using Distance Relays: Introduction to distance relaying, relay response under power swings and effect of fault resistance, setting of distance relays. zones of protection, setting and coordination of distance relays, pilot protection with distance relays, realization of distance relays using numerical relaying algorithms. Carrier Current Protection-Phase comparison and directional comparison principles.

Protection of Transformer and Bus Bar: Transformer protection: Percentage deferential protection, percentage differential relay, restricted earth fault protection, incipient faults, Buchholz relay protection against over fluxing, generator protection, stator phase and ground fault protection, protection against unbalanced loading, loss of excitation, loss of prime mover and over speeding. Bus bar protection: Lightning protection and system grounding bus bar protection, different bus bar arrangements, differential protection of bus bar, high impedance deferential relay, lightening and switching over voltages, need and types of lightening arresters, insulation co-ordination, system grounding, need, methods of system grounding, substation ground mats.

Text Books:

1. Fundamentals of Power System Protection by Y. G. Paithankar, S. R. Bhide, PHI, 2nd edition, 1996
2. Solid State Protective Relaying by Madhav Rao, Tata McGraw Hill, 1st edition, 2000
3. Computer relaying for power systems by A. G. Phadke, J. S. Thorp, Research studies press, John Wiley and sons Inc. New York, lst edition, 2001

Reference Books:

1. A Web Course on Digital Protection of Power System by Prof. Dr. S.A.Soman, IIT Bombay.
2 Switchgear Protection and Power Systems by Sunil S. Rao, Khanna Publishers, 5th edition, 2004
3. Fundamentals of Power Systems Protection by Y. G. Paithankar and S. R. Bhide, 2nd PHI,2002

Professional Elective – II

EE354U A – POWER SYSTEM STABILITY

Teaching Scheme: 03L + 00T, Total: 03 **Credits**: 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks**: 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course provides the information about the various transients occurring in the power systems, their causes and methods to restore the system as previous or new operating point.

DESIRABLE AWARENESS/SKILLS:

Knowledge of electrical power system and electrical machines and their mathematical modeling, engineering mathematics

COURSE OBJECTIVES:

The objectives of the course are to:

1. analyze the effects of lightning, faults, and switching on power systems.
2. understand the different types of stability limits
3. use different techniques to stabilize the system
4. introduce the students software to design power system e. understand the impact of rotor angle on stability

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. develop a basic understanding of the transient effects
2. simulate various faults on power systems.
3. analyze steady state stability of the system.
4. protect power system equipment from transients
5. analyze power system stability

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						2								2	
2							3							3	
3							3								3
4								2							2
5									1					1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Basic Concept: Meaning of stability, rotor, voltage and frequency, basic concepts and types and definitions of Steady State, Transient and dynamic stability, Park`s transformation equation, analysis of transient and sub transient state operation of salient and non salient pole machines, phasor diagrams, voltage behind the transient and sub-transient impedance, time constants Determination of parameters and time constants.

Steady State Stability: SSSL of short transmission lines, analytical and graphical methods of solutions, lossy line, effect of inertia, conservative criterion, synchronizing co-efficient, multi-machine system.

Factors Affecting Steady State Stability: Effect of saturation, saturated reactance, equivalent reactance, graphical method to find equivalent, effect of short circuit, effect of governor action, effect of automatic voltage regulator.

Transient State Stability: Swing equation, assumption for swing equation, and classical model, shortcoming of classical model, equal area criterion, critical clearing angle and critical clearing time, point by point solution for transient stability.

Factors Affecting Transient State Stability: Effect of type of fault, effect of grounding, effect of high speed reclosing, pre-calculated swing curve and their use, effect of fault clearing time, effect of excitation and governing action, method of improving stability, multi-machine problem.

Text books:

1. Power System Control and Stability (IEEE Press Series on Power Engineering) by Vijay Vittal, James D. McCalley, et al., 3rd edition, 2019
2. Power system stability by E. W. Kimbrak, vol-I and II, Wiley India Pvt. Ltd., 1st edition,
3. Power system stability and control by Prabha Kundur, McGraw-Hill Education, 1st edition, 1994

Reference Books:

1. Modern Power system analysis by Nagrath and Kothari, TMH
2. Generalized Electrical Machinery by P.S. Bimbhra, Khanna Publishers
3. Power System Dynamics and Stability by Peter W. Sauer and M. A. Pai, Pearson Education

Professional Elective – II

EE354U B – INDUSTRIAL AUTOMATION

Teaching Scheme: 03L + 00T, Total: 03 **Credits**: 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks**: 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course deals with the automation in industries. It focuses on Programmable Logic Control, Robotics, industrial networks and project management.

DESIRABLE AWARENESS/SKILLS:

Knowledge of automatic control systems, microcontrollers

COURSE OBJECTIVES:

The objectives of the course are to:

1. understand the generic architecture and constituent components of a Programmable Logic Controller.
2. develop architecture of SCADA explaining each unit in detail.
3. develop a software program using modern engineering tools and technique for PLC and SCADA.
4. apply knowledge gained about PLCs and SCADA systems to identify few real-life industrial applications.

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. develop and explain the working of PLC with the help of a block diagram.
2. develop architecture of SCADA and explain the importance of SCADA in critical infrastructure.
3. execute, debug and test the programs developed for digital and analog operations.
4. reproduce block diagram representation on industrial applications using PLC and SCADA.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						2								2	
2							2								2
3								3							3
4									3					3	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to PLC: Role of automation in industries, benefits of automation, necessity of PLC, history and evolution of PLC, definition, types, selection criterion, overall PLC system, PLC Input and output modules (along with Interfaces), CPU, programmers and monitors, power supplies, Solid state memory, advantages and disadvantages

Programming of PLC: Programming equipment, various techniques of programming, ladder diagram fundamentals, proper construction of ladder diagram, basic components and their symbols in ladder diagram, MCR (master control relay) and control zones, Boolean logic and relay logic timer and counter- types along with timing diagrams, shift registers, sequencer function, latch instruction Arithmetic and logical instruction with various examples

Advance PLC function: Input ON/OFF switching devices, Input analog devices, output ON/OFF devices, output analog devices, programming ON/OFF, inputs to produce ON/OFF outputs. Analog PLC operation, PID control of continuous processes, simple closed loop systems, problems with simple closed loop systems, closed loop system using Proportional, Integral and Derivative (PID), PLC interface and industrial process example.

Applications of PLC interface to various circuits: Encoders, transducer and advanced sensors (Thermal, Optical, Magnetic, Electromechanical, Flow, Level sensors) Measurement of temperature, flow, pressure, force, displacement, speed, level developing a ladder logic for sequencing of motors, tank level control, ON / OFF temperature control, elevator, bottle filling plant, car parking. Motors Controls: AC Motor starter, AC motor overload protection, DC motor controller, variable speed (Variable Frequency) AC motor Drive

SCADA Systems: Introduction, definitions and history of Supervisory Control and Data Acquisition (SCADA), typical SCADA system architecture, communication requirements, desirable properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA architectures (First generation - Monolithic, Second generation - Distributed, Third generation – Networked architecture), SCADA systems in operation and control of interconnected power system, power system automation (automatic substation control and power distribution), petroleum refining process, water purification system, chemical plant.

SCADA Protocols Open Systems Interconnection (OSI) model, TCP/IP protocol, DNP3 protocol, IEC61850 layered architecture, Control and Information Protocol (CIP), device net, control net, ethernet/IP, Flexible Function Block process (FFB), Process Field bus (Profibus). Interfacing of SCADA with PLC

Text Books:

1. Programmable Logic Controllers Programming Methods and Applications by John R. Hackworth, Frederick D., Hackworth Jr., PHI Publishers
2. Ronald L. Krutz, “Securing SCADA System”, Wiley Publications.

Reference Books:

1. Programmable Controllers Batten G. L. by McGraw Hill Inc., Second Edition
2. Real Time Computer Control by Bennett Stuart, Prentice Hall, 1988
3. Measurement Systems by Doebelin E. O., McGraw-Hill International Editions, Fourth Edition, 1990
4. Computer Based Industrial Control by Krishna Kant, PHI
5. Computer Control of Process by M. Chidambaram, Narosha Publishing
6. Programmable Logic Controllers with Applications by P. K. Srivstava, BPB Publications
7. Distributed Computer Control for Industrial Automation by Poppovik, Bhatkar, Dekkar Publications

Professional Elective – II

EE354U C – ENERGY CONSERVATION AND AUDITING

Teaching Scheme: 03L + 00T, Total: 03 **Credits**: 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks**: 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course explores inspection and survey of electrical energy. This course also imparts the analysis of energy flows in any building. It includes a process or system to reduce the amount of energy input into the system without negatively affecting the output.

DESIRABLE AWARENESS/SKILLS:

Knowledge of power system, electrical machines and their operating characteristics, tariff

COURSE OBJECTIVES:

The objectives of the course are to:

1. understand importance of energy and energy security
2. follow format of energy management, energy policy
3. learn various tools of Demand Control.
4. learn impact of use energy resources on environment and emission standards, different operating frame

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. analyze and understand energy consumption patterns and environmental impacts and mitigation method.
2. listing various energy conservation measures for various processes
3. students can carry out preliminary audits
4. work out economic feasibility

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						2								3	
2							2							2	
3								3							2
4									3						2

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Contents

Energy Conservation: Motive power (motor and drive system). b) illumination c) heating systems (boiler and steam systems) c) ventilation (fan, blower, compressors) and air conditioning systems d) pumping system e) cogeneration and waste heat recovery systems f) utility industries (T and D sector) g) diesel generators. Financial analysis and case studies. Costing techniques: cost factors, budgeting, standard costing, sources of capital, cash flow diagrams and activity chart. Financial appraisals: criteria, simple payback period, return on investment, net present value method, time value of money, break even analysis, sensitivity analysis and numerical based on it, cost optimization, cost of energy, cost of generation. Energy audit case of different sectors studies such as IT sector, textile, Municipal Corporations, educational institutes, T and D Sector and thermal power stations.

Energy Scenario: Classification of energy resources, commercial and non-commercial energy, primary and secondary sources, commercial energy production, final energy consumption, energy needs of growing economy, short terms and long terms policies, energy sector reforms, distribution system reforms and up-gradation, energy security, importance of energy conservation, energy and environmental impacts, emission check standard, United Nations frame work convention on climate change, global climate change treaty, Kyoto protocol, clean development mechanism, salient features of Energy Conservation Act 2001 and Electricity Act 2003. Indian and global energy scenario. Introduction to IE Rules. Study of Energy Conservation Building Code (ECBC), concept of green building.

Energy Management: Definition and objective of energy Management, principles of energy management, energy management strategy, energy manager skills, key elements in energy management, force field analysis, energy policy, format and statement of energy policy. Organization setup and energy management. Responsibilities and duties of energy manager under Act 2001. Energy efficiency program, energy monitoring systems. Introduction to SCADA and automatic meter reading in utility energy management.

Demand Management: Supply Side Management (SSM), various measures involved such as use of FACTS, VAR Compensation, generation system up gradation, constraints on SSM. Demand side management (DSM), advantages and barriers, implementation of DSM, areas of development of demand side management in agricultural, domestic and commercial consumers. Demand management through tariffs (TOD). Power factor penalties and incentives in tariff for demand control, apparent energy tariffs. Role of renewable energy sources in energy management, direct use (solar thermal, solar air conditioning, biomass) and indirect use (solar, wind, etc.)

Energy Audit: Definition, need of energy audit, types of audit, procedures to follow, data and information analysis, energy audit instrumentation, energy consumption – production relationship, pie charts. Sankey diagram, Cusum technique, least square method and numerical based on it. Outcome of energy audit and energy saving potential, action plans for implementation of energy

conservation options. Bench- marking energy performance of an industry. Energy Audit Report writing as per prescribed format. Audit case studies of sugar, steel, paper and cement, etc industries.

Text Books:

1. Guide books for National Certification Examination for Energy Managers/Energy Auditors Book, 1, General Aspects
2. Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 2 – Thermal Utilities
3. Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 3- Electrical Utilities
5. Guide books for National Certification Examination for Energy Managers/Energy Auditors Book

References Books:

1. Success stories of Energy Conservation by BEE (www.Bee-india.org)
2. Utilization of electrical energy by S.C. Tripathi, Tata McGraw Hill.
3. Energy Management by W.R. Murphy and Mackay, B.S. Publication.
4. Generation and utilization of Electrical Energy by B.R. Gupta, S. Chand Publication.
5. Energy Auditing made simple by Balasubramanian, Bala Consultancy Services.

Open Elective – II

EE355U A – ENERGY AUDIT AND CONSERVATION

Teaching Scheme: 03L + 00T, Total: 03 **Credits**: 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks**: 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course explores inspection and survey of electrical energy. This course also imparts the analysis of energy flows in any building. It includes a process or system to reduce the amount of energy input into the system without negatively affecting the output.

DESIRABLE AWARENESS/SKILLS:

Knowledge of power system, electrical machines and their operating characteristics and tariff

COURSE OBJECTIVES:

The objectives of the course are to:

1. understand importance of energy and energy security
2. follow format of energy management, energy policy
3. learn various tools of Demand Control
4. learn impact of use energy resources on environment and emission standards, different operating frame

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. explain the importance of global energy crises and need of energy conservation.
2. select suitable tariff for industry/organization.
3. apply proper energy conservation techniques for industrial applications.
4. carry out energy audit and prepare energy audit report.
5. analyze cost benefit and calculate payback period using various methods.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1							2							2	
2								3							3
3									3						3
4										3			1		

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Contents

Energy and Environment: World energy consumption, world fossil fuel reservoirs, per capita energy consumption, primary energy production and consumption in India. Environmental and social concerns: the greenhouse effect, pollution, acid rain, effect of global warming, global energy and environment. Energy conservation act 2001.

Tariff and Energy Management: Energy cost and recent MSEDCL tariffs, selection of tariff, energy conservation in industries by power factor improvement, automatic power factor correction, load factor, methods of improving load factor. Principles and objectives of energy management systems, duties and responsibilities of energy management.

Energy Conservation in Industries: Lighting – Methods/Techniques of energy saving. Heating – energy saving in furnaces, ovens and boilers. Cooling – energy saving in air conditioners and ventilating systems. Motive power – energy efficient motors, use of soft starters and variable frequency drives for efficient operation of motors. Pumping systems, diesel generators sets, transmission and distribution systems.

Energy Audit: Need of energy audit, types of energy audit, procedure of energy audit, ABC analysis, Energy Flow Diagram and its importance, Measurements in energy audit and various measuring instruments, Questionnaires for the energy audit, internal energy audit checklist. Energy audit report format, outcome of energy audit, action plan for implementation of energy audit options. Energy audit case studies for sugar, steel, cement, paper industries.

Energy economics: Introduction, cost benefit risk analysis, payback period, straight line depreciation, sinking fund depreciation, reducing balance depreciation. Disadvantages of payback period method, net present value method, Internal rate of return method, Probability index for benefit, cost ratio, break even analysis, cost optimization.

Text Books:

1. Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 1, General Aspects
2. Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 2 – Thermal Utilities
3. Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 3- Electrical Utilities
4. Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 4

Reference Books:

1. Success stories of Energy Conservation by BEE (www. Bee-india.org)
2. Utilization of electrical energy by S.C. Tripathi, Tata McGraw Hill.
3. Energy Management by W.R. Murphy and Mackay, B.S. Publication.
4. Generation and utilization of Electrical Energy by B.R. Gupta, S. Chand Publication.

Open Elective – II

EE355U B – ELECTRICAL ENGINEERING MATERIAL

Teaching Scheme: 03L + 00T, Total: 03 **Credits**: 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total marks**: 100

Duration of ESE: 03 Hrs

COURSE DESCRIPTION:

This course is based on basics and applications electrical and electronics engineering materials. It also gives students exposure to insulators, conductors, semi conductors, super conductors and nano-technology materials.

DESIRABLE AWARENESS/SKILLS:

Knowledge of materials and their physics and chemical characteristics

COURSE OBJECTIVES:

The objectives of the course are to:

1. develop ability to identify various electrical material used for different applications
2. understand relevant IEEE standards
3. illustrate various characteristics and relevant applications
4. learn and characterize various nano-technology schemes

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. analyze different types of electrical material
2. understanding of the physics behind the electrical material
3. learn about characteristics and application of various electrical material
4. innovate research and develop the structure and utilization of various material

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						2								2	
2							3								2
3								3							3
4									2						1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Contents

Dielectric Properties of Insulating Materials: Static field, parameters of dielectric material, dielectric constant, dipole moment, polarization, polarizability. Introduction to polar and non-polar dielectric materials. Mechanisms of polarizations-electronic, ionic and orientation polarization, Clausius Mossotti Equation. Piezo-electric, pyro-electric and ferro-electric materials, dielectric Loss and loss tangent, concept of negative tan, optical properties of materials and cells used for power generation: photo-conductivity, photo-electric emission, photo-voltaic cells (materials used, construction, equivalent circuit, working and application), materials used for photo-conductive cells, photo emissive cells.

Insulating Materials, Properties and Application: Introduction, characteristics of good Insulating material, classification, solid insulating materials-paper, press board, fibrous materials, ceramics, mica and asbestos, resins, polymers ceramics, enamels. Liquid Insulating Materials such as transformer oil, varnish, askarel, insulating gases like air, SF6. Insulating materials for Power and distribution transformers, rotating machines, capacitors, cables, line insulators and switchgears. Dielectric breakdown: Introduction, concept of primary and secondary ionization of gases, breakdown voltage, breakdown strength, factors affecting breakdown strengths of gaseous, liquid and solid dielectric materials.

Magnetic Materials: Introduction, parameters of magnetic material, permeability, magnetic susceptibility, magnetization, classification of magnetic materials, diamagnetism, para magnetism, ferromagnetism, ferri-magnetism, ferro-magnetic behavior below critical temperature, spontaneous magnetization and Curie-Weiss law, anti-ferromagnetism, ferrites, applications of ferro-magnetic materials, magnetic materials for electric devices such as transformer core, core of rotating machines, soft magnetic materials, hard magnetic materials, magnetic recording materials, compact discs. Introduction to laser and magnetic strip technology

Conducting Materials: General properties of conductor, electrical conducting materials - copper, aluminum and its applications, materials of high and low resistivity-constantan, nickel-chromium alloy, tungsten, canthal, silver and silver alloys. Characteristics of copper alloys (brass and bronze), materials used for lamp filaments, transmission lines, electrical carbon materials, material used for solders, metals and alloys for different types of fuses, thermal bimetal and thermocouple. Introduction to super-conductivity and super-conductors.

Nanotechnology: Introduction, concepts of energy bands and various conducting mechanism in nano-structures, carbon nano-structures, carbon molecules, carbon clusters, carbon nano-tubes. Applications of carbon nano-tubes, special topics in nano technology such as single electron transistor, molecular machines, BN nano-tubes, nano wires.

Text Books:

1. A Course in Electrical Engineering Materials, by S. P. Seth, Dhanpat Rai and Sons publication.
2. Electrical Engineering Materials, T.T.T.I, Madras.
3. Electrical Engineering Materials, by K. B. Raina and S. K. Bhattacharya, S. K. Kataria and Sons.
4. Material Science for Electrical Engineering, by P.K. Palanisamy, Scitech Pub.(India) Pvt. Ltd., Chennai.

Reference Books:

1. Electrical Power Capacitors-Design and Manufacture, by D. M. Tagare, Tata McGraw Hill Publication.
2. Electrical Engineering Materials, by S. P. Chalotra and B. K. Bhatt, Khanna Publishers, Nath Market. 3. Electrical Engineering Materials, by C. S. Indulkar and S. Thiruvengadam, S. Chand and Com.Ltd,
4. High voltage engg. by Kamraju and Naidu, Tata McGraw Hill Publication.
5. Introduction to Material Science for Engineering, Sixth Edition by James F. Shackelford and M. K. Muralidhara, Pearson Education.
6. Insulation Technology Course Material of IEEMA Ratner, Pearson Education
7. Introduction to Nanotechnology by Charles P. Poole, Jr. Frank and J. Ownes (Wiley Student Edition) 8. Materials Science for engineering students, by Traugott Fischer, Elsevier publications.

SH387U:INDUSTRIAL ORGANIZATION AND MANAGEMENT LAB

Teaching Scheme: 02P **Credit:** 01
Evaluation Scheme: 25 ICA **Total marks: 25**

It is a representative list of practical. The instructor may choose experiments as per his requirements (so as to cover entire contents of the course) from the list or otherwise. The practical should be performed to cover entire curriculum of course SH386U. The list given below is just a guideline.

1. Presentation on different topics on management
2. Study of recent changes in demand and supply in FMCG market of India
3. Prepare a report on locating new plant setup
4. Assignment based on syllabus of SH 368U Industrial Organization and Management
5. Formation of company using three different types of company structure
6. Application of administrative management principles in industries
7. Identify green marketing products
8. Visit industry and study provision related to factory act
9. Indentify sector wise Attrition and suggest Retention strategies
10. Identify fringe benefits given to employee in different industries

Guide lines for ICA:
Internal Continuous Assessment should support for regular performance of practical by student and his/her regular assessment with proper understanding practical carried out.

EE356U - CONTROL SYSTEM LAB

Teaching Scheme:02P; Total 02 **Credits**: 01

Examination Scheme: 25 ICA + 25 ESE **Total Marks:** 50

Duration of ESE : 03 Hrs

COURSE DESCRIPTION:

The laboratory course on feedback control system will help the students to study and plot characteristics of motors, find transfer function of various control system components. Further using any software (like MAT LAB, PSIM, etc) simulation of various controllers can be done.

DESIRABLE AWARENESS/SKILLS:

Knowledge of basic electrical and electronics, dc and ac machines, Laplace Transforms

COURSE OBJECTIVES:

The objectives of course are to:

1 know characteristics of all error detector

2. analyze torque speed characteristics of ac servo motor

3. know applications of P, PI, PD and PID Controller

4. know the stability analysis using root locus, Nyquist Plot and Bode plot using MAT LAB

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. plot characteristics of all error detectors
2. learn torque speed characteristics of dc and ac servo motor
3. apply P, PD, PD, PID Controller to various systems
4. know the stability analysis using root locus, Nyquist Plot and Bode plot using MAT LAB

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1							2							3	
2								3							2
3								2							2
4									2					1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work should consist of experiments based on theory syllabus of EE351U. Experiments should involve simulation/performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of Experiments:

1. Study of potentiometers as error detectors.
2. Study of Synchros as error detector.
3. Study of regulator system.
4. Study of rotary position control system
5. To study torque - speed characteristics of a dc servo motor
6. To study the torque-speed characteristic of ac servo motor.
7. To study the time response of a second order system.
8. Study of continuous- time and/or digital position control system.
9. Stability Analysis of First, Second and higher order systems using MATLAB
10. To study the time response of a variety of simulated linear systems and to correlate the studies with theoretical results.
11. To plot of root locus using MATLAB.
12. To plot the Bode and Nyquist plot using MATLAB.
13. Determination of transfer function of dc motor using Simulink.
14. Stability analysis and state space model for a given system using MATLAB.
15. Study of Tuning of a PID controller using MATLAB/Simulink.
16. Study of Temperature Controller.
17. Study of Control System Components like Servomotors, Actuators, Sensors, displays.
18. Determination of transfer function of dc motor.

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical's performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guide lines for ESE: The End Semester Examination (ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE357 U - POWER ELECTRONICS LAB

Teaching Scheme: 02P; Total 02 **Credits** : 01
Examination Scheme: 25 ICA + 25 ESE **Total Marks :** 50
Duration of ESE : 03 Hrs

COURSE DESCRIPTION:

This course consists of experiments and give practical knowledge of power electronics devices. Various applications of rectifiers and inverters are studied which will help students for mini and micro and major projects.

COURSE OBJECTIVES:

The objectives of the course are to:

1. describe power semiconductor devices in thyristor family.
2. know various triggering methods, commutation methods of thyristor.
3. classify controlled rectifiers and dual converters.
4. demonstrate dc-dc converters and their control techniques.

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. compare performance of various Power semiconductor devices.
2. demonstrate the performance characteristics of controlled rectifiers.
3. assess the performance of inverter circuits.
4. make use of DIAC and TRIAC for voltage control
5. investigate the performance of chopper circuits.

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						3								2	
2							3								1
3								3							2
4								2							2
5									2					1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work should consist of experiments based on theory syllabus of EE352U. Experiments should involve simulation/performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of experiments:

Any four/three from following

1. To study the SCR characteristics.
2. To study SCR turn-on methods.
3. To study of SCR Commutation methods.
4. To study IGBT / MOSFET characteristics, drivers.
5. To study TRIAC: Triggering modes

Any four/ three from following

1. To study single phase /three phase converter
2. To study dual converter
3. To study dc chopper
4. To study single phase / three phase thyristorised inverter
5. To study PWM inverter

Any three from following

1. Simulation of converter / chopper
2. Simulation of PWM inverter
3. Switched mode converter / rectifier
4. design of uninterrupted power supply

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical's performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guide lines for ESE: The End Semester Examination (ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE358 U - SWITCHGEAR AND PROTECTION LAB

Teaching Scheme: 02P; Total 02 **Credits** : 01

Examination Scheme: 25 ICA + 25 ESE **Total Marks** : 50

Duration of ESE : 03 Hrs

COURSE DESCRIPTION:

The course of switch gear and protection is covering various protection systems for various equipments/appliances. The course explores on understanding of various circuit breakers, their types and operation. It also discusses fault current protection methods for transformer, and bus bars. With advances in protective relaying, numerical relays are also introduced.

DESIRABLE AWARENESS/SKILLS:

Knowledge of basics of physics and chemistry, electrical, dc and ac machines

COURSE OBJECTIVES:

The objectives of course are to:

1. understand various types of relays
2. learn principle of circuit breakers
3. know characteristics of over current relay illustrate various protection schemes
4. understand modern static relay

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:

1. know the safety of electrical equipments
2. differentiate the relays
3. use various circuit breakers for specific applications
4. design the power system with proper protection

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						1								1	
2							2							2	
3								3						3	
4									3					1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work should consist of experiments based on theory syllabus of EE352U. Experiments should involve simulation, performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of experiments:

1. To conduct and study of Arc extinction phenomenon : Application in air circuit Breaker
2. Study of relaying components and control circuit developments.
3. To conduct and plot the characteristic of rewirable fuses and MCB
4. To conduct and plot operating characteristics of inverse time over current relay
5. To conduct over current and earth fault protection scheme for alternator
6. To conduct protection of 3 phase transformer using differential relay (Merz-Price protection scheme)
7. To conduct and study the through fault stability of differential protection scheme applied to transformer
8. To conduct protection of transmission line
9. Study of MHO distance relay to plot: R-X diagram B) Relay voltage Vs admittance characteristic admittance characteristic
10. Study of Static relay
11. Demonstration of microprocessor base protection.

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical's performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

Guide lines for ESE: The end semester examination (ESE) for the laboratory course of three hrs duration, shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

EE359U A – POWER SYSTEM STABILITY LAB

Teaching Scheme: 02P; Total 02 **Credits**: 01

Examination Scheme: 25 ICA + 00 ESE **Total Marks**: 25

Duration of ESE: 00 Hrs

COURSE DESCRIPTION:

This course emphasizes on imparting on practical knowledge and understanding of basic principle of power system stability, synchronous machines parameters and time constants, concepts of stability due to large and small disturbances and various methods to improve it.

DESIRABLE AWARENESS/SKILLS:

Detailed knowledge of power system and synchronous machines

COURSE OBJECTIVES:

The objectives of the course are to:

1. analyze the effects of lightning, faults, and switching on power systems.
2. understand the different types of stability limits
3. use different techniques to stabilize the system
4. introduce the students software to design power system e. understand the impact of rotor angle on stability

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. develop a basic understanding of the transient effects
2. simulate various faults on power systems.
3. analyze steady state stability of the system.
4. design power system to sustain transients
5. analyze power system stability

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1					2									2	
2						3									2
3							3								1
4								3							2
5									2						1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work consists of experiments based on theory syllabus of EE354U A. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of experiments:

1. Determination of parameters and time constants for synchronous machines
2. To study the effect of excitation when synchronous machines is connected to infinite bus
3. To study the effect of saturation and determine the equivalent reactance
4. Retardation test on synchronous machines
5. To obtain power angle characteristics of lossy and lossless line
6. To study the transient stability by point by point method
7. To study steady state stability of short transmission line.
8. To determine SSSL of transmission line
9. Study of Clerk's diagram
10. Study of different types of automatic voltage regulators

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical's performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

EE359 U B – INDUSTRIAL AUTOMATION LAB

Teaching Scheme: 02P; Total: 02 **Credits**: 01
Evaluation Scheme: 25 ICA + 00 ESE **Total marks**: 25
Duration of ESE: 00 Hrs

COURSE DESCRIPTION:

This course gives the students about the practical knowledge of automation in industries. Microcontrollers and various PLC's and SCADA systems are used in industries. Students will be able to learn programs, run and execute for the automation.

DESIRABLE AWARENESS/SKILLS:

Basic knowledge of microcontrollers, automatic control system

COURSE OBJECTIVES:

The objectives of course are to:

1. understand the generic architecture and constituent components of a Programmable Logic Controller.
2. develop architecture of SCADA explaining each unit in detail.
3. develop a software program using modern engineering tools and technique for PLC and SCADA.
4. apply knowledge gained about PLCs and SCADA systems to identify few real-life industrial applications using various sensors.

COURSE OUTCOMES:

On the successful completion of this course, student will be able to:

1. develop program in of PLC with the help of a block diagram.
2. develop architecture of SCADA and explain the importance of SCADA in critical infrastructure.
3. execute, debug and test the programs developed for digital and analog operations.
4. reproduce block diagram representation on industrial applications using PLC and SCADA

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						1							1		
2							2							2	
3								2							3
4									3						2

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work should consist of experiments based on theory syllabus of EE354U B. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of experiments:

1. Interfacing of lamp and button with PLC for ON and OFF operation.
2. Performed delayed operation of lamp by using push button.
3. UP/DOWN counter with RESET instruction.
4. Combination of counter and timer for lamp ON/OFF operation.
5. Set / Reset operation: one push button for ON and other push button for OFF operation.
6. DOL starter and star delta starter operation by using PLC.
7. PLC based temperature sensing using RTD.
8. PLC based thermal ON/OFF control.
9. Interfacing of Encoder with PLC (Incremental/Decremental)
10. PLC based speed, position measurement system.
11. PLC interfaced with SCADA and status read/command transfer operation.
12. Parameter reading of PLC in SCADA.
13. Alarm annunciation using SCADA.
14. Reporting and trending in SCADA system.
15. Tank level control by using SCADA.

Guide lines for ICA: Internal Continuous Assessment (ICA) shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical's performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

EE359U C – ENERGY CONSERVATION AND AUDITING LAB

Teaching Scheme: 02P; Total: 02 **Credits**: 01
Evaluation Scheme: 25 ICA + 00 ESE **Total marks**: 25
Duration of ESE: 00 Hrs

COURSE DESCRIPTION:

This course imparts about the analysis of energy flows for energy conservation in any firm. It may include a process or system to reduce the amount of energy input into the system without negatively affecting the output.

DESIRABLE AWARENESS/SKILLS:

Knowledge of power system, electrical machines and their operating characteristics, tariff

COURSE OBJECTIVES:

The objectives of the course are to:

1. understand importance of energy and energy security
2. follow format of energy management, energy policy
3. learn various tools of Demand Control.
4. learn impact of use energy resources on environment and emission standards, different operating frame

COURSE OUTCOMES:

On the successful completion of this course, students will be able to:

1. analyze and understand energy consumption patterns and environmental impacts and mitigation method.
2. listing various energy conservation measures for various processes
3. students can carry out preliminary audits
4. work out economic feasibility

Course Outcomes (COs) and Program Outcomes (POs) mapping with strength of co-relation:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1							3								3
2								3							3
3									2						2
4										2				2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

COURSE DESCRIPTION:

The laboratory work should consist of experiments based on theory syllabus of EE354U C. Experiments should involve simulation performance/design of practical, result and conclusion based on it. The sample list given below is just a guide line.

List of experiments:

1. Prepare a power point presentation/report on Global Climate Change/Energy Conservation Act 2001/Electricity Act 2003/Indian and Global Energy Scenario etc. through internet search.
2. Draw the energy flow diagram of an Industry/workshop/educational institute.
3. Estimate the requirement of capacitance for power factor improvement and suggest suitable APFC.
4. Prepare a sample energy audit questionnaire.
5. Study of various measuring instruments used for energy audit: Lux meter, Power quality analyzer, flue gas analyzer etc.
6. Identifying the energy conservation opportunities in a lab/department and preparation of energy audit report.
7. Industry visit with an aim of
   (i) Studying various energy management systems prevailing in a particular industry/Organization
   (ii) Identifying the various energy conservation methods useful in a particular industry
8. Study of Variable frequency drive based IM speed control for energy conservation.
9. Study of various energy efficient equipment like LED lighting devices, Energy Efficient motors etc.
10. Evaluating the energy conservation opportunity through various methods like simple payback period, Internal Rate of Return and Net Present Value method.
11. Study of various energy conservation methods useful in power generation, transmission and distribution.
12. Study of various energy conservation methods useful for boilers, fans, blowers, compressors, diesel engines, HVAC systems etc.

Guide lines for ICA: Internal Continuous Assessment shall support for regular performance of minimum 10 practical's and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical's performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).