SCHEME & SYLLABUS OF UNDERGRADUATE DEGREE COURSE

Electrical & Electronics Engineering

VI Semester

Effective for the students admitted in year 2021-22 and onwards.

L: Lecture, T: Tutorial, P: Practical, IA: Internal Assessment, ETE: End Term Exam, Cr: Credits

DC:	Departmental Core	DE:	Departmental Elective	UC:	University Core
UI:	University Independent Elective	UGE:	University General Elective		

Teaching and Examination Scheme

3rd Year – VI Semester

THEORY												
S. No.	Category	Code	Course Title	Contact hrs./week			Marks				Cr
				L	T	P	Exam Hrs.	IA	ETE	Total	
1	DC	6EX4-01	Modern Control Systems	3	0	0	3	30	70	100	3
2	DC	6EX4-02	Power Electronics	3	0	0	3	30	70	100	3
3	DC	6EX4-03	Power System-II	3	0	0	3	30	70	100	3
4	DC	6EX4-04	Neural Network and Fuzzy Logic Control	3	0	0	3	30	70	100	3
5	DC	6EX4-05	Signals and Systems	3	0	0	3	30	70	100	3
6	DE-3	6EX5-11	Digital Control System	2	0	0	2	30	70	100	2
		6EX5-12	Electromagnetic Field Theory								
		6EX5-13	Biomedical Instrumentation								
			Sub Total	**17**	**0**	**0**		**180**	**420**	**600**	**17**
PRACTICAL & SESSIONAL											
7	DC	6EX4-20	Power Electronics Lab	0	0	3		60	40	100	1.5
8	DC	6EX4-21	Power System Lab	0	0	3		60	40	100	1.5
9	UI	6EX7-50	Mini project	0	0	4		60	40	100	2
10	UGE	6EX8-00	*Co-Curricular Activities*	0	0	4		60	40	100	2
			Sub- Total	**0**	**0**	**14**		**240**	**160**	**400**	**7**
			TOTAL OF VI SEMESTER	**17**	**0**	**14**		**420**	**580**	**1000**	**24**

L: Lecture, **T**: Tutorial, **P**: Practical, **C**r: Credits

ETE: End Term Exam, **IA**: Internal Assessment

Syllabus
B. Tech. (Electrical and Electronics Engineering)
III Year VI Semester

6EX4-01: Modern Control Systems	
Credit: 3	**Max Marks: 100 (IA: 30, ETE: 70)**
3L+ 0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Define the state, state space, state vector and find the state model equations of electrical and mechanical systems.

CO-2: Represent a system by Physical form, Phase variables form, Canonical form & companion form and inter-convert them.

CO-3: Solve the state equations using state transition matrix. Also evaluate the controllability and observability of the given system.

CO-4: Know about the digital control systems, stability analysis in state space through Jury stability criterion and Routh-Hurwitz criterion.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**State Space Approach of Control System:** Modern versus conventional control theory, Concept of state, State variable, State vector, State space, State space equations, Writing state space equations of mechanical and electrical systems, Analogous systems.	**7**
3.	**State Space Representation:** Physical form, Phase variables form, Canonical form and companion form of system representation. Block diagram representation of state model, Signal flow graph representation, State space representation using canonical variables. Diagonal matrix. Jordan canonical form, Derivation of transfer functions from state-model.	**8**
4.	**Solution of State Equations:** Eigen values and Eigen vectors, Matrix, Exponential, State transition matrix, Properties of state transition matrix, Computation of State transition matrix, Concepts of controllability and observability, Pole placement by state feedback.	**9**
5.	**Digital Control Systems:** Introduction, sampled data control systems, signal reconstruction, difference equations, Z-transform, Z-transfer Function, Block diagram analysis of sampled data systems, z and s domain relationship.	**8**
6.	**Stability Analysis in State Space:** Modeling of sample-hold circuit, steady state accuracy, stability in z-plane and Jury stability criterion, bilinear transformation, Routh-Hurwitz criterion on s-planes, Digital PID controllers, Introduction to adaptive control.	**8**
	Total	**41**

Suggested Books:

1. I. J. Nagrath and M. Gopal: Control Systems Engineering, 3rd Ed, New Age Publication.
2. B. C. Kuo: Digital Control System, Oxford.
3. M. Gopal: Digital Control and State Variable Methods, MGH.
4. D. Roy, Choudhary: Modern Control Engineering, Prentice Hall of India.
5. Richard C. Dorf, Robert H. Bishop: Modern Control Systems, Prentice-Hall.

III Year VI Semester

6EX4-02: Power Electronics	
Credit: 3	**Max Marks: 100 (IA: 30, ETE: 70)**
3L+ 0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:
Upon successful completion of the course, the students will be able to:

CO-1: Understand the operation, characteristics and applications of Power Diode, Power Transistor, Power MOSFET, IGBT, TRIAC, DIAC and MCT.

CO-2: Know the characteristics, specification, ratings, interconnections, protection and turning-on/off methods of SCR.

CO-3: Analyze the single-phase and three-phase converters with different loads.

CO-4: Evaluate the performance of choppers with their operating principal and control strategies.

CO-5: Analyze the operation of inverter and harmonic elimination techniques in PWM Inverters.

S.No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**Power Semiconductor Devices:** Construction, operation, characteristics and applications of Power Diode, Power Transistor, Power MOSFET, IGBT, MCT, TRIAC and DIAC, pulse transformer, optical isolators.	**3**
3.	**Thyristor:** Construction, characteristics, specification and ratings of SCR, methods of turn on, Protection of SCR against over voltage, over current, dv/dt, di/dt, Gate protection.	**3**
4.	**Single-Phase & Three-Phase rectifiers**: Single-phase half and full-wave converters with RL and RLE load, Conduction angle, Extinction angle, Single-phase semi converters, Three phase half-wave converters. Three phase full converters with RL and RLE load,. Three-phase semi converters with RL and RLE load Effect of load and source impedance on the performance of converters.	**8**
5.	**DC-DC Converters (Choppers):** Introduction, Classification, Principle and Operation, Control strategies, Chopper configurations, Thyristor chopper commutation circuits, Switched Mode Power Supply, Buck, Boost and Buck-Boost converters, Cuk converter.	**8**
6.	**DC-AC Converters (Inverters):** Introduction, Classification, Single phase half and full bridge VSI, Three phase VSI: 120 and 180 degree conduction mode. Performance Parameters of Inverter, Voltage control of single phase and three phase Inverter.	**8**
7.	**PWM Inverters:** Principle of PWM control, PWM techniques classifications, Unipolar and Bipolar PWM, Sinusoidal PWM, Hysteresis band current control PWM, Comparison of PWM techniques, Voltage and frequency control of single phase and three-phase inverters, Harmonic Cancellation techniques.	**9**
	Total	**40**

Suggested Books:

1. P. S. Bimbhra: Power Electronics, Khanna Publishers.
2. M. D. Singh and K. B. Khanchandani: Power Electronics, McGraw Hill Education.
3. M. H. Rashid: Power Electronics, Circuits Devices and Applications, Pearson.
4. Ned Mohan: Power Electronics, John Wiley.

III Year VI Semester

6EX4-03: Power System-II	
Credit: 3	**Max Marks: 100 (IA: 30, ETE: 70)**
3L+ 0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:
Upon successful completion of the course, the students will be able to:
CO-1: Create the admittance and impendence model which are further used in the power system analysis.
CO-2: Solve a power flow problem using Gauss-Seidel, Newton-Raphosn, Decoupled and fast decoupled methods.
CO-3: Analyze the symmetrical and unsymmetrical faults.
CO-4: Understand the operation and applications of relay.
CO-5: Analyze the protection provided by different types of circuit breakers. Also learn about the digital protection used in power systems.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**Admittance and Impendence Model:** Percent and per unit quantities. Single line diagram for a balanced 3-phase system, Branch and node admittances, Equivalent admittance network and calculation of Y bus, Modification of an existing Y bus, Bus admittance and impedance matrices. Thevenin's theorem and Z bus. Direct determination of Z bus. Modification of an existing bus.	**8**
3.	**Fault Analysis:** Fortescue theorem, symmetrical component transformation. Sequence Impedances of transmission lines, Synchronous Machine and Transformers, zero sequence network of transformers and transmission lines. Construction of sequence networks of power system, Analysis of single line to ground faults using symmetrical components, connection of sequence networks under the fault condition, Analysis of line-to-line and double line to ground faults using symmetrical components.	**8**
4.	**Protective relays:** Functional characteristics of relays, Primary and backup protection, Classification of relays, Operation and characteristics of over current relays, Directional over current relays, Differential relays, Percentage differential relays and Distance relays, Connection of distance relays for line and earth fault protection.	**7**
5.	**Circuit Breakers:** Classification of switchgears, Arc quenching in circuit breakers, Arc interruption theories– recovery rate theory and energy balance theory. Oil circuit breakers-bulk oil and minimum oil circuit breakers, Air circuit breakers, Construction and operation of Air blast, SF6 and Vacuum circuit breakers. Selection of circuit breakers.	**8**
6.	**Digital Protection:** Introduction to digital protection, Block diagram of digital relay, Introduction to digital over-current, transformer differential and transmission line distance protection.	**9**
	Total	**41**

Suggested Books:

1. C. L. Wadhwa: Electrical Power Systems, New age international Ltd. Third Edition.
2. D. P. Kothari & I. J. Nagrath: Modern Power System Analysis, MGH.
3. P. Kundur: Power System Stability and Control, MGH.
4. W. D. Stevenson: Element of Power System Analysis, MGH.
5. O. I. Elgerd: Electric Energy System Theory, MGH. 1983

III Year VI Semester

6EX4-04: Neural Network and Fuzzy Logic Control	
Credit: 3	**Max Marks: 100 (IA: 30, ETE: 70)**
3L+ 0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Learn concepts, architecture and working of artificial neural networks.

CO-2: Understand supervised and unsupervised learning algorithms.

CO-3: Understand Fuzzy set theory and operations, Fuzzy Relations and inference system.

CO-4: Design Fuzzy logic controller for industrial applications.

S. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course.	1
2.	**Introduction to Artificial Neural Networks:** Artificial neural network and their biological motivation, Terminology, Introduction to ANN Architecture, Models of neuron, Topology, Characteristics of artificial neural networks, Types of activation functions.	6
3.	**Learning Methods:** Error correction learning, Hebbian learning, Perceptron, XOR Problem, Perceptron learning rule, Convergence theorem, Adeline.	6
4.	**Supervised and Unsupervised Learning:** Multilayer Perceptron, Back propagation learning algorithm, Momentum factor, Radial basis function network, Recurrent neural networks, Hopfield neural network, Competitive learning neural networks, Kohonen self-organizing feature map, Counter propagation network.	7
5.	**Fundamentals of Fuzzy Logic:** Introduction to classical sets - Properties, operations and relations; Fuzzy sets, Uncertainty, Operations, properties, cardinalities, membership functions. Fuzzy relations**:** Fuzzy Cartesian product, Composition-Max min and Max-product composition, Tolerance and Equivalence relations.	8
6.	**Fuzzy Inference Systems:** Fuzzification, Membership value assignment, Defuzzification to crisp sets, Defuzzification methods, Natural language, Linguistic hedges, Fuzzy rule base system, Graphical techniques of inference.	8
7.	**Fuzzy Control System:** Basic architecture of Fuzzy logic controller, Industrial applications- Aircraft landing control, Fuzzy Engineering process control.	4
	Total	**40**

Suggested Books:

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, John Wiley and sons, 2010.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication.
3. Introduction to Neural Networks using MATLAB 6.0 - S.N. Sivanandam, S. Sumathi, S.N. Deepa, TMH, 2006
4. S. Haykin, "Neural Networks, A Comprehensive Foundation", Pearson Education Inc., 2008

III Year VI Semester

6EX4-05: Signals and Systems	
Credit: 3	**Max Marks: 100 (IA: 30, ETE: 70)**
3L+ 0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Develop input output relationship for linear shift invariant system.

CO-2: understand the convolution operator for continuous and discrete time system.

CO-3: Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.

CO-4: Understand the Relation between continuous and discrete time systems.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**Introduction to Signals and Systems:** Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.	**7**
3.	**Behavior of continuous and discrete-time LTI systems**: Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.	**8**
4.	**Fourier, Laplace:** Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior.	**9**
5.	**Z- Transforms**: The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.	**7**
6.	**Sampling and Reconstruction**: The Sampling Theorem and its implications.	**8**

	Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems.	
	Total	**40**

Suggested Books:

1. Lathi, Principles Of Linear Systems And Signals, Oxford
2. Willsky, Nawab, Signals And Systems, PHI
3. M J Roberts, Signals And Systems, Mc-Graw Hill

III Year VI Semester

6EX5-11: Digital Control System	
Credit: 2	Max Marks: 100 (IA: 30, ETE: 70)
2L+ 0T+ 0P	End Term Exams: 2 hrs.

Course Outcomes:

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

CO-1: Describe the various control blocks and components of digital control systems for modeling.
CO-2: Analyze sampled data systems in z-domain.
CO-3: Design a digital controller/ compensator in frequency domain.
CO-4: Apply state variable concepts to design controller for linear discrete time system.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	1
2.	**Discrete Representation of Continuous Systems:** Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modeling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.	5
3.	**Discrete System Analysis:** Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.	5
4.	**Stability of Discrete Time System:** Design of digital control system with dead beat response. Practical issues with dead beat response design.	3
5.	**State Space Approach for discrete time systems:** State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.	8
6.	**Design of Digital Control System:** Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator. Design of discrete output feedback control.	8
	Total	**30**

Suggested Books:

1. M. Gopal: Digital Control and State Variable Methods, MacGraw Hill education
2. B. C. Kuo: Digital Control system, Oxford University Press.

III Year VI Semester

6EX5-12: Electromagnetic Field Theory	
Credit: 2	**Max Marks: 100 (IA: 30, ETE: 70)**
2L+ 0T+ 0P	**End Term Exams: 2 hrs.**

Course Outcomes:

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

CO-1: Understand the different forms of vector relations and gradients used in field theory.

CO-2: Learn about the electric and magnetic field intensity, flux density, polarization and magnetization. Also learn about their boundary conditions.

CO-3: Know the displacement current and equation of continuity, pointing vector and power considerations.

CO-4: Understand the retarded potentials and concepts of radiation, reflection and transmission coefficients at junctions.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**Vector Relation and Gradient:** Vector relation in Rectangular, cylindrical, spherical and general curvilinear coordinate system. Concept and physical interpretation of gradient, Divergence and curl, Green's Stoke's and Helmholz theorems.	**6**
3.	**Electrostatics:** Electric field due to various charge configurations, Electric field vectors: Electric field intensity, flux density and polarization, Electric potential and displacement vector, Gauss's law, Poisson's and Laplace's equation and their solution, Uniqueness theorem, Continuity equation, Electrostatic energy, Field determination by method of images, Boundary conditions.	**6**
4.	**Magnetostatics:** Magnetic field vector: Magnetic field intensity, flux density and magnetization, Biot-Savart's law, Ampere's law, Magnetic vector potential, Energy stored in magnetic field, Interaction of moving charge and current with magnetic field, Boundary conditions, Analogy between electric and magnetic fields.	**6**
5.	**Time Varying Fields:** Faraday's law, Displacement current and equation of continuity, Maxwell's equations, Uniform plane wave in free space, Dielectrics and conductors, Skin effect, Reflection of a plane wave at normal incidence, Standing wave ratio, Pointing vector and power considerations.	**6**
6.	**Radiation and Transmission Line:** Retarded potentials and concepts of radiation. Alternating current element and power radiated by Hertzian dipole. Radiation resistance. Wave velocity and wave impedance, Transmission line equation, Solution for loss-less lines, Reflection and Transmission coefficients at junctions.	**6**
	Total	**31**

Suggested Books:

1. G. S. N. Raju: Electromagnetic Field Theory and Transmission Lines, Pearson.
2. V.V. Sarwate: Electromagnetic Field and Waves, Willey Eastern Ltd.
3. Hayt: Engineering Electromagnetics, McGraw-Hill Education.
4. Matthew N. O. Sadiku: Principles of Electromagnetics, Oxford.

III Year VI Semester

6EX5-13: Biomedical Instrumentation	
Credit: 2	Max Marks: 100 (IA: 30, ETE: 70)
2L+ 0T+ 0P	End Term Exams: 2 hrs.

Course Outcomes:

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

CO-1: Learn the basics of physiology and anatomy of human body sub-systems.
CO-2: To learn about generation of bio-potentials, working of bio-transducers and bio-electrodes.
CO-3: Learn functioning of various medical instruments.
CO-4: Learn safety standards used in biomedical equipment.

S. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course.	1
2.	**Transducers and Electrodes:** Principles and classification of transducers for Bio-medical applications, Electrode theory, Different types of electrodes, Selection criteria for transducers and electrodes. **Bio-potentials-** Electrical activity of excitable cells, ECG, EMG, EEG, ERG, EOG.	4
3.	**Cardiovascular System Measurements:** Measurement of blood pressure, Blood flow, Cardiac output, Cardiac rate, Heart sounds, Electrocardiograph, Phonocardiograph, Plethysmograph, Echocardiograph.	5
4.	**Instrumentation for Clinical Laboratory:** Measurement of pH value of blood, ESR measurement, Hemoglobin measurement, O_2 and CO_2 concentration in blood, GSR measurement. Spectrophoto-metry, Chromatography, Hematology.	5
5.	**Medical Imaging**: Diagnostic X-rays, CAT, MRI, Thermography, Ultrasonography, Medical use of isotopes, Endoscopy.	4
6.	**Patient Care, Safety Measures and Biotelemetry:** Elements of Intensive care monitoring, Basic hospital systems and components, Physiological effects of electric currents, Shock hazards from electrical equipments, Safety measures, Standards & practices. **Biomedical telemetry:** Introduction, block diagram and description of single channel/multi-channel telemetry systems.	6
7.	**Therapeutic and Prosthetic Devices:** Introduction to cardiac pacemakers, Defibrillators, Ventilators, Muscle stimulators, Diathermy, Heart lung machine, Hemodialysis, Applications of Laser.	5
	Total	**30**

Suggested Books:

1. Biomedical Instrumentation and Measurements By Cromwell, 2nd edition, Pearson Education
2. Medical Instrumentation Application and Design, John G. Webster, John Wiley and sons,

New York
3. Handbook of Biomedical Instrumentation By R. S. Khandpur, TMH
4. Introduction To Biomedical Equipment Technology By Carr & Brown
5. Biomedical Digital Signal Processing, Tompkins, PHI

III Year VI Semester

6EX4-20: Power Electronics Lab	
Credit: 1.5	Max Marks: 100 (IA:60, ETE: 40)
0L+0T+3P	End Term Exams: 3 hrs.

Course Outcomes:
Upon successful completion of the course, the students will be able to:

CO-1: To plot and study characteristics of devices SCR, MOSFET, IGBT and their switching behaviour.

CO-2: To convert fixed dc to variable dc using dc-dc converter circuits.

CO-3: Study operation of semi-controlled and full-controlled operation of 1-phase & 3-phase rectifier.

CO-4: Study operation three -phase bridge inverter and obtain harmonic profile.

S. No.	List of Experiments	Hours
1.	Determine V-I characteristics of SCR and measure forward breakdown voltage, latching and holding currents.	3
2.	Find output and transfer characteristics of MOSFET and IGBT.	3
3.	Study the Buck, Boost, Buck-Boost converter circuit and obtain output waveforms.	3
4.	Study the natural, forced, auxiliary and resonant commutation circuits.	3
5.	Study and obtain waveforms of single-phase half wave controlled rectifier with and without filters.	3
6.	Study and obtain waveforms of single-phase full controlled bridge converter with R and RL loads.	3
7.	Study and obtain waveforms of Three-phase full controlled bridge converter with R and RL loads.	3
8.	Study and perform an experiment on the operation of single-phase bridge inverter with sinusoidal pulse width modulation method.	3
9.	Study the operation and harmonic profile of three -phase bridge inverter with sinusoidal pulse width modulation method.	3
10.	Control the speed of a DC motor using single-phase half -controlled rectifier. Plot armature voltage versus speed characteristics.	3
	Total	**30**

III Year VI Semester

6EX4-21: Power System Lab	
Credit: 1.5	**Max Marks: 100 (IA: 60, ETE: 40)**
0L+ 0T+ 3P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Create the MATLAB Simulink model of Swing Equation, synchronous and induction machine.

CO-2: Draw the responses of the synchronous machine with the PSS and excitation system.

CO-3: Demonstrate the Single Machine Infinite Bus (SMIB) system by writing a script in MATLAB.

CO-4: Simulate models of wind power system and solar PV system.

S. No.	List of Experiments	Hours
1.	Simulate Swing Equation in MATLAB Simulink and get its responses under different disturbance conditions.	3
2.	Model and simulate the Synchronous Machine and draw its outputs.	3
3.	Model and simulate the Induction Machine and obtain its outputs.	3
4.	Modeling and simulation of Synchronous Machine with PSS.	3
5.	Modeling and simulation of Synchronous Machine with excitation system.	3
6.	Write a script in MATLAB to simulate the Single Machine Infinite Bus (SMIB) system.	3
7.	Write a script in MATLAB to simulate the wind power generation system.	3
8.	Model and simulate the solar PV system. Verify the responses by writing a script in MATLAB.	3
9.	To study the operation of micro-controller based over current relay in DMT type and IDMT type.	3
10.	To study the micro-controller based under voltage relay and Over Voltage Relay.	3
	Total	**30**