Scheme of Instruction and Syllabi

of

BE V & VI SEMESTERS

of

FOUR YEAR DEGREE COURSE

in

ELECTRICAL AND ELECTRONICS ENGINEERING

(AICTE Model Curriculum with effect from AY 2020-21)

R-20 Regulation

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(Autonomous Institution under UGC,Affiliated to Osmania University)
Department of Electronics & Communication Engineering
Accredited by NBA and NAAC-UGC,
Chaitanya Bharathi (Post), Gandipet, Hyderabad-500075

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

OUR MOTTO: SWAYAM TEJASWIN BHAVA

Institute Vision	To be a centre of excellence in technical education and research.	
Institute Mission	To address the emerging needs through quality technical education and advanced research.	
Department Vision	To achieve Academic and Professional Excellence in Teaching and Research in the frontier areas of Electrical and Electronics Engineering Vis-a -Vis serve as a Valuable Resource for Industry and Society.	
Department Mission	M1	Emphasis on providing Strong Theoretical Foundation & Engineering Leadership Eminence, infusion of Creativity and Management skill while maintaining Ethics and Moral for Sustainable Development. **(Individual development**)
	M2	Enable the Faculty and Student Interactions to trigger interest for Applied Multidisciplinary Research and Entrepreneurship Culture resulting in Significant Advancement of the field of Specialization with Involvement of Industries and Collaborative Educational Networks. **(Sense of Ownership, Networking and Eco system Development)**
	M3	Extend the Conducive Neighborhoods for Innovation in frontier areas to keep pace with Environmental, Societal and Technological Developments of the National and International Community to Serve Humanity. **(Service to Society, Atmanirbhar Bharat)**
PEO 1		Ennoble in offering Design solutions for Complex Engineering Problems using appropriate modern Software tools, with the specified need of the Industry and Protagonist in transforming the Society into a Knowledge Society.
PEO 2		Elevate Engineering Leadership and will be recognized as Experts working in in Government, Consulting firms, International organizations with their Creativity in Design of Experiments, Analysis and Interpretation of Data and Synthesis of Information.
PEO 3		Exalt in their Professional career by Persistence in Team work, Ethical behavior, Proactive involvement, and Effective Communication.
PEO 4		Excel by becoming Researches , Professors and Entrepreneurs who will create and Disseminate new knowledge in the frontier areas of Engineering , Technology and Management.
PSO 1		Evaluate complex Engineering Problems to meet the distinct need of Industry & Society, by utilizing knowledge of Mathematics, Science, Emerging Technologies such as AI, Block chain & IT tools.
PSO 2		Exhibit Latent talent in understanding the Engineering and Administration standards at work place as a team leader to manage Projects in the Multi-Disciplinary Environments.
PSO 3		Establish Engineering Expertise in Power system, Machines and Drives Systems and also Pursue Research in the Frontier areas such as Embedded systems, Renewable Energy, E-Mobility and Smart grid.

Program Outcomes of B.E (EEE) Program

1. Engineering Knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems
2. Problem Analysis	Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/Development of Solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4. Conduct Investigations of Complex Problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern Tool Usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6. The Engineer and Society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and Sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and Teamwork	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10.Communication	Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11.Project Management and Finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12.Life-long Learning	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

V- SEMESTER

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum with effect from AY 2022-23

B.E (Electrical and Electronics Engineering)

SEMESTER – V

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20 EE C17	**Core – 10** Electrical Machines-II	3	-	-	3	40	60	3
2	20 EE C18	**Core -11** Power Systems -II	3	-	-	3	40	60	3
3	20 EE C19	**Core -12** Microcontrollers and Applications	3	-	-	3	40	60	3
4	20 EE C20	**Core -13** Control Systems	3	-	-	3	40	60	3
5	20 EE Exx	**PE- I**	3	-	-	3	40	60	3
6	20 EE Exx	**PE-2**	3	-	-	3	40	60	3
7	20 xx Oxx	OE-1	3	-	-	3	40	60	3
PRACTICALS									
8	20 EE C21	Control Systems Lab	-	-	2	3	50	50	1
9	20 EE C22	Electrical Machines- II Lab	-	-	2	3	50	50	1
10	20 EE C23	Microcontrollers and Applications Lab	-	-	2	3	50	50	1
11	20EGCO3	Employability Skills	-	-	2	3	50	50	1
12	20 EE I02	Industrial / Rural Internship	3-4 Weeks/90 Hours				50	--	2
Total			**21**	**-**	**08**	**-**	**530**	**620**	**27**
Clock Hours Per Week: 29									

L: Lecture **P: Practical/Project Seminar/Dissertation** **CIE: Continuous Internal Evaluation**
T: Tutorial **SEE: Semester End Examination**

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum with effect from AY 2022-23

B.E (Electrical and Electronics Engineering)

SEMESTER – V

List of Courses in Program Elective-I		List of Courses in Program Elective-II	
Course code	**Title of the Course**	**Course code**	**Title of the Course**
20 EE E11	Electrical Distribution Systems	20 EE E21	High Voltage Engineering
20 EE E12	Advanced Power Converters	20 EE E22	Switch Mode Power Converters
20 EE E13	Simulation Techniques in Electrical Engineering	20 EE E23	Optimization Techniques
20 EE E14	Electronic Instrumentation	20 EE E24	Renewable Energy Technologies
20 EE E15	Electrical Machine Design	20 EE E25	Special Electrical Machines
20EE E16	Computer Architecture and Organization	20EE E26	Basic VLSI Design

20EEC17

ELECTRICAL MACHINES - II

(Semester-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Electrical Engineering, Machines and Circuit analysis.

Course Objectives: This course aims to:

1. To understand the construction and operation of AC machines.
2. To analyze the performance aspects of induction motor and Synchronous generator.
3. To discuss about Synchronous Motor performance and its starting methods.

Course Outcomes: After completion of this course, students will be able to:

1. Acquire the knowledge of Constructional and operational features of ac machines.
2. Understand the various starting methods and speed control of ac machines.
3. Explain the concepts of ac machines.
4. Describe the applications of ac machines.
5. Analyse the performance characteristics of ac machines.

UNIT-I

Fundamentals of AC machine windings: Slots for windings, Harmonics (slot and teeth Harmonics),Suppression of Harmonics, full-pitch and short pitch coils, concentrated winding, distributed winding, pitch factor, distribution factor - Numerical problems.

UNIT-II

Three phase Induction Machines: Review of Construction and Operational features, equivalent circuit, torque expression, starting torque, maximum torque, torque-slip characteristics, parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency), cogging and crawling, power flow, losses and efficiency, no load and blocked rotor test-Numerical predetermination of performance characteristics using circle diagram, Doubly fed induction generator(DFIG). Starting methods: primary resistors, auto transformer, star-delta and DOL starting. Speed control methods from stator and rotor side.

UNIT-III

Single-phase induction motors : Constructional features double field revolving theory,Split phase, Shaded pole and Capacitor type motors, equivalent circuit, applications.

UNIT-IV

Synchronous generators: Constructional features, cylindrical and salient pole rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, open circuit, short circuit and zero power factor characteristics, voltage regulation by EMF, MMF and ZPF method, Salient pole alternators two reaction theory, Phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division**.** Analysis of short circuit current wave form – determination of sub-transient, transient and steady state reactance's.

UNIT-V

Synchronous motor : Theory of Operation, methods of starting, variation of current and power factor with excitation. on no load and on load-V and inverted V curves. Hunting and its prevention. Synchronizing power, Synchronous condenser.

Text Books:

1. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. J.B Gupta , S.K. Kataria & Sons, "Theory and performance of electrical machines", 14th Edition, 2014.
4. Ashfaq Hussain "Electrical Machines" Danapatrai and sons, 3rd Edition 2012.

Suggested Reading:

1. A.E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
4. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.
5. Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova, "Design of Rotating Electrical Machines", John Wiley & Sons, Ltd. 2008.

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	--	--	--	--	--	--	--	1	2	2
CO2	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO3	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO4	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO5	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2

20 EE C18

POWER SYSTEMS -II

(Semester-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power Systems-I

Course Objectives:

1. To understand the modelling of transmission lines and their performance calculations
2. To understand per unit representation of power systems and fault calculation analysis
3. To understand the causes of over voltages and power flow analysis of given power system.

Course Outcomes: After completion of this course, students will be able to:

1. Analyse the performance of different types of transmission lines and evaluate the corona effect on transmission lines
2. Understand the application of per unit quantities in power systems
3. Classify different types of faults and apply symmetrical components to solve the power system problem when subjected to different fault conditions
4. Describe the causes of over voltages and analyse reflection and refraction coefficients of overhead lines and cables
5. Apply Gauss Seidel method and Newton-Raphson method to find power flows and voltages of the given power system.

UNIT-I

Modelling of Transmission Lines: Short, medium, long lines, Line calculations, Tuned Lines, Surge impedance loading, Travelling wave equations, series and shunt compensation of Transmission lines, numerical problems; Corona: Causes, Disruptive and Visual Critical Voltages, Power loss, minimization of Corona effects.

UNIT-II

Per Unit Representation: Use of per unit quantities in power systems, Advantages of per unit system. Symmetrical Faults: Typical waveform under balanced terminal short circuit conditions: steady state, transient and sub transient equivalent circuits, Reactance of Synchronous Machines, fault calculations, Short circuit capacity of a bus.

UNIT-III

Unsymmetrical Faults: Symmetrical components of unsymmetrical Phasors, Power in terms of symmetrical components, sequence impedance and sequence networks. Sequence networks of unloaded generators, Sequence impedances of circuit elements, Single line to ground, line-to-line and double line to ground faults on unloaded generator, Unsymmetrical faults of power systems.

UNIT-IV

Transients in Power Systems: Generation of Over-voltages: Causes of over voltages, lightning and Switching Surges, Reflection and refraction coefficients, Junction of cable and overhead lines, Junction of three lines of different natural impedances, Bewley Lattice diagram.

UNIT-V

Power Flow Analysis: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations- Gauss Seidel and Newton-Raphson methods for the solution of the power flow equation.

Text Books:

1. J.J Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. C.L. Wadhwa, "Electric Power Systems Theory", New Academic Science Limited, 2012

Suggested Reading:

1. A.R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
2. D.P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
3. B.M. Weedy, B.J. Cory, N. Jenkins, J. Ekanayake & G. Strbac, "Electric Power Systems".

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	-	3	--	--	--	--	--	--	--	2	3	1
CO2	3	3	2	2	2	--	--	--	--	--	--	--	2	3	2
CO3	3	3	1	--	3	--	--	--	--	--	--	--	2	3	--
CO4	3	3	2	2	3	--	--	--	--	--	--	--	3	3	2
CO5	3	3	2	3	3	--	--	--	--	--	--	--	3	3	2

20EE C19

MICRO CONTROLLERS AND APPLICATIONS

(Semester-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have basic knowledge of Digital Electronics and programming in C language.

Course Objectives: This course aims to:

1. To Understand the fundamentals and Programming using 8051 Microcontroller
2. To Understand Programming and interfacing using 8051 Microcontroller.
3. To understand the fundamentals and programming using ARM 7 controller

Course Outcomes: After completion of this course, students will be able to:

1. Understand the internal architecture of 8051 Microcontroller
2. Do Assembly Language Programming using 8051 Microcontroller.
3. Interface Application devices to 8051 Microcontroller and Communication Protocols
4. Understand the internal architecture of ARM controller
5. Programming using ARM controller LPC 2148

UNIT – I

Fundamentals of processors controllers and the 8051 Architecture::

Fundamentals of Microprocessor, Basic Block Diagrams of Microprocessor and Microcontroller, Role of Microcontrollers in embedded Systems. 8051 microcontroller- Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles, timers, counters.

UNIT – II

Instruction Set and Programming: Instruction syntax, Data types, Addressing modes. 8051 Instruction set, Instruction timings, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools

UNIT – III

External Communication and Application Interface: Interfacing Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, memory devices. LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

Communication protocols: Brief overview on RS232, I^2C, SPI, CAN, Blue-tooth and Zig-bee..

UNIT – IV

ARM: Introduction to RISC Processors, ARM Design Philosophy, ARM Processor families, Architecture- Revisions, Registers, Program status register, Pipeline, Introduction to Exceptions.

ARM 7 Microcontroller (LPC2148): Salient features of LPC 2148, Pin description of 2148, Architectural Overview. ARM 7(LPC2148) Peripherals: Description of General-Purpose Input/output (GPIO) ports, Pin control Block. Features, Pin description, Register description and operation of PLL, Timers, PWM, ADC, DAC.

UNIT – V

ARM Instruction Set : ARM data types, Data processing instructions, Branch instructions, Load-Store instructions, Software interrupt instruction, Program Status Register instructions, Loading constants, and Conditional executions. Introduction to THUMB instructions: Differences between Thumb and ARM modes, Register usage.

Text Books:

1. M . A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, 2007.
2. Andrew N.Sloss, Domonic Symes, Chris Wright, "ARM System Developers Guide Designing and Optimizing system software", 1/e, Elsever, 2004.
3. Andew N.Sloss, Dominic Symes, Chris Wright, "ARM system developers Guide - Designing and optimizing system".

Suggested Reading:

1. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning,2004.
2. Lyla B. Das, "Architecture, Programming and Interfacing of Low-power Processors-ARM 7, Cortex-M", CENGAGE, 2017.
3. David E Simson, "Embedded system Primer", Pearson Publication

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO2	2	3	3	2	1	-	-	-	-	-	-	-	1	2	-
CO3	2	3	3	2	1	-	-	-	-	-	-	-	1	3	1
CO4	2	2	2	2	1	-	-	-	-	-	-	-	1	1	1
CO5	1	2	2	1	1	-	-	-	-	-	-	-	1	1	2

With effect from the academic year 2022-2023

20EEC20

CONTROL SYSTEMS

(Semester-V)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have a prior knowledge of Newton's laws, Circuit theory, Vector Calculus & Differential Equations, Laplace transform and their properties and linear algebra**.**

Course Objectives:

1. To understand different types of linear control systems and their mathematical modeling.
2. To study the stability analysis both in time and frequency domains.
3. To study the concepts of State space representation of Linear Time invariant systems (LTI).

Course Outcomes: After completing this course, students will be able to:

1. Understand different mathematical models for any electromechanical LTI systems.
2. Determine the Transfer function of an LTI system using block diagram & signal flow graph approach.
3. Analyze the given first and second order systems based on their performance parameters &PID controllers
4. Analyze absolute and relative stability of an LTI system using time and frequency domain techniques.
5. To understand the concepts of compensators and be able to draw its frequency response
6. Develop various state space models for LTI systems and to determine its Controllability and Observability.

UNIT-I

Introduction to Control Systems: Open loop, closed loop System with illustrations and other classification of control systems, Impulse response and Transfer Function, Mathematical modeling of Mechanical and Electrical Systems, Analogous systems, Feedback control characteristics - effects of feedback.

UNIT-II

Mathematical Models of Physical Systems: Introduction of servo motors & Synchro pair, Modeling of armature and field-controlled D.C motors, Block diagram algebra, Signal flow graphs and problems on conversion from block diagram to signal flow graph.

UNIT-III

Time Response Analysis: Standard test signals, Time response of first and second order systems for standard test inputs, Application of initial and final value theorem, Static error coefficients and steady state error (for standard test input signals), Performance parameters of a second-order systems based on the time-response. Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, root locus technique, Typical systems analyzed by root locus technique, Response with P, PI & PID controllers

UNIT- IV

Frequency Response Analysis: Introduction, Frequency domain specifications for a second order system, Relationship between time and frequency response, Bode plots, Polar plots, Nyquist stability criterion, Relative stability using Nyquist criterion. Stability analysis of plots based on gain and phase margin, Introduction to Lag and Lead networks and their Transfer functions.

UNIT-V

State Variable Analysis and Introduction to Discrete Control Systems: Concepts of state, state variable, State models of linear time invariant systems, Derivation for state models from transfer functions and differential equations, State transition matrix and its properties, Solution of state equations in time & Laplace domain, Eigen values and Stability Analysis, Concept of Controllability and Observability. Introduction to discrete control systems.

Text Book:

1. I.J. Nagrath, M. Gopal, Control System Engineering, New Age International (P) Limited Publishers, 5th Edition, 2008.
2. B.C. Kuo, Automatic Control Systems, John Wiley and son's Publishers, 9th edition, 2009
3. K. Ogata, Modern Control Systems, 5th Edition.PHI publication, 2010.
4. A. Anand Kumar, Control Systems, 2nd Edition, PHI publications, 2014.

Suggested Readings:

1. M.Gopal, Control Systems Principles and Design- Tata McGraw Hill, 2nd Edition, 2003.
2. N.C Jagan-control Systems, 2nd Edition, BS Publications, 2008
3. N. Nise, Control Systems Engineering, 6th edition, Willey Publications, 2011

CO-PO & PSO Correlation Articulation Matrix:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	2	2	-	-	-	-	-	-	-	2	-	2
CO-2	3	2	2	1	1	-	-	-	-	-	-	-	1	-	1
CO-3	3	2	1	3	2	-	-	-	-	-	-	-	1	-	2
CO-4	3	3	2	3	3	-	-	-	-	-	-	-	2	-	2
CO-5	3	2	2	2	3	-	-	-	-	-	-	-	2	-	2
CO-6	3	3	3	3	3	-	-	-	-	-	-	-	3	-	3

With effect from the academic year 2022-2023

20EE E11

ELECTRICAL DISTRIBUTION SYSTEMS

(Semester-V- Program Elective-1)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power systems-II, Switchgear and Protection

Course Objectives: The Objectives of the Course are:

1. Tostudytheloadcharacteristicsofdistributionsystemsandunderstandthesubstationschemes,voltagedropcalculationofdifferentservice areas.
2. Toknowaboutprimaryandsecondarydistributionsystemsandtheircharacteristics.
3. To study different voltage control methods and applications of capacitors in distribution systems

Course Outcomes: After Completion of the Course, Student will be able to:

1. Solve the problems on load factor, loss factor, coincidence factor and discuss the characteristic so floads along with load growth
2. Illustratethesubstationbusschemesanddeterminetherating,voltagedropofsubstations
3. Describe types and characteristics of primary and secondary distribution system and find voltage drop and power losses.
4. Find voltage drop and power loss of three-phase & non-three phase lines and analyzethedistributioncostsandvoltagecontrolmethodsinthedistributionsystem
5. Calculate the reactive power requirements of the distribution system and summarize the functions and communications used in distribution automation

UNIT-I

Load Characteristics: Demand,demandcurve,loaddurationcurve,Diversifieddemand,Non-coincident Demand, Coincidence factor, Contribution factor problems, Relationship between load and loss factors load growth, Rate structure, Customer billing, Classification of loads (residential, commercial, agricultural, and industrial) and their characteristics.

UNIT-II

Sub-Transmission Lines and Substations: Types of sub-transmission lines, Distribution substations, Substation bus schemes, Rating of distribution substation, Service area with multiple feeders, Percent voltage drop calculations.

UNIT-III

Primary and Secondary Feeders: Types of primary systems, Radial type, Loop type and Primary network, Primary feeder loading, Radial feeder with uniformly distributed load, Secondary voltage levels, Secondary banking, Secondary networks.

UNIT-IV

Voltage Drop and Power Loss Calculations: Voltage drop and power loss calculations, 3-phase, Non 3-phaseprimary lines, Single phase two-wire laterals with ungrounded neutral, Single phase two wire ungrounded laterals, two phase plus neutral lateral, Method to analyze distribution costs, Voltage control methods, Feeder voltage regulators.

UNIT-V

Application of Capacitors to Distribution Systems: Effects of series and shunt capacitors, Power factor correction, Economic justification for capacitors, Location and sizing of capacitors in distribution system.

Distribution System Automation: Definitions, control functions, Level of penetration of DA, Types of communication systems, Supervisory control and data acquisition.

Text Books:

1. Turan Gonen, Electric Power Distribution Engineering,TMH,3rdEdition,2016.
2. A.S.Pabla,ElectricPowerDistribution,TMH,6thEdition,2012.

Suggested Readings:

1. M.K.Khed Kar, G.M.Dhole, Electric Power Distributionautomation,LaxmiPublications,2010.
2. William Kersting, Distribution System Modelling and Analysis,3rdEdition CRCPress,2015.
3. S.Sivanagaraju, and V.Sankar, Electric Power Distribution and Automation, Dhanpat Rai& Co,2012

CO-PO & PSO Correlation Articulation Matrix:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO-2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO-3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO-4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO-5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1

20EE E12

ADVANCED POWER CONVERTERS

(Semester-V- Program Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Power Electronics

Course Objectives:

1. To study various modern power electronic devices and different power factor improvement techniques in converters.
2. To study the concepts of Multi pulse and Multilevel power electronic circuits.
3. To understand different applications of power converters.

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

1. Outline various features and electrical specifications for a chosen modern power electronic device.
2. Understand different power factor improvement techniques in converters.
3. Comprehend the operation of Multi-Pulse converters and design its performance parameters.
4. Apply the concepts of different Multilevel Inverters that suits for industrial applications.
5. Recognize the applications of power converters.

UNIT 1:

Modern Power Semiconductor Devices: Gate Turn Off- SCR(GTO-SCR), MOS Turn off Thyristor (MTO), Emitter Turn Off Thyristor (ETO), Integrated Gate Commutated Thyristor (IGCTs), MOS-controlled Thyristors (MCTs), symbol, structure and equivalent circuit, comparison of their features.

UNIT 2:

Power factor Improvement Techniques: Power factor improvements – extinction angle control- symmetrical angle control- PWM control- SPWM control.

UNIT 3:

Multi-Pulse converters: Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation

UNIT 4:

Multilevel Inverters: Multilevel concept, Classification of multilevel inverters, Diode clamped Multilevel inverter, principle of operation, main features, improved diode Clamped inverter, principle of operation, flying capacitors multilevel inverter, principle of operation, main features, cascaded multilevel inverter, principle of operation, main features, Multilevel inverter applications.

UNIT 5:

Applications of Power converters: AC power supplies, classification, switched mode AC power supplies, online and offline Uninterruptible Power supplies applications. DC circuit breakers

Text Books:

1. Mohammed H. Rashid, "Power Electronics, Devices, circuits and applications", Pearson Education, 4th Edition, 2017.
2. Ned Mohan Tore M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 3rd Edition, 2007.

Suggested Reading:

1. H. W. Whittington, B. W. Flynn and D. E. MacPherson, "Switched Mode Power Supplies, Design and Construction", Universities Press, 2009 Edition.
2. Umanand L., Bhat S.R., "Design of Magnetic Components for Switched Mode Power Converters", Wiley Eastern Ltd., 1992
3. Robert. W. Erickson, D. Maksimovic, "Fundamentals of Power Electronics", Springer International Edition,2013

CO-PO & PSO Correlation Articulation Matrix:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	2	3	3	1
CO2	3	3	1	-	-	-	-	-	-	-	-	2	3	3	1
CO3	3	2	1	-	-	-	-	-	-	-	-	2	3	3	1
CO4	3	2	1	-	-	-	-	-	-	-	-	2	3	3	1
CO5	2	1	1	-	-	-	-	-	-	-	-	2	3	3	1

20EE E13

SIMULATION TECHNIQUES IN ELECTRICAL ENGINEERING

(Semester-V-Program Elective-I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have prior knowledge on basic programming languages

Course Objectives: This course aims to:
1. To introduce basics of MATLAB
2. To build knowledge about matrices and plots
3. To introduce various simulation techniques and computational methods using MATLAB

Course Outcomes: After completion of the course, students will be able to:
1. Understand the basics of MATLAB programming
2. Apply matrix mathematics and functions for solution of linear and nonlinear equations
3. Understand the use of plots for visualization of the numerical solution. Develop and run the m-files
4. Analyse the basic electrical and networks applications in MATLAB environment
5. Analyse the computational Intelligence Techniques in MATLAB environment

UNIT-I
Basics: MATLAB environment, variables, Basic data types, Relational and Logic operators, Conditional statements, Input and Output, Loops and bracing.

UNIT-II
Matrices: Creating and Manipulating matrices, Matrix mathematics and Matrix functions, Colon operator, Line space, Cross product, Dot product, Logical functions, Logical indexing, 3 – dimensional arrays, Cell arrays, Structures.

UNIT-III
Plotting and M –file Scripts: Plotting: 2-D and 3-D plots: Basic plots, subplots, Histograms, Bar graphs, Pie charts, Creating saving and running an M–file, creating and running of a function, function definition line, H1 and help text lines, Function body, Sub – functions, File I/O handling

UNIT-IV
Basic Electrical and Networks Applications: Analysis of electrical networks-solution of series-parallel circuits, solution of mesh and nodal analysis, Network theorems-validation of Maximum power transfer theorem and verification of super position theorem, solution of linear differential equations-solution of First-Order differential equation-AC signal waveform analysis-resonance-Frequency response of a low-pass filter

UNIT-V
Computational Intelligence Techniques: Introduction to optimization- Teaching Learning Based Optimization (TLBO) - Particle Swarm Optimization (PSO) -Artificial Bee Colony (ABC) Algorithm- Implementation of TLBO, PSO and ABC algorithms using MATLAB for Sphere function-Booth function-Himmelblau's functions.

Text Books:
1. D Hanselman and B little field, “Mastering MATLAB 7”, Pearson Education, 2005.
2. Y Kirani Singh and B B Chaudhari, “MATLAB Programming”, Prentice Hall of India, 2007.
3. Dr. Shailendra Jain, “Modeling and Simulation using MATLAB-Simulink, Wiley publication, second edition, 2015

Suggested Reading:

1. Xin-She Yang, "Engineering Optimization An Introduction with Metaheuristic Applications", Wiley publications, 2010
2. A Gilat, "MATLAB: An Introduction with Applications", John Wiley and Sons, 2004

CO-PO & PSO Correlation Articulation Matrix:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	-	-	-	-	-	-	-	1	1	-
CO2	3	3	1	2	2	-	-	-	-	-	-	-	1	2	-
CO3	3	3	2	1	2	-	-	-	-	-	-	-	2	2	-
CO4	3	3	2	2	3	-	-	-	-	-	-	-	2	2	-
CO5	3	3	2	2	3	-	-	-	-	-	-	-	2	2	-

20EE E14

ELECTRONIC INSTRUMENTATION

(Semester-V-Program Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have a prior knowledge of Electrical Measurements and Instrumentation .

Course Objectives: This course aims to:

1. To impart a basic knowledge of International Standards for various physical quantities and to provide a basic understanding of measurement systems.
2. To expose the students to many varieties of transducers, measuring instruments, their Operating principles and construction.
3. To introduce students to various types of spectrum analyzers, virtual instrumentation techniques and their applications and an exposure to some of the prominent bio-medical Instrumentation systems.

Course Outcomes: After completion of this course, students will be able to:

1. Understand the various standards available for the measurement process.
2. Evaluate and perform accurate measurements for any engineering system with clear idea of the potential errors
3. Understand the working principles of various transducers
4. Analyse the working principles of instruments like spectrum analyzer, DSO and other virtual instrumentation techniques for appropriate measurements.
5. Understand the fundamentals of various Biomedical instrumentation systems.

UNIT– I

Introduction to Instrumentation: Accuracy and Precision - Conformity and Significant figures, Resolution and Sensitivity, Types of Errors, loading effect, Absolute errors and Relative errors, Measurement of error combinations, Statistical analysis, Probable error and Limiting errors, Calibration, IEEE standards, Elements of ISO 9001, Quality management standards.

UNIT–II

Transducers-I: Classification of transducers, factors for selection of a transducer, Passive electrical transducers: Strain gauges - gauge factor, types of strain gauges - bonded and un-bonded, rosettes, LVDT - construction and displacement measurement, Capacitive transducer and thickness measurement. Active electrical transducers: Piezo-electric transducer and different modes of operation, photo-conductive, photo-voltaic and photo - emissive transducers, semiconductor stain gauges.

UNIT–III

Transducers-II: Characteristics of sound, pressure, power and intensity levels. Microphones and their types. Temperature measurement, Resistance wire thermometers, semiconductor thermometers and thermocouples. Introduction to Micro-Electro-Mechanical Systems (MEMS)

UNIT – IV

Digital Instruments: Block diagram, specification and design considerations of different types of DVMs.Spectrum analyzers. Delayed time base oscilloscope, Digital storage oscilloscope. Introduction to Virtual Instrumentation, SCADA. Data Acquisition System- block diagram

UNIT–V

Applications of Instrumentation: Human physiological systems and related concepts. Bio-potential electrodes Bio-potential recorders - ECG, EEG, EMG and CT scanners, magnetic resonance and imaging systems, Ultrasonic Imaging systems.

Text Books:

1. Albert D. Helfric, and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI, 2010.
2. H S Kalsi, "Electronic Instrumentation", 3/e, TMH, 2011.
3. Nakra B.C and Chaudhry K.K., "Instrumentation, Measurement and Analysis", TMH, 2004

Suggested Readings:

1. David A. Bell, "Electronic Instrumentation & Measurements" PHI, 2nd Edition, 2003.
2. Khandpur. R.S., "Handbook of Bio-Medical Instrumentation", TMH, 2003.
3. Leslie Cromwell and F.J. Weibell, E.A. Pfeiffer, "Biomedical Instrumentation and Measurements", PHI, 2nd Ed, 1980

CO-PO & PSO Correlation Articulation Matrix:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	1	-	-	-	-	-	-	1	-	1	1	1	1
CO-2	3	2	1	-	-	-	-	-	-	1	-	1	1	2	1
CO-3	3	2	1	-	-	-	-	-	-	1	-	1	1	1	1
CO-4	3	2	2	-	-	-	-	-	-	1	-	1	1	2	1
CO-5	3	2	2	-	-	1	-	-	-	1	-	1	1	2	-

20EE E15

ELECTRICAL MACHINE DESIGN

(Semester-V-Program Elective-I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Electrical Engineering, Machines and Circuit analysis.

Course Objectives: This course aims to:

1. To understand the design parameters of various electrical machines**.**
2. To analyze the electrical and mechanical characteristics of electrical machines**.**
3. To become familiar with CAD usage

Course Outcomes: After completion of this course, students will be able to:

1. Calculate the various parameters required for designing.
2. Acquire the knowledge of Output equation and cooling methods.
3. Obtain the Main dimensions of AC machines.
4. Design the AC electrical machine for a given power rating.
5. Gain the concept of CAD

UNIT-I

Basics of Machine design aspects: Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT-II

Design of Transformers: Sizing of a transformer, main dimensions, KVA output for single and three-phase transformers, window space factor, overall dimensions, design of cooling tank, methods for cooling of transformers.

UNIT-III

Design of Induction Motors: Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, magnetizing current.

UNIT-IV

Design of Synchronous Machines: Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor.

UNIT-V

Computer aided Design (CAD): Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation.

Text Books:

1. A.K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.

Suggested Reading:

1. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
2. V. N. Mittle and Arvind Mittal "Design Of Electrical Machines" Standard Publishers Distributors, New Delhi, 2009.

CO-PO & PSO Correlation Articulation Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	--	1	--	--	--	--	--	--	2	3
CO2	3	2	3	1	1	--	--	--	--	--	--	--	--	2	3
CO3	3	2	3	--	--	--	2	1	--	--	--	--	--	--	1
CO4	2	1	1	2	3	1	--	--	--	--	--	2	3	1	1
CO5	1	2	2	--	1	--	--	--	--	--	--	1	3	1	1

20 EE E 16

COMPUTER ARCHITECTURE AND ORGANIZATION

(Semester-V-Program Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have basic knowledge of Digital Electronics

Course Objectives: This course aims:

1. To provide knowledge on overview of IAS computer function and addressing modes.
2. Hardware and software implementation of arithmetic unit to solve addition, subtraction, multiplication and division.
3. To provide knowledge of memory technologies, interfacing techniques and sub system devices.

Course Outcomes: After completion of this course, students will be able to:

1. Provide fundamentals on machine instructions and addressing modes.
2. Comprehend the various algorithms for computer arithmetic.
3. Analyse the performance of various memory modules in memory hierarchy.
4. Compare and contrast the features of I/O devices and parallel processors.
5. Outline the evaluation of memory organization

UNIT-I:

Introduction to Computer Architecture: Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU: Registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs.

UNIT-II :

Data representation and Computer arithmetic: Signed number representation, fixed and floating-point representations, character representation. Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format

UNIT-III:

CPU control unit design Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU. Memory system design: Semiconductor memory technologies, memory organization.

UNIT-IV:

Peripheral devices and their characteristics : Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB.

UNIT-V:

Pipelining and Memory organization: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency. Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Text Books:

1. M. M. Mano, Computer System Architecture, 3rd ed., Prentice Hall of India, 1993.
2. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, 4th Edition, Elsevier, 2012. 4.
3. Carl Hamacher, ZvonkoVranesic, SafwatZaky, NaraigManjikian, Computer Organization and Embedded Systems, McGraw-Hill Publishing, 2011

Suggested Reading:

1. John P. Hayes, Computer Architecture and Organization, McGraw-Hill, 1998
2. William Stallings, Computer Organization and Architecture: Designing for Performance, 8th Edition, Prentice Hall, 2006.

CO-PO & PSO Correlation Articulation Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO2	2	2	2	2	1	-	-	-	-	-	-	-	1	2	-
CO3	2	2	2	2	1	-	-	-	-	-	-	-	1	3	1
CO4	2	2	2	2	1	-	-	-	-	-	-	-	1	1	1
CO5	1	2	2	1	1	-	-	-	-	-	-	-	1	1	2

20EE E21

HIGH VOLTAGE ENGINEERING

(Semester-V-Program Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Fundamentals of Electromagnetics 2. Electric Power systems 3. Electrical Measurements

Course Objectives: This course aims to:
1. To know the breakdown mechanism in gases, liquids and solid dielectrics.
2. To understand the methods of generation and measurement of high voltages and currents.
3. To study the testing methods of HV electrical equipment and know about High Voltage laboratories.

Course Outcomes: After completion of the course, students will be able to:
1. Understand various breakdown processes in solid, liquid and gaseous insulating materials.
2. Acquire the knowledge about generation of DC, AC and impulse voltage and currents.
3. Know the measurement of DC, AC and impulse voltage & currents.
4. Gain knowledge about testing of HV equipment.
5. Explain about HV laboratories and safety precautions in HV labs.

UNIT-I

Breakdown in Gases: Mechanism of breakdown, Types of collisions, Ionization processes, Townsend's First and second Ionization coefficients, Townsend's breakdown mechanism, Streamer theory of breakdown, Paschen's Law, Corona discharges.

UNIT-II

Breakdown in liquid and solid insulating materials: Pure liquids and commercial liquids, Breakdown in pure and commercial liquid, Solid dielectrics and Composite dielectrics, Intrinsic breakdown, Electro-mechanical breakdown, Thermal breakdown, Breakdown due to treeing and tracking, Breakdown due to internal discharges.

UNIT-III

Generation of High Voltages and Currents: Generation of high DC voltages, Generation of high AC voltages, Generation of Impulse voltages and currents, Tripping and control of impulse generators.

UNIT-IV

Measurement of High Voltage and Currents: Measurement of Peak voltage, Impulse voltages and high Direct current measurements, Cathode Ray Oscillographs for Impulse voltage and current measurement, Measurement of dielectric constant and loss factor, Partial discharge measurements.

UNIT-V

High Voltage testing of Electrical Apparatus: Testing of Insulators, bushings, isolators, circuit breakers, Cables, Power capacitors and Power transformers. High Voltage laboratory, Indoor and Outdoor laboratories, Safety precautions in HV labs.

Text Books:

1. M.S.Naidu and V.Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.

2. C.L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.

Suggested Reading:

1. E.Kuffel, W.S.Zaengl and J.Kuffel, "High Voltage Engineering Fundamentals", Newness Publication, 2000.

2. M. Khalifa, "High Voltage Engineering: Theory and Practice", Dekker, 1990.

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	1	-	-	-	-	-	1	1	2	3	1	2	3
CO2	2	-	1	-	-	-	-	-	1	1	2	3	1	2	3
CO3	2	-	1	-	2	-	-	-	1	1	2	3	1	2	3
CO4	2	-	1	-	2	-	-	-	1	1	2	3	1	2	3
CO5	2	-	1	-	2	-	-	-	1	1	2	3	1	2	3

20EE E22

SWITCH MODE POWER CONVERTERS

(Semester-V-Program Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Students should have a prior knowledge of Power Electronics core course theory.

Course Objectives:

1. To study the design aspects of DC-DC converters and SMPS.
2. To comprehend the basic concepts of resonant converters.
3. To familiarize with the design of inductor, transformer for power converter circuits and to know various voltage control techniques in inverters.

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

1. Design different types of DC-DC converters.
2. Comprehend different types of SMPS for electrical applications.
3. Understand the operation of different resonant converters.
4. Design a suitable filter along with the suitable selection of transformer and switches that are used in power electronic converter circuits.
5. Compare different voltage control techniques in inverters.

UNIT-I

Basic Converter Circuits: Design of critical inductance and capacitance of Buck, Boost and Buck Boost Regulators, Cuk Converter Choice of Switching Frequency-Design Aspects

UNIT-II

Isolated SMPS: Fly back Converters, Forward Converters, Half Bridge and Full Bridge Converters, Push Pull Converters and SMPS with multiple outputs, Choice of Switching Frequency-Design Aspects

UNIT-III

Resonant Converters: Classification, Basic resonant circuit concepts, load resonant, Resonant switch converters, Resonant D.C Link Inverters with Zero Voltage Switching, High frequency Link Integral Half-Cycle converters.

UNIT-IV

Design of Inductor and Transformer: Selection of Output Filter Capacitor, Selection of Energy Storage Inductor, Design of High Frequency Inductor and High Frequency Transformer, Selection of Switches, Snubber Circuit Design.

UNIT-V

Voltage Control in Inverters: Voltage control Techniques in inverters, Bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage, three-phase sinusoidal modulation

Text Books:

1. Mohan N. Undeland . T & Robbins W, Power Electronics Converters, Application and Design. John Wiley, 3rd edition, 2007.
2. Mohammed H. Rashid, "Power Electronics, Devices, circuits and applications", Pearson Education, 4th Edition, 2017
3. H. W. Whittington, B. W. Flynn and D. E. MacPherson, Switched Mode Power Supplies, Design and Construction, Universities Press, 2009.

Suggested Reading:

1. Umanand L., Bhat S.R., Design of magnetic components for switched Mode Power Converters., Wiley Eastern Ltd.,1992
2. V. Ramanarayanan, Course Material on Switched Mode Power Conversion

CO-PO&PSO Correlation Articulation Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	2	2	--	--	--	--	--	--	--	2	2	2
CO-2	2	2	2	2	2	--	--	--	--	--	--	--	1	2	2
CO-3	3	2	1	2	1	--	--	--	--	--	--	--	1	2	2
CO-4	3	2	2	2	2	--	--	--	--	--	--	--	2	2	2
CO-5	2	2	1	2	2	--	--	--	--	--	--	--	2	2	2

20 EE E 23

OPTIMIZATION TECHNIQUES

(Semester-V-Program Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic mathematics

Course Objectives:

1. To study about classical optimization techniques which include single variable and multi-variable optimization with equality constraints
2. To study about linear programming and non-linear programming methods
3. To study about Genetic algorithms.

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

1. Solve the single variable and multi variable problems with and without constraints using classical optimization techniques
2. Determine the solution of linear programming problem using graphical method, simplex algorithm and revised simplex algorithm
3. Calculate the optimum of a nonlinear function using various elimination and search methods
4. Apply Steepest Descent, Conjugate Gradient, Newton method, David-Fletcher-Powell methods in finding the optimum of given non linear function
5. Discuss the different operators, selection techniques in genetic algorithm and apply the suitable selection technique for finding the maximization of function .

UNIT-I

Introduction: Classical optimization techniques: Statement of optimization problem, Objective function, Classification of optimization problems, Single-variable & Multi-variable Optimization without constraints.
Multi-variable optimization with equality Constraints, Lagrange multiplier method, Multi-variable optimization with inequality constraints, Kuhn- Tucker conditions

UNIT-II

Linear Programming: Standard form, Formulation of the LPP, Solution of simultaneous equations by Pivotal condensation, Graphical method, Simplex algorithm, Revised simplex method

UNIT-III

Non-Linear Programming-I: Unimodal function, Elimination methods: Fibonacci method, Golden Section method.
Direct Search methods: Univariate Search method, Hook and Jeeve's method, Powell's method.

UNIT-IV

Non-Linear Programming-II:
Gradient methods: Steepest Descent, Conjugate Gradient, Newton method, David-Fletcher-Powell method

UNIT-V

Genetic Algorithms: Introduction, Encoding, Fitness Function, Basic Operators, Single Point cross over, two-point cross over, uniforms cross over, mutation operator, Selection Techniques, Tournament Selection, Roulette wheel selection.

Text Books:

1. S.S.Rao, "Engineering Optimization Theory and Applications", New Age International, 3 rd Enlarged Edition (in two colour), 2013
2. Jasbir S. Arora, "Introduction to Optimum Design", Academic Press, 4th Edition, 2016.

Suggested Readings:

1. Kalyamoy, Deb, "Multi Objective Optimization using Evolutionary Algorithms", Wiley publications, 2013.
2. S. Rajasekharam, G.A. Vijaya Lakshmi, "Neural networks, Fuzzy logic and Genetic Algorithms Synthesis and Applications", PHI publications, 2010

CO-PO & PSO Correlation Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	2	2	1	-	-	-	-	-	-	-	2	-	1
CO-2	3	3	3	3	1	2	-	-	-	-	-	-	2	-	1
CO-3	3	3	2	3	2	2	-	-	-	-	-	-	3	-	2
CO-4	3	3	3	3	3	2	-	-	-	-	-	-	3	-	2
CO-5	3	2	1	2	3	2	-	-	-	-	-	-	3	-	2

20EE E24

RENEWABLE ENERGY TECHNOLOGIES

(Semester-V-Program Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Students should have prior knowledge on non-conventional sources of energy

Course Objectives:

1. To Know the different types of Non-Conventional Energy Sources.
2. To Understand the working of wind and solar renewable energy sources
3. To Explore the issues with grid integration of renewable energy sources

Course Outcomes: After completion of this course, the student will be able to

1. Know the benefits of different renewable energy sources
2. Understand the generation of Wind Power
3. Model the generator, turbine and converter suitable for a specific wind-generation topology.
4. Understand the Solar PV generation and grid interconnection technologies
5. Understand and apply the remedies for network integration issues

UNIT-I:

Fundamentals of Energy: Introduction, Classification of energy resources, Merits and Demerits of non-conventional energy sources over conventional energy sources. , Conventional and renewable sources of energy, Distributed and central station generation, DG technologies, Advantages, introduction to hydro, tidal, wave, Geothermal and biomass energy

UNIT-II

Physics of Wind Power: History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tipspeed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions. Review of modern wind turbine technologies,. Types of wind turbines, Fixed and Variable speed wind turbines Components of wind mill, operation of wind turbines

UNIT-III

Wind Generator Topologies: Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters, Generator-Converter configurations, Converter Control, Wind farm Interface with grid Power quality issues, Power system interconnection experiences in the world, Hybrid and isolated operations of wind systems.

UNIT-IV

The Solar Resource: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sunangles, solar day length, Estimation of solar energy availability. Solar thermal power generation: Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis

Solar Photovoltaic: Technologies-Amorphous, mono crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms, Converter Control, Solar PV behaviour during grid disturbances, Power quality issues, Hybrid and isolated operations of solar PV.

UNIT-V

Network Integration Issues: Overview of grid code technical requirements, Fault ride-through for wind farms -real and reactive power regulation, voltage and frequency operating limits,. Interface with grid, direct and power electronics coupling, Impact of type of interface, Power Quality issues

Text Books:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
4. Math.H.Bollen, Fainan Hassan, "Integration Of Distributed Generation In The Power System" Wiley IEEE Press, July 2011

Suggested Reading:

1. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006
2. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004
3. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	2	-	-	-	-	1	1	1	1	-
CO2	2	1	3	2	1	2	-	-	-	-	1	1	1	2	-
CO3	2	1	3	2	1	2	-	-	-	-	2	2	1	2	1
CO4	2	1	2	2	1	2	-	-	-	-	2	2	1	1	1
CO5	1	1	2	1	1	2	-	-	-	-	2	2	1	1	2

20EE E25

SPECIAL ELECTRICAL MACHINES

(Semester-V-Program Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Electrical Engineering, Machines, Control systems and Circuit analysis.

Course Objectives:

1. To study the operating principles different special machines
2. To make the learner to be aware of latest special machines which are in vogue.
3. To be familiar with salient features of special electrical machines

Course Outcomes: After completion of this course, students will be able to:

1. Recognize application specific special electrical machines
2. Explain the working principle of various special electrical machines.
3. Develop equivalent circuit of a given special electrical machine.
4. Classify the special electrical machine based on construction
5. Choose the type of armature winding suitable for a given SEM.
6. Analyse the various control methods of a given Special Electric machine.

UNIT-I

Stepper Motors: Introduction, classification, single phase, Disc Magnet and Claw-tooth stepper motors, inference from Torque equation, (no derivation) static and dynamic characteristics, open loop and closed loop control, concepts of Microprocessor based control, comparison of conventional stepper motors with permanent magnet stepper motor, VR Stepper motor and Hybrid stepper motor and applications

UNIT-II

Switched Reluctance Motor (SRM): Construction, Principle of working, constraints on pole arc and tooth arc, Inference from torque equation and Characteristics, Control of SRM, features of Microprocessor based control of SRM, Introduction to Synchronous Reluctance Motor (Sy R M)

UNIT-III

PMDC and BLDC motor: PMDC Motor: Construction, Principle of working Minor hysteresis loops and recoil line, Equivalent circuit of PM, Inference from Torque equation, performance Characteristics, moving coil motors Printed Circuit Motor

BLDC Motor: Construction, principle of working, types, and control types and differences among various controls such as Microprocessor based, DSP- based control and sensor less control,

UNIT-IV

Linear Electric Machines: Construction, equivalent circuit, characteristics, design aspects and control, Types such as – linear synchronous motor, DC Linear motor, Linear Reluctance motor and Linear Levitation Machines (elementary treatment only)

UNIT-V

Permanent Magnet Axial Flux (PMAF) Machines: Construction, Armature windings – Toroidal stator, Trapezoidal stator, Rhomboidal Stator winding, salient features of torque equation, EMF equations and Output equation [No derivations], Phasor diagram, Applications; Introduction to Permanent Magnet Synchronous Motor,

Text Books:

1. E.G. Janardhan, "Special Electrical Machines", Prentice Hall India, 2014.
2. K. Venkatarathnam, "Special Electrical Machines", Universities Press (India) Pvt. Ltd., 2013

Suggested Reading:

1. H. Bülent Ertan, M. Yildirim Üçtug, Ron Colyer, Alfio Consoli, "Modern Electrical Drives" Springer Science+Bussiness Media, 2000.

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	1	-	-	-	-	3	1	1	3
CO2	3	3	3	2	1	-	-	-	-	-	-	2	1	1	2
CO3	3	3	3	2	1	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	2	-	2	1	-	-	-	2	3	1	2	3
CO5	3	3	2	2	-	2	1	-	-	-	-	-	-	-	-
CO6	3	3	3	2	1	-	-	-	-	-	2	3	1	2	3

20EE E26

BASIC VLSI DESIGN

(Semester-V-Program Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have basic knowledge of Basic Electronics and Digital Electronics

Course Objectives: This course aims to:

1. To understand the MOSFET structures and operations
2. To learn to design logic circuits using pMOS and nMOS
3. To learn to design concepts of CMOs and HDL Programming.

Course Outcomes: After completion of this course, students will be able to:

1. To design logic circuits using pMOS and nMOS technologies
2. To design cMOS logic circuits.
3. Tosimulate logical circuits using HDL programming
4. To understand different modeling strategies
5. To understand FPGA design strategies.

UNIT-I

MOS CIRCUIT DESIGN PROCESS: Introduction of MOSFET: Symbols, Enhancement mode-Depletion mode transistor operation – Threshold voltage derivation–bodyeffect–DraincurrentVsvoltagederivation–channellength modulation .nMOS and pMOS inverter–Determination of pull upto pull down ratio–Stick diagrams–VLSI Circuit Design Flow.

UNIT-II

MOSTECHNOLOGY: Chip Design Hierarchy–IC Layers–Photolithography and Pattern Transfers– Basic MOS Transistors–CMOS Fabrication :n - well – p- well– twin tub – Latchup and prevention(SOI)–Submicron CMOS Process- Masks and Layout-CMOS Design Rules : Lambda based layout.

UNIT-III

LOGIC DESIGNUSING nMOS and cMOS: Gate delays–Logical Effort-CMOS Static Logic – Transmission Gate Logic – Tri-State Logic – Pass Transistor Logic–Dynamic CMOS Logic–Realization of logic gates–using nMOS and CMOS technologies– Stick diagrams of logic gates-Simple full adder – four input Encoder-Decoder.

UNIT-IV

VERILOG HDL: Hierarchical modeling concepts – Basic concepts: Lexical conventions–Data types–Modules and ports. Gate level modeling–Dataflow modeling–Behavioral modeling–Design examples of Combinational and Sequential circuits – Switch level modeling.

UNIT-V

VLSIIMPLEMENTATION STRATEGIES : Introduction–Design of Adders: carry look ahead-carry select-carry save. Design of multipliers Introduction to FPGA – Full custom and Semi custom design, Standard cell design and cell libraries, FPGA building block architectures.

Text Books:

1. Douglas A.Pucknell & Kamran Eshraghian,"Basic VLSI Design",3rd edition, Prentice Hall India, 2001.
2. Wayne Wolf, "Modern VLSI Design: System-on-chip design", Pearson Education,3rdedition,2002.

Suggested Reading:

1. David A.Johns& Ken Martin, "Analog Integrated Circuit Design", John Wiley & Sons,2004.
2. Neil.H.E.Weste& Kamran Eshraghian, "Principles of CMOSVLSI" Design: Asystemsperspective",2nd edition, Pearson Education,2004.

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	1	1	1	1	-
CO2	2	3	3	2	1	-	-	-	-	-	1	1	1	2	-
CO3	2	3	3	2	1	-	-	-	-	-	2	2	1	3	1
CO4	2	2	2	2	1	-	-	-	-	-	2	2	1	1	1
CO5	1	2	2	1	1	-	-	-	-	-	2	2	1	1	2

20EE C21

CONTROL SYSTEMS LAB

(Semester-V)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Students should have a prior knowledge of Newton's laws, Circuit theory, Vector Calculus & Differential Equations, Laplace transform and their properties and linear algebra**.**

Course Objectives:

1. To understand the characteristics of DC, AC Servo Motors, synchro pair and the frequency response of compensating networks.
2. To study the closed loop performance for given plant using i) P, PI and PID controllers, ii) ON/OFF controller.
3. To understand the effect of damping on the given plant using D.C position control system.

Course Outcomes: After completion of this course, students will be able to:

1. Demonstrate the characteristics of DC, AC Servo motors and Synchro Pair.
2. Analyze the performance parameters of a given second order plant in time domain.
3. Analyze the performance of different compensators through its frequency response.
4. Design P, PI, PID and ON/OFF controller of a given system and to distinguish the merits and demerits of these controllers.
5. Analyze the characteristics of magnetic amplifier for series and parallel connections.
6. Demonstrate the effect of damping on the plant using D.C position control system

LIST OF EXPERIMENTS

1. Characteristics of D.C Servo motor.
2. Characteristics of A.C. Servo motor.
3. Characteristics of Synchro Pair.
4. Performance parameters of a second order system excited with step input for different damping ratios.
5. Frequency response of lag and lead compensating networks.
6. Performance of a temperature control system using P, PI and PID Controllers.
7. Temperature control of a system using relay (ON/OFF Control).
8. Characteristics of magnetic amplifier for series and parallel connections with different values of resistive load.
9. Measurement of step angle for stepper motor.
10. Response of different components of a control system using Linear System Simulator.
11. Demonstration of damping effect on the plant using DC position control system.
12. Study of closed loop speed control of BLDC motor with the effect of PI controller

Note: At least **TEN** Experiments should be conducted in the semester from the above list of experiments

CO-PO & PSO Correlation Articulation Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	1	1	-	-	-	-	-	-	-	-	-	-	1
CO-2	3	3	2	2	2	-	-	-	-	-	-	-	1	-	1
CO-3	3	2	3	2	2	-	-	-	-	-	-	-	2	-	2
CO-4	3	3	2	3	2	-	-	-	-	-	-	-	3	-	2
CO-5	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-
CO-6	3	2	2	1	-	-	-	-	-	-	-	-	-	-	1

20EE C22

ELECTRICAL MACHINES-II LAB

(Semester-V)

Instruction	2 P Hours per Week
Duration of SEE	3Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Basic knowledge of Electrical Engineering, Machines and Circuit analysis.

Course Objectives:

1. To understand the practical connections of the machines.
2. To calculate the various parameters of induction motor and synchronous machine by performing the experiment.
3. To analyze the performance of the induction motor and synchronous machine by conducting suitable experiments.

Course outcomes: After completing this course, students will be able to:

1. Make the connections for any given AC machine based on applications.
2. Design the meter ratings for various applications of induction and synchronous machines.
3. Control the speed of the induction motor by different methods.
4. Determine the efficiency and regulation of the given alternator using various methods.
5. Test the induction motor for their no-load and load characteristics.

LIST OF EXPERIMENTS

1. Three phase to two phase conversion of transformer (Scott connection)
2. Performance characteristics of Single-phase induction motor
3. Speed control of 3 phase induction motor by rotor resistance control and stator voltage control
4. Speed control of 3 phase induction motor by V/f control method.
5. No- load test of slip ring induction motor to determine the relationship between
   i) Applied voltage and speed, ii) Applied voltage and rotor current, iii) Applied voltage and stator current, iv) Applied voltage and power factor, v) Applied voltage and power input.
6. No-load test, blocked rotor test and load test on 3-phase squirrel cage induction motor.
7. Power Factor Improvement of Induction motor using capacitors.
8. Line excited induction generator characteristics.
9. Voltage regulation of alternator by
   a) Synchronous impedance method
   b) Ampere-turn method.
10. Voltage regulation of alternator by zero power factor(ZPF) method.
11. Measurement of Xd and Xq of 3 phase salient pole synchronous machine by conducting slip test.
12. Synchronization of 3phase alternator to bus bar using dark lamp method.
13. Observation of change in the active and reactive power of an alternator connected to an infinite bus by (a) varying excitation, (b) varying mechanical-power input.
14. V and Inverted V-curves of a given synchronous motor.
15. a) Grid Synchronization of DFIG. b) Active and reactive power control of DFIG

Note: At least **TEN** experiments should be conducted in the semester.

CO-PO & PSO Correlation Articulation Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	--	--	--	--	--	--	--	1	2	2
CO2	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO3	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO4	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO5	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2

20EE C23

MICROCONTROLLERS AND APPLICATIONS LAB

(Semester-V)

Instruction	2 P Hours per Week
Duration of SEE	3Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Students should have basic knowledge of programming in C language.

Course Objectives: This course aims to:

1. Develop and understand the 8051 and ARM7 C programming
2. Understand the usage of Integrated Development Environment (Keil)
3. Control the operation of various peripherals using 8051 and ARM7 microcontroller

Course Outcomes: After completion of this course, students will be able to:

1. Develop the programs of 8051 and ARM using their respective instruction set.
2. Understand the usage of various debugging tools available to program different microcontrollers
3. Build code for 8051 and ARM7 to interface various input/output modules
4. Analyze the hardware and software interaction and integration.
5. Design and develop the 8051 and ARM 7 based embedded systems for various applications

LAB EXPERIMENTS

(Any 5 experiments. are to be conducted in each cycle)

I. 8051 Programming

1. Familiarity and use of 8051 microcontroller trainer kit, Keil IDE and simple programs under different addressing modes.
2. Assembly programming using instruction set
3. Timer and counter operations and programming using 8051.
4. Interfacing applications using LED, switch, relay and buzzer.
5. Generation of waveforms using DAC by interfacing it with 8051.
6. Stepper motor interfacing.
7. LCD interfacing.
8. Development of Embedded 'C' Code based on the module specifications. (under Structured enquiry)

II. ARM7 Programming

1. Study and use of LPC214x Microcontroller trainer kit and simple programs using its instruction set
2. Interfacing applications using LED, switches
3. Interfacing applications using relay and buzzer.
4. DC Motor interfacing.
5. Programming on-chip ADC.
6. Waveform generation using internal DAC.
7. Development of Embedded 'C' Code based on the module specifications

III. Design an experiment related to the Embedded Application of your choice using 8051/ARM based architectures. (under Open ended enquiry)

Suggested Reading:

1. Mazidi M.A, Mazidi JG &Rolin D. Mckinlay, "The 8051 Microcontroller & Embedded Systems using Assembly and C", 2/e, Pearson Education, 2007.
2. Philips semiconductors, "ARM 7 (LPC 214x) user manual", 2005

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO2	2	3	3	2	1	-	-	-	-	-	-	-	1	2	-
CO3	2	3	3	2	1	-	-	-	-	-	-	-	1	3	1
CO4	2	2	2	2	1	-	-	-	-	-	-	-	1	1	1
CO5	1	2	2	1	1	-	-	-	-	-	-	-	1	1	2

With effect from academic year 2022-23

20EGCO3

EMPLOYABILITY SKILLS

(BE / B.Tech V & VI semester - Common to all Branches)

Instruction	2 L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50 Marks
Credits	01

Course Objectives: To help the students

1. Learn the art of communication, participate in group discussions and case studies with confidence and to make effective presentations.
2. With- resume packaging, preparing them to face interviews.
3. Build an impressive personality through effective time management, leadership qualities, self-confidence and assertiveness.
4. Understand professional etiquette and to make them learn academic ethics and value system.
5. To be competent in verbal aptitude.

Course Outcomes: By the end of the course**,** the students will be able to

1. Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals, learn to mange time effectively and deal with stress.
4. Mak**e** the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
5. Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

UNIT I

Verbal Aptitude: Error Detection, Articles, Prepositions, Tenses, Concord and Transformation of Sentences-Jumbled Words/Sentences- Vocabulary, Synonyms, Antonyms, One Word Substitutes, Idioms and Phrases, Word/Sentence/Text Completion- Reading Comprehension.

UNIT II

Group Discussion & Presentation Skills: Dynamics of Group Discussion-Case Studies- Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Accuracy, Coherence. Elements of Effective Presentation – Structure of a Presentation – Presentation tools – Body language - Preparing an Effective PPT

UNIT III

Behavioural Skills: Personal strength analysis-Effective Time Management- Goal Setting- Stress management-

Corporate Culture – Grooming and etiquette-Statement of Purpose (SOP).

UNIT IV

Mini Project: Research-Hypothesis-Developing a Questionnaire-Data Collection-Analysis-General and Technical Report - Writing an Abstract –Technical Report Writing-Plagiarism-Project Seminar.

UNIT V

Interview Skills: Cover Letter andRésumé writing – Structure and Presentation, Planning, Defining the Career Objective, Projecting ones Strengths and Skill-sets – Interviews: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Mock Interviews.

Suggested Reading:

1. Leena Sen, "Communication Skills", Prentice-Hall of India, 2005
2. Dr. Shalini Verma, "Body Language - Your Success Mantra", S Chand, 2006
3. Edgar Thorpe and Showick Thorpe , "Objective English", 2nd edition, Pearson Education, 2007
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills", New Delhi: Pearson, 2010
5. Gulati and Sarvesh, " Corporate Soft Skills", New Delhi: Rupa and Co. , 2006
6. Van Emden, Joan, and Lucinda Becker, "Presentation Skills for Students", New York: Palgrave Macmillan, 2004
7. A Modern Approach to Verbal & Non-Verbal Reasoning by R S Aggarwal, 2018
8. Covey and Stephen R, "The Habits of Highly Effective People", New York: Free Press, 1989

20EEI02

Industrial Internship/ Rural Internship

(Semester-V)

Instruction	3-4 Weeks/90 Hours
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: Knowledge of Basic Sciences and Engineering Sciences/Knowledge about rural environment

Course Objectives: This course aims to:

1. Exposing the students to the industrial environment/ rural environment
2. Create awareness with the current industrial technological developments relevant to program domain
3. Provide opportunity to understand the social, economic and administrative considerations in organizations/rural areas

Course Outcomes: After completion of this course, students will be able to:

1. Understand Engineer's responsibilities and ethics
2. Use various materials, processes, products and quality control
3. Provide innovative solutions to solve real world problems
4. Acquire knowledge in technical reports writing and presentation
5. Apply technical knowledge to real world industrial/rural situations

For implementation procedures and letter formats, annexures I and III of Internship document may be referred.

Evaluation of Internship: The industrial training/internship of the students will be evaluated in three stages:

a) Evaluation by the Industry (in the scale of 1 to 10 where 1-Unsatisfactory; 10-Excellent)

b) Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (15 marks)

c) Evaluation through seminar presentation/Viva-Voce at the Institute by the constituted committee (25 marks)

Evaluation through Seminar presentation/Viva-Voce at the institute: Students shall give a seminar before an E*xpert Committee* constituted by college (Director, HoD / Senior faculty, mentor and faculty expert from the same department) based on his/her training/internship carried out

. The evaluation will be based on the following criteria:

- Quality of content presented
- Proper planning for presentation
- Effectiveness of presentation
- Depth of knowledge and skills
- Attendance record, daily diary, departmental reports shall be analyzed along with the internship Report

Monitoring/ Surprise Visits: During the internship program, the faculty mentor makes a surprise visit to the internship site, to check the student's presence physically. If the student is found to be absent without prior intimation to the concerned industry, entire training/internship may be canceled. Students should inform through email to the faculty mentor as well as the industry supervisor at least one day prior to avail leave.

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	3	3	-	3	-	3	3	-	-	3
CO2	1	1	1	3	3	-	2	1	-	-	-	-	3	3	-
CO3	2	3	3	3	3	2	3	1	1	-	-	-	3	3	-
CO4	-	-	-	-	-	3	-	1	3	3	-	1	-	-	3
CO5	1	3	3	3	3	2	3	-	1	-	-	1	3	3	3

VI- SEMESTER

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum with effect from AY 2022-23

B.E (Electrical and Electronics Engineering)

SEMESTER – VI

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20 EE C24	**Core -13** Power System Protection	3	-	-	3	40	60	3
2	20 EE C25	**Core -14** Power System Operation and Control	3	-	-	3	40	60	3
3	20 EE C26	**Core -15** Electrical Drives	3	-	-	3	40	60	3
4	20 EE C27	**Core -16** IoT for Electrical Engineering	3	-	-	3	40	60	3
5	20 EE Exx	**PE- 3**	3	-	-	3	40	60	3
6	20 EG M01	Indian Constitution& Fundamental Principles	2	-	-	2	-	-	NC
PRACTICALS									
7	20 EE C28	Power Systems Lab	-	-	2	3	50	50	1
8	20 EE C29	Electrical Simulation Lab	-	-	2	3	50	50	1
9	20 EE C30	Electrical Drives Lab	-	-	2	3	50	50	1
10	20 EE C31	IoT Lab	-	-	2	3	50	50	1
Total			**17**	**-**	**08**	**30**	**440**	**510**	**22**
Clock Hours Per Week: 25									

L: Lecture **P: Practical/Project Seminar/Dissertation** **CIE: Continuous Internal Evaluation**

T: Tutorial **SEE: Semester End Examination**

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum with effect from AY 2022-23

B.E (Electrical and Electronics Engineering)

SEMESTER – VI

List of Courses in Program Elective-III	
Course code	**Title of the Course**
20 EE E31	Advanced power System Protection
20 EE E32	Power Electronics for Renewable Energy Systems
20 EE E33	Utilization of Electrical Energy
20 EE E34	Power Quality Engineering
20 EE E35	Advanced Electrical Drives
20 EE E36	Digital Signal Processing

20EE C24

POWER SYSTEM PROTECTION

(Semester-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Electrical Engineering and Circuit analysis.

Course Objectives: This course aims to:

1. To analyze principles of operation of the different Protection Devices.
2. To understand the different protection schemes employed in the protection of power system
3. To acquire knowledge of Numerical Protection Algorithm

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

1. Understand basic terminology of relays and types of over current protection of power system.
2. Distinguish the type of distance protection with principle & their application to three phase transmission lines.
3. Choose suitable differential scheme for the protection of various equipment in electrical power system.
4. Describe the principle of operation, and able to calculate the ratings of circuit breakers.
5. Familiarize with different protection methods against over-voltages.
6. Identify various elements of numerical relays, their functions and different techniques used in their design.

UNIT-I

Introduction to Protection Schemes: Need for protection, Backup protection, Zones of protection, Definitions of relay pickup, dropout and reset values, Classification of relays, Operating principles and construction of electromagnetic and induction relays.

Over-current Protection: Time-current characteristics, current settings, time settings, over-current protection schemes, direction relay, applications of Definite Time, IDMT and Directional relays distribution feeders, Earth fault and phase fault protection schemes, directional earth fault relay, static over current relay, fuse characteristics, types of fuses

UNIT-II

Distance Protection: Introduction, Impedance relay, reactance relay, MHO relay, effect of arc resistance and Power Swings on the performance of Distance Relaying, Selection of distance relays, Three-stepped Distance protection, Comparison of different distance protection schemes, Distance protection of three-phase lines.

UNIT-III

Differential protection: Introduction, simple differential protection, zone of differential protection, Percentage differential relay, Earth-leakage protection, Percentage Differential Protection of Transformers, Differential protection of transformer against Inrush phenomenon, Inter-turn faults in transformer. Differential protection of Bus-bars, Internal and External faults, Protection of Three-phase bus bars. Introduction to the Basic protection of Generator and Induction Motors

UNIT-IV

Circuit Breakers: Arc interruption, restriking voltage, recovery voltage, RRRV, current chopping, resistance switching, classification of circuit breakers, selection of circuit breakers

Over voltage protection: causes for over voltages, protection of transmission lies against direct lightning strokes, ground wires, arcing horns, lightning arrestors, surge absorbers, Peterson coils, insulation coordination

UNIT–V

Basics of Numerical Protection: Block diagram of numerical relay, Sampling theorem, Least Error Square Technique, Digital Filtering, Numerical Relaying for overcurrent, Differential and distance protection (Elementary Treatment).

Text Books:

1. Badriram Viswakarma, "Power System Protection and Switchgear", Tata McGraw Hill, 2011
2. Y.G. Paithankar, S.R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.

Suggested Reading:

1. T.S.Madhava Raao, Power System Protection: Static Relays, Tata McGraw-Hill Education 1989
2. P.M.Anderson, Power System Protection, John Wiley, 2012
3. Electricity Training Association, Power System Protection. Vol.2.: Systems and Methods, Institute of engineering and Technology, 1995

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	1	-	-	-	-	1	-	2	3	3	1
CO2	3	1	2	-	1	-	-	-	-	1	-	3	3	3	1
CO3	3	2	2	-	1	-	-	-	-	1	-	2	3	3	1
CO4	3	2	2	-	1	-	-	-	-	1	-	2	3	3	1
CO5	3	2	2	-	1	-	-	-	-	1	-	2	3	3	1
CO6	3	1	1	-	2	-	-	-	-	1	-	2	3	3	1

With effect from the academic year 2022-23

20EE C25

Power System Operation and Control

(Semester-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power Systems, Control Systems, Synchronous Machines

Course Objectives:

1. To understand the importance of Economic Operation of power system
2. To understand the load frequency control of Power Systems
3. To gain the knowledge of power system stability

Course Outcomes: After completion of this course, students will be able to:

1. Demonstrate the Economic operation of power system without and with Losses
2. Illustrate the concept of Unit Commitment
3. Analyze the Load Frequency Control for single and two area systems
4. Examine the rotor angle stability of a power system under any disturbance.
5. Identify and Explain the Voltage Stability problems.

UNIT-I

Economic Operation of Power System: Input-Output curves, Heat rate and Incremental Cost curves, Economic Operation neglecting Transmission Losses, with and without Generator Limits, Derivation of B_{mn} Coefficients, Economic Operation including transmission losses, Numerical problems.

UNIT-II:

Unit Commitment (UC): Introduction, Constraints in UC, Thermal unit constraints and other constraints, Solution Methods: Priority-list method, Dynamic Programming solution, Lagrange Relaxation Solution, Numerical problems.

UNIT-III:

Control of Frequency: Introduction to Automatic Generation Control (AGC), Frequency control, Concept of Single-area Load Frequency control, Modeling of Single-area control, Steady state and Dynamic Analysis on Single-area, PI Control for Single-area, Introduction to Two-Area Load Frequency control, Modeling of Two-area control,

Control of Voltage:

Conventional Methods for Reactive power Generation and Absorption, Automatic Voltage Regulators, Flexible AC Transmission Systems.

UNIT-IV

Rotor Angle Stability: Introduction to Rotor Angle Stability, Classification, Steady state stability, Steady state stability Limit, Factors affecting the Steady state stability, Introduction to Transient Stability, Swing Equation, Equal-area Criterion, Critical Clearing Angle, Critical Clearing Time, Application of equal area criterion, Factors affecting the Transient stability

UNIT-V

Voltage Stability: Introduction to Voltage Stability, comparison between Angle stability and voltage stability, Mathematical formulation of Voltage Stability, Modeling requirements to carryout Voltage stability analysis, Prevention of Voltage Instability

Text Books:

1. I. J. Nagrath & D.P. Kothari, Modern Power System Analysis,4th Edition TMH Publication,2011
2. Allen J. Wood, Bruce. F.Woolenberg, Power Generation, Operation & Control, Wiley Publishers, 2006
3. K. R. Padiyar, Power system dynamics: stability and control, Second Edition, BS Publications, 2008

Suggested Reading:

1. O. Elgard, Electric Energy Systems Theory, 2nd Edition. TMH Publication,2001
2. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

CO-PO& PSO Correlation Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2	1	-	-	-	1	2	1	2	3	1	-
CO2	3	3	2	2	1	-	-	-	2	2	2	3	3	2	1
CO3	3	2	1	2	1	-	-	-	1	1	1	2	1	1	1
CO4	3	2	1	2	1	-	-	-	1	1	1	2	1	1	-
CO5	3	1	1	1	-	-	-	-	1	1	1	1		2	-

20EE C26

ELECTRICAL DRIVES

(Semester-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power Electronics, Electrical Machines

Course Objectives:

1. To Understand the characteristics of various Electric Drives and its control using different power electronic converter circuits
2. To apply and analyse the concept of speed control DC motor drives with single phase, three-phase converters and choppers.
3. To apply and analyse the concept of speed control induction motor by using AC voltage controller, VSI, CSI and cyclo-converter.

Course Outcomes: After completion of this course, students will be able to:

1. Acquire the knowledge about classification, choice, dynamics and stability of Electric Drives.
2. Analyse 1-Φ & 3-Φ converters fed DC motors.
3. Understand the operational variance between single and multi-quadrant operation of various Electric Drives
4. Analyse chopper fed DC motors.
5. Comprehend the speed control of a converter fed induction motor drives and synchronous motor drives.
6. Differentiate the features of closed loop operation of DC and AC electric drive and their controllers.

UNIT-I

Electric Drive: Introduction, Block diagram and parts of electric drive.

Dynamics of Electrical Drives: Types of Load- Types and Characteristics of load torque – Dynamics of motor- load combination – steady state & transient stability of an electrical drive.

Phase control converters fed DC drivers: Review of speed control techniques of DC motors, Single Phase and Three-phase semi and fully controlled converters connected to DC separately excited and DC series motors– continuous current mode of operation, output voltage and current waveforms, Speed and Torque expressions, Speed- Torque Characteristics. Problems on Converter fed DC motors.

UNIT –II

Four quadrant operation of DC drive: Introduction to four quadrant operation, motoring operation, electric braking – Plugging, Dynamic and regenerative braking operations. Four quadrant operation of D.C motors by dual converters – Closed loop operation of DC motor

UNIT –III

Chopper fed DC drives: Single, two and four quadrant chopper fed dc separately excited and series excited motors– continuous current operation, output voltage and current wave forms, speed torque expressions, speed torque characteristics, Problems on Chopper fed DC Motors, closed loop operation.

UNIT-IV

Induction Motor Drives: Variable voltage characteristics – Control of Induction Motor by AC Voltage Controllers – Wave forms – Speed torque characteristics, Variable Voltage, Variable Frequency control of induction motor by voltage source inverter (VSI), current source inverter (CSI) and cyclo-converters, Comparison of VSI and CSI. Static rotor resistance control,

closed loop speed control with static rotor resistance control, Slip power recovery schemes–Static Scherbius drive, Static Kramer Drive and their performance, speed torque characteristics, closed loop operation of induction motor drives.

UNIT-V

Synchronous Motor Drives: Operations from fixed frequency supply, Synchronous Motor variable speed drives, Variable frequency control of Multiple Synchronous Motors, Self–controlled Synchronous Motor Drive Employing Load Commutated Thyristor Inverter, Self-controlled Synchronous Motor Drive Employing a Cyclo-converter, closed loop operation of Synchronous Motor Drive.

Text Books:

1. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1989.
2. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall, 2001.
3. M.H.Rashid, "Power Electronic Circuits, Devices and applications", PHI.

Suggested Reading:

1. G. K. Dubey, "Fundamentals of Electrical Drives", CRC Press, 2002.
2. W. Leonhard, "Control of Electric Drives", Springer Science & Business Media, 2001.

CO-PO & PSO Correlation Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	--	--	--	--	--	--	--	--	--	2	2
CO2	3	3	2	3	--	--	--	--	--	--	--	--	1	3	3
CO3	3	2	2	3	--	--	--	--	--	--	--	--	1	2	3
CO4	3	2	2	3	--	--	--	--	--	--	--	--	1	2	3
CO5	3	2	2	3	--	--	--	--	--	--	--	--	1	2	2
CO6	3	2	2	3	--	--	--	--	--	--	--	--	1	2	2

20EE C27

IoT for Electrical Engineering

(Semester-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have prior knowledge on basic programming knowledge and networking

Course Objectives:

1. To provide knowledge of basic IoT Network Architectures, IoT Processing, Connectivity and Communication technologies
2. To provide knowledge of Arduino boards and basic components and Develop skills to design and implement various smart system application.
3. To provide knowledge of programming skills, application development and prototyping using Python.

Course Outcomes: After completion of this course, students will be able to:

1. Understand the basic principles and terminologies of computer networking, network security, WSN, M2M, CPS, sensors and actuators.
2. Describe various data types in IoT applications, connectivity protocols in IoT, communication protocols in IoT.
3. Understand basic concepts of Arduino UNO and Design smart system applications using Arduino UNO.
4. Apply Python programming for Problem solving and application development.
5. Understand the working of Raspberry Pi and develop IoT applications.

UNIT-I

Introduction to IoT: Introduction-Network types-IoT Protocol and Architecture-Network Security- Wireless Sensor Networks (WSN)- Machine-to-Machine (M2M) Communications- Cyber Physical Systems (CPS)- Differentiate between WSN, M2M, and CPS- IoT Sensors and Actuators-Advantages and Disadvantages of IoT.

UNIT-II

IoT Processing, Connectivity and Communication: Data format- Importance of Processing in IoT- Processing Topologies- IoT Device Design and Selection Considerations- IEEE 802.15.4-Thread- ISA100.11A- WirelessHART- RFID- LoRa- Wi-Fi- Bluetooth- Infrastructure Protocols- Discovery Protocols- Data Protocols- Identification Protocols

UNIT-III

Introduction to Arduino Programming: Introduction-Features of Arduino-Types of Arduino board-Arduino UNO-Arduino IDE overview-Sketch Structure-Data types-Function libraries-Operators in Arduino-Control statement-Loops-Arrays-String-Math Library-Random number-Interrupts-Example program: Blink LED-Traffic Control system- Pulse Width Modulation-Analog to Digital Conversion- Wireless Connectivity to Arduino- Integration of Sensors with Arduino- Integration of Actuators with Arduino

UNIT-IV

Introduction to Python Programming: Introduction to Python- Variables and Data types- Operators-NumPy-matplotlib-Array- Pandas-Lists- Loops- Conditional statements-Functions-Strings-Tuples- Sets-Dictionaries- Array- Data Visualization-File handling.

UNIT-V

Introduction to Raspberry Pi and IoT Applications: Introduction to Raspberry Pi-Basic architecture- Working of Raspberry Pi-Pin configuration- Example program: Blink LED- Capture Image using Raspberry Pi -Implementation of IoT with Raspberry Pi: Sensor and actuator interfaced with Raspberry Pi-IoT application-Speed control of DC and AC machines-Measuring parameters of DC machine, AC machine and solar panel.

Text Books:

1. S. Misra, A. Mukherjee, and A. Roy, "Introduction to IoT", Cambridge University Press, 2020
2. S. Misra, C. Roy, and A. Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0", CRC Press, 2020
3. Adeel Javed, "Building Arduino Projects for the Internet of Things Experiments with Real-World Applications", Apress, 2016
4. Allen B. Downey, "Think Python", O'Reilly, 2016
5. John Zelle, "Python Programming an introduction to computer science", Tom Sumner, 2012
6. Rajkumar Buyaa and Amir V Dastjerdi, Internet of things: Principles and Paradigms, Morgan Kaufmann
7. A Bahga& V Madisetti, Internet of Things: A Hands On Approach, Universities Press

Suggested Readings:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press, 2017
2. Mark Lutz, "Learning Python", O'Reilly, 2009.
3. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley
4. Olivier Hersent, David Boswarthick and Omar Elloumi, The Internet of Things: Key applications and Protocols, Wiley

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	-	-	-	-	-	-		1	1	-
CO2	3	3	2	2	3	-	-	-	-	-	-		1	2	-
CO3	3	3	2	2	3	-	-	-	-	-	-		2	3	-
CO4	3	3	2	2	3	-	-	-	-	-	-		3	2	-
CO5	3	3	2	2	3	-	-	-	-	-	-		2	3	-

20EE E31

ADVANCED POWER SYSTEM PROTECTION

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power System Protection

Course Objectives:

1. To study the operating principles and application aspects of static relays
2. To study the architecture and the required mathematical background for the design and development of digital relays
3. To understand the application of various algorithms for the digital protection of practical power system.

Course Outcomes: After completion of this course, students will be able to:

1. Remember the basic terminology and components of static relays and grounding methodologies
2. Recognize the need and architecture of digital relays
3. Comprehend the application of mathematics in power system protection
4. Distinguish various mathematical algorithms used for the estimation of power system parameters.
5. Explain various algorithms used for the digital protection of power system.

UNIT-I

Static Relays: Comparators, Amplitude and Phase comparison schemes, Duality between Amplitude and phase comparators, General equation for comparators for different types of relays, Static comparators, Coincidence circuits, Phase splitting methods, Hall effect comparators, Operating principles, Use of level detectors, Time delay circuits, Filters, Thyristors, Triggering circuits and DC power supplies, Advantages and Disadvantages of static relays

UNIT-II

Basic Elements of Digital Protection: Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing Error, sample and hold circuits, multiplexers, analog to digital conversion, Digital relay subsystem, filtering concepts.

UNIT-III

Sinusoidal-Wave-Based Algorithms: sample, first, second derivative techniques, two-sample and three-sample techniques, Fourier-analysis-based algorithms, walsh-function-based techniques

UNIT-IV

Algorithms based on Least Squares: Least Squares-based Algorithm: Integral LSQ fitting, Power series LSQ fitting, Multi-variable series LSQ

Differential Equation-based Algorithm: Representation of Transmission line, differential equation protection, simultaneous equation techniques.

UNIT-V

Digital Protection: Digital Protection of Transformers: Principles of protection, FIR-filter based algorithms, Least-square curve fitting based algorithms, Fourier-based Algorithms, Digital Protection Transmission Lines: current-based differential Protection, composite voltage and current based protection schemes

Text Books:

1. Badriram and Viswakarma D.N.,'PowerSystemProtectionandSwitchgear',TataMcGrawHill,April,2001.
2. MadhavaraoT.S.,'Power System Protection Static relays with microprocessor applications', Tata Mc Graw Hill,2001.
3. A.T.Johns and S .K.Salman,'Digital protection for power systems', IEE series,1989.
4. S.R.Bhide "Digital Power System Protection" PHI Learning Pvt. Ltd.2014

Suggested Reading:

1. Warrington A.R.Van C,'Protective Relays', VolI & II Chapman & Hall,John Wiley & Sons,1977.
2. Bhuvanesh AOZA, Nirmalkumar C.Nair, Rashesh P Mehta,Vijay H.M.,'Power system protection and Switch gear', Tata McGraw Hill,2010.
3. J.Lewis Blackburn,Thomas J Domin, 'Protective relaying Principles and Applications',CRCpress,2014.
4. L.P.Singh,'Digital Protection: Protective Relaying from Electro mechanical to Micro processor', John Wiley & Sons,1994.
5. Stanley H Horowitz,A.G.Phadke,'Power system relaying',4th Edition,Wiley publications, 2014.

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO2	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO3	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO4	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO5	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2

With effect from the academic year 2022-23

20EE E32

POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power Electronics

Course Objectives:

1. To Understand the different types of Non-Conventional Energy Sources.
2. To Explore the issues with grid integration of Renewable Energy Sources.
3. To Familiarize concepts on Fuel-Cell and Hybrid Energy Storage Systems

Course Outcomes:

1. Acquaint with different renewable energy sources
2. Understand different techniques of Power extraction fromSolar and Wind energy systems
3. Modelling of generator, turbine and suitable converters for a RES and energy storage systems.
4. Understand the concepts and working with fuel-cell for efficient energy system.
5. Understand necessity and functioning of Hybrid Energy storage system.

UNIT-I:

Introduction to Renewable Energy Systems: Wind power, Hydropower, Solar energy-Biomass,Bio-fuel, Geothermal Heat energy, Solar-thermal plants, Applications.

UNIT-II:

Solar Energy: Introduction to PV-Cells, Array, Solar power extraction using PV-Cells, I-V Characteristics, PV-Inverters without D.C. to D.C. converters, Grid interfacing-with isolation, without isolation, Maximum power point tracking - Methods, PV-Inverters with D.C. to D.C. converters-on low frequency side and high frequency side with isolation, without isolation.

UNIT-III:

Wind Energy: Sources and potentials, Evaluation of Wind Intensity, Topography, General Classification of Wind Turbines and Technologies, Speed control methods Wind Power, Fixed speed with capacitor bank, Rotor resistance control, Synchronous Generator-external magnetized, Synchronous Generator-permanent magnets.

UNIT-IV:

Fuel Cells: Fuel cells, Commercial Technologies for Generation of Electricity, Constructional Features ofSolid Oxide Fuel Cells, Constructional Features of Proton Exchange Membrane Fuel Cells, Advantages and Disadvantages of Fuel Cells, Application of DC Converters in Fuel Cell Systems: Single stage topology,Multi-stage topology.

UNIT-V:

Hybrid Energy Systems: Need for Hybrids systems, range and type of hybrid systems, hybridization of solar, wind and fuel cell, battery manage system. Conventional and recent developments in Energy/battery management schemes.

Text Books:

1. S. N. Bhadra, D. Kastha, S. Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.
2. D. Yogi Goswami , “Principles of Solar Engineering” 3rd Edition, , CRC Press, 2015.
3. Yves Brunet, “Energy Storage", Wiley-ISTE, 1st Edition, 2010

Suggested Reading:

1. Nikos Hatziargyiou, "Microgrids: Architectures and Control" ISBN: 978-1-118-720684,Wiley-IEEE Press, December 2013.
2. Roger Messenger, Amir Abtahi, "Photovoltaic Systems Engineering", 3rd edition, CRC Press, 2010
3. B. H. Khan Non-conventional Energy sources Tata Mc-Graw-hill Publishing Company, New Delhi,2009.
4. Robert A.Huggins, "Energy Storage", Springer, 2nd Edition, 2015.

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO2	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO3	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO4	2	2	2	1	-	-	-	-	-	-	1	1	3	3	2
CO5	2	2	2	1	-	-	-	-	-	-	1	1	3	3	2

20EE E33

UTILIZATION OF ELECTRICAL ENERGY

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Understand the adaptability of heating and welding concepts for a given application
2. Know the necessity of illumination for specified requirement
3. Know selection of proper traction system and its corresponding drive for industrial applications

Course Outcomes: After completion of this course, students will be able to:

1. Acquire knowledge about electric heating concepts for a given application
2. Understand principles of welding concepts for a given application
3. Familiar with principles of illumination concepts
4. Identify the necessity of illumination and luminaries for specified requirement
5. Select proper traction system and its corresponding drive for industrial applications
6. Able to estimate energy consumption levels at various modes of operation.

UNIT-I

Electric Heating: Introduction, Classification of electric heating Advantages of electrical heating, Properties of good heating material, Different types of heating material, Causes of failure of heating element, Design of heating element, Numerical Problems

Power frequency heating Methods: Resistance heating- Direct resistance heating, Indirect resistance heating, Infrared or radiant heating, Electric arc heating- Direct arc heat, Indirect arc heating

High frequency heating Methods: Induction heating- Direct induction heating, indirect induction heating - Dielectric heating.

UNIT-II

Electric Welding: Introduction, Classification of Welding Processes, Formation and Characteristics of Electric Arc, Electrodes for Metal Arc Welding, Advantages of Coated Electrodes, Types of Joints

Principle of Electric Arc welding: Advantages and disadvantages of electric welding, Electric Arc welding methods: Carbon Arc Welding, Submerged Arc Welding, Atomic Hydrogen Welding.

Principle of Resistance Welding: Advantages and disadvantages of Resistance Welding,Spot Welding, Seam Welding, Projection Welding, Butt Welding, Flash Butt Welding, Upset Welding, Electron Beam Welding, Laser Welding

UNIT-III

Illumination: Introduction, Terms used in illumination, laws of illumination, Polar Curves of C.P. Distribution – Determination of M.S.C.P. and M.H.C.P. from Polar Diagrams- Rousseau's construction, Design of Lighting Schemes for different applications- Numerical Problems

Electric Lamps: Incandescent lamps, Fluorescent lamps, CFL, LED, Mercury vapour lamps

UNIT-IV

Electric Traction-I: Introduction, Systems of electric traction and track electrification- DC system, single phase and 3-phase low frequency and high frequency system, composite system, kando system, comparison between AC and DC systems- Train Movement-Typical Speed/Time Curve - Factors affecting scheduled speed - Simplified Speed/Time Curve - Average and Schedule Speed- Tractive Effort for Propulsion of a Train - Power Output from Driving Axles - Energy Output from Driving Axles - Numerical Problems.

UNIT-V

Electric Traction-II: Specific Energy Output - Evaluation of Specific Energy Output - Energy Consumption - Specific Energy Consumption - Adhesive Weight – Coefficient of Adhesion – Mechanism of Train Movement – Numerical Problems

Text Books:

1. C L Wadhwa, Generation, Distribution and Utilization of Electrical Energy- 3 rd Edition New age international publishers, 2015.
2. B.L. Theraja, A Textbook of Electrical Technology Volume-III Transmission and Distribution S. Chand Limited, 23rd Edition, 2013.
3. Partab H, Art and Science of Utilization of Electric power, Dhanpatrai& Sons, 2014

Suggested Reading:

1. J.B.GUPTA, Utilization of Electric Power and Electric Traction- S.K.Kataria& Sons, 2013.
2. R K. Rajput, Utilization of Electrical Power-, 2 nd Edition, Laxmi Publications (p) Ltd, 2016.

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	3	2	-	1	-	1	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	2	-	-	-	-	-	-	-	1	-
CO4	2	2	-	1	-	2	-	-	-	-	-	-	-	1	-
CO5	3	2	1	1	-	2	-	-	-	-	-	1	-	-	2
CO6	3	2	2	2	-	2	-	-	-	-	-	1	-	1	2

20 EE E34

POWER QUALITY ENGINEERING

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge in power systems and power electronics

Course Objectives:
1. Understand the Power Quality (PQ) standards and its monitoring concepts
2. Understand PQ issues and sources of harmonics in Industrial systems and its mitigation.
3. Understand the problems and solutions to wiring and Grounding

Course Outcomes: After completion of this course, students will be able to:
1. Illustrate the basic concepts of power quality issues and power quality monitoring, standards and measuring instruments.
2. Determine the voltage sag magnitude in radial, Non-radial and Meshed systems
3. Analyze voltage sags effect on three-phase AC- Adjustable speed drive (ASD), DC- Adjustable speed drive (ASD) for industrial applications.
4. Identify the sources of harmonics and its mitigation techniques in industrial systems.
5. Discuss the protection devices for transient over voltages and solutions for Wiring and Grounding problems

UNIT-I

Power Quality problems in distribution systems: Voltage Sag, Swells, Interruptions, and Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations, flicker and its measurement. Tolerance of Equipment: CBEMA curve. Power quality monitoring, standards and measuring instruments.

UNIT-II

Voltage Sags-Characterization: Voltage Sag Magnitude, Sag Magnitude in Radial and Non-Radial Systems, Voltage sag Calculations in Meshed Systems.

UNIT-III

PQ Consideration in Industrial Power Systems: Adjustable speed drive (ASD) systems and applications, Characterization of voltage sags experienced by three-phase AC-ASD, DC-ASD systems, Effects of momentary voltage dips on the operation of induction and synchronous motors.

UNIT-IV

Harmonics: Sources of power system harmonics, Harmonic distortion, Harmonic Indices, Odd and Even Order Harmonics, Causes of Voltage and Current Harmonics, Locating Harmonic sources, Effect of Harmonics on Power System Devices, Mitigation of harmonics.

UNIT-V

Transient Over-voltages & Wiring and Grounding: Sources of Transient Overvoltage's, Principles of Overvoltage Protection Devices, Definitions, Reasons for Grounding and wiring, Typical Wiring and Grounding Problems, Solutions to Wiring and Grounding Problems.

Text Books:

1. C.Sankaran, 'Power Quality', CRC Press, 2001.
2. R. Sastry Vedam, M. Sarma, "Power Quality- Var Compensation in Power Systems ", CRC Press, 2009.

Suggested Reading:

1. Math H.J. Bollen, 'Understanding Power Quality Problems', IEEE Press, 2000.
2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, 'Electrical Power Systems Quality', 3rd Edition, Tata McGraw-Hill, 2012.

CO-PO-PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	3	2	3	1	1	-	-	-	1	2	2	-			
CO3	3	3	2	-	3	1	1	2	1	2	2	-	-	3	3
CO4	3	3	3	3	1	1	1	1	1	1	-	-	-	2	1
CO5	3	2	3	1	1	-	1	1	1	1	-	-		2	1

20EE E35

ADVANCED ELECTRICAL DRIVES

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Electrical Drives, Microprocessors, Control Systems

Course Objectives::

1. To understand the principles of commutation in converters and study the performance, stability and control aspects of DC motors and Induction motors.
2. To understand the microprocessor-based control of electric drives
3. To study the working principles and control aspects of special motors: Brushless DC motor, Switched Reluctance Motor drives.

Course Outcomes: After completion of this course, students will be able to:

1. Identify and consider the requirement of power converters for a given application.
2. Illustrate the digital methods of DC motor speed control techniques.
3. Show how the changes effect in different speed control schemes of Induction motor.
4. Analyse the performance of Synchronous motor with and without sinusoidal supply.
5. Recognize and formulate problems encountered by special motor drives for a particular application.

UNIT-I

Review of Power Converters: Overview of Power converters in Electric Drives, Commutation in Thyristor power converters, Principle of natural commutation and forced commutation, Discontinuous conduction in converters, DC choppers, Force commutated inverters, Frequency conversion. Inverter voltage control, Harmonic neutralization, Voltage controller.

UNIT-II

DC Drives: General considerations, Evaluation of a dc drive performance Forced commutation schemes to improve the performance of the drives, Steady-State Analysis of the Three-Phase Converter Controlled rectifiers, Steady-state analysis of chopper-controlled dc motors, Closed-loop control of solid-state DC drives, DC motor speed control using ma microprocessor (Block Diagram and Flowchart Approach only)

UNIT-III

Induction Motor Drive: Speed control of IM, Analysis of IM on non-sinusoidal voltage waveforms, Scalar and vector control of induction motor, Direct torque and flux control of induction motor, Analysis of CSI fed IM, Performance of CSI fed IM, Static slip energy recovery schemes employing Converter cascades in the rotor circuit Dynamic behavior and stability of Variable frequency IM, Induction motor speed control using a microprocessor (Block Diagram and Flowchart Approach only).

UNIT-IV

Synchronous Motor Drive: Analysis of SM fed from non-sinusoidal supplies, Performance of SM on non-sinusoidal voltages, Performance of CSI fed SM, Marginal angle control of SM, stability of SM on non-sinusoidal supplies, Self-controlled synchronous motor drive, Vector control of the synchronous motor, Synchronous motor speed control using a microprocessor (Block Diagram and Flowchart Approach only).

UNIT-V

Special Motor Drives: Introduction to various special motor drives. Switched reluctance motor-drive construction, Working principle, Normalized torque-speed characteristics, Speed Control Schemes, Brushless DC Motor–construction, Working principle, Torque-speed characteristics, Speed Control Schemes, Permanent magnet motor drives, Solar Powered Drive- motors suitable for pump drives, solar-powered pump drives, Battery Powered Drives-battery powered vehicles, basics, current status and scope for growth.

Text Books:

1. Vedam Subramanyam, 'Thyristor Control of Electric Drives', Tata McGraw Hill Publishing Co., New Delhi,1987.
2. G.K.Dubey, Fundamentals of Electrical Drives; Narosa Publishing House, 1995.
3. P.S.Bimbra, Generalised theory of Electrical Machines, Khanna Publication, 2006.

Suggested Reading:

1. R. Krishnan, 'Electric Motor Drive: Modeling, Analysis and Control' Prentice Hall of India, 2001.
2. B.K.Bose, 'Power Electronics and AC Drives', Prentice Hall, 2002

CO-PO-PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	2	1	2	-	1	-	2	1	2
CO2	3	3	2	1	2	1	-	-	-	-	-	-	-	1	2
CO3		1	1	2	-	-	1	-	-	-	-	-	-	1	1
CO4	3	3	1	1	-	-	-	-	-	-	-	-	1	2	2
CO5	3	2	3	3	2	1	1	-	-	-	-	-	-	2	3

20EE E36

DIGITAL SIGNAL PROCESSING

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have basic knowledge of Signals and Systems.

Course Objectives:

1. To understand the representation of signals mathematically in continuous, discrete time and frequency domain
2. To analyse the discrete time systems using Z-transforms, Discrete-Fourier Transform (DFT) and the FFT algorithms
3. To design IIR and FIR digital filters for various applications.

Course Outcomes: After completion of this course, students will be able to:

1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain
2. Analyse discrete-time systems using z-transform
3. Analyse the Discrete-Fourier Transform (DFT) and FFT algorithms
4. Design digital IIR filters
5. Design digital FIR filters.

UNIT-I

Discrete-time signals and systems: Sequences, representation of signals, classification of discrete time systems, Representation of discrete systems using difference equations, Sampling and reconstruction of signals, aliasing, Sampling theorem and Nyquist rate.

UNIT-II

Z-transform: Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of Z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms. Implementation of Discrete Time Systems (Direct Form-I, Direct Form-II, Cascade and Parallel).

UNIT-III

Discrete Fourier Transform: Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform (FFT) Algorithm, Parseval's Identity..

UNIT-IV

IIR Filters: Design of Butterworth and Chebyshev filters, IIR filter design by Impulse Invariant and Bilinear Transformation Techniques, Step Invariance Method.

UNIT-V

FIR Filters: Characteristics of FIR Digital Filters. Frequency response, comparison of FIR and IIR filters, Window techniques, Design of these filters using Rectangular, Hamming, Bartlet, Kaiser windows, Architecture and features of TMS 320F/2047 and ADSP signal processing chips, Applications of DSP.

Text Books:

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Prentice Hall, 1997.
4. B. Venkataramani, M. Bhaskar, "Digital Signal Processo1; Architecture, Programming & Application", Tata McGraw Hill-2004

Suggested Reading:

1. Anandkumar A, Digital Signal Processing, Second edition PHI learing, 2015
2. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall,1992.
3. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
4. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons,1988.

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	1	1	1	1	-
CO2	2	3	3	2	1	-	-	-	-	-	2	1	1	2	-
CO3	2	3	3	2	1	-	-	-	-	-	2	2	2	3	1
CO4	2	2	2	2	1	-	-	-	-	-	2	2	2	1	2
CO5	2	2	2	1	1	-	-	-	-	-	2	2	2	1	2

20EG M01

INDIAN CONSTITUTION & FUNDAMENTAL PRINCIPLES

(Semester-VI)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	--
CIE	--
Credits	NC

Course Objectives : The course will introduce the students to:

1. History of Indian Constitution and how it reflects the social, political and economic perspectives of the Indian society.
2. Growth of Indian opinion regarding modern Indian intellectuals constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism
3. Various Organs of Governance and Local Administration.

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

1. Understand the making of the Indian Constitution and its features.
2. Identify the difference among Right To equality, Right To freedom and Right to Liberty.
3. Analyze the structuring of the Indian Union and differentiate the powers between Union and States.
4. Distinguish between the functioning of Lok Sabha and Rajya Sabha while appreciating the importance of Judiciary.
5. Differentiate between the functions underlying Municipalities, Panchayats and Co-operative Societies.

UNIT-I

Constitution of India: Constitutional history-Govt of India Act 1909, 1919 and 1935, Constitution making and salient features. Directive Principles of State Policy - Its importance and implementation.

UNIT-II

Scheme of the Fundamental Rights & Duties: The Fundamental Rights - To Equality, to certain Freedom under Article 19, to Life and Personal Liberty Under Article 21. Fundamental Duties - the legal status.

UNIT III

Union Government and its Administration - Structure of the Indian Union: Federalism, distribution of legislative and financial powers between the Union and the States.

Parliamentary form of government in India: Executive-President's role, power and position.

UNIT IV

Legislature and Judiciary: Central Legislature-Powers and Functions of Lok Sabha and Rajya Sabha.
Judiciary: Supreme Court-Functions, Judicial Review and Judicial Activism

UNIT V

Local Self Government - District's Administration Head (Collector): Role and Importance. Municipalities & Municipal Corporations: Introduction, Chairperson/Mayor, Commissioner and Role of Elected Representatives. Panchayati Raj: Introduction, Zilla Panchayat, Chairperson, CEO, Elected Officials and their roles. Block/Mandal level: Organizational Hierarchy (Different departments). Village level: Role of Elected and Officials.

Text Books:

1. Indian Government & Politics, Ed Prof V Ravindra Sastry, Telugu Akademy, 2nd edition, 2018.
2. Indian Constitution at Work, NCERT, First edition 2006, Reprinted- January 2020.

Suggested Reading:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

20EE C28

POWER SYSTEMS LAB

(Semester-VI)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Power systems-I, Power systems-II, Switchgear and Protection

Course Objectives: The objective of the course is to

1. Determine regulation &efficiency of short, medium and long transmission lines and to calculate A, B, Cand,D constants .
2. Understand the importance of protective relays in power system such as different protection of Transformer, IDMT Characteristics of over current relay and static relays.
3. Understand steps involved in finding sequence parameter of Transformers and Alternators.
4. Determine dielectric strength of Transformer oil, sting efficiency and Fault location of Underground cables cable

Course Outcomes: After completion of the course student will be able to

1. Calculate ABCD constants of transmission lines and evaluate regulation and efficiency.
2. Examine relay setting and compensation techniques for safe operating of power system.
3. Identity sequence parameters of transformer and alternator and discuss its importance.
4. Calculate the time constant, perform Fault Analysis of an Alternator and Identify Fault location of an Underground Cable.
5. Determine the dielectric strength of transformer oil and calculate the efficiency of string insulators of a transmission line.

List of Experiments

1. Determination of regulation & efficiency of 3-Phasetransmission lines.
2. IDMT characteristics of Over-current relay.
3. Determination of A, B, C, D constants of 1-Phasetransmissionline.
4. Differential protection of 1-phase transformer.
5. Sequence impedance of 3-PhaseAlternators by fault Analysis.(LG,LL & LLL)
6. Determination of positive, negative and zero-sequence impedance of 3 – Phase transformers.
7. Determination of Synchronous machine reactance and Time constant from 3-Phase S.C test.
8. Determination of dielectric strength of Transformer oil and Megger.
9. Characteristics of Static Over current Relays.
10. Measurement of capacitance of 3-corecables.
11. Determination of positive, negative and zero-sequence impedance of 3 phase Alternator.
12. Determination of Voltage distribution and String efficiency of string of Insulators.
13. Study of Series-shunt compensation of a long transmission line.
14. Fault location of Underground cables.
15. Visiting nearby substation and submitting the report

Note: At least **TEN** experiments should be completed in the semester.

CO-PO & PSO Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	1	2	1	1	2	-	-	-	1	-	1	2	-	1
CO2	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO3	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO4	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO5	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1

20EE C29

Electrical Simulation Lab

(Semester-VI)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Electrical Circuit Analysis, Control Systems, Power Systems, Power system Operation and Control, Artificial Intelligence Techniques.

Course Objectives:

1. To understand the time and frequency response of the system
2. To understand the load flows, transient stability studies, economic load dispatch and load frequency control in power system
3. To understand the soft computing techniques

Course Outcomes: After completion of this course, students will be able to:

1. Analyze the DC and AC circuits
2. Demonstrate the time and frequency response of the system
3. Perform Load flow studies and economic load dispatch
4. Conduct Load frequency control and transient stability studies
5. Realize the Electrical operations using ANNs and Heuristic Techniques.

List of Experiments:

1. Verification of Basic Theorems
2. Time response of R, L, C circuits.
3. Determination of power angle diagram for Salient and Non-salient pole synchronous machine.
4. Time Domain Analysis of LTI Systems
5. Effect of PID Controllers
6. Stability Analysis of Unity Feedback Control Systems
7. Computation of line parameters
8. Modeling of Transmission Lines
9. Load Flow Studies.
10. Fault Analysis.
11. Transient stability studies.
12. Economic load dispatch.
13. Load Frequency control of single-area and two-area systems
14. Determination of Load Flows using ANNs
15. Economic Load Dispatch using Genetic Algorithm

Note: At least **TEN** experiments should be conducted in the Semester

CO-PO & PSO Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	2	-	-	-	1	-	1	2	-	1
CO2	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO3	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO4	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO5	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1

20EE C30

ELECTRICAL DRIVES LAB

(Semester-VI)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Power Electronics, Machines Theory, and labs.

Course Objectives:

1. To experiment and analyze the motor performance connected with power semi conductor source.
2. To be familiar with different speed control techniques of Drives.
3. To validate the experiment allresults with simulations.

Course Outcomes: After completion of this course, Students will be able to:

1. Analyze the control strategies to modify the output parameters of dc and ac drives.
2. Develop, testing and experimental procedures by applying basic knowledge in electrical and electronics.
3. Demonstrate the principle of energy efficient motors by load matching.
4. Interpret the performance of a given drive by suitable experimentation.
5. Investigate the performance of a given drive by using suitable simulation software.

LIST OF EXPERIMENTS

PART-A

1. Speed control of DC drive using Thyristor controlled rectifier.
2. Speed control of DC drive using DC-DC Chopper.
3. Four-Quadrant Operation of DC drive.
4. Closed loop speed control of DC motor using PID controller.
5. Speed control of single-phase induction motor speed using TRIAC.
6. Speed control of Three-Phase Induction Motor using V/f control.
7. Speed Control of Three-Phase Induction Motor using AC-AC converter.
8. Regenerative/Dynamic braking operation for AC drive.

PART-B

1. Simulation of Speed control of DC Motor using BJT-H bridge.
2. Simulation of Regenerative/ Dynamic breaking operation of DC motor.
3. Simulation of Step/ Ramp speed response of DC motor.
4. Simulation of VSI-fed3-PhaseInduction Motor drive.
5. Simulation of CSI-fed3-PhaseInduction Motor drive.
6. Simulation of Permanent Magnet synchronous motor drive.
7. Simulation of speed control of Permanent Magnet synchronous motor using V/f control method.

Note: Any **Six** experiments from **Part-A** and **Four** from **Part-B** should be performed

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	-	-	-	-	3	1	1	2	3	3	1
CO2	2	3	1	2	-	-	-	-	3	1	1	2	3	3	1
CO3	2	2	1	2	-	-	-	-	3	1	1	1	3	3	1
CO4	2	2	1	2	-	-	-	-	3	1	1	1	3	3	1
CO5	2	3	1	3	1	-	-	-	3	1	1	2	3	3	1

20EEC31

IoT Lab

(Semester-VI)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisites: Students should have prior knowledge on basic understanding of C programming language, understanding the IoT technologies and standards.

Course Objectives:

1. To understand fundamental connectivity schemes of Arduino / Raspberry Pi boards
2. To understand the recent application domains of IoT in everyday life
3. To interface external objects with Arduino / Raspberry Pi
4. To develop programming skills, application development and prototyping using Arduino/ Raspberry Pi.

Course outcomes: After completion of this course, students will be able to:

1. Understand use of Arduino / Raspberry Pi board circuit
2. Implement interfacing of various sensors with Arduino /Raspberry Pi
3. Demonstrate the ability to transmit data wirelessly between different devices
4. Show an ability to upload/download sensor data on cloud and server
5. Analyze basic protocols in wireless sensor network

List of Experiments

1. Interfacing of Raspberry Pi with existing system components
2. Characteristics of p-n junction diode, Zener diode and Light Emitting Diode (LED) using Arduino IDE
3. Design of half wave rectifier using Arduino /Raspberry Pi
4. Temperature measurement using Arduino /Raspberry Pi
5. Distance measurement using Arduino /Raspberry Pi
6. Stopwatch control using Arduino / Raspberry Pi
7. Traffic Light Controller using Arduino /Raspberry Pi
8. Dark Sensing LED using Arduino/Raspberry Pi
9. Design of digital dc voltmeter and ammeter using Arduino /Raspberry Pi
10. Design of digital ac voltmeter and ammeter using Arduino / Raspberry Pi
11. Measurement of power and energy using Arduino / Raspberry Pi
12. Speed control of dc motor using Arduino / Raspberry Pi
13. Monitoring of temperature and humidity in PC screen using Raspberry Pi
14. Interfacing of motor using relay with Arduino /Raspberry Pi and write a program to turn ON motor when push button is pressed
15. Interfacing of Bluetooth with Arduino /Raspberry Pi and write a program to send sensor data to smart phone using Bluetooth
16. Uploading of temperature and humidity data from Arduino/Raspberry Pi to thing speak cloud
17. Retrieval of temperature and humidity data from thing speak cloud to Arduino/Raspberry Pi

Note: At least **TEN** experiments from above should be conducted in the semester

CO-PO and CO-PSO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	2	1	-	-	-	-	-	3	2	1	-
CO2	3	3	3	3	3	2	-	-	3	3	1	3	3	2	-
CO3	3	3	3	3	3	2	-	-	3	3	1	3	3	2	-
CO4	3	3	3	3	3	2	-	-	3	3	1	3	3	2	-
CO5	3	3	3	3	3	2	-	-	3	3	1	3	3	2	-