SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE
(AUTONOMOUS)

(Approved by AICTE, New Delhi, Affiliated to JNTUK, Kakinada)

Accredited by NAAC with 'A+' Grade.

Recognised as Scientific and Industrial Research Organisation

SRKR MARG, CHINA AMIRAM, BHIMAVARAM – 534204 W.G.Dt., A.P., INDIA

Regulation: R23	**III / IV - B.Tech. I - Semester**

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE

(With effect from 2023-24 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E.	S.E.E.	Total Marks
B23EE3101	Signals & Systems	PC	3	0	0	3	30	70	100
B23EE3102	Transmission and Distribution Systems	PC	3	0	0	3	30	70	100
B23EE3103	Power Electronics	PC	3	0	0	3	30	70	100
#PE-I	Professional Elective -I	PE	3	0	0	3	30	70	100
#OE-I	Open Elective-I	OE	3	0	0	3	30	70	100
B23EE3108	Power Electronics Laboratory	PC	0	0	3	1.5	30	70	100
B23EE3109	Solar Energy Systems Laboratory	PC	0	0	3	1.5	30	70	100
B23BS3101	Soft Skills	SEC	0	1	2	2	30	70	100
B23EE3110	Tinkering Laboratory	ES	0	0	2	1	30	70	100
B23EE3111	Evaluation of Community Service Internship	PR	--	--	--	2	--	50	50
	TOTAL		**15**	**01**	**10**	**23**	**270**	**680**	**950**

	Course Code	Course
#PE-I	B23EE3104	Solar and Wind Energy Systems
	B23EE3105	Energy Storage Systems
	B23EE3106	Distributed Generation & Micro grids
	B23EE3107	MOOCS-I
#OE-I	Student has to study one Open Elective offered by AIDS or AIML or CE or CIC or CSBS or CSG or CSE or CSIT or ECE or ME or IT or S&H from the list enclosed.	

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3101	PC	3	--	--	3	30	70	3 Hrs.

SIGNALS AND SYSTEMS

(For EEE)

Course Objectives: Students will learn about

1.	The properties of signals and systems and their classification.
2.	The convolution and differential/difference equation approach for LTI system analysis in time domain.
3.	The Fourier analysis for representation and analysis of periodic signals.
4.	The Fourier Transform to analyze the Continuous Time (CT) and Discrete Time (DT) systems.
5.	The Z-transform approach for analyzing DT systems and sampling of CT signals.

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

S.No	Outcome	Knowledge Level
1.	Apply the properties of continuous time and discrete time signals and systems to classify them.	K3
2.	Apply convolution to analyze CT and DT systems in the Time domain.	K3
3.	Analyze the spectral characteristics of periodic signals using Fourier series analysis.	K4
4.	Apply Fourier Transform to analyze the signals & systems.	K3
5.	Analyze discrete time signals and systems using Z–Transforms and apply sampling theorem for signal conversion.	K4

SYLLABUS

UNIT-I (10Hrs)	**Introduction to Continuous–time and Discrete–time Signals and Systems:** Basic continuous time and discrete time signals, Signal Energy and Power, Transformations of the independent variable, Periodic Signals, Even and odd Signals, Complex Exponential signals, The Unit Impulse and Unit step Functions, Classification of systems, Basic system properties.
UNIT-II (10 Hrs)	**Linear Time – Invariant (LTI) systems:** Representation of signals in terms of impulses, Convolution sum and Convolution integral. Systems described by differential and difference equations. Block diagram representation of LTI systems, Singularity functions.
UNIT-III (10 Hrs)	**Fourier Series Representation of Periodic Signals:** Approximation of a function by a set of mutually orthogonal functions, The Continuous time and Discrete time Fourier series, Trigonometric and Exponential Fourier series, Convergence of Fourier series, Properties of Fourier Series.
UNIT-IV (10 Hrs)	**Continuous and Discrete Time Fourier Transform**: Fourier transform of continuous time and discrete time Aperiodic signals and periodic

	signals, properties of continuous time Fourier transforms. Frequency response of LTI systems characterized by linear constant coefficient differential and difference equations. First order and Second order systems and their analysis using Fourier Transform.
UNIT-V (10 Hrs)	**Z-transform and Sampling**: The Z-transform, Region of Convergence (ROC), relation between Z-transform and Fourier transform, Properties of z-transform, Inverse z-transform: Long Division method, Partial Fraction method, Determination of transfer function and impulse response of an LTI system, poles and zeros, system stability. Representation of a CT signal by its samples, The Sampling theorem, Reconstruction of a signal from its samples using zero order hold (ZOH), Effect of under sampling, Aliasing effect.
Textbooks:	
1.	Signals and Systems, Alan V. Oppenheim, Alan S. Willsky and S.Hamid Nawab, Pearson publishers, 2nd Edition, 2015.
2.	Principles of Linear Systems and Signals, B. P. Lathi., Oxford University Press, 2nd Edition,2009
Reference Books:	
1.	Signals and Systems, H.P.Hsu, Schaum's Outlines, McGraw Hill, 4th Edition, 2019.
2.	Signals and Systems, A. Anand Kumar, PHI Publishers, 3rd Edition, 2013.
e-resources:	
1.	https://nptel.ac.in/courses/108104100/
2.	https://nptel.ac.in/courses/117104074/

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3102	PC	3	--	--	3	30	70	3 Hrs.

TRANSMISSION & DISTRIBUTION SYSTEMS

(For EEE)

Course Objectives: Students will learn about

1.	The different types of transmission distribution systems
2.	The inductance and capacitance of transmission lines
3.	The performance analysis of transmission lines
4.	The mechanical design of transmission line conductors and insulators.
5.	The underground cables and substations

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

S.No	Outcome	Knowledge Level
1.	Explore different types of transmission and distribution networks and apply Kelvin's law.	K3
2.	Calculate the Inductance and Capacitance of transmission lines.	K3
3.	Determine the performance of short, medium and long transmission lines.	K3
4.	Explore the mechanical and electrical design aspects of transmission lines.	K3
5.	Explore the underground cables and illustrate different types of substations.	K3

SYLLABUS

UNIT-I (10Hrs)	**Power Supply Systems & Distribution Systems:** Transmission and distribution systems- D.C 2-wire and 3- wire systems, A.C single phase, three phase 3 - wire and three phase 4- wire systems, comparison of copper efficiency. Primary and secondary distribution systems, concentrated & uniformly distributed loads on distributors fed at both ends, ring distributor, voltage drop and power loss calculation, Kelvin's Law.
UNIT-II (10 Hrs)	**Inductance & Capacitance Calculations:** Types of conductors, line parameters, calculation of inductance and capacitance of single and double circuit transmission lines, three phase lines with bundle conductors. Skin effect and proximity effect.
UNIT-III (10 Hrs)	**Performance of Transmission Lines:** Generalized network constants and equivalent circuits of short, medium and long transmission lines. Line performance: Regulation and efficiency, Ferranti effect.
UNIT-IV (10 Hrs)	**Overhead Line Insulators:** Types of insulators, potential distribution over a string of suspended insulators, string efficiency, methods of equalizing potential. Corona: phenomenon of corona, corona loss, concept of radio interference.

	Mechanical Design of Transmission Lines: Different types of towers, sag –tension calculations, sag template, string charts.
UNIT-V (10 Hrs)	**Underground Cables and Substations:** Construction, Insulation resistance, capacitance and dielectric strength in a single core cable. Capacitance grading, Intersheath grading. Substations: Functions of a Substation, Classification of substations, Comparison between outdoor and indoor substation, Symbols for equipment in substation, Bus bar arrangement in Substations - advantages and disadvantages.

Textbooks:	
1.	Electric Power Systems, Wadhwa, C.L., New Age International Private Limited, 8th edition ,2022.
2.	Power System Engineering, Nagarath, I.J, and Kothari, D.P., McGraw Hill Education; 3rd edition ,2019.
Reference Books:	
1.	Electrical Power Systems (Generation, Transmission, Distribution, Protection and Utilization of Electrical Energy), by Dr. S.L. Uppal , Prof. Sunil S. Rao , Khanna Publishers; 15th edition.
2.	A Text book on Power System Engineering, A. Chakrabarti, M.L. Soni, P.V. Gupta, U.S. Bhatnagar, Dhanpat Rai Publishing Company (P) Ltd, 2008.
e-Resources:	
1.	https://nptel.ac.in/courses/108102047
2.	https://nptel.ac.in/courses/108105104

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B23EE3103	PC	3	--	--	3	30	70	3Hrs.

POWER ELECTRONICS

(For EEE)

Course Objectives: Students will learn about

1.	The basic theory of power semiconductor devices.
2.	The principle of operation of phase-controlled rectifiers with different loads, different chopper circuits and their output voltage control.
3.	The DC - AC converters and sinusoidal PWM (SPWM) technique.
4.	The AC – AC Power conversion.
5.	The different multilevel Inverters.

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

Sl.no	Outcome	Knowledge Level
1.	Illustrate the power semiconductor device characteristics and gate driver circuit.	K3
2.	Analyze the phase-controlled rectifiers with different loads and operation of choppers.	K4
3.	Analyze the inverter operation and Sinusoidal PWM technique.	K4
4.	Analyze the operation of ac voltage controllers and Midpoint Cyclo-converter.	K4
5.	Explore the Multilevel Inverter topologies.	K3

SYLLABUS

UNIT-I (10 Hrs)	**Power Semiconductor Devices:** Introduction to power electronics, scope and applications, power semiconductor switches and their static & dynamic characteristics: SCR, Power MOSFET, IGBT; SCR Commutation – Load Commutation, Optocoupler based gate driver circuit, switching losses in a generic power semiconductor device, Introduction to Wide bandgap switching devices.
UNIT-II (10 Hrs)	**AC-DC Converters (Phase Controlled Rectifiers):** Introduction - Diode bridge rectifier with R and RL load with & without filter - Principle of phase-controlled rectifier - Single-phase full wave - controlled rectifier with R, RL, RL with freewheeling diode and RLE load, Average, RMS output voltage expressions, Effect of load and source inductances. **DC-DC Converters (Choppers):** Operation of Buck, Boost, Buck-Boost converters with waveforms - Input and Output voltage relationship, critical value of inductance and capacitance, Simple Problems.
UNIT-III (10 Hrs)	**DC-AC Converters (Inverters):** Introduction, principle of operation, single phase full bridge inverter with R & RL load, 3-

	phase full bridge inverter – 120^0 and 180^0 mode of operation, Pulse Width Modulation (PWM) – Sinusoidal Pulse Width Modulation (SPWM), Unipolar PWM, Bipolar PWM.
UNIT-IV (10 Hrs)	**AC – AC Converters (AC Voltage Controllers):** Introduction, principle & operation of single phase and three phase voltage controllers for R & RL load - applications – simple problems. **Cycloconverters:** Principle & operation of single-phase step-up & step-down mid-point cycloconverter.
UNIT-V (10 Hrs)	**Multilevel Inverters:** Introduction - Multilevel Inverters (Three level), Diode Clamped multilevel inverter, Flying capacitor multilevel inverter, H- bridge multilevel inverter, Applications, Advantages.
Text Books:	
1.	Power Electronics - Circuits, Devices and Applications- Muhammad H. Rashid, Pearson, 2018, 4^{th} Edition.
2.	Introduction to Power Electronics - Daniel W. Hart, Prentice Hall, 1^{st} edition.
Reference Books:	
1.	P.S. Bimbhra, Power Electronics, Khanna Publishers, 2022, 7^{th} Edition.
2.	Power Electronics: Converters, Applications and Design – Ned Mohan, Tore M. Undeland and William P. Robbins, 3^{rd} edition.
e-Resources:	
1.	https://nptel.ac.in/courses/108101038
2.	https://nptel.ac.in/courses/108101126

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3104	PE	3	--	--	3	30	70	3 Hrs.

SOLAR AND WIND ENERGY SYSTEMS

(For EEE)

Course Objectives: Students will learn about

1.	The operation of solar cell, Characteristics, equivalent circuit parameters.
2.	The Series and Parallel connection of cells, Module design and its protection.
3.	The different Maximum Power Point Tracking (MPPT) techniques and selection of converters for PV application.
4.	The wind generators and different configurations of wind energy systems.
5.	The Various configurations of Wind Energy Conversion System (WECS).

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

S.No	Outcome	Knowledge Level
1.	Explore the operation of solar cell, its Characteristics and equivalent circuit parameters.	K3
2.	Explore the design aspects of PV Module considering series & parallel interconnection schemes and mismatch.	K4
3.	Explore the MPPT techniques, standalone and grid connected solar systems.	K3
4.	Illustrate the wind turbine operation and different types of Wind turbines.	K3
5.	Illustrate various configurations of wind energy conversion systems.	K3

SYLLABUS

UNIT-I (10Hrs)	**Introduction To Solar Cells and Solar Radiation:** Introduction to solar energy, measurement of solar radiation - Solar cell - Generation of Photo voltage, Light generated current, I-V Characteristics. Limits of Cell Parameters - Short circuit current, Open circuit voltage, Fill factor and efficiency. Losses in Solar cell - Model of PV cell, Effect of Series & Shunt Resistance, Solar Radiation and Temperature on Efficiency - Simple problems - Recent trends in Solar Cell Technologies.
UNIT-II (10 Hrs)	**Solar Photovoltaic Modules Design:** Solar PV Modules from solar cells - Series and Parallel connection of cells — Mismatch in Cell/Module, Mismatch in series connection, Mismatch in Parallel connection, Design and structure of PV Modules-number of solar cells in a module, Wattage of Modules, PV Module Power output, I-V Equation of PV Modules, Ratings of PV Modules, I-V and Power curve of Module, Effect of Solar radiation and Temperature on PV Modules - Data sheet study - Simple problems.
UNIT-III (10 Hrs)	**Solar Power Conversion with MPPT:** MPPT Concept - Concept of load line - Input Impedance of Buck converter, Boost converter and Buck-Boost Converter- Algorithms for MPPT- Perturb and Observe method, Incremental Conductance method. Applications of Solar systems- Standalone mode - Grid connected mode **[Elementary**

	treatment only].
UNIT-IV (10 Hrs)	**Introduction to Wind Energy & Wind Turbine:** Introduction, Basic Principles of Wind Energy Conversion-Nature of the wind, Power in the wind, Maximum Power, Forces on the Blades, Lift and drag, Site selection considerations, Basic Components of a WECS (Wind Energy Conversion System), Wind Energy Collectors- Horizontal Axial Machines, Vertical axis Machines, Number of Blades. Analysis of Aerodynamic Forces acting on the Blade, Power Characteristics of Wind Turbine.
UNIT-V (10 Hrs)	**Wind Energy Conversion System Configurations (WECS):** Introduction, Fixed-Speed WECS, Variable-Speed Induction Generator WECS- Wound Rotor Induction Generator with External Rotor Resistance, Doubly Fed Induction Generator WECS with Reduced Capacity Power Converter, SCIG Wind Energy System with Full-Capacity Power Converters, Variable-Speed Synchronous Generator WECS-Configuration with Full-Capacity Back-to-Back Power Converters, Configuration with Diode Rectifier and DC - DC Converters, Configuration with Distributed Converters for Multi winding Generators.

Textbooks:	
1.	"Solar Photovoltaics- fundamentals, Technologies and Applications", Chetan Singh Solanki, PHI learning private limited, 3rd edition, 2018.
2.	Gilbert M. Masters & Kevin F. Hsu, "Renewable and Efficient Electric Power Systems", 3rd Edition, 2023.
3.	G. D. Rai, "Non-Conventional Energy Sources", 5th edition, Khanna Publishers, 2015.
Reference Books:	
1.	Bin Wu,Yongqiang Lang, Navid Zargari and Samir Kouro, "Power Conversion and Control of Wind Energy Systems ", IEEE Press, 2011.
2.	"Wind and Solar Power Systems", Mukund R. Patel, CRC Press, 1999.
e-Resources:	
1.	https://nptel.ac.in/courses/108108078
2.	https://nptel.ac.in/courses/117108141

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3105	PE	3	--	--	3	30	70	3 Hrs.

ENERGY STORAGE SYSTEMS

(For EEE)

Course Objectives: Students will learn about

1.	The classification of energy storage systems and their techno-economical aspects.
2.	The Electro chemical energy storage system types and their principles of operation.
3.	The mechanical and thermal energy storage systems.
4.	The electrical, electromagnetic and chemical energy storage systems.
5.	The applications of Energy Storage.

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

S.No	Outcome	Knowledge Level
1.	Explore the techno-economic characteristics of Energy Storage technologies.	K3
2.	Illustrate different types of batteries and their working principles.	K3
3.	Explore the principles of Mechanical and Thermal Energy Storage Systems.	K3
4.	Explore the principles of Electrical, Electromagnetic storage and chemical energy storage systems.	K3
5.	Apply Energy Storage Systems to utility and grid operations.	K3

SYLLABUS

UNIT-I (10Hrs)	**Introduction to Energy Storage Systems:** Introduction - Overview of Energy Storage Technologies, Applications and Technical benefits of energy storage systems, Financial Benefits of energy storage systems, Techno economic characteristics of energy storage systems.
UNIT-II (10 Hrs)	**Electro Chemical Energy Storage:** Battery Energy Storage Systems (BESS): Lead-acid (Pb-acid) Battery, Valve Regulated Lead-acid Battery (VRLA), Nickel Cadmium Batteries-Nickel Iron (NiFe) -Nickel-metal hydride (NiMH), Lithium-ion Battery, Flow Batteries-Vanadium Redox-Flow Battery (VRFB), Iron-Chromium Redox-flow Battery (Fe-Cr RFB), Sodium – ion Battery.
UNIT-III (10 Hrs)	**Mechanical Energy Storage:** Pumped Hydroelectric Storage (PHS), Compressed-Air Energy Storage (CAES), Flywheel Energy Storage (FES), Comparison of PHS, CAES and FES. **Thermal Energy Storage:** Sensible Heat Storage (SHS), Latent Heat Storage (LHS).
UNIT-IV (10 Hrs)	**Electrical & Electromagnetic:** Capacitors, Super Capacitors (SC's), Battery Vs Super capacitor, Superconducting Magnets, Comparison.

	Chemical Energy Storage: Hydrogen Production, Hydrogen Storage Technologies, Hydrogen Fuel Cell.
UNIT-V (10 Hrs)	**Applications of Energy Storage:** Introduction, Applications for Utilities and Grid Operators, Applications for Consumer, Integrating Renewable Energy to Grid, Smart Grid, Power Electronics in DER Systems, Battery SCADA System.
Textbooks:	
1.	Principles of Energy Storage Systems by P. Jayarama Reddy, B S Publications, 2023.
2.	Energy Storage Technologies and Applications, Ahmed Faheem Zobaa, Intech Publishers, 2013.
Reference Books:	
1.	Energy storage technologies and applications by C. Michael hoff, 2022, Artech house.
2.	Towards Next Generation Energy Storage Technologies by Minghua Chen, First Edition, 2025 by WILEY-VCH.
e-Resources:	
1.	https://nptel.ac.in/courses/113105102
2.	https://nptel.ac.in/courses/112106318

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3106	PE	3	--	--	3	30	70	3 Hrs.

DISTRIBUTED GENERATION AND MICRO-GRIDS

(For EEE)

Course Objectives: Students will learn

1.	The basic concepts of distributed generation (DG)
2.	The various types of DGs
3.	The fundamental concepts of energy storage
4.	The basic concepts of microgrid
5.	The stability and power quality concepts of microgrid

Course Outcomes: Student will be able to

S.No	Outcome	Knowledge Level
1.	Explore the need for DG and different types of DGs.	K3
2.	Illustrate different types of Renewable DGs and their Grid integration.	K3
3.	Explore different types of Energy Storage Systems.	K3
4.	Illustrate different types of microgrids and their topologies.	K3
5.	Explore power quality, stability analysis and standards in microgrids.	K3

SYLLABUS

UNIT-I (10Hrs)	**INTRODUCTION TO DISTRIBUTED GENERATION (DG)** Introduction - Distributed Vs Central station Generation - Traditional power systems - Transmission and Distribution (T&D) system costs - Power from Grid as a target for DG - Types of DG Planning Methods, comparison of various types of DG systems.
UNIT-II (10 Hrs)	**RENEWABLE DISTRIBUTED GENERATION** Types of Distributed Generations – Solar Power Generation (PV & Thermal power generation) - Wind Power Generation - Fuel Cell Powered DG - Gas Turbine Powered DG - Grid Interconnection Options - Types of Grid Interconnection.
UNIT-III (10 Hrs)	**ENERGY STORAGE SYSTEMS** Introduction - Energy Storage Systems - Battery Storage - Super conducting magnetic Energy Storage (SMES) - Capacitor storage - Mechanical storage: Pumped storage, flywheel & Compressed air - comparison of energy storage technologies.
UNIT-IV (10 Hrs)	**MICROGRID - I** Concept and definition of microgrid - microgrid drivers and benefits - typical structure and configuration of a microgrid - AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids - modes of operation and control of microgrid: grid connected and islanded mode.

UNIT-V (10 Hrs)	**MICROGRID - II** Power quality issues in microgrids - Stability analysis of Microgrid - Regulatory standards, Microgrid economics - Introduction to smart microgrids.
Textbooks:	
1.	H. Lee Willis, Distributed Power Generation Planning and Evaluation, CRC Press.
2.	S. Chowdhury; S. P. Chowdhury; P. P. Crossley, Microgrids and Active Distribution Networks, IET Publications, 2009, ISBN: 978-1-84919-014-5.
Reference Books:	
1.	F. Katiraei, M.R. Iravani, "Transients of a Micro-Grid System with Multiple Distributed Energy Resources" International Conference on Power Systems Transients (IPST-05) in Montreal, Canada on June 19-23, 2005.
2.	Z.Ye R. Walling, N.Miller, P.Du.K.Nelson,"FacilityMicrogrids, General Electric Global Research Center, Niskayuna, New York, Subcontract report, May 2005.
e-Resources	
1.	nptel.ac.in/courses/108108034
2.	nptel.ac.in/courses/108107143

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B23EE3108	PC	--	--	3	1.5	30	70	3Hrs

POWER ELECTRONICS LABORATORY

(For EEE)

Course Objectives: Students will learn about

1.	The characteristics of power semiconductor devices.
2.	The design of buck and boost converters along with gate driver circuit.
3.	The performance of full bridge converter with different loads.
4.	The performance of 3-phase inverters and multilevel inverters.
5.	The Speed control of DC and AC Motors using Power Converters.

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

Sl.no	Outcome	Knowledge Level
1.	Explore the characteristics of semiconductor switches for switch selection.	K4
2.	Explore the design aspect of Gate driver circuit for MOSFET.	K4
3.	Investigate the performance of Controlled rectifiers, DC-DC converters with different loads.	K4
4.	Analyze the performance of three phase and multilevel inverters.	K4
5.	Implement the Speed control of DC and AC Motors using Power Converters.	K4

LIST OF EXPERIMENTS

1	v-i characteristics of SCR & MOSFET/IGBT
2	v-i characteristics of SiC & GaN Switches
3	Implementation of Optocoupler based Gate driver for MOSFET
4	Open loop control of boost converter with R Load / RL Load
5	Closed loop control of buck converter with R Load / RL Load
6	Single phase full wave rectifier with and without freewheeling diode with R Load / RL-load
7	Voltage control of three phase inverter with R Load / RL Load
8	Neutral Point Clamping (NPC) multilevel inverter with R Load / RL Load
9	Speed Control of DC Motor using Single Phase Full Converter
10	Speed Control of Induction Motor using AC – DC – AC Converter.
Add-On Experiments:	
11	Generation of PWM pulses using TMS320F28379D DSP Microcontroller.
12	Study of cascaded H-Bridge Multilevel Inverter
13	R & RC Triggering Circuits for SCR
Reference Books:	
1.	Power Electronics: Converters, Applications and Design –Ned Mohan, Tore M. Undeland and William P. Robbins, 3rd edition

2.	Muhammad H. Rashid, Power Electronics - Circuits, Devices and Applications, Pearson, 2018,4th Edition.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3109	PC	--	--	3	1.5	30	70	3 Hrs.

SOLAR ENERGY SYSTEMS LABORATORY

(For EEE)

Course Objectives: Students will learn about

1	The Solar energy extraction, Photovoltaic (PV) panels and connections.
2	The characteristics of PV Modules.
3	The Partial shading effect on PV Array and maximum power extraction.
4	The PV Off-Grid and ON-Grid mode configurations.
5	The estimation of required number of PV panels and their connections.

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

S.No	Outcome	Knowledge Level
1	Illustrate PV Panel specifications, Solar power and its measurement.	K3
2	Plot and analyze the performance Characteristics of a PV Module	K4
3	Illustrate partial shading effect on PV Modules and maximum power extraction.	K4
4	Analyse the Standalone and Grid connected PV systems.	K4
5	Estimate the required number of PV panels and configuration for a given load.	K5

LIST OF EXPERIMENTS

1	Study and verify the specifications of a given PV module.
2	Plot the I-V and P-V Characteristics for a given PV Module.
3	Effect of Irradiance and Temperature on PV module.
4	Effect of tilt angle on PV module performance
5	Plot the I-V and P-V characteristics for Series, Parallel and series-parallel connection of PV Panels.
6	Performance of PV array under partially shaded conditions
7	Effect of Bypass diode on PV string under partially shaded conditions
8	Solar MPPT controller
9	Off-Grid mode of PV System
10	On-Grid mode of PV System
Add-On Experiments:	
11	Study of Street light connection
12	Design & Verification of PV Array for a given load.
13	Study of tools required for PV installation.
Reference Books:	
1	Chetan Singh Solanki, “Solar Photovoltaics: Fundamentals, Technologies and Applications” PHI Publication, 3rd edition.

2	G. D. Rai, “Non-Conventional Energy Sources”, 5th edition, Khanna Publishers, 2015.
3	https://nptel.ac.in/courses/117108141

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23BS3101	SEC	--	1	2	2	30	70	3 Hrs.

SOFT SKILLS

(For AIDS, CIC, CSIT, CSD, ECE and EEE)

Course Objectives:

1	To familiarise students with soft skills and how they influence their professional growth.
2	To build/refine the professional qualities/skills necessary for a productive career and to instill confidence through attitude building.

Course Outcomes:

S.No	Outcome	Knowledge Level
1	Interpret the essence of key soft skills such as creativity & problem solving, emotional intelligence, leadership qualities, etc.	K2
2	Outline interview essentials for graduate-job prospects.	K2
3	Apply presentation skills in academic and professional settings.	K3
4	Demonstrate knowledge about domain specific industry and the prospective workplace.	K2

SYLLABUS

1	**INTRODUCTION** Introduction to soft skills, definition and meaning, importance and need in personal and professional settings; soft skills vs. hard skills; personality development.
2	**INTRA-PERSONAL AND INTER-PERSONAL COMMUNICATION** Significance of Inter & Intra-Personal Communication; SWOT Analysis; Goal Setting – Guidelines for Goal Setting; Emotional Intelligence; Creativity & Problem Solving; Stress and Time Management; Leadership & Team Work; Building a positive attitude, Social Consciousness.
3	**WRITTEN COMMUNICATION** Resume Preparation: Common resume blunders, Tips for betterment, Resume Review; Report Writing; Writing an SOP (Statement of purpose).
4	**PRESENTATION SKILLS** Importance of Presentation Skills; JAM; Essential guidelines for Group Discussions; Debates; Role Plays; PPTs etc.
5	**INTERVIEW SKILLS** Employability Skills: Knowing about Selection Process; Interview Skills, types of Interviews, E-Interviews, Do's and Don'ts of Interviews, FAQs, Mock Interviews; Awareness about Industries; Importance of researching the prospective workplace.

Text Books:	
1	Sherfield, M. Robert et al, Cornerstone Developing Soft Skills,(4th edition), Pearson Publication, New Delhi, 2014.
2	Alka Wadkar, Life Skills for Success,(1st edition), Sage Publications India Private Limited, 2016.
3	Soft Skills : Know Yourself and Know the World by Dr. K. Alex, S. Chand & Company Ltd., New Delhi, 2009.
Reference Books:	
1	Sambaiah.M. Technical English, Wiley Publishers India. New Delhi. 2014.
2	Gangadhar Joshi, From Campus to Corporate, SAGE TEXT, 2015.
3	Alex.K, Soft Skills, 3rd ed. S. Chand Publication, New Delhi, 2014.
4	Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principle and Practice, Oxford University Press, 2009.
5	Emotional Intelligence by Daniel Goleman, Random House Publishing Group, 2012.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3110	ES	--	--	2	1	30	70	3 Hrs.

TINKERING LABORATORY

(For EEE)

Course Objectives: Students will learn about

1	Hands-on designing and testing embedded systems for real-time monitoring and control.
2	Sensor interfacing, signal acquisition and wireless communication techniques using Arduino, ESP32 and LoRa/Zigbee modules.
3	Skills in hardware prototyping, PCB fabrication and power electronics for auxiliary systems.
4	IoT platforms and data visualization tools such as MATLAB and ThingSpeak.
5	CAD modeling and 3D printing.

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

S.No	Outcome	Knowledge Level
1	Design and implement embedded systems using microcontrollers for data acquisition and control applications.	K4
2	Interface sensors and wireless modules (LoRa, Zigbee, GPS, ESP32-CAM) for real-time IoT-based monitoring.	K4
3	Fabricate and test custom power supply systems including AC-DC auxiliary converters and battery packs.	K4
4	Analyze the electrical signals using DSOs and generate PWM pulses with MATLAB-Arduino interfacing.	K4
5	Fabricate mechanical components using parametric CAD tools and additive manufacturing.	K4

LIST OF EXPERIMENTS

1	Design of DC auxiliary supply from AC supply
2	Fabrication of a PCB-Based DC Auxiliary Power Supply from AC Mains
3	PWM signal generation using Arduino interfacing with MATLAB
4	Calibration of DC/AC voltage and current sensor card
5	Design and testing of a Custom Battery Pack using cells
6	Visualization and Measurement of Electrical Signals using a Digital Storage Oscilloscope (DSO)
7	Parametric modelling and additive manufacturing of Dice in Fusion 360 and 3D Printing
8	Real time Electrical Energy monitoring system
9	Identification and Assembly of Basic Components in a Drone System
10	IoT-Based Water Quality Monitoring and Visualization using Arduino and ThingSpeak
11	Voice-Assisted Smart Home Automation Using Arduino and Google Assistant
12	Image Capture and local access using ESP32-CAM

13	Humidity and Temperature measurement & communication with LoRa gateway
14	Acquisition and Display of GPS Coordinates using Arduino
15	Wireless Sensor Communication using Zigbee Modules with Arduino
Reference Books:	
1	Blum, Jeremy. Exploring Arduino: tools and techniques for engineering wizardry. John Wiley & Sons, 2019.
2	Buyya, Rajkumar, and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier, 2016.
3	https://onlinecourses.nptel.ac.in/noc25_cs147/preview
4	https://onlinecourses.swayam2.ac.in/aic20_sp04/preview

Regulation: R23	**III / IV - B.Tech. II - Semester**

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE
(With effect from 2023-24 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E.	S.E.E.	Total Marks
B23EE3201	Microprocessors& Microcontrollers	PC	3	0	0	3	30	70	100
B23EE3202	Control Systems	PC	3	0	0	3	30	70	100
B23EE3203	Power Systems Analysis and Stability	PC	3	0	0	3	30	70	100
#PE-II	Professional Elective -II	PE	3	0	0	3	30	70	100
#PE-III	Professional Elective -III	PE	3	0	0	3	30	70	100
#OE-II	Open Elective-II	OE	3	0	0	3	30	70	100
B23EE3212	Microprocessors & Microcontrollers Laboratory	PC	0	0	3	1.5	30	70	100
B23EE3213	Control Systems Laboratory	PC	0	0	3	1.5	30	70	100
B23EE3214	Electrical System Simulation Laboratory	SEC	0	1	2	2	30	70	100
B23MC3201	Employability Skills	MC	2	--	--	--	30	--	30
		TOTAL	**20**	**1**	**8**	**23**	**300**	**630**	**930**

	Course Code	Course
#PE-II	B23EE3204	Power Electronics for Renewable Energy
	B23EE3205	Electrical Distribution Systems
	B23EE3206	Computer Architecture &Organisation
	B23EE3207	MOOCS-II
#PE-III	B23EE3208	High Voltage Engineering
	B23EE3209	Special Electrical Machines
	B23EE3210	Digital Signal Processing
	B23EE3211	MOOCS-III
#OE-II	Student has to study one Open Elective offered by AIDS or AIML or CE or CIC or CSBS or CSG or CSE or CSIT or ECE or ME or IT or S&H from the list enclosed.	
*Mandatory Industry Internship /Mini Project of 08 weeks duration during summer vacation		

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B23EE3201	PC	3	--	--	3	30	70	3 Hrs.

MICRO PROCESSORS AND MICRO CONTROLLERS

(For EEE)

Course Objectives: Students will learn about

1.	The architecture of 8085 microprocessor, Memory interfacing with processor and Memory & I/O operations.
2.	The 8085-microprocessor instruction set and assembly language programming.
3.	The architecture of different peripherals (8259,8255,8279) and A/D & D/A converters.
4.	The architecture of ARM Microcontroller.
5.	The instruction set and programming using ARM Microcontroller.

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

S.No	Outcome	Knowledge Level
1.	Illustrate the architecture of 8085 Microprocessor, timing diagrams and memory interfacing.	K3
2.	Apply the 8085-processor instruction set for assembly level programming.	K3
3.	Illustrate how different peripherals are interfaced with 8085 Microprocessor.	K3
4.	Illustrate the architecture of ARM Cortex-M Microcontroller.	K3
5.	Explore the instruction set of ARM Cortex-M microcontroller.	K3

SYLLABUS

UNIT-I (10 Hrs)	**8085 Microprocessor**: Introduction to microprocessor – Architecture– pin out diagram– addressing modes, Memory interfacing, Machine cycles and bus timings for opcode fetch, memory read, memory write, I/O read, I/O write operations – Memory mapped I/O and I/O mapped I/O.
UNIT-II (10 Hrs)	**8085 Instructions and programming:** Difference between Machine language, Assembly language and High-level language – Brief description of the instruction set – programming using data transfer group, arithmetic group, logical group, branch transfer group- Stack and Subroutines – Counters and delay.
UNIT-III (10 Hrs)	**Interfacing peripherals to 8085:** D/A and A/D converters – Interfacing D/A and A/D converters. Description and interfacing of 8251 USART, 8253/8254 programmable timer, 8255 PPI, 8279 programmable keyboard/display interface.
UNIT-IV (10 Hrs)	**The ARM Cortex-M Processor Architecture:** Introduction to Cortex-M Microcontroller, Microprocessor Architecture-ARM Instruction Set Architecture, Register Set, Processor Operating Modes, Interrupts and Processor Reset Sequence, Pipelined Architecture and Data Path, Memory Address Map, Nested interrupt vector controller, Bus system and Bus Matrix, Memory and Peripherals.

UNIT-V (10 Hrs)	**ARM Cortex-M Programming:** Basics of Assembly programming, Data processing instructions, Memory Access instructions, Branch and Control Instructions, Simple programs using Instruction set (Elementary treatment).
Text Books:	
1.	Microprocessor Architecture Programming and Application - Ramesh S. Gaonkar, Penram International (P)ltd., Mumbai, ISBN- 978-8187972884, 6th Education, 2013.
2.	ARM® Microprocessor Systems, Cortex®-M Architecture, Programming, and Interfacing, Muhammad Tahir and Kashif Javed, CRC Press Taylor & Francis Group, Special Indian edition, 2018.
Reference Books:	
1.	Micro-processors & Interfacing- Douglas V. Hall, Tata McGraw Hill, 3rd Edition, 2017.
2.	ARM Assembly Language – William Hohl, ISBN:978-81-89643-04-1. CRC Press, 2nd edition, 2014.
Web links:	
1.	https://nptel.ac.in/courses/117106111

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B23EE3202	PC	3	--	--	3	30	70	3 Hrs.

CONTROL SYSTEMS

(For EEE)

Course Objectives: Students will learn about

1.	The modelling of linear systems using transfer functions and obtain transfer functions using block diagrams and signal flow graphs.
2.	The significance of time response and find it for system analysis in transient and steady state.
3.	The concept of stability and know different techniques of stability analysis.
4.	The concept of frequency domain analysis, Bode plots, Polar plots.
5.	The concept of state space modeling and analysis.

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

S.No	Outcome	Knowledge Level
1.	Model electrical and mechanical physical systems by applying laws of physics and derive transfer functions from block diagrams & Signal Flow Graphs.	K4
2.	Analyze systems in time domain for transient and steady-state behavior.	K4
3.	Analyze the stability of a system by RH criterion and Root locus.	K4
4.	Analyze the behavior of system using frequency response plots.	K4
5.	Model and analyze the LTI system using state space approach.	K4

SYLLABUS

UNIT-I (10 Hrs)	**Mathematical Modelling of Control Systems:** Open loop and closed loop systems, Transfer Function models of linear Systems - Modelling of Mechanical & Electrical Systems, Block Diagram representation of Control Systems – Block Diagram Reduction - Transfer Function of Armature voltage-controlled DC servo motor - Signal Flow Graph representation of control systems, Mason's gain formula.
UNIT-II (10 Hrs)	**Time Domain Analysis of Control Systems:** Time Response of First and Second Order Systems with Standard Input Signals -Time Domain Specifications of Second Order Systems - Steady State Error, Steady State Error Constants - Basic Control Actions- Effects of proportional (P)- proportional integral (PI)- proportional derivative (PD) and proportional integral derivative (PID) systems.
UNIT-III (10 Hrs)	**Stability Analysis of Control Systems:** Concept of Stability, Routh-Hurwitz Criterion, Relative Stability Analysis - The Concept and Construction of Root Loci - Simple problems.

UNIT-IV (10 Hrs)	**Frequency Domain Analysis of Control Systems:** Frequency Response -Bode Plots- Log Magnitude versus Phase Plots, Polar Plots – Frequency Domain specifications - Correlation between Time and Frequency Responses. Stability in Frequency Domain- Nyquist Stability Criterion - Assessment of Relative Stability, Gain Margin and Phase Margin.
UNIT-V (10 Hrs)	**State Space Analysis of LTI Systems:** Concept of state, State Variables and State Models- State space models for LTI electrical Systems, Phase variable form and diagonal canonical form - Conversion between Transfer Function models and State space Models- Solution to the State Equation, State Transition Matrix - Concept of Controllability and Observability.
Text Books:	
1.	I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Publishers (Sixth Edition) 2018.
2.	Norman S.Nise, 'Control systems Engineering ', Wiley publications, 7th Edition, 2015.
Reference Books:	
1.	Katsuhiko Ogata, "Modern Control Engineering" PHI, 4th Edition, 2009.
2.	Richard C. Dorf and Robert H. Bishop, „Modern Control Systems", Addison-Wesley Publishers (Eight Edition) 1998.
e – resources:	
1.	https://nptel.ac.in/courses/107106081/
2.	https://nptel.ac.in/courses/108106098/

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B23EE3203	**PC**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs**

POWER SYSTEMS ANALYSIS AND STABILITY

(For EEE)

Course Objectives: Students will learn about

1.	The Single line diagram, per unit system, per unit reactance diagram.
2.	Formation of Y-bus, Gauss-seidel method, Newton-Raphson method, fast decoupled method.
3.	To calculate short circuit momentary current, interrupting current, and short circuit MVA.
4.	About Symmetrical components, sequence networks, LG, LL, and LLG Faults on a power system.
5.	About Swing equation, equal area criterion, steady-state stability, and transient stability of a power system.

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

S. No	Outcome	Knowledge Level
1.	**Compute** the p.u. reactance and draw the per unit reactance diagram of a power system.	K3
2.	**Apply** the load flow techniques to **analyze** load flow problems in the power system.	K4
3.	**Compute** short circuit MVA and **analyze** symmetrical fault currents and voltages in a power system.	K4
4.	**Determine** the symmetrical components and un-symmetrical fault currents in a power system.	K4
5.	**Derive** swing equation and apply equal area criterion to **analyze** steady-state and transient stability of a power system.	K4

SYLLABUS

UNIT-I (10 Hrs)	**Per Unit (P.U) Representation:** One- Line Diagram, Impedance or Reactance Diagram, P.U. quantities, P.U. representation of transformer, P.U. Impedance Diagram of a Power System, Equivalent circuit of 3-Winding Transformers.
UNIT-II (10 Hrs)	**Load Flow Studies:** Network Model Formulation, Y-Bus formation by direct inspection method, Load Flow Problem, Gauss-Seidel Method, Newton-Raphson Method & Fast Decoupled Method of Solving Load Flow Problems.
UNIT-III (10 Hrs)	**Symmetrical Fault Analysis:** Transient on a Transmission line, Short Circuit of Synchronous Machine (No Load), Short Circuit of a loaded Synchronous Machine, Short Circuit MVA Calculations.

UNIT-IV (10 Hrs)	**Symmetrical Components and Sequence Networks:** The Symmetrical Components transformation, Sequence Impedances of transmission lines, Sequence impedance and Networks of synchronous machine, Sequence impedance and Networks of Transformers, 3-Phase Power in terms of Symmetrical Components. **Un-Symmetrical Faults:** LG, LL and LLG Faults on a power system under Unloaded Condition.
UNIT-V (10 Hrs)	**Power System Stability:** Dynamics of Synchronous Machine, Swing Equation, Steady State Stability, Transient Stability, Equal Area Criterion, Critical Clearing Angle and Critical Clearing time, Solution of Swing Equation by Step-by-Step Method, Factors Affecting Transient Stability.
Text Books:	
1.	Modern Power System Analysis by D.P. Kothari & I.J. Nagarath, 5th Edition, TMH Publication.
2.	Elements of Power System Analysis, William D. Stevenson, Jr, Mc Graw Hill Pub, 4th edition, 1982.
Reference Books:	
1.	Power System Analysis by Hadi Sadat, 2nd Edition, Mc Graw Hill Pub 2002.
2.	Electrical Power Systems by C.L. Wadhwa, 7th Edition, New Age International Publications, 2017.
e - resources:	
1.	https://nptel.ac.in/courses/108105067
2.	https://nptel.ac.in/courses/108107127

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B23EE3204	PE	3	--	--	3	30	70	3 Hrs.

POWER ELECTRONICS FOR RENEWABLE ENERGY

(For EEE)

Course Objectives: Students will learn about

1.	The importance of renewable energy sources and need of Power Electronics for their use.
2.	The Power electronic topologies in PV systems and their importance
3.	The Power electronics for Type - III and Type - IV wind energy system.
4.	The basic configurations of power conversion system for Fuel cells.
5.	The requirements and issues of grid integration of renewables.

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

S.No	Outcome	Knowledge Level
1.	Explore the use of power electronics to renewable energy sources.	K3
2.	Apply the fundamentals of Power Electronics to enhance the PV system efficiency	K3
3.	Illustrate power electronic topologies for Type – III and Type – IV wind energy systems.	K3
4.	Apply DC – DC converters for fuel cells	K3
5.	Analyze the grid integration issues of PV and Wind energy systems	K4

SYLLABUS

UNIT-I (10Hrs)	**Introduction to Renewable Energy:** Classification of Energy Sources, Importance of renewable energy sources, Impacts of renewable energy generation on environment (cost-GHG Emission), Qualitative study of renewable energy resources: Photovoltaic Systems, Wind Energy Systems, Fuel Cells - PEMFC, Renewable Energy sources and their Interconnections, Attributes of power electronics for renewable energy systems.
UNIT-II (10 Hrs)	**Photovoltaic Power Electronics:** Mismatch losses, PV system configurations (S, P, SP & TCT), Power electronic topologies in PV Standalone systems (Single stage and two stage), Design of photovoltaic array for single and two stage standalone system based on the Sine PWM technique for inverter, MPPT operation with various DC-DC Converters (non-isolated), Advantages and disadvantages of inverter for two stage and single stage system.
UNIT-III (10 Hrs)	**Wind Power Electronics:** Control of wind turbines, Slip power recovery schemes, wind generators DFIG and PMSG principle of operation, Type III and Type IV control of wind turbines.

UNIT-IV (10 Hrs)	**Fuel Cell Power Electronics:** Power Electronic Converter for Fuel Cell, Basic configurations of power conversion system (PCS) for FC, DC-DC converters: non-isolated, Full bridge Converter, Bidirectional converters.
UNIT-V (10 Hrs)	**Grid Connected Power Electronics:** Grid requirement for PV, Grid connected and Islanding mode, Grid synchronization, Basic PLL operation, Grid connection Issues, Grid control strategy for PV and Wind systems – dq0 control strategy.
Textbooks:	
1.	Sudipta Chakraborty, Marcelo G. Simões, William E. Kramer, "Power Electronics for Renewable and Distributed Energy Systems" Springer 2013.
2.	Mukund R Patel, "Wind and Solar Power Systems", CRC Press, 1st edition, 1999.
Reference Books:	
1.	Power Electronics: Circuits Devices and Applications – M.H. Rashid, Prentice Hall of India, 4th edition, 2017.
2.	Solar Photovoltaics, Fundamentals, Technologies and Applications, Chetan Singh Solanki, 3rd edition.
e-Resources:	
1.	https://www.youtube.com/watch?v=TOwDy4V0ubw

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3205	PE	3	--	--	3	30	70	3 Hrs.

ELECTRICAL DISTRIBUTION SYSTEMS

(For EEE)

Course Objectives: Students will learn about

1.	The types of Loads and Load Characteristics, the role of computers in planning.
2.	The design considerations of distribution feeders and substations
3.	Compute voltage drop and power loss in Feeders
4.	About the protection of distribution systems.
5.	The principles of power factor improvement and voltage control.

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

S.No	Outcome	Knowledge Level
1.	Analyze distribution system characteristics, and utilize computational tools for efficient system planning and operation.	K4
2.	Examine distribution feeder designs, assess substation locations.	K4
3.	Compute voltage drop and power loss in radial and three-phase distribution networks.	K3
4.	Apply various protective devices and its coordination techniques to distribution system	K3
5.	Apply voltage control methods for improving power factor and system voltage regulation.	K3

SYLLABUS

UNIT-I (10Hrs)	**General:** Introduction to Distribution systems, an overview of the role of computers in distribution system planning, definition of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor- Load curves and Load- duration curves Relationship between the load factor and loss factor - Classification of loads (Residential, Commercial, Agricultural and Industrial) and their characteristics. Load Forecasting, Load management.
UNIT-II (10 Hrs)	**Distribution Feeders and Substations:** Design consideration of Distribution feeders: Radial and loop types of primary feeders, voltage levels, and feeder-loading. Design practice of the secondary distribution system. Location of Substations: Rating of a Distribution Substation, service area with *n* primary feeders. Benefits derived through optimal location of substations.
UNIT-III (10 Hrs)	**System Analysis:** Voltage drop and Power loss calculations: Introduction, DC 2-Wire Distribution System, DC 3-Wire System, AC Single-Phase and Three - Phase Distribution System, Voltage Drop Computation based on Load Density, non-three-phase primary lines.

UNIT-IV (10 Hrs)	**Protective Devices and Coordination**: Basic definitions, Overcurrent protection devices (fuses – [Type K & Type T fuse links Datasheet], Automatic Circuit Reclosers, Automatic line sectionalizer and Automatic circuit breakers). Objectives of distribution system protection, Coordination of protective devices, General coordination procedure Fuse-Fuse, Recloser-Recloser, Recloser-Fuse, Fuse-Circuit-Breaker Coordination.
UNIT-V (10 Hrs)	**Capacitive Compensation for Power Factor Control:** Different types of power capacitors, shunt and series capacitors, effects of shunt (Fixed and switched) and series capacitors, power factor correction. Economic justification, Practical Procedure to determine the best capacitor location. Voltage control, line drop compensation.
Textbooks:	
1.	"Electric Power Distribution System Engineering" by Turan Gonen, Mc.Graw-Hill Book Company, 3rd edition.
2.	"Electrical Power Distribution Systems" V.Kamaraju-Tata Mc Graw Hill ,2nd Edition.
Reference Books:	
1.	"Electric Power Distribution"-by A.S.Pabla, Tata Mc Graw-Hill Publishing Company, 4th edition.
2.	"Electrical Distribution Systems"- 2nd Edition by Dale R.Patrick and Stephen W.Fardo, CRC press.
e-Resources:	
1.	Operation And Planning Of Power Distribution Systems - Course
2.	Electrical Distribution System Analysis - Course

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3206	PE	3	--	--	3	30	70	3 Hrs.

COMPUTER ARCHITECTURE & ORGANIZATION

(For EEE)

Course Objectives: Students will learn about

1.	The concept of register transfer and micro-operations.
2.	The structure of an instruction code and different methods used for expressing instructions.
3.	The basic CPU organization.
4.	The memory organization and different types of memories
5.	The Input – output organization and different ways of communications used in a basic computer.

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

S.No	Outcome	Knowledge Level
1.	Explore the register transfer language (RTL) and various micro-operations.	K3
2.	Illustrate the instruction cycle, interrupt cycle, instruction formats, and the register & memory reference instructions in basic computer organization.	K3
3.	Differentiate general register organization & stack organization and explore Micro programmed control & Reduced instruction set computer architecture.	K3
4.	Illustrate the memory hierarchy and different memory types used in a computer.	K3
5.	Explore the different modes of transfer used in I/O organization and the operation of peripheral devices.	K3

SYLLABUS

UNIT-I (10Hrs)	**Register Transfer and Micro Operations**: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro operations – Binary Adder, Binary Adder- subtracter, Binary incrementor, Arithmetic circuit, Logic Micro operations, Shift Micro operations, Arithmetic Logic Shift Unit.
UNIT-II (10 Hrs)	**Basic Computer Organization:** Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Register Reference instructions, Memory-Reference Instructions, Input-Output and Interrupt.
UNIT-III (10 Hrs)	**Micro Programmed Control:** Control Memory- Control word, Micro instruction, Micro program. Address Sequencing. **Central Processing Unit:** Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC)

UNIT-IV (10 Hrs)	**Memory Organization:** Memory Hierarchy, Main memory, Auxiliary memory, Associate Memory, Cache Memory, and Virtual memory, Memory Management Hardware.
UNIT-V (10 Hrs)	**Input/Output Organization:** Peripheral Devices, I/O interface, Asynchronous data transfer, Modes of transfer, priority Interrupt, Direct memory access, Input-Output Processor (IOP), Serial Communication.
Textbooks:	
1.	Computer System Architecture, M. Morris Mano, Pearson India, Revised 3rd ed., 2017.
2.	Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 6th Edition, McGraw Hill India, 2022.
Reference Books:	
1.	Computer Organization and Architecture, William Stallings, 11th Edition, Pearson India, 2022.
2.	John P.Hayes, "Computer architecture and Organisation", Tata McGraw-Hill, 3rd edition, 2012.
e-Resources:	
1.	https://nptel.ac.in/courses/106105163
2.	https://nptel.ac.in/courses/106103180

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3208	PE	3	--	--	3	30	70	3 Hrs.

HIGH VOLTAGE ENGINEERING

(For EEE)

Course Objectives: Students will learn about

1.	The over voltages in power systems, electric field distribution and computation in different configuration of electrode systems.
2.	The HV breakdown phenomena in gases, liquids and solid dielectrics .
3.	The generation of HV DC, AC and Impulse voltages and currents.
4.	The different methods of measuring HV AC, DC and Impulse voltages and currents.
5.	Testing of power apparatus and insulation coordination.

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

S.No	Outcome	Knowledge Level
1.	**Apply** the knowledge of over voltages, electric stress and field configuration to compute electric fields.	K3
2.	**Explore** the breakdown behaviour of solid, liquid and gaseous dielectric materials.	K3
3.	**Illustrate** the generation of High AC, DC & Impulse voltages and currents.	K3
4.	**Apply** different methods to measure High AC, DC & Impulse voltages and currents.	K3
5.	**Analyse** the different testing methods used in HV engineering and insulation coordination.	K3

SYLLABUS

UNIT-I (10Hrs)	**Introduction to High Voltage Engineering:** Electric Field Stresses – Uniform and non–uniform field configuration of electrodes – Estimation and control of electric Stress – Numerical methods for electric field computation. Over voltages in power systems: Causes of over voltages and its effects on power system – Lightning, switching surges and other abnormal conditions, Corona and its effects
UNIT-II (10 Hrs)	**Break Down Phenomenon for Uniform Fields in Gaseous, Liquid and Solid Insulation** Gases as insulating media – Collision process – Ionization process – Townsend's criteria of breakdown in gases – Paschen's law – Liquid as Insulator – Pure and commercial liquids Breakdown in pure and commercial liquid – Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown –Breakdown of solid dielectrics in practice.

UNIT-III (10 Hrs)	**Generation of High Voltages and High Currents:** Generation of High DC voltages: Rectifiers, voltage multipliers, Van de graf generators: generation of high impulse voltages: single and multistage Marx circuits- generation of high AC voltages: cascaded transformers, resonant transformers and tesla coils. Generation of high impulse currents – triggering and control of impulse generators.
UNIT-IV (10 Hrs)	**Measurement of High Voltages and High Currents:** High resistance with series ammeter – dividers, resistance, capacitance and Mixed dividers – peak voltmeter, Generating voltmeters – capacitance voltage transformers, Electrostatic voltmeters – sphere gaps, measurement of high current – resistive shunts, Rogowski coil.
UNIT-V (10 Hrs)	**High Voltage Testing & Insulation Coordination:** High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers - Insulation Coordination & testing of cables.

Textbooks:	
1.	M S Naidu and V Kamaraju, "High Voltage Engineering", Tata McGraw Hill, 3rd Edition, 2004.
2.	E Kuffel and W S Zaengl, "High Voltage Engineering Fundamentals", Pergamon Press, Oxford, London, 1986.
Reference Books:	
1.	C L Wadhwa, "High Voltage Engineering", New Age Publications, 3rd Edition, 2012.
2.	R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.
e-Resources:	
1.	https://nptel.ac.in/courses/108108116
2.	https://nptel.ac.in/courses/108104048

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3209	PE	3	--	--	3	30	70	3 Hrs.

SPECIAL ELECTRICAL MACHINES

(For EEE)

Course Objectives: Students will learn about

1.	The construction, principle of operation and control of Stepper Motor.
2.	The construction, principle of operation and control of Permanent Magnet Brushless DC.
3.	The construction, principle of operation and control of Permanent Magnet Synchronous Motors.
4.	The construction, principle of operation of Switched Reluctance Motor.
5.	The construction, principle of operation of Synchronous Reluctance Motor.

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

S.No	Outcome	Knowledge Level
1.	Explore different types of stepping motors, their characteristics & applications.	K3
2.	Illustrate the operation and control of Permanent Magnet Brushless DC Motor	K3
3.	Illustrate the operation and control of Permanent Magnet Synchronous motor.	K3
4.	Explore the working of SRM operation, control and applications.	K3
5.	Explore the Axial and Radial flux types of Synchronous reluctance Motor and their applications.	K3

SYLLABUS

UNIT-I (10Hrs)	**Stepping Motors:** Introduction, Types: Variable Reluctance Motor, Permanent Magnet Motor, Hybrid Motor, Torque Equation, Characteristics of Stepper Motor, Open & Closed – loop Control of Stepper Motor, Applications of Stepping Motors.
UNIT-II (10 Hrs)	**Permanent Magnet Brushless DC Motor (PMBLDC):** Construction –Principle of operation – Types – EMF Equation, Torque equations – Commutation - Power Converter Circuits and their controllers – Motor characteristics and control– Applications.
UNIT-III (10 Hrs)	**Permanent Magnet Synchronous Motor (PMSM):** Construction, Principle of Operation, EMF Equation, Torque Equation, Phasor Diagram, Comparison for Conventional Synchronous Motor and PMSM, Control of PMSM, Applications.
UNIT-IV (10 Hrs)	**Switched Reluctance Motor (SRM):** Constructional features, Principle of Working, Basics of SRM, Analysis, Torque Equation and Characteristics, Power Converter Circuits & Control of SRM, Rotor Position Measurement, Applications.

UNIT-V (10 Hrs)	**Synchronous Reluctance Motor (SYRM):** Constructional features – Types – Axial and Radial flux motors – Working principle – Variable Reluctance Motors – Voltage and Torque Equations – Phasor diagram - performance characteristics – Applications.
Textbooks:	
1.	K. Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
2.	E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.
Reference Books:	
1.	T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
2.	R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
e-Resources:	
1.	https://nptel.ac.in/courses/108102156/
2.	https://nptel.ac.in/courses/108104140/

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B23EE3210	PE	3	--	--	3	30	70	3 Hrs

DIGITAL SIGNAL PROCESSING

(For EEE)

Course Objectives: Students will learn about

1.	The basic concepts and techniques for processing signals.
2.	The DTFT, DFT and convolution of sequences.
3.	The FFT algorithms.
4.	The design techniques for IIR digital filters.
5.	The design techniques for FIR digital filters.

Course Outcomes: Students will be able to

Sl.No	Outcome	Knowledge Level
1.	Apply Sampling theorem to analyze the Discrete time signals, systems and realize digital filters.	K4
2.	Analyze discrete signals in the frequency domain and compute the linear and circular convolutions of discrete sequences.	K4
3.	Apply FFT algorithms to find the DFT of Discrete sequence.	K3
4.	Design the IIR filter by considering the given specifications.	K4
5.	Design the FIR filter by using window techniques.	K4

SYLLABUS

UNIT-I (10 Hrs)	**Discrete - Time Signals and Systems:** Signal processing, Advantages, limitations and applications of DSP**.** Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate; Discrete time signals, Sequences; Linear Shift – Invariant Systems, Linear Constant Coefficient Difference Equations, System Function H (Z), Stability, Structure and Realization of Digital Filters.
UNIT-II (10 Hrs)	**Discrete Time Fourier Transform (DTFT) & Discrete Fourier Transform (DFT):** DTFT and its properties Representation of Periodic Sequences, Properties of DFS, DFT and its Properties. Convolution of Sequences, Long Duration Sequence Filtering.
UNIT-III (10 Hrs)	**Fast – Fourier Transforms (FFT):** Radix – 2 Decimation – In – Time (DIT) and Decimation – In – Frequency (DIF) FFT Algorithms, Radix – 2 Inverse DIT- FFT, Radix – 2 Inverse DIF FFT.
UNIT-IV (10 Hrs)	**IIR Digital Filter Design Techniques:** General Considerations in Digital Filter Design - IIR Filter Design - Bilinear Transformation Method - Impulse Invariance Technique - Design of IIR Filters from Analog Filters (Butterworth Approximation Only) - Frequency Transformations.

UNIT-V (10 Hrs)	**FIR Digital Filter Design:** Linear Phase FIR filters - Fourier Series Method - Design of FIR Filter Using Windows (Rectangular, Bartlett, Hamming & Hanning Windows), Comparison of IIR and FIR Filters.
Text Books:	
1.	P. Ramesh Babu:Digital Signal Processing ,4th Edition, Scitech Publications.
2.	A. Anand Kumar, "Digital Signal Processing:2nd Edition, PHI Publications, 2015.
Reference Books:	
1.	Alan V. Oppenheim & Ronald W. Schafer: Digital Signal Processing 1st Edition published by Pearson Education.
2.	J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.
e-Resources:	
1.	https://nptel.ac.in/courses/117102060
2.	https://nptel.ac.in/courses/108106151

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3212	PC	--	--	3	1.5	30	70	3 Hrs.

MICROPROCESSOR & MICROCONTROLLER LABORATORY

(For EEE)

Course Objectives: Student will learn about

1	The Assembly Language Programs (ALP) execution using arithmetic, data transfer and logical instructions of 8085 Microprocessor.
2	The programs execution for array processing, number system conversions and conditional logic using 8085 Microprocessor
3	The Assembly Language Program (ALP) execution using instruction set of ARM Microcontroller
4	The interfacing peripheral devices with 8085 Microprocessor
5	The interfacing peripheral devices with ARM Microcontroller

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

S.No	Outcome	Knowledge Level
1	Develop assembly language programs for arithmetic, logical, and data manipulation operations using instruction set of 8085 Microprocessor	K3
2	Demonstrate the use of 8085 instructions for solving basic computational tasks like sorting, counting, number conversions	K3
3	Develop assembly language programs using instruction set of ARM Controller	K3
4	Implement programs for interfacing peripherals using 8085 Microprocessor	K3
5	Implement programs for interfacing peripherals using ARM Microcontroller	K3

SYLLABUS

PART A: SOFTWARE EXPERIMENTS:

1	Program to add two 8-bit binary numbers using 8085 Microprocessor
2	Program to add an array of 8-bit binary numbers using 8085 Microprocessor
3	Program to pick the largest even number from an array of 8- bit binary numbers using 8085 Microprocessor
4	Program to find the sum of an array of 2- digit packed BCD numbers using 8085 Microprocessor
5	Program to convert an 8- bit binary number into BCD using 8085 Microprocessor
6	Program to add two 64-bit binary numbers using ARM Microcontroller
7	Program to find the sum of 10 integer numbers using ARM Microcontroller
8	Program to find the factorial of a given number using ARM Microcontroller
9	Program to find Largest/Smallest number in an array using ARM Microcontroller
10	Program to arrange a series of 32-bit numbers in ascending/descending order using ARM Microcontroller

PART B: INTERFACING EXPERIMENTS	
11	Matrix Keyboard interfacing with 8085 Microprocessor
12	Interfacing stepper motor with 8085 Microprocessor for speed control
13	Seven Segment/LCD Display interfacing with ARM Controller
14	DC Motor Speed Control with ARM Controller
Add-on Experiments	
1	Traffic light control / LED blinking with 8085 Microprocessor
2	Interface and control an LED with ARM Controller
3	Interface a simple Switch and display its status through Relay, Buzzer and LED with ARM Controller
Reference Books:	
1	Ramesh S. Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, Penram International Publishing, New Delhi, 5th edition, 2008.
2	Microprocessors & Its Applications by Theagarajan, R., Dhanpal, S. & Dhanaseturan, S., New Age India Ltd., 1998
3	A. P. Godse, "ARM Controllers", Technical Publications-First Edition, 2020
4	ARM® Microprocessor Systems, Cortex®-M Architecture, Programming, and Interfacing, Muhammad Tahir and Kashif Javed, CRC Press Taylor & Francis Group

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3213	PC	--	--	3	1.5	30	70	3 Hrs.

CONTROL SYSTEMS LABORATORY

(For EEE)

Course Objectives: Students will learn about

1.	The time and frequency responses of dynamic systems using both MATLAB simulation and Hardware.
2.	The applications of AC Servomotor, DC servomotor, Synchro and Magnetic amplifier in control systems.
3.	The Root locus plots, Bode plots and Nyquist plots for system analysis.
4.	The state space modeling and analysis of control system.
5.	The compensators, PLCs, PID controller and 4-DOF (Degree of Freedom) robotic arm.

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

1	Analyze the Time and Frequency response of a given system by using MATLAB/Simulink software and experimentally.	K4
2	Draw the characteristics of AC servomotor, DC servo motor, Synchro and Magnetic amplifier.	K4
3.	Analyze system performance by drawing Root Locus, Bode and Nyquist plots using MATLAB/Simulink software.	K4
4.	Explore state space modeling and verify controllability & observability.	K4
5	Analyze the performance of a system with PLCs, PID controller, lag-lead compensators and explore 4-DOF robotic arm.	K4

LIST OF EXPERIMENTS / PROGRAMES

	Part-A (Experimentation)
1	Time Response of First / Second order system
2	PID Control of Second order system
3	Speed - Torque characteristics of AC Servomotor
4	Speed - Torque characteristics of DC Servomotor
5	Frequency response of RC filter
6	Frequency response of Second order system
7	Synchro Transmitter and Receiver pair
8	Real time control of 4DOF Robotic Arm
	Part-B (Simulation)
9	Time Response of First and Second order systems
10	PID Controller parameter tuning
11	Stability analysis by Root-locus plot
12	Gain Margin and Phase Margin from Bode plot
13	State space modelling and analysis
14	Design of Lag, Lead & Lag-Lead compensators

ADD ON experiments:	
1	Ladder logic Programming using PLC
2	Magnetic Amplifier
3	Design of state feedback controller
4	Stability analysis using Nyquist plot
Reference Books:	
1.	Benjamin C. Kuo, „Automatic Control Systems", PHI, 9th Edition,2014.
2.	Katsuhiko Ogata, "Modern Control Engineering" PHI, 4th Edition, 2009.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23EE3214	**SEC**	**--**	**1**	**2**	**2**	**30**	**70**	**3 Hrs.**

ELECTRICAL SYSTEM SIMULATION LABORATORY

(For EEE)

Course Objectives: Students will learn about

1	The open and closed loop operation of DC-DC converters using MATLAB software
2	The single phase and three phase inverters with square wave & Sinusoidal PWM (SPWM) techniques using MATLAB software.
3	The simulation of transmission line faults and protection with relays using PSCAD software.
4	The islanding detection in grid connected systems and partial shading effect of PV system using PSCAD software.
5	The computation of Y-bus, Fault currents and load flow with Gauss – Seidel (GS) method using MATLAB Programming/ETAP software.

Course Outcomes: At the end of the course, the students will able to

S.No	Outcome	Knowledge Level
1	Simulate and analyze the isolated and non – isolated DC-DC Converters using MATLAB software	K4
2	Simulate and analyze single phase and three phase inverters with PWM techniques using MATLAB software	K4
3	Simulate transmission lines faults and protection with distance/overcurrent relays using PSCAD software	K4
4	Simulate Partial shading effect on PV system and implement islanding detection on grid-connected system using PSCAD software.	K4
5	Compute the Y-bus, Fault currents and load flow with Gauss – Seidel (GS) method using MATLAB Programming /ETAP software.	K4

LIST OF EXPERIMENTS

1	Closed loop control of Boost Converter simulation using MATLAB/SIMULINK
2	Open loop control of Fly back Converter simulation using MATLAB/SIMULINK
3	Open loop control of Bidirectional Buck-Boost Converter simulation using MATLAB/SIMULINK
4	Simulation of Square wave & Sinusoidal PWM (SPWM) for 3-phase Inverter using MATLAB/SIMULINK
5	Simulation of 5-level Cascaded H-Bridge Multilevel-inverter using MATLAB/SIMULINK.
6	Y-bus formation by direct inspection method using MATLAB
7	Power flow solution by Gauss-seidel method using MATLAB
8	Transient stability with swing curve using MATLAB/SIMULINK
9	Simulation of faults on two terminal transmission lines using PSCAD
10	Simulation of Over current relay for transmission lines using PSCAD
11	Implement islanding detection on grid-connected systems using PSCAD
12	Effect of partial shading in PV System using PSCAD

Add on Experiments:	
13	Power flow solution by Gauss-seidel method using ETAP software
14	Fault Analysis on power system network using ETAP software
Reference Books:	
1	Power system analysis by John J. Grainger and William D. Stevenson, McGraw Hill Education**,** July 2017.
2	Simulation and Analysis of Modern Power Systems by Ranjana Sodhi, 1st Edition, Kindle Edition, McGraw Hill, 2021.
3	MATLAB/Simulink for Power Electronics Simulations by Farzin Asadi, Apress, 2022.
4	Power Systems Analysis Illustrated with MATLAB AND ETAP (HB 2019) by Hemchra Madhusudan Shertukde, CRC Press; 1st edition, 2019.
5	Electrical Transients in Power Systems by Allan Greenwood, 2nd Edition, 2018.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23MC3201	MC	2	--	--		30	--	

EMPLOYABILITY SKILLS

(For AIDS, CIC, CSIT, CSD, ECE and EEE)

Course Objectives:

1.	To introduce concepts required in framing grammatically correct sentences and identifying errors while using standard English.
2.	To acquaint the learner of making a coherent and cohesive sentences and paragraphs for composing a written discourse.
3.	To inculcate logical thinking in order to frame and use data as per the requirement.

Course Outcomes

S.No	Outcome	Knowledge Level
1	Match various vocabulary items that appear in competitive examinations with their contextual meanings accurately.	K1
2.	Identify grammatical and ungrammatical usage of English language in all the grammar related questions asked in various competitive examinations like CAT, GRE, IBPS.	K3
3.	Infer meaning from complex texts that are set as questions in different competitive examinations held for higher education or employment	K2
4.	Find solutions to complex arithmetic problems set as questions in the competitive examinations held for employment or higher education	K1
5.	Apply logical thinking abilities in solving the problems of reasoning that appear in the examinations like CAT, GRE, GATE, IBPS.	K3

SYLLABUS

UNIT-I (10Hrs)	Synonyms, Antonyms, Frequently Confused Words, Foreign Phrases, Idioms and Phrasal Verbs, Collocations. Spotting Errors, Sentence Improvement
UNIT-II (10 Hrs)	Time and work, Pipes and Cisterns. Time and Distance Problems, Problems on boats and streams. Percentages, Profit and loss, Simple interest and Compound interest. Discount Problems.
UNIT-III (10 Hrs)	Analogies, Odd One Out. (Verbal ability) Number Series, Letter Series, Analogy, Alpha Numeric Series, Order and Ranking, Directions, Data sufficiency, Syllogisms.

UNIT-IV (10 Hrs)	Sentence Completion, Sentence Equivalence, Close Test Reading Comprehension , Para Jumbles
UNIT-V (10 Hrs)	Number System: Divisibility tests, finding remainders in various cases, Problems related to numbers, Methods to find LCM, Methods to find HCF.
Textbooks:	
1.	*How to Prepare for Verbal Ability and Reading Comprehension for CAT* (10th edition) by Arun Sharma and Meenakshi Upadhyay, McGraw Hill Education, 2022.
2.	How to Prepare for Quantitative Aptitude for CAT (10th edition) by by Arun Sharma , McGraw Hill Education, 2022.
Reference Books:	
1.	*English Collocation in Use*- Intermediate (2nd edition) by Michael McCarthy& Felicity O'Dell, CUP, 2017.
2.	*Magical Book On Quicker Maths* (5th Edition) By M.Tyra, BSC Publishing Co Pvt. Ltd, 2018.
e-Resources	
1.	www.Indiabix.com
2.	www.800score.com