PDA COLLEGE OF ENGINEERING,KALABURAGI
B E. Third Semester

Engineering Mathematics-III for Electrical & Electronics Engineering Stream
[As per Choice Based Credit System (CBCS) scheme]
(From the academic year 2023-24)

Course Code	22MATE31	CIE Marks	50
Credits	03	SEE Marks	50
Contact Hours/Week (L-T-P)	2-2-0	Total Marks	100
Contact Hours	42	Exam Hours	03

Course Learning Objectives: To enable the students to obtain the knowledge of Engineering Mathematics in the following topics

1. Z-transforms, Fourier Series, Fourier transforms and and its application in engineering fields
2. Probability distribution of discrete and continuous random variables
3. Joint probability distributions and discrete and continuous random variables

Module-I **9hours**

Difference equations and Z-Transforms :

Difference equations –Basic definitions, Z-Transform-Definitions, standard Z-transform, linearity property, damping rule, shifting rule , initial value theorem ,final value theorem .
Inverse Z-Transform and applications.

RBT Levels: L1, L2 & L3

Module-II **8 hours**

Fourier series:

Periodic functions, Fourier series with periods $(0, 2\pi)$, $(-\pi, \pi)$, $(0, 2l)$ and $(-l, l)$. Half range Fourier series, Practical harmonic analysis and problems.

RBT Levels: L1, L2 & L3

Module-III **9 hours**

Fourier Transform:

Finite and Infinite Fourier transforms, Fourier sine and cosine transforms, properties, Inverse Fourier transforms and problems

RBT Levels: L1, L2 & L3

Module –IV **8 hours**

Probability distributions:

Random variable (Discrete and continuous) p.d.f., c.d.f., Binomial distribution, Poisson distributions, Normal distribution and problems.

RBT Levels: L1, L2 & L3

Module –V **8 hours**

Joint probability distributions:

Concept of joint probability distribution, discrete and continuous random variables independent random variables .problems on expectation and variance

RBT Levels: L1, L2 & L3

Text books:

1 Higher Engineering Mathematics by B.S.Grewal, Khanna publishers; 40th Edition.2007

2 Engineering Mathematics by N. P. Bali and Manish Goyal. Laxmi publications, latest edition

Reference books:

1.Advanced Engineering Mathematics by E. Kreyszig, John Willey & sons 8th Edn.

2.A short course in differential equations – Rainvile E.D.9th Edition.

3.Advanced Engineering Mathematics by R.K.Jain & S.R.K Iyengar; Narosa publishing House.

4.Introductory methods of numerical analysis by S.S.Sastry

4. Statistical Methods Authored By Gupta S.P. Publisher: Sultan Chand & Sons. Publishing Year: 2021
5. Fundamentals of Mathematical Statistics Authored By Gupta S.C.& Kapoor V.K. Publisher:Sultan Chand & Sons.Publishing Year: 2020

Course Outcomes: On completion of this course, students are able to:

CO1: Understanding the characteristics and properties of the Z-transform

CO2: Construction of Fourier series for periodic signals and Fourier series to analyze circuits.

CO3: Determine Fourier transformation for continuous time signals and systems

CO4: : Solve problems using theoretical probability distributions

CO5: Apply the concepts of joint probability, to find covariance, correlation, independent variables

Course Title: **Electrical Circuit Analysis**		
Course Code	**22EE32**	**CIE: 50**
Number of Lecture Hours/Week	**3+2Hrs (Theory/Practical)**	**SEE: 50**
Total Number of Lecture Hours	**42**	**SEE Hours: 03**
	Credit:	**04**

Prerequisite: Students should have the knowledge of
1. Electrical Engineering
2. Analysis of AC and DC circuits.

Course Objectives:

1. To understand the basic concept of Loop and Nodal analysis of circuits and Network Topology.
2. To apply the different theorems to analyze the networks.
3. To study different parameters of two port networks and Network functions.
4. To implement Laplace transform and study the transient behavior of circuits.
5. To study the Network Synthesis.

Modules	**Teaching Hours**
Module I **Basic Concept:** Loop and Nodal Analysis with independent sources of DC and AC networks, Super mesh and super node analysis. **Network topology:** Concept of Graph, tree, Co-tree, Incidence matrix, Tie-set, Cut-set, network solutions using Tie-set and Cut-set schedules. **Practical Component:** Loop and Nodal Analysis	**8hrs**
Module II **Network Theorems:** DC and AC circuit analysis by Superposition theorem, Thevinin's theorem, Norton's theorem, Maximum power transfer theorem, Milliman's theorem and Reciprocity theorem. **Practical Component:** Superposition theorem, Thevinin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem	**8hrs**
Module III **Two port Networks:** Types of two port networks, Z, Y, ABCD and Hybrid parameters. Interconnection of two port networks (Cascaded, Series, Parallel, Series-Parallel & Parallel-Series Connections). **Practical Component:** Z parameter of two port network	**9hrs**
Module IV **Laplace Transform and Applications:** Introduction**,** Laplace transform of important functions, Voltage-Current relationships of R, L, C in frequency domain. **Transient behavior and Initial Conditions:** Initial and final value theorem, Behavior of circuit elements under switching conditions in R-L, R-C and R-L-C circuits for DC excitations.	**8hrs**

Module V **Network Functions:** Introduction, network functions of one port, two port networks, Poles and Zeros of network functions, Restrictions on location of Poles and Zeros for network functions, stability. **Network Synthesis :** Introduction, Hurwitz polynomial, Procedure for obtaining the continued fraction expansion, positive real functions.	**9hrs**
Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.	
Reference books: 1. Network Analysis by M. E. Van Valkenberg, Pearson Education, 3rd Edition, 2014 2. Network Analysis and Synthesis by Mohammed Arshad 3. Network analysis and Synthesis by Franklin F, Wiley International Edition. 4. Electric Circuits by P.M. Chandrashekharaiah. 5. Electrical Networks by Ravish R Singh.	
E books and online course materials:	
Course outcomes: On completion of the course, the student will have the ability to:	

Course Code	CO #	Course Outcome (CO)
	CO1	Gain the knowledge of loop, nodal analysis and network topology.
	CO2	Analyze the different networks theorems
	CO3	Analyze different parameters of two port networks
	CO4	Implement Laplace transform, examine transient behavior and initial conditions of circuits
	CO5	Evaluate network functions of network and Understand the Network Synthesis.

Course Articulation Matrix for the Academic Year 2023-24

S.No.	PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	2											3	2	
2	CO2	3	2											3	2	
3	CO3	3	2											3	2	
4	CO4	3	2											3	2	
5	CO5	3	2											3	2	
CAM	AVERAGE															

Course Title: **Analog and Digital Electronics**		
Course Code	**22EE33**	CIE: 50
Number of Lecture Hours/Week	**3Hrs (Theory) + 2hrs(Practical)**	SEE: 50
Total Number of Lecture Hours	**42**	SEE Hours: 03
	Credits:	04

Prerequisite: Students should have

1. Basic knowledge of Electronics and Electronic Devices
2. Basic knowledge of Number system and its conversion.
3. Knowledge of Logic gates and its analysis using k-map.

Course Objectives:

1.To study the clipper and clamper circuits and their applications.
2.To study the transistor and also biasing circuits using transistor.
3. To study the Parameters and frequency response of transistor.
4.To understand the Combinational logic circuits and also designs of it.
5.To understand about Design of combinational Logic using Flip flops.

Modules	**Teaching Hours**
Module- I **Clipping & Clamping Circuits:** Series clippers, parallel clippers, parallel clipper circuits with reference voltage, two way parallel clipper circuit. Negative clamper, positive clamper and addition of battery in clamper. Applications of clippers and clampers.	**8hrs**
Module- II **Transistor Biasing:** Analysis of fixed bias circuits, its load line analysis, selection of operating point, advantages and disadvantages. **Emitter stabilized biased circuit:** Analysis of emitter stabilized biased circuit and its advantages & disadvantages. **Voltage divider bias circuit**: Analysis of voltage divider bias circuit and its simplified circuit.	**9hrs**

Module- III **Transistor at Low Frequencies & Frequency response :** **Transistor at low frequency :** BJT transistor modeling, Hybrid equivalent model, r_e model (CE Fixed bias configuration, voltage divider bias, Emitter follower configuration) **Frequency Response :**General frequency considerations, low frequency response, Miller effect capacitance, high frequency response, Multistage frequency effects	**9hrs**
Module IV **Principles of Combinational logic- 1:** Definition, types of Boolean equations, Canonical forms, truth tables, realization of Boolean equations using basic gates and universal gates, Don't care terms, Simplification of Boolean equations using Karnaugh's maps for 2,3,4 and 5 variables.	**8hrs**
Module V **Principles of Combinational logic-2** Quine-McClusky minimization technique, Map Entered Variable method. **Analysis and Design of combinational Logic :** Adders, Look ahead Carry Adder, Subtractors, Digital Multiplexers. Decoders, Encoders, PLDs: PROM,PLA and PAL, Different types of Flipflops and their truth tables.	**8hrs**
Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.	

Reference/Text books:

1. "Electronic Devices and circuit theory", Robert L. Boylestad and Louis Nashelsky, PHI/Pearson Education. 10th edition 2013.
2. "Integrated Electronics", Jacob Millman and Christos C.Halkias, TMH, 1991 edition.
3. "Operational Amplifiers and Linear ICs", David A. Bell, PHI publication, 2nd edition, 2008.

E books and online course materials:

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Analyze the clipping and clamping circuits.
	CO2	Design the biasing circuit for transistor.
	CO3	Study the Parameters and frequency response of transistor.
	CO4	Understand about Principles of Combinational logic.
	CO5	Understand the use of Sequential Circuits.

Course Articulation Matrix for the Academic Year 2023-24

S.No.	PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	3											2	1	
2	CO2	3	3	3										2	1	
3	CO3	3	3											2	1	
4	CO4	3	3											2	1	
5	CO5	3	3											2	1	
CAM	AVERAGE	3	3	3										2	1	

Course Title: **Electrical Machines - I**		
Course Code	**22EE34**	CIE: 50
Number of Lecture Hours/Week	**2Hrs (Theory) + 2hrs(Tutorial)**	SEE: 50
Total Number of Lecture Hours	**42**	SEE Hours: 03
	Credits:	03

Prerequisite: Students should have
1. Knowledge of AC circuit analysis
2. Basic knowledge of Single and Three phase transformer and its performance analysis.
3. Basic knowledge of Construction and working of Single phase Induction motor.

Course Objectives:

1. To understand the basic concept, construction, working of the single-phase transformer and different tests to be carried out for performance evaluation.
2. To study the condition for parallel operation, load sharing, autotransformer, copper saving, constant voltage and current transformer and variable frequency transformer
3. Basic concept about three phase transformer types of connections, conversion techniques and equivalent circuit.
4. Basic concept of three phase induction motor, its performance evaluation, cogging and crawling.
5. To understand about starting and speed control of three phase Induction motor and also basic concept single phase induction motor.

Modules	**Teaching Hours**
Module-I **Single Phase transformers:** *Review of Basic concepts*, Concept of ideal transformer, operation of power transformer under no-load and load conditions (with phasor diagrams). Equivalent resistance and reactance, Equivalent circuit, losses, efficiency; condition for maximum efficiency, all day efficiency. In rush current in transformers.	**9hrs**
Module-II **Testing and Parallel operation:** Open circuit & short circuit tests, calculation of parameters of equivalent circuit. Voltage regulation, predetermination of efficiency and regulation. Polarity test and sumpner's test. Need and conditions to be satisfied for parallel operation of two or more transformers. Load sharing in case of similar and dissimilar transformers.	**8hrs**
Module-III **Autotransformer and Three phase transformers:** Auto transformers, copper economy. Introduction, constructional features, choice between single unit three phase transformer and bank of three single phase transformers, transformer connection for 3phase operation: star/star, delta/delta, star/delta, delta/star and open delta connections. Phase conversions, Scott connection three phase to two phase.	**8hrs**
Module-IV **Three phase induction motor:** Review of basic concepts, starting and running torque, torque-slip characteristics, Induction motor as generalized transformer, phasor diagram, losses, efficiency, No-load and blocked rotor tests, equivalent circuit, circle diagram and performance evaluation of the motors; cogging and crawling	**9hrs**

Module-V **Starting & Speed Control of Three Phase Induction Motor:** Need of starter, Direct on line (DOL) starter, Star-Delta starter, autotransformer starting, rotor resistance starting, speed control using voltage, frequency & rotor resistance methods. **Single phase induction motor:** Double revolving field theory and principle of operation, Types of single phase Induction motor: split phase, capacitor start, capacitor run, shaded pole motors.	**8hrs**

Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.

Reference/Text books:

1. Electrical Machine, I.J. Nagrath and D.P Kothari, T.M.H, 4th Edition 2011.
2. Electrical Machines, Mulukuntla .S. Sarma, Mukesh K. Pathan, Cengage learning First edition 2009.
3. Theory of alternating current machines, Alexandar Langsdrof, T.M.H-2nd edition 2001.
4. Electrical machines and transformers, Kosow, Pearson 2nd edition 2007.
5. A Text of Electrical Technology Vol II, AC & DC machines B.L.Theraja, A.K.Theraja, S. Chand publication – 2000.
6. A Textbook of Electric Machines, Ashfaq Hussain, Dhanpat Rai Publication, 2nd Edition.

E books and online course materials:

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	**Explain the working of single phase transformer and induction motor on various load conditions**
	CO2	**Analyze the performance of single phase transformer**
	CO3	**Illustrate different 3phase transformer connections**
	CO4	**Test and analyze the performance of single phase transformer and 3phase induction motor**
	CO5	**Explain different types starters of 3phase induction motors**

Course Articulation Matrix for the Academic Year 2023-24

S.No.	PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	1											3	1	
2	CO2	3	3		1								1	3	2	1
3	CO3	1	1											3		
4	CO4	3	2		1									3	2	1
5	CO5	2	1											3	1	
CAM	AVERAGE	2.4	1.6										1	3	1.5	1

Course Title: **Field Theory**		
Course Code	**22EE36X**	CIE: 50
Number of Lecture Hours/Week	**3Hrs (Theory)**	SEE: 50
Total Number of Lecture Hours	**42**	SEE Hours: 03
	Credits:	03

Prerequisite:Students should have
1. Basic Knowledge of Coulomb's Law
2. Basic knowledge of Laplace transform.

Course Objectives:
1. To understand about coulomb's law & electric field intensity.
2. To study energy & potential, conductors, dielectrics & capacitance.
3. To study Poisson's and Laplace equations, time varying field & Maxwell's equations.
4. To understand the concept of steady magnetic field.
5. To know about uniform plane wave.

Modules	**Teaching Hours**
Module I **Coulomb's Law and electric field intensity:** Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge, Sheet of charge. Electric flux density, Relation between Electric flux density and electric field intensity, Gauss' law and divergence, Applications of Gauss law, Maxwell's First equation (Electrostatics), vector operator and divergence theorem.	**8hrs**
Module II **Energy and potential:** Energy expended in moving a point charge in an electric field, The line integral, Definition of potential and Potential differences, The potential due to a point charge and system of charges, Potential gradient , Energy density in an electrostatic field . **Conductors, Dielectrics and capacitance:** Current and current density, Continuity of current, metallic conductors, Conductor properties and boundary conditions between conductor and free space, boundary conditions for perfect Dielectrics, capacitance and examples.	**5hrs** **4 hrs**

Module III **Poisson's and Laplace's equations:** Derivations of Poisson's and Laplace's Equations, Uniqueness theorem, Examples of the solutions of Laplace's and Poisson's equations. **The Steady Magnetic field:** Biot- Savart law, Ampere's circuital law, Curl, Stokes' theorem, magnetic flux and flux density, scalar and Vector magnetic potentials.	**4hrs** **4hrs**
Module IV **Magnetic forces**: Force on a moving charge and differential current element, Force between differential current elements, Force and torque on a closed circuit, boundary condition between two magnetic fields. **Time varying fields and Maxwell's equations:** Faraday's law, displacement current, Maxwell's equation in point and Integral form for time varying fields, retarded potential.	**5hrs** **4hrs**
Module V **Uniform plane wave:** Wave propagation in free space(conductors in terms of E,H,D and B) and dielectrics, Poynting's theorem and wave power, propagation in good conductors – (skin effect), Reflection of uniform plane waves at normal incidence, Plane wave propagation in general directions.	**8hrs**

Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.

Reference/Text books:

3. "Fundamentals of Engineering Electromagnetics", by David K Cheng, Pearson, 2014.
4. "Electromagnetics", J.A.Edminister, McGraw Hill, 3rd edition 2010.

E books and online course materials:

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	**Use coulombs law and gauss law for evaluation of electric field**
	CO2	**Estimate the energy & potential due to a system of charges & behavior of conductors, dielectrics & capacitance**
	CO3	**Apply Poisson's & Laplace equations in magnetic fields**
	CO4	**Explain the behavior of time varying fields.**
	CO5	**Explain behavior of magnetic field & wave propagation**

1. "Engineering Electromagnetics", William .H .Hayt and John A Buck, Tata Mcgraw-Hill. 8th edition 2014.
2. "Principles of Electromagnetics", by Mathew.N.O, Sadiku, Oxford University press, 4th edition 2009.

Course Articulation Matrix for the Academic Year 2023-24

S.No.	PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	3		1									2	2	
2	CO2	3	3		1									2	2	
3	CO3	3	3		1									2	2	
4	CO4	3	3		1									2	2	
5	CO5	3	3		1									2	2	
CAM	AVERAGE	**3**	**3**		1									2	2	

Course Title: **Electrical Machine - I Lab**		
Course Code	**22EEL35**	CIE: 50
Number of Lecture Hours/Week	**2Hrs Practical**	SEE : 50
	Credits:	01

Experiments	**Teaching Hours**
1. OC, SC test on single phase transformer and pre-determination of efficiency and regulation for different loads and PFs. 2. Determination of efficiency and regulation for single phase transformer by direct loading. 3. Polarity test and Sumpner's test. 4. Parallel operation of single phase transformers. 5. Study of single phase transformers for three phase connections. 6. Scott – connection for balanced and unbalanced loads. 7. Load test on three phase induction motor and performance evaluation. 8. No load and blocked rotor test on three phase induction motor, and performance evaluation using : i) Equivalent circuit ii) Circle diagram 9. Determination of equivalent circuit and performance evaluation of single phase induction motor 10. Load test on single phase induction motor.	

E books and online course materials:

Course outcomes: On completion of the course, the student will have the ability to:		
Course Code	**CO #**	**Course Outcome (CO)**
	CO1	**Analyze the performance of single phase transformer by Direct and In-direct methods.**
	CO2	**Testing of two transformers for parallel operation and determine the sharing of load.**
	CO3	**Demonstrate the three phase transformer connections by using three single phase transformers.**
	CO4	**Determine the performance of the three phase induction motor by direct loading.**
	CO5	**Develop equivalent circuit and circle diagram to determine the performance of induction motor by No-load and Blocked rotor tests.**

Course Articulation Matrix for the Academic Year 2023-24

S.No.	PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3			2					3				3	2	2
2	CO2	3			3					3				3	2	2
3	CO3	3			1					3				3	2	2
4	CO4	3			1					3				3	2	2
5	CO5	3			2					3				3	2	2
CAM	AVERAGE	3			1.8					3				3	2	2

Course Title: **Electrical Machines II**		
Course Code	**22EE41**	CIE: 50
Number of Lecture Hours/Week	**2Hrs (Theory) + 2hrs(Tutorial)**	SEE: 50
Total Number of Lecture Hours	**42**	SEE Hours: 03
	Credits:	03

Prerequisite: Students should have knowledge of

1. Electromagnetic Induction
2. DC Machines and its performance

Course Objectives:

1. To understand the concepts of DC Generators and DC Motors and to evaluate their performance.
2. To conduct tests on DC Generators and DC Motors.
3. To understand the concepts of Synchronous Generators and to evaluate their performance.
4. To conduct tests to find regulation by different methods.
5. To explain the requirement for the parallel operation of synchronous generators.
6. To understand the synchronous motor operation and its performance.

Modules	**Teaching Hours**
Module - I **Direct current Generator :** Review of construction, types, armature windings, relation between no load and terminal voltage (No question shall be set from the review portion). Armature reaction, Commutation, types and methods to improve commutation, compensating windings, magnetization curve, no load and full load characteristics of DC generators. **DC Motors:** Review of Classification, Back emf, Torque equation, and significance of back emf. Characteristics of shunt, series & compound motors. Starters: Need of starters, 2-point and 3-point starters for series and shunt motors, Application of motors.	**8hrs**
Module-II **DC Motors :** Speed control of shunt, series and compound motors. Losses in DC motors, power flow diagram, efficiency. Direct & indirect testing on DC motors: Brake load test, Swinburne's test, Retardation test, Hopkinson's test, Field's test, merits and demerits of tests.	**8hrs**

Module-III **Synchronous generators :** Review of construction and operation of salient & non-salient pole synchronous generators (No question shall be set from the review portion). Armature windings, winding factors, emf equation. Harmonics: Effects, causes and elimination. Leakage reactance, Armature reaction, Synchronous reactance, Equivalent circuit, Phasor diagram, Generator load characteristics. Power-angle characteristics and synchronizing power.	**9hrs**

Module-IV **Synchronous generators:** Effects of saliency, two-reaction theory, Direct and Quadrate reactance, power-angle diagram, reluctance power, slip test. Open circuit and short circuit characteristics, short circuit ratio, Voltage regulation and pre-determination of voltage regulation by EMF, MMF and ZPF methods.	**9hrs**
Module-V **Synchronous generators:** Parallel operation of generators, methods of synchronization, synchronous generator connected to infinite bus. **Synchronous motor:** Principle of operation, effect of variation in load, effect of variation in excitation, V and inverted V curves, hunting, starting methods.	**8hrs**
Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.	
Reference/Text books: 1. Electric Machines, D. P. Kothari, I. J. Nagrath, Mc Graw Hill 4th Edition, 2011. 2. Performance and Design of A.C. Machines, M. G. Say, CBS Publishers 3rd Edition, 2002 3. Electrical Technology Volume II, B, L, Theraja S Chand Publications, 2015. 4. Electric Machines Mulukuntla S.Sarma, at el Cengage Learning 1st Edition, 2009 5. Electrical Machines, Drives and Power systems Theodore Wild Pearson 6th Edition, 2014 6. Electrical Machines, M.V. Deshpande, PHI Learning 1st Edition, 2013 7. Electrical Machines, Abhijit Chakrabarti et al Mc Graw Hill, 1st Edition, 2015 8. A Textbook of Electric Machines, Ashfaq Hussain, Dhanpat Rai Publication, 2nd Edition	
E books and online course materials:	

Course outcomes: On completion of the course, the student will have the ability to:		
Course Code	**CO #**	**Course Outcome (CO)**
	CO1	**Explain the operation of DC generator and DC motor and describe characteristics.**
	CO2	**Discuss the speed control methods and applications of DC motors**
	CO3	**Test and analyze the performance of DC motors by direct & indirect methods.**
	CO4	**Discuss armature windings, harmonics, armature reaction & parallel operation of synchronous generators**
	CO5	**Analyze the performance of synchronous generator and motors**

Course Articulation Matrix for the Academic Year 2023-24

S.No.	PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3												3	2	
2	CO2	3	2											3	2	1
3	CO3	3	2											3	2	1
4	CO4	3	2		2									3	2	1
5	CO5	3	2		2									3	2	1
CAM	AVERAGE	3	2		2									3	2	1

Electrical Measurement

Course Code	**22EE42**	CIE: 50
Number of Lecture Hours/Week	**3Hrs (Theory) + 2hrs(Practical)**	SEE: 50
Total Number of Lecture Hours	**42**	SEE Hours: 03
	Credits:	04

Prerequisite: Students should have:
Knowledge of Units and Dimensions of Electrical and Mechanical quantities
Knowledge of AC and DC circuits analysis.
Study of Digital Electronics and circuits.

Course Objectives:

1. **To know about the measurement of resistance, inductance and capacitance using bridges.**
2. **To understand about measurement of power, calibration of single and three phase energy meters, power factor meter and frequency meters.**
3. **To study about the extension of instrument ranges for both A.C and D.C meters.**
4. **To understand electronic and digital instruments.**
5. **To know the working of sensors and transducers.**
6. **To study different display devices and know the functions of DAS and PLC.**

Modules	**Teaching Hours**
Module-I **Introduction to Measurement, Measurement of Resistance, Inductance and Capacitance:** Accuracy, Precision, resolution, reliability, repeatability, validity, Errors and Standards of measurement. Wheatstone's bridge, sensitivity, limitations. Kelvin's double bridge. Earth resistance measurement by fall of potential method and by using Megger, Sources and detectors, Maxwell's inductance and capacitance bridge, Anderson's bridge, Desauty's bridge, Schering bridge.	**8hrs**
Module - II **Measurement of Power, Energy, Power factor and Frequency:** Measurements of real and reactive power in 3 phase circuits, UPF and LPF Wattmeter. Errors adjustments and calibration of single and three phase energy meters, Construction and operation of single-phase and three phase dynamometer type power factor meter. Weston frequency meter and phase sequence indicator. Extension of Instrument Ranges: Desirable features of ammeters and voltmeters. Shunts and multipliers. Construction and theory of instrument transformers, Desirable characteristics, Errors of CT and PT, Turns compensation, D.C. and A.C. Potentiometers	**10hrs**

Module - III **Electronic and digital Instruments:** Introduction. Essentials of electronic instruments, Advantages of electronic instruments. True RMS reading voltmeter. Electronic millimeters. Digital voltmeters (DVM) - Ramp type DVM, Integrating type DVM, Continuous – balance DVM and Successive - approximation DVM. Q meter. Principle of working of electronic energy meter (block diagram treatment).	**8hrs**
Module - IV **Sensors and Transducers :** Electrical Transducer, selection of transducer, Resistive transducer, Inductive transducer, Capacitive transducer, Temperature transducer(RTD), Position transducer (LVDT).	**8hrs**
Module- V **Display Devices:** Introduction, Character formats, Segment displays, Dot matrix displays, Bar graph displays. Cathode ray tubes, Light emitting diodes, Liquid crystal displays. **Data Acquisition System:** Block diagram of DAS, objectives of DAS, Signal Conditioning of inputs, Single channel DAS, Multi-channel DAS. **Programmable Logic controller:** Introduction, advantages, function of each part in PLC, PLC Hardware and PLC operation.	**8hrs**
Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.	
Reference/Text books: 1."Electrical and Electronic Measurements and Instrumentation", A.K. Sawhney, Dhanpat Rai and son's Delhi. 2. "Modern Electronic Instrumentation and Measuring Techniques", Cooper D and A.D. Heifrick Pearson First Edition, 2015. 3. "Electronic Instrumentation and Measurements", David A Bell Oxford University 3rd Edition, 2013. 4. "Electronic Instrumentation", H.S.Kalsi Mc Graw Hill 3rd Edition,2010. 5. "Electrical and electronic Measurements and Instrumentation", Er.R.K. Rajput S Chand 5th Edition, 2012. 6. "A Course in Electronics and Electrical Measurements and Instrumentation", J. B. Gupta Katson Books 2013 Edition. 7. "Electrical Measuring Instruments and Measurements", S.C. Bhargava BS Publications 2013.	
E books and online course materials:	

Course outcomes: On completion of the course, the student will have the ability to:		
Course Code	**CO #**	**Course Outcome (CO)**
22EE42	**CO1**	Measure the Resistance, Inductance and Capacitance using bridges.
	CO2	Measure Power, Energy, Power factor, Frequency of three phase circuits and extend the instrument ranges of AC and DC meters.
	CO3	Understand Electronic and Digital instruments.
	CO4	Working of Sensors and Transducers.
	CO5	Functions of Display Devices, Data Acquisition System and Programmable Logic controller.

Course Articulation Matrix for the Academic Year 2023-24

S.No.	PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	2											3	2	
2	CO2	3	2											3	2	
3	CO3	3	2											3	2	
4	CO4	3												3	2	
5	CO5	3												3	2	
CAM	AVERAGE	3	2											3	2	

Control Systems		
Subject code:22EE43	**Credits:04**	**Total hours:42**
CIE:50 marks	**SEE:50 Marks**	**SEE:03hrs**
Hours/week:3hrs.(Theory)+ 2hrs.(Practical) Credits:04		

Objectives of overall learning of the subject:

1. To study open –loop and closed –loop control system
2. To understand mathematical modelling of system.
3. To study the block diagram and signal flow graph reduction techniques.
4. To know and study time-response control systems and stability analysis of control system.
5. To understand frequency response and root locus analysis of control system.
6. To understand the state variable and analysis.

MODULE -I

Physical Systems modelling:-Basic definitions of control systems, requirements of control systems, classification of control systems, and comparison of open loop and closed loop systems. Effect of feedback on closed loop systems. Modelling of basic mechanical & electrical components, modelling of mechanical, electrical and electromechanical systems using Laplace transform and differential equations, Analogous systems.

To Study the MATLAB Package for simulation of control system design 08 hrs

MODULE -II

Block Diagram Reduction Techniques: Block diagram representations, development of block diagram, reduction techniques to obtain over all transfer function using Block diagram Algebra. Signal flow graph and its properties, Mason's gain formula and its applications.
To Reduce Linear Systems Block Diagram Using Series, Parallel and Feedback Configuration using MATLAB 08 hrs

MODULE -III

Time Response & Stability Analysis: Time response, transient and steady state response of first order and second order systems for unit step input, Time domain specifications for second order systems. Classification of stability, BIBO stability, R-H criterion for stability Analysis and its special cases.

To verify the output response of a Second Order System using RLC circuit. 08 hrs

MODULE –IV

Root Locus & Frequency Domain Analysis: Root Locus, General rules to construction of root locus diagram, stability analysis using root locus. Frequency domain specifications, co-relation between time – domain & frequency domain specifications, Bode plot, Stability analysis. Polar plot, Nyquist stability, Nyquist plot, stability Analysis.

To analyze frequency response of a system by plotting Root locus, Bode plot and Nyquist plot using MATLAB software. 09 hrs

MODULE –V

State variable Analysis: Concepts of state variables, State space model, Diagonalization of State Matrix, Solution of state equations, Eigen values and Stability Analysis, Concept of controllability and observability. Difference Equations of time domain system. State-space models of linear discrete-time systems, Stability of linear discrete-time systems.

To develop state space model for a transfer function using MATLAB 09 hrs

Question Paper Pattern: Answer five full Questions selecting one full question from each module.

Course Out comes: At the end of the course student will able to

CO1: Explain basic terminologies of control system & mathematical modeling.
CO2: Analyze block diagram and signal flow graphs reduction techniques.
CO3: Use stability and time response analysis.
CO4: Explain Root Locus, analysis frequency response, frequency domain stability.
CO5: Explain basic state variables and state space models.

Text/Reference books:

1. Control system Engg, I.J. Nagrath & M Gopal , 5th edition New-Age Publications.

2. Control Engg: Theory and Practice: B N Bandyopadhaya, PHI Publications.

3. Control systems: Ashfaq hussain and Haroon Ashfaq, Dhanpat Rai and co.

4. Automatic control systems B.C. KUO PHI publications VII edition.

5.A Text books of Automatic control system Engg , Dr. N.K Joain, Dhanpat rai & co.

6. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.

Course Articulation Matrix for the Academic Year 2023-24

S.No.	PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	3			1								3	2	
2	CO2	3	3			1								3	2	
3	CO3	3	3			1								3	2	
4	CO4	3	3			1								3	2	
5	CO5	3	3			1								3	2	
CAM	AVERAGE	3	3			1								3	2	

Course Title: Electrical Power Generation Transmission and Distribution		
Course Code	**22EE45X**	CIE: 50
Number of Lecture Hours/Week	**3Hrs (Theory)**	SEE: 50
Total Number of Lecture Hours	**42**	SEE Hours: 03
	Credits:	03

Prerequisite: Students should have the knowledge of
Basic electrical engineering

Course Objectives:

1. To classify different sources of energy and basic concept of Hydel, Nuclear and thermal power stations.
2. To study line parameters and to understand performance of transmission lines.
3. To study AC distribution system and undergrounded cables.
4. To study components of substation and to analyse overhead line insulators.

Modules	**Teaching Hours**
Module – I Importance of Electrical Energy, Generation Electrical energy, Sources of Energy, Comparison of Energy sources, Units of Energy, Relationship among Energy Units, Efficiency **Generating Stations**: Steam (Thermal) power station, Schematic arrangement of Steam power station, Choice of site for steam power stations, Efficiency of steam power station, Equipment of Steam power stations, Hydroelectric Power station, Schematic arrangement of Hydroelectric Power station, choice of Site for Hydroelectric Power stations, Constituents of Hydroelectric plant, Nuclear Power station, schematic arrangement of Nuclear Power station, Selection of site for Nuclear Power station, Gas turbine power plant, Schematic arrangement of Gas turbine power plant, Comparison of various power plants.	**08hrs**
Module – II **Line Parameters**: Calculation of Inductance and Capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing. Inductance of Composite conductor lines. Effect of ground on capacitance of transmission lines.	**09hrs**
Module -III **Performance of Power Transmission lines:** Types of transmission lines and their performance: Short, Medium(End condenser, nominal T and nominal π configuration), Long transmission lines by Rigorous method. ABCD parameters of transmission lines.	**09hrs**

Module –IV **Underground Cables and AC Distribution:** Construction. Types of cables, Insulation Resistance, Capacitance of single core cable. Grading of cables: Capacitance and Inter sheath grading. **A.C. Distribution** : Radial and Ring main systems, Distribution with concentrated loads.	**08hrs**
Module – V **Overhead Line Insulators:** Types of Insulators, potential distribution over string of suspension insulators, string efficiency and methods to improve string efficiency. **Substations:** Classification of substations, comparison between outdoor and indoor substations, layout of substations, brief description of equipment in substation.	**08hrs**
Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.	
Reference/Text books: 1. Electrical Power Systems, S.L.Uppal, S.Rao, Khanna Publishers. New Delhi, 2014 Edition. 2. Power System Engineering. D.P.Kothari and I.J. Nagrath. Tata McGraw-Hill Publishing Company, New Delhi, Second Edition, 2008. 3. Principles of Power Systems by V. K. Mehta and Rohit Mehta, S.Chand Publications, Multicolour Edition, 2015. 4. A Course in Electrical Power by Soni, Gupta and Bhatnagar, Dhanpat Rai and Sons Publications, New- Delhi. 5. Electrical Power Generation, Transmission and Distribution by S. N. Singh, Prentice Hall of India Publications, Second edition, 2008. 6. Electrical Power Systems by C.L. Wadhwa, New Age International Publications, 7th edition, 2017. 7. Electrical Power Systems by Ashfaq Hussain, CBS Publishers, 5th Edition, 2010.	
E books and online course materials: NPTEL Course on Power System Generation, Transmission and Distribution by D.P.Kothari, IIT Delhi available at https://nptel.ac.in> courses.	

Course outcomes:On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	**Discuss the different types of power generation.**
	CO2	**Compute inductance and capacitance of different types of transmission line.**
	CO3	**Evaluate the performance of transmission lines.**
	CO4	**Analyze underground cables and A.C.Distribution.**
	CO5	**Access the performance of insulator and identify components of substation.**

Course Articulation Matrix for the Academic Year 2023-24

S.No.	PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	2										1	3	1	1
2	CO2	3	3											3	1	1
3	CO3	3	3											3	1	1
4	CO4	3	3											3	1	1
5	CO5	3	3				2							3	1	1
CAM	AVERAGE	3	3				2						1	3	1	1

Course Title: **Electrical Machines II Lab**		
Course Code	**22EEL44**	CIE: 50
Number of Lecture Hours/Week	**3Hrs Practical**	SEE: 50

Modules	**Teaching Hours**
1. Open Circuit Characteristics of D.C. Generator 2. Load test on D.C. Generator 3. Load test on a D.C. motor. 4. Speed control of D.C. motor, by i) Armature voltage control ii) Flux control 5. Swinburne's test 6. Hopkinson's test 7. Field's test on DC series motor. 8. Voltage regulation of Alternator by i) EMF ii) MMF iii) ZPF method. 9. Synchronization of alternator. 10. V and inverted V curves of a synchronous motor.	

Question paper pattern:

E books and online course materials:

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	**CO #**	**Course Outcome (CO)**
	CO1	**Conduct open circuit and load test on D.C. generator to determine its performance.**
	CO2	**Perform the different speed control methods of D.C. Shunt motor.**
	CO3	**Conduct direct and indirect loading on D.C. machines to determine their performance.**
	CO4	**Perform O.C and S.C tests on three phase alternator to determine the voltage regulation by different methods.**
	CO5	**Demonstrate the synchronization of three phase alternator with grid**

Course Articulation Matrix for the Academic Year 2023-24

S.No.	PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	3	2						2				3	2	2
2	CO2	3	3	3						2				3	2	2
3	CO3	3	3	2						2				3	2	2
4	CO4	3	3	2						2				3	2	2
5	CO5	3	3	2						2				3	2	2
CAM	AVERAGE	3	3	2.2						2				3	2	2