VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

(VJTI)

MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)

Curriculum

(Scheme of Instruction & Evaluation and Course contents)

For

Second Year Undergraduate Programme Leading to

Bachelor of Technology (B. Tech.) Degree

in

Electrical Engineering

Implemented from the batch admitted in Academic Year 2023-24

Program Educational Objectives (PEOs)

Electrical Engineering Graduates will have ability to

- Face technological challenges in the area of Electrical Engineering and ICT.
- Demonstrate expertise to articulate and use for problem solving, analysis design and evolution of electrical and electronics devices and systems.
- Develop leadership, team building and leadership skill**s.**

Program Outcomes (POs)

Engineering Graduates will be able to:

- **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

- **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Electrical Engineering Graduates will be able to

- Critically understand the generation, transmission and distribution concepts of Electrical Power Systems and its control.

- Gain in-depth knowledge to handle/control various electrical machines/drives used in industry.

Credit Framework for UG Programme in Electrical Engineering (Level 5.0 - UG Diploma) - Semester - III

Sr.	Course Code	Course Name	L	T	P	Hrs	Cr	Examination Weightage in %			Ownership
								TA	MST	ESE	
1	R5MA2003T	Mathematics III for Electrical Engineers	3	1	0	4	4	20	30	50	Mathematics
2	R5EE2001T	Electrical Networks	3	0	0	3	3	20	30	50	Electrical
3	R5EE2002T	Electrical Machines - I	3	0	0	3	3	20	30	50	Electrical
4	R5EE2003T	Introduction to Power Systems	3	1	0	4	4	20	30	50	Electrical
5	R5XX22XXT	Multi-disciplinary Minor – I	2	0	0	2	2	20	30	50	Electrical
6	R5EE2004L	Electrical Measurement Laboratory	1	0	2	3	2	ISCE: 60		40	Electrical
7	R5EE2002L	Electrical Machines – I Laboratory	0	0	2	2	1	ISCE: 60		40	Electrical
8	R5CH2401O	Environmental Science	2	0	0	2	2	ISCE: 60		40	Humanities
9	R5HS250XO	Modern Indian Language (Marathi/ Hindi/ Sanskrit/ Kannada/Gujarati/ Punjabi)	2	0	0	2	2	ISCE: 60		40	Humanities
		Total	**19**	**2**	**4**	**25**	**23**				

Credit Framework for UG Programme in Electrical Engineering (Level 5.0- UG Diploma) - Semester – IV

Sr.	Course Code	Course Name	L	T	P	Hr	Cr	Examination Weightage in %			Ownership
								TA	MST	ESE	
1	R5EE2005T	Electromagnetic Fields	3	0	0	3	3	20	30	50	Electrical
2	R5EE2006T	Electrical Machines - II	3	0	0	3	3	20	30	50	Electrical
3	R5EE2007T	Basic Electronics and Digital Circuits	3	0	0	3	3	20	30	50	Electrical
4	R5EE2008T	Numerical Techniques	2	0	0	2	2	20	30	50	Electrical
5	R5EE2009T	Signals and Systems	3	0	0	3	3	20	30	50	Electrical
6	R5XX22XXT	Multi-disciplinary Minor-II	2	0	0	2	2	20	30	50	Electrical
7	R5EE2005L	Electromagnetic Fields Laboratory	0	0	2	2	1	ISCE: 60		40	Electrical
8	R5HS2402O	Universal Human Values	2	0	0	2	2	ISCE: 60		40	Humanities
9	R5EE2006L	Electrical Machines - II Laboratory	0	0	2	2	1	ISCE: 60		40	Electrical
10	R5EE2007L	Basic Electronics and Digital Circuits Laboratory	0	0	2	2	1	ISCE: 60		40	Electrical
11	R5EE2601P	Field Project	0	0	4	4	2	ISCE: 60		40	Electrical
		Total	**18**	**0**	**10**	**28**	**23**				

Multi-disciplinary Minor Courses (Ownership: Electrical Engineering):

Semester	Credits	Multi-Disciplinary Minor	Minor in Intelligent and Resilient Grids*	Minor in Electrical Engineering**	Minor in Electric Vehicles***
III	2	MDM-I	Elements of Power Systems	Elements of Electrical Engineering	Electromechanical Energy Conversion
IV	2	MDM-II	Alternate Energy Sources	Electrical Machines	Conventional Vehicles and Components of Electric Vehicles
V	3	MDM-III	Electrical Distribution Systems and Smart Grids	Control Systems	Battery Management System
VI	3	MDM-IV	Wide Area Monitoring and Measurement Systems	Power Systems	Hybrid Electric Vehicles
VII	4	MDM-V	Power Grid Security	Power Electronics and Drives	Socio-Economic Impact of EV
Total	**14**		*Eligibility: Students of Electrical Engg. Only	**Eligibility: Students of any discipline except Electrical Engg.	***Eligibility: Students of any discipline

Open Elective Courses (Ownership: Electrical Engineering):

Semester	Open Elective	Open Elective
VI	OE-I	Electrical Safety and Disaster Management
VII	OE-II	Energy Audit and Management

Abbreviations: **L**: Lecture (hrs/week), **T**: Tutorial (hrs/week), **P**: Practical (hrs/week), **Hrs**: Total hrs/week, **Cr**: Course Credits, **TA**: Teacher Assessment / Term work Assessment, **MST**: Mid Semester Tests, **ESE**: End Semester Written Examination, **ISCE**: In-semester Continuous Evaluation

Course Codes for Multi-Disciplinary Minors (MDM): Sem III

Sr. No.	Course Code	Name of the MDM Course in sem III	Name of the MDM	Ownership
1	R5CE2201T	UnderstandingIncubation and Entrepreneurship	Innovation and Entrepreneurship	Civil & Environmental Engineering
2	R5CE2202T	Legal Framework for Construction	Contract Law, Arbitration, andValuation	Civil & Environmental Engineering
3	R5CE2203T	Principles of Sustainability	Sustainable Environment	Civil & Environmental Engineering
4	R5IT2201T	Introduction to Artificial Intelligence & Machine Learning	Artificial Intelligence & Machine Learning (AIML)	Computer Engineering & Information Technology
5	R5CO2201T	Introduction to Data Science.	Data Science	Computer Engineering & Information Technology
6	R5EL2201T	Foundations of Cyber security	Cyber Security	Electrical Engineering
7	R5EL2202T	Introduction to IoT Systems	Internet Of Things(IOT)	Electrical Engineering
8	R5EL2203T	Signals and Systems	Signal And Image Processing	Electrical Engineering
9	R5EE2201T	Electro-mechanicalEnergy Conversion	Electrical Vehicles	Electrical Engineering
10	R5ME2201T	Introduction to Robotics	Robotics	Mechanical Engineering
11	R5ME2202T	Warfare Platforms & Systems	Defence Technology	Mechanical Engineering
12	R5ME2203T	Introduction to Aerospace Engineering	Aerospace Technology	Mechanical Engineering
13	R5IL2201T	Orientation Programme in Entrepreneurship	Entrepreneurship and Start-up	E Cell of the Institute

Course Codes for Languages

Sr. No.	Course Code	Name of the Language course sem III	Ownership
1	R5HS2501T	Marathi	Humanities & Management
2	R5HS2502T	Hindi	
3	R5HS2503T	Sanskrit	
4	R5HS2504T	Kannada	
5	R5HS2505T	Gujarati	
6	R5HS2506T	Punjabi	

List of Exit Courses after completion of Semester III and IV

1. The exit option is available for students who have earned a total of 88 credits at the End of the Fourth Semester.
2. Student who wants to avail the exit option after the second year have to earn an additional 6-8 credits from the list of courses shown below.
3. These courses students have to complete within summer vacation after 2nd Year.
4. After fulfillment as mentioned in 1 to 3 above, Students can earn a U.G. Diploma and the same will be issued by the Institute.

List of Exit Courses after completion of Semester III and IV: Electrical Engineering										
Sr.	Course Code	Course Name	L	T	P	Hr	Cr	Examination Weightage in %		
								TA	MST	ESE
1	R5EE2901I	Internship (6-8 weeks)	-	-	-	-	6	ISCE: 60		40
2	R5EE2902P	Project / Mini-Project	0	0	12	12	6	ISCE: 60		40
3	R5EE2903L	Microprocessor Lab	0	0	4	4	2	ISCE: 60		40
4	R5EE2904L	Power Electronics Lab	0	0	4	4	2	ISCE: 60		40
5	R5EE2905T	Signals and Systems	2	0	0	2	2	20	30	50
6	R5EE2906L	Internet of Things Lab	0	0	4	4	2	ISCE: 60		40

Syllabus for

SEMESTER III

	B. TECH. IN ELECTRICAL ENGINEERING	SECOND YEAR SEM- III				
COURSE CODE	R5MA2003T	CREDITS ASSIGNED				
		THEORY	TUTORIAL	LAB	TOTAL HRS	TOTAL CREDITS
		3	1	-	4	4
COURSE TITLE	MATHEMATICS III FOR ELECTRICAL ENGINEERS	EVALUATION SCHEME				
		TA	MST	ESE	TOTAL MARKS	
		20	30	50	100	

Prerequisite:

1. Differential and Integral Calculus
2. Polynomial and concept of zeros and poles
3. Partial derivatives and partial fraction

COURSE OUTCOMES

Students should be able to:

1. Compute the Laplace transform and Fourier transform of various functions.
2. Apply Laplace transforms to find the solution of ordinary differential equations.
3. Obtain the orthogonal and normal canonical reduction of a quadratic form.
4. Construct a Singular Value Decomposition of a matrix and apply it to solve Engineering problems
5. Find the Fourier series representation of a periodic function and evaluate the value of a series of real numbers.
6. Apply properties of Z transform and its inverse to analyze digital systems in a systematic way.

COURSE CONTENTS	
MODULE I	LAPLACE TRANSFORMS
	• Definition of the Laplace transform, Laplace transforms of standard functions like polynomials, trigonometrics. Exponential, hyperbolic functions. • Properties of Laplace transform Linearity, First shifting theorem, change of scale, Multiplication, and division by t, second shifting theorem. Transforms of derivatives and integrals • Heaviside unit step function, Dirac's delta function, Laplace transform of Periodic function, • Inverse Laplace transforms using linear property, partial fractions, and convolution theorem, Solution of Ordinary Differential Equations using Laplace and Inverse Laplace transforms.
MODULE II	QUADRATIC FORMS

	• Diagonalization of Symmetric matrices, Spectral theorem for symmetric matrices, • Quadratic forms, Canonical forms, application to Constrained optimization. • Singular value Decomposition of a matrix.
MODULE III	**Z-TRANSFORMS**
	• Z-Transform, Properties of z-transform, Theorem, change of Scale, Shifting property. • Inverse Z-Transform solution of Difference Equation, Multiplication by k, Division by k, Initial value, Final value, Partial sum, Inversion by residue method, Solution of Difference Equation. • Convolution, Convolution property of Causal Sequence, Inverse of Z Transform by Division, By Binomial Expansion and partial fraction
MODULE IV	**FOURIER SERIES AND FOURIER TRANSFORMS**
	• Orthogonal and Orthonormal sets, Expressions of a Function in Series of Orthogonal Functions. • Dirchlet's conditions. Fourier series of periodic function with period 2l, 2π. • Fourier series of even and odd functions. Half range series expansion, Parseval's Identity. • Complex form of Fourier series. • Fourier Integrals and Fourier transforms.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & sons, 2006.
2. Ramana B. V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
4. S. Kumaresan, Linear Algebra: A Geometric Approach.

	B. TECH. IN ELECTRICAL ENGINEERING	SECOND YEAR SEM- III				
COURSE CODE	R5EE2001T	CREDITS ASSIGNED				
		THEORY	TUTORIAL	LAB	TOTAL HRS	TOTAL CREDITS
		3	-	-	3	3
COURSE TITLE	ELECTRICAL NETWORKS	EVALUATION SCHEME				
		TA	MST	ESE	TOTAL MARKS	
		20	30	50	100	

Prerequisite:

1. Basic Electrical Engineering
2. Basic Mathematics
3. Concept of active and passive elements

COURSE OUTCOMES

Students should be able to:

1. Apply and analyze the fundamental theorems in electric circuits.
2. Analyze the transient and steady-state behavior of circuits.
3. Understand network functions and calculate network parameters.
4. Analyze two-port networks.

COURSE CONTENTS	
MODULE I	NETWORK THEOREMS
	Solution of network using dependent sources, mesh analysis, super mesh analysis, nodal analysis, super node analysis, source transformation and source shifting, superposition Thevenin's theorems and Norton's theorem, maximum power transfer theorem. Tellegen's theorem, Millman's theorem, and reciprocity theorem. Three Phase circuits balanced and unbalanced load, Phasor diagram, Neutral Shift calculations, Power measurement in three-phase systems
MODULE II	TRANSIENT CIRCUITS AND SOLUTIONS
	The initial condition of networks, General and partial solutions, time constant, formation of First Order and Second order differential equations and their solution for R-L, R-C, R-L-C circuits. The Laplace transform and its application to network analysis, transient and steady-state response to step, ramp, impulse, and sinusoidal input function, transform of other signal waveforms, shifted step, ramp, and impulse function, waveform synthesis.
MODULE III	NETWORK FUNCTIONS AND NETWORK PARAMETERS

	Network functions for one port and two-port networks, driving point and transfer functions, ladder network, General network, poles and zeros of network functions, restrictions on Pole and zero locations for driving point functions and Transfer functions, time domain behavior from pole - zero plot.
MODULE IV	**TWO PORT PARAMETERS**
	Open circuit, short circuit, transmission, and hybrid Parameters, relationships between parameter sets, reciprocity, and symmetry conditions, and Interconnection of two-port networks.

TEXT BOOKS

1. "Engineering Circuit Analysis", by W H Hayt, S M Durbin, J E Kemmerly, 7th Edition Tata McGraw-Hill Education.
2. "Network Analysis", by M. E. Van Valkenburg, 3rd Edition, PHI Learning.
3. "Networks and Systems", by D. Roy Choudhury, 2nd Edition, New Age International.
4. "Linear Circuits", by M. E. Van Valkenburg, Prentice Hall.

REFERENCE BOOKS

1. "Network Analysis and Synthesis", by F. F. Kuo, John Wiley and sons.
2. "Linear Network Theory: Analysis, Properties, Design and Synthesis", by N. Balabanian and T.A. Bickart, Matrix Publishers, Inc.
3. "Network Analysis and Synthesis", by C. L. Wadhwa, New Age International.
4. "Fundamentals of Electric Circuits", Alexander Charles K. and Sadiku Matthew, 5th ed., McGraw Hill.

EED, VJTI	**B. TECH. IN ELECTRICAL ENGINEERING**	**SECOND YEAR SEM- III**				
COURSE CODE	**R5EE2002T**	**CREDITS ASSIGNED**				
		THEORY	**TUTORIAL**	**LAB**	**TOTAL HRS**	**TOTAL CREDITS**
		3	**-**	**-**	**3**	**3**
COURSE TITLE	**ELECTRICAL MACHINES-I**	**EVALUATION SCHEME**				
		TA	**MST**	**ESE**	**TOTAL MARKS**	
		20	**30**	**50**	**100**	

Prerequisite:

1. Basic Electrical Engineering
2. Basics of Physics
3. Concepts of Fleming rule, Faraday laws

COURSE OUTCOMES

Students should be able to:

1. Demonstrate electro-mechanical energy conversion principles.
2. Calculate efficiency & regulation of transformers.
3. Calculate efficiency and other performance parameters of DC.
4. Analyse speed control and speed-torque characteristics of the DC machine and the construction of Induction Machine.

COURSE CONTENTS	
MODULE I	**BASICS OF MAGNETISM AND ELECTROMECHANICAL ENERGY CONVERSION**
	Magnetic field, Magnetic circuit, Numerical from series parallel magnetic circuit, Flux linkage, Inductance and energy, Hysteresis and eddy current losses. Principle of electromechanical energy conversion, Energy stored in magnetic field, Torque in singly excited magnetic field, doubly excited magnetic field.
MODULE II	**TRANSFORMERS**
	Transformer principle of operation, EMF equation, Equivalent Circuit, Phasor diagram, voltage regulation, Losses and Efficiency, All day Efficiency, Polarity Test, OC and SC Test, Autotransformer and its comparison with two winding transformers. Three-phase transformer connections and phasor groups. Parallel operation of single and three-phase transformers, Excitation Phenomenon in transformers, Harmonics in three-phase transformers, Suppression of harmonics.
MODULE III	**CONSTRUCTION AND OPERATION OF DC MACHINE**
	Construction of DC machine, Simplex lap and wave windings, Principle of operation, Significance of commutator and brushes, EMF and torque equation, concept of back EMF, Armature reaction, DC Generators & Motors with different Connections,

	Characteristics of DC Motors, speed-torque characteristic equations, losses and efficiency.
MODULE IV	**INTRODUCTION TO AC MACHINES**
	3-ph AC machines stator construction, rotating magnetic field theory, types of rotor based on the construction. Applications based on the construction of 3-ph AC machine

TEXT BOOKS

1. "Electrical Machinery, Performance and Applications", by Bimbhra P. S., Khanna Publisher Fifth Edition.
2. "Electrical Machines", by A. E. Fitzgerald & C. Kingsley, 3rd Edition, TMH Publication
3. "Electric machinery fundamentals", Chapman Stephen J., New York, McGraw-Hill, 2012.

REFERENCE BOOKS

1. "Electric motor drives", by R. Krishnan, Pearson Edu.
2. "The performance and design of A.C. Machines", by M. G. Say., C B S Publications, 2005.

	B. TECH. IN ELECTRICAL ENGINEERING	SECOND YEAR SEM- III

Course Code	R5EE2002L	Credits Assigned				
		Theory	Tutorial	Lab	Total Hrs	Total Credits
		-	-	2	2	1
Course Title	ELECTRICAL MACHINES LABORATORY-I	Evaluation Scheme				
		ISCE		ESE	Total Marks	
		60		40	100	

Prerequisite:

1. Basic Electrical Engineering
2. Basics of Physics
3. Concepts of Fleming's rule, Faraday's laws

COURSE OUTCOMES

Students should be able to:

1. Demonstrate electro-mechanical energy conversion principles.
2. Calculate the efficiency and regulation of transformers.
3. Calculate efficiency and other performance parameters of DC machines.

	LIST OF EXPERIMENTS
1.	Construction and working of meters used in Machines Lab (V, A, W, cos ϕ, multimeter)
2.	Construction of Electrical Machines
3.	Open circuit and short circuit test on single-phase Transformer
4.	Load Test on single-phase Transformer
5.	Vector Groups of single-phase Transformer.
6.	Sumpner's Test on single phase Transformer
7.	Swinburne Test on DC machines
8.	Speed Control of DC shunt motor
9	Load test on dc shunt motor
10	Hopkinson's test on DC machines

	B. TECH. IN ELECTRICAL ENGINEERING		**SECOND YEAR SEM- III**			
COURSE CODE	**R5EE2003T**	**CREDITS ASSIGNED**				
		THEORY	**TUTORIAL**	**LAB**	**TOTAL HRS**	**TOTAL CREDITS**
		3	**1**	**-**	**4**	**4**
COURSE TITLE	**INTRODUCTION TO POWER SYSTEMS**	**EVALUATION SCHEME**				
		TA	**MST**	**ESE**	**TOTAL MARKS**	
		20	**30**	**50**	**100**	

Prerequisite:

1. Basic Electrical Engineering
2. Fundamentals of Electrical Machines
3. Fundamentals of Electromagnetic Field Theory

COURSE OUTCOMES

Students should be able to:

1. Calculate transmission line parameters and ABCD parameters for different line length.
2. Analyse performance of overhead transmission lines and underground cables.
3. Analyze the need for VAR compensation.
4. Analyse faults in transmission lines and understand insulation coordination.

COURSE CONTENTS	
MODULE I	**STRUCTURE OF POWER SYSTEMS**
	Vertically integrated and restructured Power Systems, Conventional and non-conventional sources, Schematic of different conventional generation and function of different components. Variable load on Power Stations, Load curve and Load Duration Curve, Factors related to operation of power systems.
MODULE II	**TRANSMISSION LINES OPERATION AND PERFORMANCE**
	Overhead and underground transmission, Bundle conductor, Line parameters, Introduction to cables, string efficiency, sag calculation. Short, medium, and long line model, ABCD parameters, Ferranti effect, Surge Impedance loading, power flow through transmission lines.
MODULE III	**REPRESENTATION OF POWER SYSTEM COMPONENTS**
	Single phase representation of balanced three phase networks. Single line diagram, impedance and reactance diagram. Per unit (p.u.) system, per unit impedance diagram, representation of loads, transformer and generator.
MODULE IV	**FAULT ANALYSIS AND INSULATION COORDINATION**

	Types of Faults, Symmetrical Fault Calculations, sequence components, Unsymmetrical Faults. Introduction to Insulation coordination, Insulation level (SIL and BIL), Neutral Grounding and Equipment Earthing.

TEXT BOOKS

1. "A Text Book on Power System Engineering", M. L. Soni, P. V. Gupta, U. S. Bhatnagar, DhanpatRai Publishing Company (P) Limited.
2. "Modern Power System Analysis", D. P. Kothari and I. J. Nagrath, McGraw-Hill Publication.
3. "A Course in Power system", J.B. Gupta, S. K. Kataria & Sons.

REFERENCE BOOKS

1. "Power Systems Analysis", by Hadi Saddat, Tata McGraw Hill.
2. "Electrical Power", S.L. UPPAL, Khanna Publishers.
3. "Power System Analysis", by John Grainger, William Stevenson Jr., McGraw-Hill.
4. "Power System: Analysis & Design", Thomas Overbye, J. Duncan Glover, Mulkutla .S. Sarma, Cengage Learning.

EED, VJTI	**B. TECH. IN ELECTRICAL ENGINEERING**			**SECOND YEAR SEM- III**		
COURSE CODE	**R5EE2201T**	**CREDITS ASSIGNED**				
		THEORY	**TUTORIAL**	**LAB**	**TOTAL HRS**	**TOTAL CREDITS**
		2	**-**	**-**	**2**	**2**
COURSE TITLE	**ELECTRO-MECHANICAL ENERGY CONVERSION**	**EVALUATION SCHEME**				
		TA	**MST**	**ESE**	**TOTAL MARKS**	
		20	**30**	**50**	**100**	

Prerequisite:

1. Basic Electrical Engineering
2. Basics of Physics
3. Concepts of Fleming's rule, Faraday's laws
4. Basic motor generator rule

COURSE OUTCOMES

Students should be able to:

1. Understand and Analyze Electromagnetic Principles.
2. Evaluate, Analyze, and Design Transformers.
3. Compare and Select Electric Motors for EV Applications.
4. Understand the Application of Generators in EVs.

COURSE CONTENTS	
MODULE I	**FUNDAMENTALS OF ELECTROMAGNETIC FIELDS AND INDUCTION**
	Concepts of electromagnetic fields, basics of electric and magnetic fields, Coulomb's Law, Gauss's Law, magnetic flux density, and permeability; Faraday's Law of Induction, Lenz's Law, and the principles of electromagnetic induction in coils, self-inductance and mutual inductance; Maxwell's Equations; Energy stored in electric and magnetic fields; introduction to electromechanical systems.
MODULE II	**TRANSFORMERS**
	Fundamentals of transformers, construction and working principles, ideal and real transformer models, voltage regulation, and efficiency; Role of transformers in electric vehicles, use in EV power systems, high-frequency transformers in chargers, and step-up and step-down transformers.
MODULE III	**ELECTRIC MOTORS FOR ELECTRIC VEHICLES**
	Overview of electric motors used in EVs, - DC motors, induction motors, and permanent magnet motors and their performance characteristics; Working principles

	of DC motors, series, shunt, and compound motors, and their application in EVs; Induction motors, squirrel cage and wound rotor designs, and their use in commercial EVs; Permanent magnet synchronous motors (PMSM) and brushless DC (BLDC) motors, advantages and applications in electric vehicles.
MODULE IV	**GENERATORS**
	Basics of electric generators, principles of electromagnetic generators, the types of generators (AC and DC), and their application in regenerative braking systems in EVs.

TEXT BOOKS

1. Chapman, S. J. (2011). Electric Machinery Fundamentals (5th ed.). McGraw-Hill Education.
2. Sen, P. C. (2013). Principles of Electric Machines and Power Electronics (3rd ed.). John Wiley & Sons.
3. Lyshevski, S. E. (2008). Electromechanical Systems and Devices. CRC Press.

REFERENCE BOOKS

1. Weiner, M. E. (2023). *Electric Vehicle Engineering*. CRC Press.
2. Hughes, A., & Drury, B. (2019). Electric Motors and Drives: Fundamentals, Types and Applications (5th ed.). Elsevier.

	B. TECH. IN ELECTRICAL ENGINEERING	SECOND YEAR SEM- III				
COURSE CODE	R5EE2004L	CREDITS ASSIGNED				
		THEORY	TUTORIAL	LAB	TOTAL HRS	TOTAL CREDITS
		1	-	-	1	-
COURSE TITLE	ELECTRICAL MEASUREMENT	EVALUATION SCHEME				
		TA	MST	ESE	TOTAL MARKS	
		-	-	-	-	

Prerequisite:

1. Basic Electrical Engineering
2. Basics of Physics
3. Concepts of Fleming's rule, Faraday's laws
4. Basic measurement and instrumentation rule

COURSE OUTCOMES

Students should be able to:

1. Analyze different errors in measurement and their sources.
2. Apply different measuring principles AC as well as DC quantities.
3. Use correct measurement techniques for electrical and magnetic parameters
4. Understand and explain various transducers and their working
5. Understand and use CRO.

COURSE CONTENTS	
MODULE I	**Basic Measurement Concepts**
	Measurement systems—Types of Error, accuracy and precision. Moving coil and Moving iron Instruments, Ammeters Shunts & Voltmeter Multiplier. Extension of ranges. Bridge measurements-Resistance, inductance, Capacitance, frequency measurement. Resolution & sensitivity of digital meters. CRO – General purpose and advanced types, Signal and function generators, Specification and their interpretation for DSO and Waveform generator.
MODULE II	**Transducers and Measurement of Current and Voltage**
	Classification of transducers, Resistive, Capacitive and Inductive — LVDT – Thermoelectric – Piezoelectric Transducers for measurement of displacement – temperature. CT and PT construction working Ratio and phase angle errors.

TEXT BOOKS

1. "Electrical Measurements and Measuring Instruments", by Golding. E. W, and Widdis F.C,5th Edition, A. H. Wheeler & Company, 2003.
2. "A Course in Electrical and Electronics Measurements and Instrumentation", by Sawhney A.K, 18th Edition, Dhanpat Rai & Company Private Limited, 2007.
3. "Measurement Systems - Application and Design", Ernest O. Doebelin, TMH, 2007.

REFERENCE BOOKS

1. "Electronic Instrumentation", by Kalsi. H. S, 2nd Edition, Tata McGraw Hill, 2004.
2. "Modern Electronic Instrumentation and Measurement Technique", by Copper. W. D and Hlefrick A. D, 5th Edition, Prentice Hall of India, 2002.

	B. TECH. IN ELECTRICAL ENGINEERING	**SECOND YEAR SEM- III**				
COURSE CODE	**R5EE2004L**	**CREDITS ASSIGNED**				
		THEORY	**TUTORIAL**	**LAB**	**TOTAL HRS**	**TOTAL CREDITS**
		-	**-**	**2**	**2**	**2**
COURSE TITLE	**ELECTRICAL MEASUREMENT LABORATORY**	**EVALUATION SCHEME**				
		ISCE		**ESE**	**TOTAL MARKS**	
		60		**40**	**100**	

Prerequisite:

1. Basic Electrical Engineering
2. Basics of Physics
3. Concepts of Fleming's rule, Faraday's laws
4. Basic understanding of ammeter, voltmeter, wattmeter, and energy meter

COURSE OUTCOMES

Students should be able to:

1. To determine unknown inductance, resistance, capacitance by performing experiments on D.C Bridges & A.C Bridges.
2. To determine the ratio and phase angle errors of current transformer and potential transformer.
3. To measure accurately the electrical parameters voltage, current, power, energy and electrical characteristics of resistance, inductance and capacitance.
4. To Understand and use CRO.
5. To Understand and explain various transducers and their working.

LIST OF EXPERIMENTS

1. Measurement of Displacement with the help LVDT.
2. Measurement of different ranges of temperatures using i) RTD ii) Thermo- couple
3. Measurement of voltage, frequency & phase with the help of CRO
4. Measurement of load with the help of strain gauges.
5. Measurement of % ratio error and phase angle of given C.T.
6. Measurement of % ratio error and phase angle of the given PT
7. Measurement of tolerance of batch of low resistances by Kelvin's double bridge
8. Measurement of voltage, current and resistance using DC potentiometer
9. Measurement of Self Inductance by Maxwell Bridge.
10. Measurement of Capacitance using any ac bridge.

	B. TECH. IN ELECTRICAL ENGINEERING	**SECOND YEAR SEM- III**				
COURSE CODE	**R5CH2401O**	**CREDITS ASSIGNED**				
		THEORY	**TUTORIAL**	**LAB**	**TOTAL HRS**	**TOTAL CREDITS**
		2	**-**	**-**	**2**	**2**
COURSE TITLE	**ENVIRONMENTAL SCIENCE**	**EVALUATION SCHEME**				
		ISCE		**ESE**	**TOTAL MARKS**	
		60		**40**	**100**	

Prerequisite:

1. Basic Electrical Engineering
2. Energy conservation, audit, etc
3. Sustainable energy

COURSE OUTCOMES

Students should be able to:

1. Imply the basic knowledge of environmental protection, sustainable development and improvement.
2. Categorize and scrutinize impact of human development on natural resources and its conservation.
3. Interpret the impact of environmental problems on socio-economic growth.
4. Apply different Science and Technology (S&T) based sustainability solutions and technological improvement, and methods for the remediation of degraded environment.
5. Familiarize with the legislation, management and protocols existing for environmental protection.

COURSE CONTENTS	
MODULE I	**SIGNIFICANCE OF ENVIRONMENT SCIENCE**
	Definition, basic principles and scope of environment science. Need for awareness Industrialization & Urbanization; Basic Ecological Concepts Ecosystems, nature of environmental threats, Current environmental problems, Importance of clean air.
MODULE II	**NATURAL RESOURCES MANAGEMENT AND SUSTAINABILITY**
	Concept of Ecosystem, Conservation of ecosystem: Natural Resources, Renewable and Non-renewable Resources, Natural resources and challenges with the conservation. Forest resources, Water resources, Energy resources. Role of an individual in conservation of natural resources. Impact of energy use on Environment. Energy conservation and sustainability.
MODULE III	**ENVIRONMENT & SOCIETY**

	Urbanization and environment, social movements, Community participation, JFM, participation by NGOs Impact of energy use on Environment, energy production on environment change, nuclear explosion, impact of dam construction, Energy conservation and sustainability.
MODULE IV	**GREEN TECHNOLOGIES**
	Role of advancements in science and technology in developing environment friendly technologies. 3 R's for Green Technology, Green technology towards sustainable future. Reduction of ecological footprint, Concept of Sustainability and Green Chemistry as a tool for sustainable development.
MODULE V	**ENVIRONMENTAL LEGISLATION, MANAGEMENT & POLICIES**
	Aims And Objectives of Environmental, Impact Assessment (EIA), Environmental Management Plan (EMP), Indian forest act, The water act (prevention and control of water pollution), The Air act (prevention & control of air pollution). *International efforts for environmental protection and contribution of India for same, National Action Plan on Climate Change Role of Ministry of Environment, forest and climate.* Mitigation measures for climate change, international protocols, Montreal protocol, Kyoto protocol, Carbon credits and carbon trading

TEXT BOOKS

1. De., Environmental Chemistry, 6th Edition, New Age International.
2. Erach Bharucha, Text Book of Environmental Studies for Undergraduate Courses, Universities Press, Second Edition (UGC Recommended).
3. P.K.Goel, Water Pollution, Causes, Effects and Control, New Age International.
4. Dr. Jagdish Krishnaswamy and Dr. R. J. Ranjit Daniels, Environmental Studies, Wiley India Private Limited, New Delhi, First Edition, 2009.

REFERENCE BOOKS

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad.
2. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., Environmental Encyclopedia, Jaico Publ. House, Mumbai, 2000.
3. Jadhav, H &Bhosale, V.M., Environmental Protection and Laws. Himalaya Pub. House, Delhi, 1995.
4. Wanger K.D., Environmental Management. W.B. Saunders Co. Philadelphia, USA, 1998.
5. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R).

Syllabus for

SEMESTER IV

COURSE CODE	R5EE2005T	CREDITS ASSIGNED				
		THEORY	TUTORIAL	LAB	TOTAL HRS	TOTAL CREDITS
		3	-	-	3	3
COURSE TITLE	ELECTROMAGNETIC FIELDS	EVALUATION SCHEME				
		TA	MST	ESE	TOTAL MARKS	
		20	30	50	100	

Prerequisite:

1. Fundamentals of mathematics
2. Basics of Physics
3. Concept of scalar and vector
4. Concept of linear algebra

COURSE OUTCOMES

Students should be able to:

1. Identify and make use of different coordinate systems for representation of vector fields, and apply basic laws of electrostatics.
2. Describe electric fields in materials and apply Poisson's and Laplace equation.
3. Apply basic laws of magnetism to solve physical problems.
4. Summarize time varying Maxwell's equations and explain electromagnetic wave propagation.

COURSE CONTENTS	
MODULE I	ELECTROSTATICS
	Coordinate Systems, Scalar and Vector Fields, Gradient, Divergence and Curl Operations; Coulomb's law and field intensity, Electric fields due to continuous charge distributions, Electric flux density, Gauss's law, Applications of Gauss's law, Electric potential, Potential gradient, Relation between E and V, Electric dipole and flux lines, Equipotential contours Energy density in electrostatic fields.
MODULE II	ELECTRIC FIELDS IN MATERIAL'S SPACE AND BOUNDARY VALUE PROBLEMS
	Properties and materials, Convection and conduction current, Current density, Conductors, Polarization in dielectrics, Dielectric constant and strength, Continuity equation and boundary condition, Poisson's and Laplace equation, Uniqueness theorem, Resistance, capacitance and super-conductance, The Earth capacitor: an automatic electrostatic pilot.
MODULE III	MAGNETIC FIELD
	Biot-Savart's law, Ampere's circuit law – Maxwell's equation, Applications of Ampere's law, Magnetic flux density – Maxwell's equation, Maxwell's equation for static fields, Magnetic scalar and vector potentials, Derivations of Biot-Savart's law and Ampere's Law. Forces due to magnetic fields, Magnetic torque and moment, Magnetic dipole, Magnetisation in materials, The solenoid, Classification of magnetic materials,

	Magnetic boundary conditions, Inductor and inductance, Magnetic energy and circuits, Forces on magnetic materials.
MODULE IV	**MAXWELL'S EQUATIONS**
	Faraday‟s law, Transformer and motional electromotive forces, Displacement current, Inconsistency of Ampere‟s law, Maxwell‟s equation in time varying and harmonic form, Analogies between electric and magnetic field. Tensorial representation of Maxwell's Equations.
MODULE V	**ELECTROMAGNETIC WAVE PROPAGATION**
	Electromagnetic wave equatgion, Propagation in lossy dielectric, Plane wave in lossless dielectrics, Plane waves in free space, Plane waves in good conductors, Power and Pointing vector, Reflection of plane wave at normal incidence.

TEXT BOOKS

1. "Principles of Electromagnetics", Matthew N. O. Sadiku and S. V Kulkarni, Sixth edition, 2015, Oxford university press".
2. Electromagnetic Waves and Radiating Systems", Edward C. Jordan, Keith G. Balmain, "Second edition, Prentice-Hall.

REFERENCE BOOKS

1. "Engineering Electromagnetics", William Hayt, McGraw Hill.
2. Schaum‟s series in Electromagnetics", Edminister, McGraw Hill.

COURSE CODE	R5EE2005L	CREDITS ASSIGNED				
		THEORY	TUTORIAL	LAB	TOTAL HRS	TOTAL CREDITS
		-	-	2	2	1
COURSE TITLE	ELECTROMAGNETIC FIELDS LABORATORY	EVALUATION SCHEME				
		ISCE		ESE	TOTAL MARKS	
		60		40	100	

Prerequisite:

1. Fundamentals of mathematics
2. Basics of Physics
3. Concept of scalar and vector
4. Concept of linear algebra

COURSE OUTCOMES

Students should be able to:

1. Identify and make use of different coordinate systems for representation of vector fields, and apply basic laws of electrostatics.
2. Describe electric fields in materials and apply Poisson's and Laplace equation.
3. Apply basic laws of magnetism to solve physical problems.
4 Summarize time varying Maxwell's equations and explain electromagnetic wave propagation.

LIST OF EXPERIMENTS

1. To perform vector operations using GeoGebra.
2. To visualize scalar and vector fields using GeoGebra.
3. To study Gradient of a scalar field, Curl & Divergence of a vector field.
4. To solve and simulate an electrostatic problem using COMSOL, HFSS or any FEM Simulator.
5. To solve and simulate a magnetostatic problem using open source FEMM.
6. To study phasor notation and graphically illustrate uniform plane waves.
7. To study the concept of electromagnetic radiation and plot the radiation pattern of a half wave dipole antenna.
8. To develop a project on electromagnetics applications using COMSOL, HFSS, MATLAB, etc.

EED, VJTI	**B. TECH. IN ELECTRICAL ENGINEERING**	**SECOND YEAR SEM- IV**				
COURSE CODE	**R5EE2006T**	**CREDITS ASSIGNED**				
		THEORY	**TUTORIAL**	**LAB**	**TOTAL HRS**	**TOTAL CREDITS**
		3	**-**	**-**	**3**	**3**
COURSE TITLE	**ELECTRICAL MACHINES-II**	**EVALUATION SCHEME**				
		TA	**MST**	**ESE**	**TOTAL MARKS**	
		20	**30**	**50**	**100**	

Prerequisite:

1. Fundamentals of Electrical Engineering
2. Basics of Physics
3. Concept of Motor and generator principle
4. Fundamental of Emft

COURSE OUTCOMES

Students should be able to:

1. Analyse equivalent circuits and performance of induction machines, including starting and speed control.
2. Evaluate construction, emf generation, and operation of synchronous machines with harmonics and armature reaction.
3. Apply synchronization and load sharing in parallel operation of transformers and synchronous generators.
4. Explain construction and operation of special machines like PM, BLDC, PMSM, stepper, SRM, and synchronous reluctance motors.

COURSE CONTENTS	
MODULE I	**OPERATION AND CONTROL OF INDUCTION MACHINE**
	RMF theory revision, types of induction motor, Equivalent Circuit of IM, Torque- slip characteristics, regulation calculation, Losses, and Efficiency. Methods of starting induction motors; Principles of speed control. Single-phase induction motor working, double revolving field theory, equivalent circuit, torque-speed characteristic.
MODULE II	**SYNCHRONOUS MACHINES**
	Classification and constructional features of salient pole and cylindrical rotor three-phase synchronous machine. Generated emf, winding coefficients, and harmonics in generated emf, armature reaction, regulation calculation, efficiency calculation. Steady state operating characteristic of synchronous motor; O and V-curves and phasor diagram, hunting.
MODULE III	**PARALLEL OPERATION OF SYNCHRONOUS MACHINES**
	Parallel operation of synchronous generators, Synchronization of alternator with grid, load sharing in parallel operation.

MODULE IV	SPECIAL MACHINES FOR VARIOUS APPLICATIONS
	Basic principle and operation of Permanent Magnet Machines, Brushless DC motor, Stepper Motor, Permanent Magnet Synchronous Motor, Synchronous Reluctance Motor, Switched Reluctance Motor.

TEXT BOOKS

1. "Electrical Machinery, Performance and Applications", by Bimbhra P. S., Khanna Publisher Fifth Edition.
2. "Electrical Machines", by D. P. Kothari and I. J. Nagrath, Tata McGraw Hills.
3. "Electric machinery fundamentals", Chapman Stephen J., New York, McGraw-Hill, 2012.

REFERENCE BOOKS

1. "Electrical Machines", by A. E. Fitzgerald & C. Kingsley, 3rd Edition, TMH Publication
2. "The performance and design of A.C. Machines", by M. G. Say., C B S Publications, 2005.
3. "Electric motor drives", by R. Krishnan, Pearson Edu.

	B. TECH. IN ELECTRICAL ENGINEERING	SECOND YEAR SEM- IV				
Course Code	R5EE2006L	Credits Assigned				
		Theory	Tutorial	Lab	Total Hrs	Total Credits
		-	-	2	2	1
Course Title	ELECTRICAL MACHINES LABORATORY-II	Evaluation Scheme				
		ISCE		ESE	Total Marks	
		60		40	100	

Prerequisite:

1. Fundamental of motor and generator
2. Fundamentals of Matalab tool
3. Concept of linear algebra

COURSE OUTCOMES

Students should be able to:

1. Demonstrate electro mechanical energy conversion principles.
2. Calculate efficiency and regulation of Induction Machines.
3. Calculate efficiency and other performance parameters of Induction machines.

	LIST OF EXPERIMENTS
1.	Construction and working of meters used in Machines Lab (frequency meter, phase sequence meter, synchroscope)
2.	Revision of Construction of Electrical Machines (feedback panel, special machines)
3.	No load and blocked rotor test on single-phase Induction Motor.
4.	No load and blocked rotor test on three-phase induction motor.
5.	Speed control of 3-ph induction motor.
6.	O.C.C. / S.C.C./ Z.P.F.C. on synchronous machine
7	Slip test on synchronous machine.
8	Synchronization of alternator (demo)
9	Load test on three-phase Induction Motor.
10	V-curves of syn. Motor

	B. TECH. IN ELECTRICAL ENGINEERING	**SECOND YEAR SEM- IV**				
COURSE CODE	**R5EE2007T**	**CREDITS ASSIGNED**				
		THEORY	**TUTORIAL**	**LAB**	**TOTAL HRS**	**TOTAL CREDITS**
		3	**-**	**-**	**3**	**3**
COURSE TITLE	**BASIC ELECTRONIC AND DIGITAL CIRCUITS**	**EVALUATION SCHEME**				
		TA	**MST**	**ESE**	**TOTAL MARKS**	
		20	**30**	**50**	**100**	

Prerequisite:

1. Fundamentals of semiconductors
2. Basics of Physics
3. Fundamentals of material
4. Basic of electrical and electronics

COURSE OUTCOMES

Students should be able to:

1. Understand the characteristics and applications of semiconductor devices.
2. Analyze the operation of JFETs and MOSFETs, different feedback amplifiers, and oscillator circuits.
3. Demonstrate binary arithmetic and Boolean algebra.
4. Design and analyze combinational and sequential logic circuits, including multiplexers, decoders, encoders, flip-flops, counters, and shift registers.
5. Apply operational amplifiers in designing analog signal processing circuits for various linear applications.

COURSE CONTENTS	
MODULE I	**DIODES AND BIPOLAR JUNCTION TRANSISTORS**
	Characteristics of PN junction diode; Half and full wave rectifier circuits; BJT Operation, input and output characteristics, Configurations; Biasing Circuits: Types, DC analysis, load line, thermal runway, stability factor;
MODULE II	**FIELD EFFECT TRANSISTORS: JFET AND MOSFET**

	FET construction and their characteristics; Biasing circuits for FET amplifiers; Types of FET: JFET and MOSFET. Introduction to positive and negative feedback amplifiers; Negative feedback current, voltage, Series and Shunt type. Introduction to Power amplifiers; Operation of various types: Class A, B, C and D amplifiers, angle of conduction, push-pull, efficiency of conversion for different types; Positive feedback oscillators, frequency of oscillation.
MODULE III	**NUMBER SYSTEMS AND BOOLEAN ALGEBRA**
	Decimal, Binary, Octal and Hexadecimal number system and conversion, binary weighted codes, 1"s and 2"s complement addition and subtraction in 1"s and 2"s complement system, binary multiplication and division. Basic theorems and properties of Boolean Algebra, Various logic Gates (NOT, AND, OR, NAND, NOR, XOR, XNOR) and their truth tables, SOP and POS forms of Boolean functions, Minimization of Boolean function using Karnaugh Map, design of logic circuit for given truth table, Adder and Subtractor
MODULE IV	**COMBINATIONAL LOGIC AND SEQUENTIAL LOGIC**
	Code converters, Multiplexer, Multiplexers as function generators, De-multiplexer, Decoder, Encoder. Basic flip flops – SR, D, JK and T; flip flop applications – synchronous counters, shift registers.
MODULE V	**OP-AMP BASED CIRCUITS**
	Linear Applications: Inverting and non-inverting amplifier, voltage follower, summing amplifier, subtractor, instrumentation amplifier, voltage to current and current to voltage converter, integrator, differentiator. Monostable and bistable multivibrator.

TEXT BOOKS

1. "Electronic Devices and Circuits" by Robert Boylestad and Louis Nashelsky, Prentice-Hall of India.
2. "Electronic Devices and Circuits" by Millman and Halkias, Tata McGraw-Hill.
3. "Digital Logic and Computer Design", by M. Morris Mano, PHI, 2006.
4. "Modern Digital Electronics", by R. P. Jain, TATA McGraw Hill.

REFERENCE BOOKS

1. "Electronic Devices and Circuits" by David Bell, Oxford University Press
2. "Electronic Circuit Analysis and Design" by D. A Neamen, McGraw-Hill International.
3. "Integrated Circuits", by Botkar, Vikas Book House.
4. "Digital Principles and Applications", by Malvino, Leach, Saha, TATA McGraw Hill .

	B. TECH. IN ELECTRICAL ENGINEERING			**SECOND YEAR SEM- IV**		
COURSE CODE	**R5EE2007L**	**CREDITS ASSIGNED**				
		THEORY	**TUTORIAL**	**LAB**	**TOTAL HRS**	**TOTAL CREDITS**
		-	**-**	**2**	**2**	**1**
COURSE TITLE	**BASIC ELECTRONIC AND DIGITAL CIRCUITS LABORATORY**	**EVALUATION SCHEME**				
		ISCE		**ESE**	**TOTAL MARKS**	
		60		**40**	**100**	

Prerequisite:

1. Fundamentals of semiconductors
2. Basics of Physics
3. Fundamentals of material
4. Basic of electrical and electronics

COURSE OUTCOMES

Students should be able to:

1. Plot and interpret the V-I characteristics of PN Junction and Zener Diodes, and demonstrate the use of a Zener diode in voltage regulation.
2. Construct and evaluate Half Wave and Full Wave Rectifier circuits with and without filters, and measure their output performance.
3. Determine the input-output characteristics of BJTs in different configurations and identify suitable biasing methods.
4. Analyze the output and transfer characteristics of JFETs and determine their region of operation.
5. Examine the behavior of enhancement and depletion mode MOSFETs and plot their output characteristics.
6. Measure voltage gain and frequency response of amplifier circuits and validate theoretical results.

LIST OF EXPERIMENTS

1. VI Characteristics of PN Junction Diode, Zener Diode (including voltage regulation).
2. Half Wave and Full Wave Rectifiers.
3. Transistor Characteristics and Biasing.
4. Output and Transfer Characteristics of JFET.
5. MOSFET Characteristics (Enhancement and Depletion types).
6. Voltage Gain and Frequency Response.

7. Sinusoidal Oscillators RC Phase Shift Oscillator Wien Bridge Oscillator using Op-Amp Hartley or Colpitts Oscillator using BJT.
8. Operational Amplifiers Inverting and Non-Inverting Amplifiers Integrator and Differentiator.
9. Digital Logic Circuits Logic Gates and Verification of Truth Tables AND, OR, NOT, NAND, NOR, XOR, XNOR using ICs.
10. Combinational Logic Circuits 4-bit Adder/Subtractor Multiplexer/Demultiplexer
11. Sequential Logic Circuits Flip-Flops (SR, JK, D, T)Counters (Asynchronous and Synchronous) Shift Registers Serial In/Serial Out and Parallel In/Out using ICs.

	B. TECH. IN ELECTRICAL ENGINEERING	SECOND YEAR SEM- IV				
COURSE CODE	R5EE2008T	CREDITS ASSIGNED				
		THEORY	TUTORIAL	LAB	TOTAL HRS	TOTAL CREDITS
		2	-	-	2	2
COURSE TITLE	NUMERICAL TECHNIQUES	EVALUATION SCHEME				
		TA	MST	ESE	TOTAL MARKS	
		20	30	50	100	

Prerequisite:

1. Fundamentals of mathematics
2. Fundamental skill of computer
3. Fundamental of Matlab tool
4. Concept of linear algebra

COURSE OUTCOMES

Students should be able to:

1. Perform an error analysis for a given numerical method.
2. Solve linear algebraic equations
3. Solve numerical on curve fitting problems
4. Perform numerical integration and differentiation

COURSE CONTENTS	
MODULE I	ERRORS IN NUMERICAL COMPUTATION
	Error types, analysis and estimation. Error propagation.
MODULE II	SYSTEMS OF LINEAR ALGEBRAIC EQUATIONS
	Bracketing Methods – The Bisection method, The False position method. Open Methods – The Newton-Raphson method, The Secant method. Gauss-Elimination method – Technique, pitfalls, improvement. Gauss-Jordan method. LU decomposition and matrix inversion. Gauss-Seidel method. (all the methods with relevant engineering applications)
MODULE III	CURVE FITTING
	Interpolation – Newton's divided difference, Lagrange Interpolating polynomials. Approximation - Least square approximation technique, linear regression, and polynomial regression. (relevant engineering applications)

MODULE IV	NUMERICAL DIFFERENTIATION AND INTEGRATION
	Methods based on interpolation and finite differences. (relevant engineering applications) The Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule.

TEXT BOOKS

1. Seven C Chopra, Raymond C Canale, Numerical Methods for engineers, fourth edition, Tata McGraw Hill, 2002.

REFERENCE BOOKS

1. Robert J Schillig, Sandra L Harris, Applied numerical Methods for Engineers First Edition Thomson AsiaPvt. Ltd., 2002.

	B. TECH. IN ELECTRICAL ENGINEERING	SECOND YEAR SEM- IV				
COURSE CODE	R5EE2009T	CREDITS ASSIGNED				
		THEORY	TUTORIAL	LAB	TOTAL HRS	TOTAL CREDITS
		3	-	-	3	3
COURSE TITLE	SIGNALS AND SYSTEMS	EVALUATION SCHEME				
		TA	MST	ESE	TOTAL MARKS	
		20	30	50	100	

Prerequisite:

1. Fundamentals of linear and nonlinear system
2. Fundamental of differential and integral calculus
3. Fundamental of partial fraction
4. Basic of electrical and electronics

COURSE OUTCOMES

Students should be able to:

1. Characterize signals and systems and obtain output of LTI systems in continuous-time and discrete time domains.
2. Obtain Laplace transform and Z-domain and their inverse in CT and DT domains respectively.
3. Analyse CT and DT signals and systems in frequency domain domains using Fourier Series and Transforms.
4. Solve differential and difference equations and to realize CT and DT systems.

COURSE CONTENTS	
MODULE I	BASIS OF SIGNALS & SYSTEMS (CT AND DT DOMAIN)
	Definition of Signal, Signal classification, Signal manipulations, Periodicity in CT (Continuous Time) & DT(Discrete Time) domain, Concept of a system, System representations & classification, Concept of LTI system and Impulse Response, Convolution in CT domain, Linear and Circular Convolution in DT domain, BIBO stability.
MODULE II	FOURIER SERIES & FOURIER TRANSFORM (CTFS, CTFT, DTFS & DTFT)
	Concept, properties and uses, Transforms and inverse, Amplitude & phase spectra, Energy Spectral Density, Power Spectral Density. Frequency response, Magnitude and Phase response.
MODULE III	LAPLACE TRANSFORMS

	Definition & properties of Two-sided & one-sided Laplace Transform, Region of Convergence (ROC), System transfer function, Relationship with Fourier Transform & mapping.
MODULE IV	**Z TRANSFORM**
	Definition & properties of Two-sided & one-sided Z Transform, Region of Convergence (ROC), Relationship with Fourier and Laplace Transform, & mapping, Inverse Z Transform. Transfer Function.
MODULE V	**INTRODUCTION TO CT SYSTEMS**
	System Transfer function & Impulse response, Differential Equations, Solutions to Differential Equations, Zero state & Zero input responses.
MODULE VI	**INTRODUCTION TO DT SYSTEMS**
	System Transfer function & Impulse response, FIR & IIR systems, Difference equation, Solution of a difference equation, zero input & zero state response, System realization: Direct forms, Cascade & parallel forms.

TEXT BOOKS

1. "Signals and Systems" S. Haykin, Wiley Eastern Publication.
2. "Signals and Systems", H P Hsu and R. Ranjan, Tata McGrew Hill Education Private Ltd.

REFERENCE BOOKS

1. "Discrete- Signals and Systems", A V Oppenheim and A S Willsky with S H Nawab, Prentice Hall of India.
2. "Analog and Digital Signal Processing",Ambardar, Thomson Learning, second edition.
3. "Discrete- Time Signal Processing", A V Oppenheim and Schafer with Buck, Prentice Hall of India.
4. "Digital Signal Processing: Principles, Algorithms and applications", J G. Proakis, D G. Manolakis, Prentice Hall of India.

	B. TECH. IN ELECTRICAL ENGINEERING	**SECOND YEAR SEM- IV**				
COURSE CODE	**R5HS2402O**	**CREDITS ASSIGNED**				
		THEORY	**TUTORIAL**	**LAB**	**TOTAL HRS**	**TOTAL CREDITS**
		2	**-**	**-**	**2**	**2**
COURSE TITLE	**UNIVERSAL HUMAN VALUES**	**EVALUATION SCHEME**				
		ISCE		**ESE**	**TOTAL MARKS**	
		60		**40**	**100**	

Prerequisite:

7. Fundamentals of ethical laws
8. Family rule and regulation
9. Fundamental difference between I and Body
10. Fundamental of family life cycle and their coordination

COURSE OBJECTIVES

1. To help the student see the need to develop a holistic perspective of life.
2. To help sensitize the student about the scope of life – individual, family (interpersonal relationship),
   society and nature.
3. To strengthen self-reflection
4. To develop more confidence and commitment to understand, learn and act accordingly

COURSE OUTCOMES

Students shall be able to:

1. Analyze the significance of value inputs provided in formal education along with skills and develop a broader perspective about life and education.
2. Formulate their aspirations and concerns at different levels of living, and the way to fulfill them them in a sustainable manner.
3. Evaluate their current state of understanding and living, and model a healthy lifestyle.
4. Examine the issues of homesickness, interactions with seniors on the campus, peer pressure with better understanding and feeling grateful towards parents, teachers and others.
5. Develop more confidence and commitment to value-based living in family, society and nature.

COURSE CONTENTS	
MODULE I	**ASPIRATIONS, CONCERNS AND SELF-MANAGEMENT**
	Aspirations and concerns – Understanding basic human aspirations, fixing one's goals, and the need for a holistic perspective in form of Universal Human values Self management – self confidence, handling peer pressure, time management, anger, stress, personality development and self improvement which leads to harmony in the human being.
MODULE II	**UNDERSTANDING HEALTH**
	Understanding Health – Health issues, healthy diet, healthy lifestyle which shall lead to Harmony of the self and body in forms of mental and physical health.
MODULE III	**RELATIONSHIPS**
	Relationships – Learning to handle home sickness, gratitude towards parents, teachers and others, understanding impact of ragging and interaction, competition and cooperation to achieve harmony in relationships.
MODULE IV	**SOCEITY**
	Participation in society, participation in nature leading to harmony in the society and nature/existence, Role of education in developing holistic perspective.

TEXT BOOKS

1. Brooks, D. (2016). *The road to character.* Random House Trade Paperback edition. New York, Random House.
2. Haidt, Jonathan. *The Happiness Hypothesis: Finding Modern Truth in Ancient Wisdom.* New York, Basic Books, 2006.

REFERENCE BOOKS

1. Seligman, M. E. P. (2011). *Flourish: A visionary new understanding of happiness and well-being.* Free Press.
2. Xiv, D. L., & Cutler, H. C. (1999). *The art of happiness*. Hodder Paperback.