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

of

Four Year Undergraduate Programme Leading to

Bachelor of Technology (B. Tech.) Degree

in

Electrical Engineering

Implemented from the batch admitted in Academic Year 2014 - 15

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

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In

103 B Tech (Electrical Engineering)

B. Tech. Electrical Engineering

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.

SEMESTER III

Scheme of Instruction				Scheme of Evaluation				
S. No	**Course code**	**Course Title**	**L-T-P (Hours / week)**	**Credits**	**TA**	**IST**	**ESE**	**ESE hours**
1	MA2003S	Mathematics for Electrical Engineers- I	3-1-0=4	4	10	30	60	3
2	EE2001S	Network Analysis and Circuit Theory	3-1-0=4	4	10	30	60	3
3	CE2012S	Environmental Studies	3-0-0=3	3	10	30	60	3
4	EE2002T	Electronics Devices & Circuits-I	3-0-0=3	3	10	30	60	3
	EE2002P	Electronics Devices & Circuits-I Lab	0-0-2=2	1	100 % CIE			
5	EE2003T	Electrical Machines – I	3-0-0=3	3	10	30	60	3
	EE2003P	Electrical Machines Lab – I	0-0-2=2	1	100 % CIE			
6	EE2004T	Numerical Methods	3-0-0=3	3	10	30	60	3
	EE2004P	Numerical Methods Lab	0-0-2=2	1	100 % CIE			
7	EE2005A	Economics for Engineers	3	3 Units	100 % CIE			
		Total	**29**	**23**				

SEMESTER IV

Scheme of Instruction				Scheme of Evaluation				
S. No	**Course code**	**Course Title**	**L-T-P (Hours / week)**	**Credits**	**TA**	**IST**	**ESE**	**ESE hours**
1	MA2013S	Mathematics for Electrical Engineers-II	3-1-0=4	4	10	30	60	3
2	EE2011S	Introduction to Power Systems	3-1-0=4	4	10	30	60	3
3	EE2012S	Signals and Systems	3-1-0=4	4	10	30	60	3
4	EE2013T	Network Synthesis	3-0-0=3	3	10	30	60	3
	EE2013P	Network Synthesis Lab	0-0-3=3	1.5	100 % CIE			
5	EE2014T	Electrical Machines – II	3-0-0=3	3	10	30	60	3
	EE2014P	Electrical Machines Lab – II	0-0-3=3	1.5	100 % CIE			
6	EE2015T	Electronics Devices & Circuits-II	3-0-0=3	3	10	30	60	3
	EE2015P	Electronics Devices & Circuits-II Lab	0-0-2=2	1	100 % CIE			
7	HM2001L	Presentation and Communication Skills	1-0-2=3	2	100 % CIE			
		Total	**32**	**27**				

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **IST**: In Semester Tests (comprise of average of two in semester tests), **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation.

Programme Name	**B. Tech (Electrical Engineering), SEMESTER - III**
Course Code	MA2003S
Course Title	**MATHEMATICS FOR ELECTRICAL ENGINEERING - I**

COURSE OUTCOMES

- Able to identify and determine analytic functions, and also know various transformations.
- Able to evaluate the line integral of a function of a function of complex variable and apply the Cauchy's integral formula.
- Compute the Taylor and Laurent's series expansions of functions of complex variables and use residues to calculate complex integrals.
- Compute forward and inverse Laplace transforms of various functions and also know the properties of the Laplace transform.
- Apply the Laplace transform to solve ordinary differential equations in one dependent variable.
- Explain Fourier series and use it to represent periodic functions. Also, summarize Fourier transforms.

COURSE CONTENTS

Module I	**Complex Variables I**
	1.1 Function of Complex variable. Analytic function, Necessary and sufficient conditions for f(Z) to be analytic. Cauchy-Riemann equations in polar coordinates. 1.2 Milne-Thomson method to determine analytic function f(Z) when its real or imaginary part or its combination is given. 1.3 Harmonic function, orthogonal trajectories. Transformations 1.4 Conformal mapping and standard transformations such as Rotation, Magnification and inversion. 1.5 Bilinear Transformation and Mapping under bilinear Transformation with geometrical interpretation. Cross ratio and fixed points.

Module II	**Complex Variables II**
	2.1. Line integral of a function of Complex variable, Properties of line integral, Cauchy's theorem for analytic function. Cauchy's Goursat theorem (without proof), Cauchy's integral formula and deductions. 2.2 Series of Complex Term: Taylor's and Laurent's Series (without proof), Singularities and poles, Residues, Residue Theorem and its evaluation. 2.3 Application of Residue to evaluate real Function.
Module III	**Laplace Transforms I**
	3.1. Functions of bounded variation 3.2 Linear property of Laplace transforms. 3.3 Laplace transforms of standard functions such as; 1, t^n, e^{at}, $\sin at$, $\cos at$, $\sinh at$, $\mathrm{erf}(t)$. 3.4 Change of scale property ,First shifting theorem, Second shifting theorem $L\{t^n f(t)\}$, $L\{f'(t)\}$, $L\{f(t)/t\}$, $L\{\int_0^t f(u)du$, , $L\{\frac{d^n}{dt^n}f(t)\}$,
Module IV	**Laplace Transform II**
	4.1. Inverse Laplace transform using linear property, theorems, partial fractions and convolution theorem. 4.2. Unit step functions, Heaviside, Dirac delta functions, Periodic functions and their Laplace transforms. 4.3. Application to solve ordinary differential equations with one dependent variable.
Module V	**Fourier Series**
	5.1 Orthogonal, Orthonormal sets, Expressions of a Function in Series of Orthogonal Functions. 5.2 Dirchlet's conditions. 5.3 Fourier series of periodic function with period 2π, 2l. 5.4 Dirchlet's theorem, even and odd functions. 5.5 Half range expansions, Parseval's relations. 5.6 Complex form of Fourier series. 5.7 Fourier integral and Fourier transform.
Text Books:	
1.	Advanced Engineering Mathematics, H K Dass, S Chand & Co. Ltd, 3rd Edition, 2006
2	Higher Engineering Mathematics, Dr B S Grewal, Khanna Publications, 39th

	Edition, 2005
3	A Text Book of Engineering Mathematics, N.P. Bali & Dr. Manish Goyal, Eight Edition, Laxmi Pubilcation.
4	Complex Variables & Applications: Churchil, Mc Graw Hill, 2003, 7^{th} Edition
Reference Books:	
1	Theory of functions of complex variables, Shanti Narayan, S Chand & Co, 2006.
2	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Ltd
3	Engineering Mathematics for semester III, T Veerrajan, Tata McGraw Hill.
4	Matrices , A R Vasishtha , 2005
5	Advanced Engineering Mathematics, Jain & Iyengar, II Edition, Narosa Publication
6	Engineering Mathematics, Srimanta Pal & Subodh C.Bhunia, OXFORD University Press, First Published in 2015.

Programme Name	**B. Tech (Electrical Engineering), SEMESTER – III**
Course Code	EE2001S
Course Title	**NETWORK ANALYSIS AND CIRCUIT THEORY**

COURSE OUTCOMES

- Use techniques of nodal and mesh analysis to solve circuits with dependent sources.
- Apply network theorems to solve ac and dc circuits.
- Apply graph theory for network analysis.
- Compute transient response of R-L , R-C and R-L-C networks in time domain.
- Solve networks using Laplace transform.
- Compute network functions for one and two port networks.

COURSE CONTENTS

Module I	**Network Theorems**
	1.1 Solution of network using dependent sources, mesh analysis, super mesh analysis, nodal analysis, super node analysis, source transformation and source shifting, superposition theorem, Thevenin's theorems and Norton's theorem, maximum power transfer theorem. Solution of network with A.C. sources, magnetic coupling, mesh analysis, nodal analysis, superposition theorem, Thevenin's theorems, Norton's theorem, maximum power transfer theorem, Tellegen's theorem, Millman's theorem, reciprocity theorem. 1.2 Three Phase systems. Star and delta connections, phasor diagram for balanced and unbalanced load. Measurement and Calculation of power in three phase systems, different connections, calculation of neutral shift and problems based on it.
Module II	**Graph Theory and Network Topology**
	Introduction, graph of network, tree, co-tree, loop incidence matrix, cut set matrix, tie set matrix and loop current, number of possible tree of a graph, analysis of network equilibrium equation, duality.
Module III	**First Order and Second Order Differential Equations**
	Initial condition of networks, General and partial solutions, time constant, integrating factor, geometrical interpretation of derivative. Transient response of R-L ,R-C and R-L-C networks in time domain.

Module IV	**Laplace Transform**
	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 waveform, shifted step, ramp and impulse function, waveform synthesis. Solution of networks by using Laplace transform.
Module V	**Network Functions**
	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 behaviour from pole - zero plot.
Text Books:	
1.	W H Hayt, S M Durbin, J E Kemmerly, _Engineering Circuit Analysis‘, 7th Edition Tata McGraw-Hill Education.
2	M. E. Van Valkenburg, _Network Analysis‘, 3rd Edition, PHI Learning.
3	D. Roy Choudhury, _Networks and Systems‘, 2nd Edition, New Age International.
4	M. E. Van Valkenburg, _Linear Circuits‘, Prentice Hall.
Reference Books:	
1	F. F. Kuo,‘ Network Analysis and synthesis‘, John Wiley and sons.
2	N Balabanian and T.A. Bickart, _Linear Network Theory: Analysis, Properties, Design and Synthesis‘, Matrix Publishers, Inc.
3	C. L.Wadhwa, _Network Analysis and synthesis‘, New Age international.
4	B. Somanathan Nair, —Network Analysis and Synthesis‖, Elsevier Publications

Programme Name	**B. Tech (Electrical Engineering), SEMESTER – III**
Course Code	CE2012S
Course Title	**ENVIRONMENTAL STUDIES**

COURSE OUTCOMES

Demonstrate understanding of the definition, scope and importance of environmental studies.

- Demonstrate knowledge of various kinds of natural resources and their associated problems, ecosystems, and the importance of biodiversity.
- Demonstrate knowledge of different kinds of environmental pollution and how they can be controlled and also various other threats to the environment and how they can be mitigated.
- Perform field work by documenting local environmental assets, visiting nearby polluted sites and studying local ecosystems.

COURSE CONTENTS

Module I	**Multidisciplinary Nature of Environmental Studies**
	Definition, Scope and Importance, Need for Public awareness
Module II	**Natural Resources**
	Renewable and Non-renewable Resources, Natural resources and associated problems. a. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. b. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, Case studies. e. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.
Module III	**Ecosystems**
	Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem

	b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)
Module IV	**Biodiversity and its Conservation**
	Introduction, definition: genetic, species and ecosystem diversity. Bio-geographical classification of India. ***Value of biodiversity***: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at Global, National and Local levels. India as a mega-diversity nation. Hot-spots of biodiversity. ***Threats to biodiversity***: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. ***Conservation of biodiversity***: in-situ and ex-situ conservation of biodiversity.
Module V	**Environmental Pollution**
	Definition, Causes, effects and control measures of ; a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. ***Solid waste management***: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. ***Disaster management***: Foods, earthquake, cyclone and landslides.
Module VI	**Social Issues and Environment**
	Unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. ***Environmental ethics***: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.
Module VII	**Human Population and Environment**
	Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. Case Studies.

Module VIII	**Field Work**
	Visit to a local area to document environmental assets—river/forest/grassland/hill/ mountain. Visit to a local polluted site—Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.
Text Books:	
1	Soli J Arceivala and Shyam R. Asolekar, Environmental Studies A Practitioner‘s Approach, Tata McGraw Hill Education Private Limited, New Delhi, First Edition, 2012.
2	R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press, USA, Second Edition, 2011.
3	Benny Joseph, Environmental Studies, McGraw Hill Education (India) Private, Second Edition, 2008
Reference Books:	
1	Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., Environmental Encyclopedia, Jaico Publ. House, Mumbai, 2001
2	Jadhav, H & Bhosale, V.M., Environmental Protection and Laws. Himalaya Pub. House, Delhi, 1995
3	Wanger K.D., Environmental Management. W.B. Saunders Co. Philadelphia, USA, 1998

Programme Name	**B. Tech (Electrical Engineering), SEMESTER – III**
Course Code	EE2002T
Course Title	**ELECTRONIC DEVICES AND CIRCUITS - I**

COURSE OUTCOMES

- Describe the operation of a diode and demonstrate understanding of different types of diodes, along with various diode circuits.
- Design biasing circuits for transistors and perform their small signal analysis, deriving characteristics like gain and impedance.

COURSE CONTENTS

Module I	**Diodes**
	Construction Principle of operation, characteristics and application of p-n junction and special diodes i.e. Zener, LED, Schottky, Photo-diode etc. Half and full wave rectifier, filter analysis C, LC, CLC & RC filter. Ripple factor and voltage regulation. Clipping and clamping circuits, specification of the devices.
Module II	**Bipolar Junction Transistors**
	2.1 PNP and NPN transistors. 2.2 Biasing Circuits: Types, dc circuit analysis, load line, thermal runway, stability factor Q analysis, thermal stabilization and compensation, operation, input and output characteristics. 2.3 Modeling: Small signal analysis of CE, CB, CC configurations with different biasing network using h-parameter model and high frequency models. 2.4 Amplification. Derivation of expression for voltage gain, current gain, input impedance and output impedance of CC, CB, CE amplifiers, Study of frequency response of BJT amplifier.
Module III	**Field Effect Transistors: JFET and MOSFET**
	Types, construction and their characteristics, Biasing circuits for FET amplifiers, FET small signal analysis, derivation of expressions for voltage gain and output impedance of CS amplifiers.
Text Books:	
1.	Robert Boylestad and Louis Nashelsky, Electronic Devices and Circuits, Prentice-Hall of India.
2	Millman and Halkias, *Electronic Devices and Circuits*', Tata McGraw-Hill.
3	David Bell, *Electronic Devices and Circuits*, Oxford University Press
Reference Books:	
1	Thomas Floyd, *Electronic Devices'*, Prentice-Hall of India
2	Neamen D. A., *Electronic Circuit Analysis and Design*, McGraw Hill International.
3	S. Salivahanan, N. Suresh Kumar, –*Electronic Devices and Circuits" TMH*.

Programme Name	**B. Tech (Electrical Engineering), SEMESTER – III**
Course Code	EE2002P
Course Title	**ELECTRONICS DEVICES AND CIRCUITS - I LAB**

LIST OF EXPERIMENTS

1. To study forward and reverse characteristics of PN junction diode.
2. To study forward and reverse characteristics of Zener diode.
3. To study Zener diode as voltage regulator.
4. To study static and dynamic characteristics of BJT
5. BJT bias circuit – Design, assemble and test.
6. JEET/MOSFET bias circuits – Design, assemble and test.
7. Design, assemble and test of BJT common-emitter circuit – D.C and A.C performance: Voltage gain, input impedance and output impedance with bypassed and un-bypassed emitter resistor.
8. Design, assemble and test of BJT emitter-follower – D.C and A.C performance: A.C. voltage gain, input impedance and output impedance.
9. Design, assemble and Test of JFET/MOSFET common-source and common-drain amplifiers – D.C and A.C performance: Voltage gain, input impedance and output impedance.

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – III**
Course Code	EE2003T
Course Title	**ELECTRICAL MACHINES – I**

COURSE OUTCOME

- Demonstrate understanding of transformers and electromagnetic energy conversion principles
- Describe construction and working of various rotating electrical machines.
- Demonstrate understanding of various parts of a DC machine and their speed control.

Module I	**Transformer**
	1.1 Transformer principle of operation and Construction Ideal Two-Winding Transformer, Transformer phasor diagram at various load conditions, Equivalent Circuit of a Transformer, The per Unit System & Rating of Transformers 1.2 Open-Circuit And Short-Circuit Tests, Voltage Regulation of a Transformer, Transformer Losses and Efficiency, hysteresis and eddy current losses, Testing of Transformers, Autotransformers, Parallel Operation of Single-Phase Transformers, on load and no load tap changer 1.3 Three phase transformer connections, Vector groups.
Module II	**Electromechanical Energy Conversion Principles**
	Principle of Energy Conversion, Single and doubly Excited Magnetic System, Electromagnetic and Reluctance torques.
Module III	**Basic Concepts of Rotating Electrical Machines**
	3.1 Constructional Features of Rotating Electrical Machines (Direct current machine, Poly phase induction machines, Synchronous machines). 3.2 Concepts of General Terms Pertaining to Rotating Machines. 3.3 Generated EMF‘s, in (full pitched coil, short pitched coil, Ac machines, dc machines) and torque equations. 3.4 E.M.F‘s Polygon, Distribution (Breadth) Factor, Pitch (Coil-Span) Factor, Elimination of Harmonics from Alternator, E.M.F Waveforms. 3.5 Rotating Magnetic field, Choice of power of electrical machines and

	applications.
Module IV	**D.C. Machines**
	4.1 Significance of commutator and brushes in DC machine, Armature reaction, Methods to minimize the effect of armature reaction, Process of commutation, Methods to improve commutation. Testing methods of d c machines., relation between electrical load and mechanical torque. 4.2 Series, Shunt, Compound Generators, characteristics for various loads. 4.3 Torque speed characteristics and speed control of DC Motors
Text Books:	
1.	Electrical Machinery, Performance and applications, Bimbhra P.S., Khanna Publisher, 1995, Fifth Edition
2	Electric Machines, D. P. Kothari and I. J. Nagrath , Tata McGraw Hills
Reference Books:	
1	Electrical Machines, TMH Publication, A. E. Fitzgerald & C. Kingsley, 3rd edition.
2	A.C. Machines , M.G. Say

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – III**
Course Code	EE2003P
Course Title	**ELECTRICAL MACHINES LAB – I**

Module I	**Laboratory introduction**
	Introduction to electrical machines, laboratory equipment, measuring system, power supplies, protective devices, etc.
Module II	**Transformer**
	No load and short-circuit test, Polarity Test , Parallel Operation , Load Test , Sumpner Test
Module III	**D.C Machines**
	No Load Test, Speed control, Swimburn Test

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – III**
Course Code	EE2004T
Course Title	**NUMERICAL METHODS**

COURSE OUTCOMES

- Describe how finite precision affects the accuracy of numerical methods.
- Demonstrate understanding and implementation of various numerical methods for finding roots of equations.
- Apply techniques of solution of linear algebraic equations to obtain currents and voltages in circuits.
- Apply numerical methods of integration and solution of ordinary differential equations to electric circuits.

COURSE CONTENTS

Module I	**Modeling and Error Analysis**
	A simple mathematical model , Conservation Laws and Engineering Approximations and Round-off errors, Truncation errors
Module II	**Roots of equation**
	Bracketing Methods- The Bisection Method, The False-Position method. Open Methods-Simple Fixed –Point Iteration, The Newton-Raphson method, The secant method, Brent‘s Method, Multiple Roots, Application for the design of electrical circuits.
Module III	**Linear Algebraic Equations**
	Naïve Gauss Elimination, Gauss – Jordan, LU Decomposition, Gauss-Seidal Solution of currents and voltages in Resistor circuits.
Module IV	**Curve Fitting**
	Linear Regression ,Interpolation with Newton‘s divided- difference interpolating polynomials, Lagrange interpolating polynomials, Coefficients of interpolating polynomials, Inverse interpolation, curve fitting with sinusoidal functions.
Module V	**Integration and Ordinary Differential Equation**
	Trapezoidal Method , Simpson‘s Rules Predictor –corrector methods, Euler‘s Method, Runge-Kutta methods, Milne‘s method, Adams-Bashforth method. Simulating transient current for an electric circuit.

Text Books:	
1	Chapra Seven C, Canale R P, Numerical Methods for Engineers, Tata McGraw Hill.
2	Schilling, Robert J. Numerical Methods for Engineers (using MATLAB and C). Thomson Asia Pvt. Ltd.
Reference Books:	
1	M.K. Jain, Numerical Methods for Scientific & Engineering Computation
2	S. Rajasekaran , Numerical Methods in Science and Engineering

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – III**
Course Code	EE2004P
Course Title	**NUMERICAL METHODS LAB**

LIST OF EXPERIMENTS

1. Introduction to MATLAB
2. Simple Equation Solution and Number System Conversion
3. To find solution of equations using Newton-Raphson method.
4. To find solution of equations using Secant Method
5. To find solution of equations using Bisection Method
6. Solution of Linear Algebraic Equations by Gauss – Jordan, LU Decomposition, Gauss-Seidal Method.
7. Curve fitting solutions using different methods
8. Integration and ODE solutions using different methods

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – III**
Course Code	EE2005A
Course Title	**ECONOMICS FOR ENGINEERS**

COURSE OUTCOMES

- Demonstrate understanding of basic principles of economics, such as demand and supply.
- Demonstrate understanding of banking, financial markets and fiscal policy tools, cost control and budgets.
- Ability to describe the post-independence Indian economy.

COURSE CONTENTS

Module I	Basic Principles and Methodology of Economics. Demand/Supply – elasticity –Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes
Module II	Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve.
Module III	Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Budgets, Break even Analysis, Capital Budgeting. Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money. Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.
Module IV	Indian economy Brief overview of post independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment– Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.
Text Books :	
1	Mankiw Gregory N.(2002), Principles of Economics, Thompson Asia
2	V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGraw Hill
3	Misra, S.K. and Puri (2009), Indian Economy, Himalaya
4	Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publisher

Programme Name	**B. Tech. (Electronics Engineering), SEMESTER – IV**
Course Code	EE2012S
Course Title	**SIGNALS AND SYSTEMS**

COURSE OUTCOMES

After completion of this course, students should be able to

- Differentiate between CT and DT signals and their properties.
- Differentiate between and describe discrete and continuous time Fourier series and transforms.
- Describe Laplace and Z-transforms and their properties.
- Describe in detail CT and DT systems. Also, summarize the different types of DT systems and their structures.
- To analyze DT systems in time domain.

COURSE CONTENTS

Module I	**Introduction to 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 Impulse Response, Convolution in CT and DT domain
Module II	**Fourier Series & Fourier Transform (CTFS, CTFT, DTFS & DTFT)**
	Concept, properties and uses, Amplitude & phase spectra, Energy Spectral Density, Power Spectral Density
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, Zero state & zero input responses
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

Module V	**Introduction to CT Systems**
	System Transfer function & Impulse response, Differential Equations
Module VI	**Introduction to DT Systems**
	Difference equation, FIR & IIR systems, System transfer function, System realization: Direct forms, Cascade & parallel forms, Linear and circular Convolution, BIBO stability.
Module VII	**Time Domain Analysis of DT Systems**
	System Transfer function & Impulse response, Difference equation, Solution of a difference equation, zero input & zero state response calculations
Text Books:	
1.	S. Haykin, Signals and Systems , Wiley Eastern Publication
2.	J.G. Proakis, D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and applications, Prentice Hall of India.
3.	Ashok Ambardar, Analog and Digital Signal Processing, Thomson Learning, second edition
4.	Oppenheim and Schafer with Buck, Discrete- Time Signal Processing, Prentice Hall of India

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – IV**
Course Code	MA2013S
Course Title	**MATHEMATICS FOR ELECTRICAL ENGINEERS - II**

COURSE OUTCOMES

- Ability to compute Eigen values, Eigen vectors and rank of a square matrix and apply linear transformations to quadratic forms.
- Differentiate between scalar and vector point functions and compute curl and divergence.
- Define Stoke's and Green's theorem.
- Solve Bessel's and Legendre's equations.
- Summarize Z-transform and its properties and apply them in the solution of difference equations.

COURSE CONTENTS

Module I	**Matrices**
	1.1. Eigen values Eigen vectors of square matrix. 1.2. Cayley Hamilton's theorem and function of square matrix. 1.3. Similarity Matrices, Modal Matrix 1.4. Function of Square a Matrix, Minimal Polynomial and Minimal Equation of a Matrix, Derogatory and Non-Derogatory Matrices. 1.5. Quadratic forms : Linear Transformation , Linear Transformation of Quadratic forms , Congruence of a square Matrix 1.6. Reduction to Canonical form under Congruent and Orthogonal Transformation of Quadratic form, rank, index, signature and class value of Quadratic form.
Module II	**Vector Calculus and Analysis**
	2.1. Scalar and vector point functions, Directional derivative, Curl and Divergence, Conservative, Irrotational and Solenoid field. 2.2. Line integral, Green's theorem for plane regions and Properties of Line integral. 2.3. Stoke's theorem, Gauss's divergence theorem (without proof) related identities and deductions.
Module III	**Bessel Functions**
	3.1. Bessel's Equation**, Solution's of Bessel's function,** Bessel's Function of $J_n(x)$. 3.2. Recurrence formula $J_n(x)$, Equation Reducible to Bessel's equation 3.3. Orthogonality of Bessel's functions, A Generating function for $J_n(x)$, 3.4. Trigonometric Expansion involving Bessel's functions, 3.5. Bessel's Integral, Legendre's Equation, Legendre's Polynomial, General solution of Legendre's Equation, Rodrigue's Formula, A Generating function of Legendre polynomial, Orthogonality of Legendre polynomial. 3.6. Recurrence formula for $p_n(x)$.
Module IV	**Z Transform**

	4.1. Z-Transform, Properties of z-transform, Theorem, change of Scale, Shifting property. 4.2. Inverse Z-Transform solution of Difference Equation, Multiplication by k, Division by k, Initial value, Final value, Partial sum. 4.3. Convolution, Convolution property of Casual Sequence, Transform Important Sequence. 4.4. Inverse of Z-transform by Division, By Binomial Expansion and partial fraction, Partial fraction. 4.5. Inversion by residue method, Solution of Difference Equation.
Text Books:	
1	Advanced Engineering Mathematics. H. K. Dass S. Chand & Co. Ltd- 3rd Edition
2	Advanced Engineering Mathematics. Erwin Kreyszig, 9 th edition
3	A Text Book of Engineering Mathematics. N.P. Bali & Dr. Manish Goyal, Laxmi Publication, Eight Edition
Reference Books:	
1	Higher Engineering Mathematics, B. V. Ramana, McGraw Hill Education Publication, Delhi
2	Engineering Mathematics- T. Veerarrajan Tata McGraw-Hill- IInd Edition
3	Engineering Mathematics, Babu Ram, Pearson , 1 st Edition.
4	Engineering Mathematics, Srimanta Pal & Subodh C.Bhunia, OXFORD University Press.

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – IV**
Course Code	EE2011S
Course Title	**INTRODUCTION TO POWER SYSTEMS**

COURSE OUTDCOMES

- Summarize transmission line parameters, viz. resistance, inductance and capacitance.
- Describe short, medium and long line models of transmission line.
- Describe overhead transmission lines and underground cables.

COURSE CONTENTS

Module I	**Basic Structure of Power System**
	Conventional and non conventional sources, Type of Generation, variable load on Power Stations, Load curve and Load Duration Curve.
Module II	**Transmission Line Parameters**
	2.1 **Resistance:** Resistance, skin effect and proximity effect 2.2 **Inductance:** Definition of inductance, inductance of single phase two wire line, conductor types, and bundled conductors. Inductance of composite conductor, single circuit three phase line, double circuit three phase line 2.3 **Capacitance:** Potential difference between two conductors of a group of parallel conductors, capacitance of a two wire line, three phase line with equilateral spacing, earth effect on transmission line capacitance, bundled conductors
Module III	**Performance of Transmission Line**
	3.1 **Representation of power system components:** Single phase solution of balanced three phase networks. One line diagram, impedance and reactance diagram. Per unit (p.u.) system, per unit impedance diagram, representation of loads 3.2 **Transmission line model:** Short, medium, and long line model. Equivalent circuit of a long line. Ferranti effect Surge impedance loading, power flow through transmission lines
Module IV	**Overhead Transmission Lines**
	4.1 **Mechanical design of transmission line:** Components of overhead lines, cross arms, conductor configuration, spacing and clearance span lengths, sag and tension (Numerical compulsory)

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – IV**
Course Code	EE2013T
Course Title	**NETWORK SYNTHESIS**

COURSE OUTCOMES

- Summarize the concept of frequency response.
- Compute two-port network parameters
- Computation of Fourier transform and writing state space representation
- Performing circuit synthesis using Foster and Cauer forms.

COURSE CONTENTS

Module I	**Introduction and Concept of Frequency Response**
	1.1. Mutual inductance, Energy considerations, the linear transformer, the ideal transformer 1.2. Complex frequency, Damped sinusoidal forcing function, Z(s) and Y(s), Frequency response as a function of sigma, The complex frequency plane, Natural response and the s-plane, A technique for synthesizing the voltage ratio, Parallel resonance and Series resonance.
Module II	**Two Port Networks Parameters**
	One port networks, Two port networks, Admittance parameters, Impedance parameters, Hybrid parameters, Transmission parameters.
Module III	**Fourier Transforms and State Variable Techniques**
	3.1 Definition of Fourier transform, Properties of Fourier transform, Unit impulse function, Fourier transform of general periodic time function, Formulation and circuit response in time domain, System function and response in frequency domain, Physical significance of system function 3.2 State variables and normal form equations, Writing a set of normal form equations, The use of matrix notation, Solution of first-order equation, Solution of matrix equation
Module IV	**Fundamentals of Synthesis and Filter Design**
	Concept of stability, Hurwitz polynomials, Properties and testing of positive real functions, Driving point synthesis of LC, RC, RL network. Circuit synthesis using Foster and Cauer forms for RL, RC, RLC and LC circuits. Introduction to

	filters, first and second order filters, Butterworth and Chebyshev Approximations and introduction to filter design.
Text Books:	
1	W H Hayt, S M Durbin, J E Kemmerly, _Engineering Circuit Analysis‘, 7th Edition Tata McGraw-Hill Education.
2	M. E. Van Valkenburg, _Network Analysis‘, 3rd Edition, PHI Learning.
3	D. Roy Choudhury, _Networks and Systems‘, 2nd Edition, New Age International.
4	M. E. Van Valkenburg, _Linear Circuits‘, Prentice Hall.
Reference Books:	
1	F. F. Kuo,‘ Network Analysis and synthesis‘, John Wiley and sons
2	N Balabanian and T.A. Bickart, _Linear Network Theory: Analysis, Properties, Design and Synthesis‘, Matrix Publishers, Inc.
3	C. L.Wadhwa, _Network Analysis and synthesis‘, New Age international.
4	B. Somanathan Nair, ―Network Analysis and Synthesis‖, Elsevier Publications

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – IV**
Course Code	EE2013P
Course Title	**NETWORK SYNTHESIS LAB**

COURSE CONTENTS

Module I	**Laboratory Introduction**
	Course introduction, Introduction to power supplies, laboratory equipment, measuring instruments, active and passive components, Study of simple circuits and their response.
Module II	**Software Introduction**
	Introduction to modelling of circuits using Pspice, MATLAB, Simulation of simple circuits, few complex circuits for home work.
Module III	**DC Analysis**
	DC analysis of electric circuits, behaviour of R, L, and C under DC excitation at Steady-State.
Module IV	**Time Domain Analysis**
	Step response of simple RL and RC circuits, Response of RL and RC circuits with other excitation.
Module V	**RLC Circuit Dynamics**
	Complete response of the RLC circuit, Study of over-damped, critically damped and under-damped series and parallel RLC circuits.
Module VI	**Circuit Analysis**
	Superposition, Source transformations and Thevenin‘s theorem. Nodal, mesh and loop analysis.
Module VII	**Transient Analysis**
	Transient analysis of complex circuits with different excitations.
Module VIII	**Frequency Domain Analysis**
	Response to sinusoidal excitation, Phasors and their relationships with R, L and C parameters.
Module IX	**Frequency Response Analysis**
	Frequency response of the RLC circuit, Magnitude and phase plots, Concept of resonance, Impedance and admittance functions.
Module X	**Analysis of Power System Network**
	Concept of complex power, power factor control, introduction to three phase system.
Module XI	**Simulation of Circuits**
	Concepts and methods behind circuit simulation, simulation of simple circuits using Matlab/C++.

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – IV**
Course Code	EE2014T
Course Title	**ELECTRICAL MACHINES - II**

COURSE OUTCOMES

- Describe in detail the operation and characteristics of synchronous motor and generator.
- Describe in detail the operation and characteristics of three-phase and single-phase induction motor.

Module I	**Synchronous Machines**
	Polyphase Synchronous Machines Excitation Systems, Flux and m. m. f. Phasors Synchronous Machines, Cylindrical rotor, Salient-pole machines. **Synchronous generator** • Phasor Diagram Of synchronous machines, the open circuit, short circuit, ZPF characteristics and potier triangle. • Voltage Regulation Of An Alternator: The EMF method or synchronous impedance method, The MMF method, ZPF method • Operating Characteristics of Alternators and their Ratings, External load characteristics, Alternator compounding characteristics. • Power Flow through an Inductive Impedance, Maximum power conditions, Reactive power, Circle Diagrams of Synchronous Machines, • Power Factor Control of Synchronous Machines. • Synchronizing, Parallel operations of two alternators, Synchronous Machine on Infinite Bus **Synchronous motor** • Two-Reaction Theory of Salient-Pole Machines, Power-Angle Characteristics. • Synchronous Machine Stability, Synchronizing Power And Synchronizing Torque , Hunting And Damper Windings

Module II	3 **Phase Induction Motor**
	2.1 Polyphase Induction Motors, Induction Motor as a Transformer, Flux And m.m.f. Phasors In Induction Motors, rotor Frequency, e.m.f. , Current, Power, Phasor diagram, Losses & Efficiency, Equivalent Circuit, Torque-slip characteristics. 2.2 Performance Characteristics Of Induction Motors, Induction motor stability, Circle Diagram, Power Factor Control 2.3 Starting and speed control of Polyphase Induction Motors, Double cage rotor 2.4 Applications of Induction Machines. 2.5 dqo transformation
Module III	**Single Phase Induction Motor**
	Double revolving field theory. Different types, starting methods, characteristics and applications.
Text Books:	
1	Electrical Machinery, Performance and Applications, Khanna Publisher, Bimbhra P. S., Fifth Edition
2	Electrical Machines, D. P. Kothari and I. J. Nagrath, Tata McGraw Hills
Reference Books :	
1	Electrical Machines, TMH Publication, A. E. Fitzgerald & C. Kingsley, 3rd edition
2	A.C. Machines , M. G. Say

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – IV**
Course Code	EE2014P
Course Title	**ELECTRICAL MACHINES LAB - II**

LIST OF EXPERIMENTS

1. O.C.C. / S.C.C. / Z.P.F.C. on synchronous machine.
2. Synchronization of alternator with infinite bus & _V‘ curves of synchronous motor.
3. Slip test on synchronous machine.
4. _V‘ curves of synchronous induction motor.
5. Load test on synchronous Machine.
6. No load & blocked rotor test on 3-ph induction motor.
7. Load test on 3-ph induction motor. 8. Speed control of 3-ph induction motor.
8. No load & blocked rotor test on 1- phase Induction Motor.
9. Parallel operation of two alternators

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – IV**
Course Code	EE2015T
Course Title	**ELECTRONICS DEVICES AND CIRCUIT - II**

COURSE OUTCOMES

- Describe the effect of positive and negative feedback in circuits.
- Design power amplifier circuits with the given specifications.
- Describe the operation of various oscillator circuits.

COURSE CONTENTS

Module I	**Feedback Amplifier**
	1.1 Introduction to positive and negative feedback, negative feedback -current, voltage, Series and Shunt type. Effect on input impedance, output impedance, voltage gain, current gain and bandwidth. 1.2 **Cascade amplifiers:** Types of coupling, effect of coupling on performance of BJT and JFET amplifiers, cascade connection, Darlington-pair, Miller effect capacitance and boot strapping.
Module II	**Power Amplifiers**
	2.1 Introduction definitions and amplifier of various types: class A, B, C and D amplifiers 2.2 Design circuits and operation.
Module III	**Oscillators**
	Positive feedback oscillators, frequency of oscillation and condition for sustained oscillations of a) RC phase shift, b) Wien bridge, c) Hartley/ Colpitts with derivations, crystal Oscillator.
Text Books:	
1	Donald A. Naeman, Electronic Circuit Analysis and Design, Second Edition, McGraw Hill International Edition 2001.
2	Martin Roden, Gordon Carpenter, William Wieserman, Electronic Design, Fourth edition, Shroff Publishers,2002.

Reference Books	
1	Donald Schilling and Charles Belove, Electronic Circuits Discrete and Integrated, Third edition, McGraw Hill International Edition, 1989
2	Adel Sedra and, Kenneth Smith, Microelectronic Circuits, Fourth edition, Oxford University Press, 1998.

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – IV**
Course Code	EE2015P
Course Title	**ELECTRONICS DEVICES AND CIRCUIT – II LAB**

LIST OF EXPERIMENTS

1. Various experiments on Frequency response and performance parameters of single stage and at least two stage BJT/MOSFET amplifiers.
2. Various experiments on power amplifiers of different types.
3. Voltage and current series and shunt feedback using BJT/ FET. It‘s effect on frequency response.
4. Experiments on amplifiers tending towards oscillators because of feedback.
5. Experiments on Various oscillator configurations.

Programme Name	**B. Tech. (Electrical Engineering), SEMESTER – IV**
Course Code	HM2001L
Course Title	**PRESENTATION AND COMMUNICATION SKILLS**

COURSE OUTCOMES

- Develop ability to carry out business communication.
- Develop professional grooming and etiquette and learn cross-cultural communication.
- Develop ability to use technical vocabulary and avoid common errors in communication.
- Learn nuances of communication such as intonation and modulation, and gain confidence in public speaking.

COURSE CONTENTS

Module I	Basics of Business Communication a. Concept and meaning of communication b. Verbal and non-verbal communication **c.** barriers to the process of communication d. Channels of communication e. Role of communication in the age of information technology
Module II	Professional grooming and etiquette; cross-cultural communication
Module III	Grammar, vocabulary and summarization techniques a. Common errors b. Use of articles, prepositions, subject - verb agreement c. Punctuation and capitalization d. Technical vocabulary: business idioms, phrasal verbs e. Summarization
Module IV	Speaking a. Intonation b. Modulation c. Basics of public speaking d. Gaining confidence

Module V	Presentation Skills a. Public speaking b. Oral presentation c. Graphic presentation
Module VI	Career Oriented Communication a. Resume, Language and format of job application b. Job Interviews i. Purpose and process ii. How to prepare for interviews iii. Language and style to be used in interview iv. Types of interview questions and how to answer them c. Group Discussion: structure, dynamics and techniques of effective participation
Module VII	Technical Writing a. Technical writing process b. Style and organization in technical writing c. objectivity, clarity, precision as defining features of technical communication d. Language and format of various types of business letters, reports; proposals, e-mails, minutes of meeting, research paper
Module VIII	Language Laboratory a. Listening and comprehension skills b. Reading Skills c. Sound Structure of English d. Intonation patterns
Text Books:	
1	Business Communication by Hory Shankar Mukharjee, OUP
2	Effective Technical Communication by Asharaf Rizvi, The McGraw Hill
3	Business Communication by Meenakshi Raman, Prakash Singh, OUP
Reference Books:	
1	Basic Managerial Skills for All by E.H. McGrath, PHI Learning Pvt Ltd
2	Professional Ethics by R. Subramanian, OUP
3	https://learnenglish.britishcouncil.org/en/english-grammar