

SHRI VENKATESHWARA UNIVERSITY



Syllabus B.TECH Electrical Engineering IV SEMESTER (Four Years Degree Programme) Batch 2019-23

(w.e.f. 2019-20)

**SCHOOL OF ENGINEERING &
TECHNOLOGY**

**Electrical Engineering
SEMESTER- IV**

Sl No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	SEE- 401	Power Electronics	3	0	0	20	10	30		70		100	3
	SEE- 402	Electrical Machines – II	3	0	0	20	10	30		70		100	3
3	SEE-403	Digital Electronics	3	0	0	20	10	30		70		100	3
4	SEE-404	Electromagnetic Fields	3	1	0	20	10	30		70		100	4
5	SEE-405	Electrical Circuit Analysis	3	1	0	20	10	30		70		100	4
6	SEE- 406	Signals and Systems	2	1	0	20	10	30		70		100	3
7	SEE-411	Power Electronics Lab	0	0	2				25		25	50	1
8	SEE-412	Electrical Machines – II Lab	0	0	2				25		25	50	1
9	SEE-413	Digital Electronics Lab	0	0	2				25		25	50	1
10	SNM-101	Environmental Science	3	0	0	20	10	30		70			0
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	Environmental Science - Noncredit Mandatory courses												

SEE-404	Electromagnetic Fields	3L:1T:0P	4 credits
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Course Outcomes:

At the end of the course, students will demonstrate the ability

- To understand the basic laws of electromagnetism.
- To obtain the electric and magnetic fields for simple configurations under static conditions.
- To analyse time varying electric and magnetic fields.
- To understand Maxwell's equation in different forms and different media.
- To understand the propagation of EM waves.

This course shall have Lectures and Tutorials. Most of the students find difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.

Module 1: Review of Vector Calculus (6 hours)

Vector algebra- addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus- differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Module 2: Static Electric Field (6 Hours)

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Module 3: Conductors, Dielectrics and Capacitance (6 Hours)

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Module 4: Static Magnetic Fields (6 Hours)

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Module 5: Magnetic Forces, Materials and Inductance (6 Hours)

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Module 6: Time Varying Fields and Maxwell's Equations (6 Hours)

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Module 7: Electromagnetic Waves (6 Hours)

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Text / References:

1. M. N. O. Sadiku, “Elements of Electromagnetics”, Oxford University Publication, 2014.
 2. A. Pramanik, “Electromagnetism - Theory and applications”, PHI Learning Pvt. Ltd, New Delhi, 2009.
 3. A. Pramanik, “Electromagnetism-Problems with solution”, Prentice Hall India, 2012.
 4. G. W. Carter, “The electromagnetic field in its engineering aspects”, Longmans, 1954.
 5. W. J. Duffin, “Electricity and Magnetism”, McGraw Hill Publication, 1980.
 6. W. J. Duffin, “ Advanced Electricity and Magnetism”, McGraw Hill, 1968.
 7. E. G. Cullwick, “The Fundamentals of Electromagnetism” , Cambridge University Press, 1966.
 8. B. D. Popovic, “Introductory Engineering Electromagnetics”, Addison-Wesley Educational Publishers, International Edition, 1971.
 9. W. Hayt, “Engineering Electromagnetics”, McGraw Hill Education, 2012.
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SEE-405	Electrical Circuit Analysis	3L:1T:0P	4 credits
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Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
- Analyse two port circuit behavior.

Module 1: Network Theorems (10 Hours)

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

Module 2: Solution of First and Second order networks (8 Hours)

Solution of first and second order differential equations for Series and parallel R-L, R-C, R- L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Module 3: Sinusoidal steady state analysis (8 Hours)

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Module 4: Electrical Circuit Analysis Using Laplace Transforms (8 Hours)

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

Module 5: Two Port Network and Network Functions (6 Hours)

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Text /References:

2. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
3. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
4. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
5. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
6. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

SEE-403	Digital Electronics	3L:0T:0P	3 credits
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Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.
- Understand the process of Analog to Digital conversion and Digital to Analog conversion.
- Be able to use PLDs to implement the given logical problem.

Module 1: Fundamentals of Digital Systems and logic families (7Hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri- state logic.

Module 2: Combinational Digital Circuits (7Hours)

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractions, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3: Sequential circuits and systems(7Hours)

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D-types flipflops, application of flipflops, shift registers, application of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Module 4: A/D and D/A Converters (7Hours)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

Module 5: Semiconductor memories and Programmable logic devices. (7Hours) Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDs), Field Programmable Gate Array (FPGA).

Text/References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

BEE-412: Digital Electronics Laboratory (0:0:2 – 1 credit)

SEE-402	Electrical Machines – II	3L:0T:0P	3 credits
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Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the concepts of rotating magnetic fields.
- Understand the operation of ac machines.
- Analyse performance characteristics of ac machines.

Module 1: Fundamentals of AC machine windings (8 Hours)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor

Module 2: Pulsating and revolving magnetic fields (4 Hours)

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current

Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Module 3: Induction Machines (12 Hours)

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

Module 4: Single-phase induction motors (6 Hours)

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

Module 5: Synchronous machines (10 Hours)

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Text/References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

Electrical Machines Laboratory– II (0:0:2 – 1 credit)

SEE-401	Power Electronics	3L:0T:0P	3 credits
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Course Outcomes:

At the end of this course students will demonstrate the ability to

- Understand the differences between signal level and power level devices.
- Analyse controlled rectifier circuits.
- Analyse the operation of DC-DC choppers.
- Analyse the operation of voltage source inverters.

Module 1: Power switching devices (8Hours)

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module 2: Thyristor rectifiers (7Hours)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Module 3: DC-DC buck converter (5Hours)

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Module 4: DC-DC boost converter (5Hours)

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module 5: Single-phase voltage source inverter (10Hours)

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Module 6: Three-phase voltage source inverter (8Hours)

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Text/References:

1. M. H. Rashid, “ *Power electronics: circuits, devices, and applications*”, Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, “*Power Electronics: Converters, Applications and Design*”, John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, “ *Fundamentals of Power Electronics* ”, Springer Science & Business Media, 2007.
4. L. Umanand, “*Power Electronics: Essentials and Applications*”, Wiley India, 2009.

Power Electronics Laboratory (0:0:2 – 1 credit)

BEE-406	Signals and Systems	2L:1T:0P	3 credits
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Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the concepts of continuous time and discrete time systems.
- Analyse systems in complex frequency domain.
- Understand sampling theorem and its implications.

Module 1: Introduction to Signals and Systems (3 hours):

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Module 2: Behavior of continuous and discrete-time LTI systems (8 hours)

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Module 3: Fourier, Laplace and z- Transforms (10 hours)

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Module 4: Sampling and Reconstruction (4 hours)

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text/References:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.
 2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
 3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
 4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
 5. A. V. Oppenheim and R. W. Schaffer, "Discrete-Time Signal Processing", Prentice Hall, 2009.
 6. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
 7. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.
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