


SIDDHARTHA INSTITUTE OF ENGINEERING & TECHNOLOGY

Vinobha Nagar, Ibrahimpatnam, Ranga Reddy District – 501506
(Approved by AICTE, Affiliated to JNTUH, Accredited to NBA & NAAC)



**B.Tech. in ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE STRUCTURE & SYLLABUS**

Applicable from AY 2025-26 Batch

I Year I Semester (25 Hours)

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA101BS	Matrices and Calculus	3	1	0	4
2	PH102BS	Advanced Engineering Physics	3	0	0	3
3	CS103ES	Programming for Problem Solving	3	0	0	3
4	EE104ES	Electrical Circuits – I	2	0	0	2
5	ME105ES	Engineering Drawing and Computer Aided Drafting	2	0	2	3
6	EN106HS	English for Skill Enhancement	3	0	0	3
7	PH107BS	Applied Physics Laboratory	0	0	2	1
8	CS108ES	Programming for Problem Solving Lab	0	0	2	1
9	EN109HS	English Language and Communication Skills Lab	0	0	2	1
		Induction Program				
		Total Credits	16	1	8	21

I Year II Semester (25 Hours)

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA201BS	Ordinary Differential Equations and Vector Calculus	3	0	0	3
2	CH202BS	Engineering Chemistry	3	0	0	3
3	CS203ES	Python Programming	3	0	0	3
4	CS204ES	Data Structures	3	0	0	3
5	EE205ES	Electrical Circuits - II	3	0	0	3
6	CH206BS	Engineering Chemistry Lab	0	0	2	1
7	CS207ES	Python Programming Lab	0	0	2	1
8	CS208ES	Data Structures Lab	0	0	2	1
9	EE209ES	Electrical Circuits Lab	0	0	2	1
10	ME210ES	Engineering Workshop	0	0	2	1
		Total Credits	15	0	10	20

II YEAR I SEMESTER (25 Hours)

S. No.	Course Code	Course Title	L	T	P	Credits
1	EE301PC	Electro Magnetic Fields	3	0	0	3
2	EE302PC	Electrical Machines-I	3	0	0	3
3	EC303PC	Electronic Devices and Circuits	3	0	0	3
4	EE304PC	Power System-I	3	0	0	3
5	EE305PC	Electrical Measurements and Sensors	2	0	0	2
6	MS306HS	Innovation and Entrepreneurship	2	0	0	2
7	EE307PC	Electrical Machines - I Lab	0	0	2	1
8	EE308PC	Electrical Measurements and Sensors Lab	0	0	2	1
9	EC309PC	Electronic Devices and Circuits Lab	0	0	2	1
10	EE310SD	Design of Electrical Systems Using AutoCAD	0	0	2	1
11	VA300ES	Environmental Science	1	0	0	1
		Total Credits	17	0	8	21

II YEAR II SEMESTER (25 Hours)

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA401BS	Numerical Methods and Complex variables	3	0	0	3
2	EE402PC	Electrical Machines–II	3	0	0	3
3	EE403PC	Power System-II	3	0	0	3
4	EC404PC	Digital Electronics	3	0	0	3
5	EE405PC	Control Systems	3	0	0	3
6	MA406PC	Computational Mathematics Lab	0	0	2	1
7	EE407PC	Electrical Machines - II Lab	0	0	2	1
8	EE408PC	Control Systems Lab	0	0	2	1
9	EC409PC	Digital Electronics Lab	0	0	2	1
10	EC410SD	PCB Design	0	0	2	1
		Total Credits	15	0	10	20

ELECTRICAL CIRCUIT – I**B.Tech. I Year I Sem.**

L	T	P	C
2	0	0	2

Prerequisites: Mathematics**Course Objectives:**

- To gain knowledge in circuits and to understand the fundamentals of derived circuit laws.
- To learn steady state and transient analysis of single phase and three-phase circuits.
- To understand Theorems and concepts of magnetic coupled circuits.

Course Outcomes: After successful completion of the course, the student will be able to:

- Apply knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits.
- Solve the complex AC& DC electric circuits by applying suitable principles and theorems.
- Examine balanced and unbalanced three-phase systems and determine power in star and delta connected loads.
- Apply network theorems for the analysis of complex electrical circuits
- Examine the behavior of magnetically coupled circuits and their applications in electrical engineering.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To gain knowledge in circuits and to understand the fundamentals of derived Circuit laws.	3	2	2	1	1	-	-	1	-	-	-	1
To learn steady state analysis of single-phase and three- phase circuits.	3	2	1	1	1	-	-	1	-	-	-	1
To understand Theorems and concepts of magnetic coupled circuits.	3	1	1	1	1	-	-	1	-	-	-	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Apply knowledge of mathematics, science, and engineering to the analysis and design of electrical Circuits.	3	2	2	1	1	-	-	1	-	-	-	1
Solve the complex AC& DC electric circuits by applying suitable principles and theorems.	3	3	2	2	1	-	-	1	-	-	-	1
Examine balanced and unbalanced three-phase systems and determine power in star and delta connected loads.	3	2	2	2	1	-	-	1	-	-	-	1
Apply network theorems for the analysis of complex electrical circuits	3	3	2	2	1	-	-	1	-	-	-	1
Examine the behavior of magnetically coupled circuits and their applications in electrical engineering.	3	2	2	2	1	-	-	1	-	-	-	1

UNIT-I:

Network Elements & Laws: Active elements- Independent and dependent sources, Passive elements- R, L and C, Energy stored in Inductance and Capacitance, Kirchhoff's laws, Source transformation, Star-Delta transformation, Node voltage method, and Mesh current method.

UNIT-II:

Single-Phase Circuits: RMS and average values of periodic sinusoidal and non-sinusoidal waveforms, Phasor representation, j-Notation, Steady-state analysis of series, parallel circuits. Impedance, Admittance, Active and

Reactive Powers, Complex Power.

Resonance: Series and parallel circuits, Bandwidth and Q-factor.

UNIT-III:

Three-Phase Circuits: Analysis of balanced and unbalanced three-phase circuits, Star and delta connections, Measurement of three-phase power for balanced and unbalanced loads.

UNIT-IV:

Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorems, Maximum power transfer Theorem, Tellegen's theorem, Compensation theorem, Milliman's theorem and Reciprocity theorem.(AC & DC).

UNIT-V:

Coupled circuits: Concept of self and mutual inductance, Dot convention, Coefficient of coupling, Analysis of circuits with mutual inductance.

TEXTBOOKS:

1. Van Valkenburg M.E, "Network Analysis", Prentice Hall of India, 3rd Edition, 2000.
2. Ravish R Singh, "Network Analysis and Synthesis", McGrawHill, 2nd Edition, 2019.

REFERENCE BOOKS:

1. B. Subramanyam, "Electric Circuit Analysis", Dreamtech Press & Wiley, 2021.
2. James W.Nilsson, Susan A.Riedel, "Electric Circuits", Pearson, 11th Edition, 2020.
3. A Sudhakar, Shyammohan S Palli, "Circuits and Networks: Analysis and Synthesis", McGrawHill, 5th Edition, 2017.
4. Jagan N.C, Lakshrninarayana C., "Network Analysis", B.S. Publications, 3rd Edition, 2014.
5. William Hayt H, Kimmerly Jack E. and Steven Durbin M, "Engineering Circuit Analysis", McGrawHill, 6th Edition, 2002.
6. Chakravarthy A., "Circuit Theory", Dhanpat Rai & Co., First Edition, 1999.

Online Recourses:

1. <https://nptel.ac.in/courses/108/104/108104139/>
2. <https://nptel.ac.in/courses/108/106/108106172/>

ELECTRICAL CIRCUITS – II**B.Tech. I Year II Sem.****L T P C**
3 0 0 3**Prerequisites:** Matrices and Calculus and Electrical Circuits-I**Course Objectives:**

- To study the transient and steady state analysis of RL, RC and RLC circuits (Series and Parallel)
- To understand the applications of Laplace transform.
- To learn about two-port networks and concept of filters.

Course Outcomes: After successful completion of the course, the student will be able to:

- Observe the response of transient and steady state analysis of RL, RC and RLC circuits (Series and Parallel).
- Examine the behavior of circuits using Laplace transforms.
- Obtain network topology methods (tie-set, cut-set, incidence matrices) for circuit analysis.
- Evaluate two-port network parameters and their interconnections.
- Design and classify filters using Constant-k and M-derived techniques.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study the transient and steady state analysis of RL, RC and RLC circuits (Series and Parallel)	3	2	2	3	2	-	-	1	-	-	-	1
To understand the applications of Laplace transform.	3	2	2	2	2	-	-	1	-	-	-	1
To learn about two-port networks and concept of Filters.	3	2	2	3	2	-	-	1	-	-	-	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Observe the response of Transient and steady state analysis of RL, RC and RLC circuits (Series and Parallel).	3	2	2	3	2	-	-	1	-	-	-	1
Examine the behavior of Circuits using Laplace transforms	3	2	2	2	2	-	-	1	-	-	-	1
Obtain network topology methods (tie-set, cut-set, incidence matrices) for circuit analysis.	3	2	3	2	1	-	-	1	-	-	-	2
Evaluate two-port network parameters and their interconnections.	3	2	3	2	2	-	-	1	-	-	-	2
Design and classify filters using Constant-k and M-derived techniques.	2	2	3	2	2	-	-	1	-	-	-	2

UNIT-I:**Transient analysis:** Significance of Initial conditions of R, L and C elements,

Transient response of series RL, RC and RLC circuits using integral-differential approach for DC and Sinusoidal excitations. Transient response of parallel RL, RC and RLC circuits using integral-differential approach for DC and Sinusoidal excitations.

UNIT-II:**Electrical circuit Analysis using Laplace Transforms:**

Laplace Transforms of step, ramp, exponential, impulse functions (inputs)

Transient response of series RL, RC and RLC circuits using Laplace Transforms approach for DC and Sinusoidal excitations. Transient response of parallel RL, RC and RLC circuits using Laplace Transforms approach for DC and Sinusoidal excitations.

UNIT-III:**Network Topology**

Graph, tree, chord, Tie-set, cut-set, incident matrices, Problems on Tie-set and cut-set matrices.

UNIT-IV:

Two port network parameters: Open circuit impedance, short-circuit admittance, Transmission, Hybrid parameters & inter-relationships, Series, parallel and cascade connection of two port networks.

UNIT-V:

Filters: Classification of filters – Low pass, High pass, Band pass and Band Elimination, Elementary treatment of Constant-k and M- derived filters-Low pass and High pass Filters, Band pass and Band elimination filters.

TEXTBOOKS:

1. Van Valkenburg M.E, "Network Analysis", Prentice Hall of India, 3rd Edition, 2000.
2. Ravish R Singh, "Network Analysis and Synthesis", McGrawHill, 2nd Edition, 2019.

REFERENCE BOOKS:

1. B. Subramanyam, "Electric Circuit Analysis", Dreamtech Press & Wiley, 2021.
2. James W. Nilsson, Susan A. Riedel, "Electric Circuits", Pearson, 11th Edition, 2020.
3. A Sudhakar, Shyammoohan S Palli, "Circuits and Networks: Analysis and Synthesis", McGrawHill, 5th Edition, 2017.
4. Jagan N.C, Lakshminarayana C., "Network Analysis", B.S. Publications, 3rd Edition, 2014.
5. William Hayt H, Kimmerly Jack E. and Steven Durbin M, "Engineering Circuit Analysis", McGrawHill, 6th Edition, 2002.
6. Chakravarthy A., "Circuit Theory", Dhanpat Rai & Co., First Edition, 1999.

Online Recourses:

1. <https://nptel.ac.in/courses/108/104/108104139/>
2. <https://nptel.ac.in/courses/108/106/108106172/>
3. <https://www.digimat.in/nptel/courses/video/108105159/L01.html>
4. <https://www.digimat.in/nptel/courses/video/108102042/L01.htm>

ELECTRICAL CIRCUITS LABORATORY**B.Tech. I Year II Sem.**

L	T	P	C
0	0	2	1

Prerequisites: Electrical Circuits-I**Course Objectives:**

- To design electrical systems and analyze them by applying various Network Theorems
- To measure three phase Active and Reactive power.
- To understand the concept of resonance.

Course Outcomes: After successful completion of the course, the student will be able to:

- Analyze complex DC and AC linear circuits
- Apply concepts of electrical circuits across engineering
- Evaluate response of a given network by using theorems.
- Determine two-port parameters and three-phase power in balanced loads.
- Perform frequency domain analysis of filters.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To design electrical systems and analyze them by applying various Network Theorems	3	2	2	3	3	-	-	1	2	2	2	1
To measure three phase Active and Reactive power	3	2	2	2	3	-	-	1	2	2	2	1
To understand the concept of resonance.	3	2	2	3	3	-	-	1	2	2	2	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Analyze complex DC and AC linear circuits.	3	2	2	3	3	-	-	1	2	2	2	1
Apply concepts of electrical circuits across engineering	3	2	2	2	3	-	-	1	2	2	2	1
Evaluate response of a given network by using theorems.	3	2	2	3	3	-	-	1	2	2	2	1
Determine two-port parameters and three-phase power in balanced loads.	3	2	3	2	2	-	-	1	2	2	2	2
Perform frequency domain analysis of filters.	2	2	3	2	3	-	-	1	2	2	2	2

The following experiments are required to be conducted as compulsory

1. Verification of Series and Parallel Resonance using any circuit simulation software (LTSpiceetc...).
2. Determination of Time response of first order RL and RC circuit for periodic non sinusoidal inputs –Time Constant and Steady-state error using any circuit simulation soft ware (LT Spice etc...).
3. Determination of Two port network parameters–Z, Y, Transmission and Hybrid parameters.
4. Measurement of 3-phase power in Balanced Star connected load using Two-Wattmeter method.
5. Determination of Co-efficient of coupling, self and mutual inductance in magnetic Coupled Circuits.
6. Frequency domain analysis of Low-pass filter and High-pass filters using circuit simulation software (LT Spice etc...).
7. Verification of Superposition and Maximum Power Transfer theorems using any circuit simulation software (LT Spice etc...).
8. Verification of Thevenin's and Norton's theorems using any circuit simulation soft ware (LT Spice etc...).

In addition to the above eight experiments, at least any two of the experiments from the following list are required to be conducted

1. Measurement of Active Power for Delta connected balanced loads.
2. Measurement of Reactive Power for Star and Delta connected balanced loads.
3. Frequency domain analysis of Band-pass filters.
4. Frequency domain analysis of Band-stop filters
5. Determination of Time response of first order RL, RC circuit for periodic non—sinusoidal inputs —Time Constant and Steady state error.
6. Verification of Compensation theorem.

TEXTBOOKS:

1. Van Valken burg M.E, “Network Analysis”, Prentice Hall of India, 3rd Edition, 2000.
2. Ravish R Singh, “Network Analysis and Synthesis”, Mc Graw Hill, 2nd Edition, 2019.

REFERENCE BOOKS:

1. B. Subramanyam, “Electric Circuit Analysis”, Dream tech Press & Wiley, 2021.
2. James W.Nilsson, Susan A. Riedel, “Electric Circuits”, Pearson, 11th Edition, 2020.
3. A Sudhakar, Shyammohan S Palli, “Circuits and Networks: Analysis and Synthesis”, Mc Graw Hill, 5th Edition, 2017.
4. Jagan N.C, Lakshrninarayana C., “Network Analysis”, B.S. Publications, 3rd Edition, 2014.
5. William Hayt H, Kimmerly Jack E. and Steven Durbin M, “Engineering Circuit Analysis”, McGrawHill, 6th Edition, 2002.
6. Chakravarthy A., “Circuit Theory”, Dhanpat Rai & Co., First Edition, 1999.

Online Recourses:

1. <https://nptel.ac.in/courses/108/104/108104139/>
2. <https://nptel.ac.in/courses/108/106/108106172/>
3. <https://ocw.mit.edu/search/ocwsearch.htm?q=laboratory>

ELECTROMAGNETIC FIELDS**B.Tech. II Year I Sem.****L T P C**
3 0 0 3**Prerequisites:** Mathematics & Physics**Course Objectives:**

- To introduce the concepts of electric field and magnetic field.
- To know Applications of electric and magnetic fields in the development of the theory for power transmission lines and electrical machines.
- To study about electromagnetic waves.

Course Outcomes: After successful completion of the course, the student will be able to:

- Understand the basic laws of electromagnetism and their applications.
- Analyze conductors, dielectrics, capacitance, and field equations.
- Analyze time varying electric and magnetic fields.
- Understand Maxwell's equation in different forms and different media.
- Understand the propagation of EM waves.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To introduce the concepts of electric field and magnetic field	3	3	2	1	2	-	-	-	-	-	-	2
To know Applications of electric and magnetic fields in the Development of the theory for power transmission lines and electrical machines.	3	3	1	2	2	-	-	-	-	-	-	2
To study about electromagnetic waves	3	3	1	1	2	-	-	-	-	-	-	2

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand the basic laws of electro magnetism and their applications	3	3	3	2	2	-	-	-	-	-	-	2
Analyze conductors, dielectrics, capacitance, and field equations.	3	3	3	2	1							2
Analyze time varying electric And magnetic fields.	3	3	3	1	2	-	-	-	-	-	-	2
Understand Maxwell's equation in different forms and different media	3	2	2	2	2							2
Understand the propagation of EM waves	3	2	2	1	1	-	-	-	-	-	-	2

UNIT-I:

Static Electric Field: Review of conversion of a vector from one coordinate system to another coordinate system, 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.

UNIT-II:

Conductors, Dielectrics and Capacitance: Current and current density, Ohms Law in Point form, Continuity equation, Boundary conditions of conductors and dielectric materials. Capacitance, Capacitance of a two-wire line, Poisson's equation, Laplace's equation.

UNIT-III:

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

Force on a moving charge, Force on a differential current element, Force between differential current elements, Magnetic boundary conditions, Magnetic circuits, Self-inductances and mutual inductances.

UNIT-IV:

Time Varying Fields and Maxwell's Equations: Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces.

UNIT-V:

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

TEXT BOOKS:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.

REFERENCE BOOKS:

1. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
2. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
3. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
4. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
5. E. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 1966.
6. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
7. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.

Online Recourses:

1. <https://nptel.ac.in/courses/108/106/108106073/>
2. <https://nptel.ac.in/courses/115/101/115101005/>
3. <https://nptel.ac.in/courses/108/106/108106023/>

ELECTRICAL MACHINES - I**B.Tech. II Year I Sem.**

L	T	P	C
3	0	0	3

Prerequisites: Electrical Circuits -I & II**Course Objectives:**

- To study and understand different types of DC machines and their performance evaluation through various testing methods.
- To understand the operation of single and Three-phase Transformers
- To analyze the performance of transformers through various testing methods.

Course Outcomes: After successful completion of the course, the student will be able to:

- Identify different parts of a DC machines & understand their operation.
- Carry out different excitation, starting, speed control methods and testing of DC machines.
- Understand the operation and performance of single-phase transformers.
- Analyze single-phase transformers and their performance through various testing methods.
- Analyze three phase transformers and their performance.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study and understand different types of DC Machines and their performance evaluation through various testing methods.	3	3	3	2	-	2	1	-	2	-	1	1
To understand the operation of single-phase and three- phase Transformers	3	3	3	2	-	2	1	-	2	-	1	1
To analyse the performance of transformers through various Testing methods	3	3	3	2	-	2	1	-	2	-	1	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Identify different parts of a DC machines & understand their operation	3	3	3	2	-	2	1	-	2	-	1	2
Carry out different excitation, starting, speed control methods and testing of DC machines	3	3	3	2	-	2	1	-	2	-	1	2
Understand the operation and performance of single-phase transformers.	3	3	3	2	-	2	1	-	2	-	1	2
Analyze single-phase transformers and their performance through various testing methods.	3	2	3	2	-	2	2	-	2	-	1	1
Analyze three phase transformers and their performance.	3	2	3	2	-	2	1	-	2	-	1	2

UNIT-I:

D.C. Generators: Principle of operation – Action of commutator – constructional features – armature windings – lap and wave windings – simplex and multiplex windings (elementary treatment only) – E. M.F Equation. Concept of Armature reaction and commutation – Cross magnetizing and de-magnetizing AT/pole.

Methods of Excitation – separately excited and self-excited generators – build-up of E.M.F - critical field resistance and critical speed. Performance Characteristics of shunt, series and compound generators and applications.

UNIT-II:

D.C Motors: Principle of operation – Back E.M.F. - Torque equation – characteristics and application of shunt, series and compound motors.

3-point starter, Speed control of DC shunt and series motors- Armature voltage and field flux control methods. Losses – Constant & Variable losses–calculation of efficiency– condition for maximum efficiency.

Testing Of DC Machines: Methods of testing – direct, indirect, and regenerative testing – Brake test – Swinburne's test – Hopkinson's test.

UNIT-III:

Single Phase Transformers: Types – constructional details- minimization of hysteresis and eddy current losses- EMF equation - operation on no-load and on load - phasor diagrams and Applications.

UNIT-IV:

Equivalent circuit - losses and efficiency – regulation - All day efficiency - effect of variations of frequency & supply voltage on iron losses.

Testing of Transformers: Open Circuit and Short Circuit tests- Sumpner's Test- pre determination of efficiency and regulation-separation of losses test.

UNIT-V:

Parallel operation with equal and unequal voltage ratios - auto transformers-equivalent circuit - comparison with two winding transformers.

Poly-phase transformers – Poly-phase connections - Y/Y, Y/ Δ , Δ /Y, Δ / Δ and open Δ , Scott connection and Applications.

TEXT BOOKS:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

REFERENCE BOOKS:

1. Prithwiraj Purkait, Indrayudh Bandyopadhyay, "Electrical Machines", Oxford, 2017.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
4. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

Online Recourses:

1. <https://nptel.ac.in/courses/108/105/108105155/>
2. <https://nptel.ac.in/courses/108/105/108105017/>
3. <https://nptel.ac.in/courses/108/106/108106071/>

POWER SYSTEM - I**B.Tech. II Year I Sem.**

L	T	P	C
3	0	0	3

Prerequisites: Electrical Circuits - I & II**Course Objectives:**

- To understand the power generation through conventional and non-conventional sources.
- To illustrate the economic aspects of power generation and tariff methods.
- To know about substations and distribution systems.

Course Outcomes: After successful completion of the course, the student will be able to:

- Understand the operation of conventional and renewable electrical power generating stations.
- Evaluate the power tariff methods and Economics associated with power generation.
- Analyze the operation and components of Air Insulated Substations (AIS).
- Understand the operation and components of Gas Insulated Substations (GIS).
- Analyze the structure and performance of distribution systems.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the power generation through conventional and non-conventional sources	3	3	3	2	-	2	1	-	2	-	1	1
To illustrate the economic aspects of power generation and Tariff methods	3	3	3	2	-	2	1	-	2	-	1	1
To know about substations and distribution systems	3	3	3	2	-	2	1	-	2	-	1	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand the operation of conventional and renewable electrical power generating stations	3	3	3	2	-	2	1	-	2	-	1	2
Evaluate the power tariff Methods and Economics associated with power generation	3	3	3	2	-	2	1	-	2	-	1	2
Analyze the operation and components of Air Insulated Substations (AIS).	3	3	3	2	-	2	1	-	2	-	1	2
Understand the operation and components of Gas Insulated Substations (GIS).	3	3	2	2	-	2	1	-	2	-	1	2
Analyze the structure and performance of distribution systems.	3	3	3	2	-	2	1	-	2	-	1	2

UNIT-I:**Generation of Electric Power:**

Operation of Hydel, Thermal, Nuclear and Gas Power plant with layouts – Description of components- Choice of Site-advantages and disadvantages, Introduction and description of components- renewable energy sources and Plants (solar and wind).

UNIT-II:

Economics of Power Generation: Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, Load curve, Load duration curve, number and size of generator units. Base load and peak load plants.

Cost of electrical energy-fixed cost, running cost, Tariffs.

UNIT-III:

Air Insulated Substations (AIS): Indoor & Outdoor substations: Substations layout showing the location of all the substation equipment. Bus bar arrangements in the Sub-Stations: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.

UNIT-IV:

Gas Insulated Substations (GIS): Advantages of Gas insulated substations, different types of gas insulated substations, single line diagram of gas insulated substations, bus bar, construction aspects of GIS, Installation and maintenance of GIS, Comparison of Air insulated substations and Gas insulated substations.

UNIT-V:

A.C. DISTRIBUTION: Introduction, AC distribution, Single phase, 3-phase 3 wire , 3 phase 4 wire system, bus bar arrangement, Selection of site for substation. Voltage Drop Calculations (Numerical Problems) in A.C. Distributors for the following cases: Power Factors referred to receiving end voltage and with respect to respective load voltages.

TEXT BOOKS:

1. C.L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", 2nd Edition, New Age International, 2009.
2. A.Chakrabarti, M.L. Soni, P.V. Gupta, U.S. Bhatnagar, "A Textbook on Power System Engineering", Dhanpat Rai Publishing Company (P) Ltd, 2008.
3. J.B.Gupta, "A Course in Power Systems" Katson Books, 11th Edition, 2016

REFERENCE BOOKS:

1. C.L. Wadhwa, "Electrical Power Systems", 5th Edition, New Age International, 2009.
2. M.V. Deshpande, "Elements of Electrical Power Station Design", 3rd Edition, Wheeler Pub. 1998.
3. H.Cotton & H. Barber, "The Transmission and Distribution of Electrical Energy", 3rd Edition, 1970.
4. W.D.Stevenson, "Elements of Power System Analysis", 4th Edition, McGraw Hill, 1984.
5. V. K. Mehta and Rohit Mehta, "Principles of Power Systems", S. Chand & Company Ltd, New Delhi, 2004.

Online Recourses:

1. <https://nptel.ac.in/courses/108/102/108102047/>
2. [https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-2\(TB\)\(ET\)\(\(EE\)NPTEL\).pdf](https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-2(TB)(ET)((EE)NPTEL).pdf)
3. https://onlinecourses.nptel.ac.in/noc20_ee67/preview

EE305PC: ELECTRICAL MEASUREMENTS AND SENSORS

B.Tech. II Year I Sem.

L	T	P	C
2	0	0	2

Prerequisites: Electrical Circuits I & II, Analog Electronics and Electro Magnetic Fields.**Course Objectives:**

- To introduce the basic principles of all measuring instruments.
- To deal with the measurement of voltage, current, Power factor, power, energy and magnetic measurements.
- To understand the basic concepts of smart and digital metering.

Course Outcomes: After successful completion of the course, the student will be able to:

- Understand different types of measuring instruments, their construction, operation and characteristics and identify the instruments suitable for typical measurements.
- Apply the knowledge about transducers and instrument transformers to use them effectively.
- Apply the knowledge of smart and digital metering for industrial applications.
- Apply DC and AC bridge techniques to measure resistance, inductance, capacitance, and loss angle, and analyze their sensitivity and applications.
- Analyze the principles, construction, and applications of various sensors and smart instruments, including intelligent transducers, MEMS, smart energy meters, and advanced metering systems.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To introduce the basic principles of all measuring instruments	3	3	2	2	2	-	-	-	1	-	-	1
To deal with the measurement of voltage, current, Power factor, power, energy and magnetic measurements.	3	3	2	2	2	-	-	-	1	-	-	1
To understand the basic concepts of smart and digital metering	3	3	2	2	2	-	-	-	1	-	-	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand different types of measuring instruments, their construction, operation and characteristics and identify the instruments suitable for typical measurements	3	3	2	2	2	-	-	-	1	-	-	1
Apply the knowledge about transducers and instrument transformers to use them effectively	3	3	2	2	2	-	-	-	1	-	-	1
Apply the Knowledge of Smart and digital metering for industrial applications	3	3	2	2	2	-	-	-	1	-	-	1
Apply DC and AC bridge techniques to measure resistance, inductance, capacitance, and loss angle, and analyze their sensitivity and applications.	3	3	2	3	2	-	-	-	1	-	-	2
Analyze the principles, construction, and applications of various sensors and smart instruments, including intelligent transducers, MEMS, smart energy meters, and advanced metering systems.	3	2	2	3	3	-	-	-	1	-	-	2

UNIT - I:

Introduction To Measuring Instruments: Classification – deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type instruments – expression for the deflecting torque and control torque – Errors and compensations, extension of range using shunts and series resistance. Electrostatic Voltmeters-electrometer type and attracted disc type, Extension range of electro static voltmeters.

UNIT-II:

Potentiometers & Instrument Transformers: Principle and operation of D.C. Crompton's potentiometer – standardization – Measurement of unknown resistance, current, voltage. A.C. Potentiometers: polar and coordinate type's standardization – applications. CT and PT – Ratio and phase angle errors (Qualitative approach).

UNIT-III:

Measurement Of Power & Energy: Single phase dynamometer wattmeter, LPF and UPF, Double element and three element dynamometer wattmeter, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems.

Single phase induction type energy meter – driving and braking torques – errors and compensations –testing by phantom loading using R.S.S. meter. Three phase energy meter – tri-vector meter, maximum demand meters (Qualitative approach).

UNIT-IV:

DC & AC Bridges: Method of measuring low, medium and high resistance – sensitivity of Wheat- stone's bridge – Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method.

Measurement of inductance- Maxwell's bridge, Hay's bridge, Anderson's bridge. Measurement of capacitance and loss angle –De sauty's Bridge - Wien's bridge – Schering Bridge (Qualitative approach).

UNIT-V:

Sensors: Classification of transducers, Temperature sensors- Proximity sensor- Pressure sensor- IR sensors- Motion detection sensors- Ultrasonic sensors- Rotor Position Sensors, Operation of Strain Gauge- Thermo couples, construction and working of LVDT, Piezo electric transducers, Photovoltaic, Photo conductive cells and photo diode-Applications.

Smart Instruments: Intelligent transducer, self-diagnosis and remote calibration features, HART communication, MEMS, non-linearity compensation; smart energy meter components, working principle; Automatic Meter Reading (AMR), Advanced Metering Infrastructure (AMI) environments.

TEXTBOOKS:

1. A. K. Sawhney, "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co. Publications, 2005.
2. Dr. Rajendra Prasad, "Electrical Measurements & Measuring Instruments", Khanna Publishers 1989.

REFERENCE BOOKS:

1. G. K. Banerjee, "Electrical and Electronic Measurements", PHI Learning Pvt. Ltd., 2nd Edition, 2016.
2. R. K. Rajput, "Electrical & Electronic Measurement & Instrumentation", S. Chand and Company Ltd., 2007.
3. S. C. Bhargava, "Electrical Measuring Instruments and Measurements", BS Publications, 2012.
4. Buckingham and Price, "Electrical Measurements", Prentice – Hall, 1988.
5. Reissland, M. U, "Electrical Measurements: Fundamentals, Concepts, Applications", New Age International (P) Limited Publishers, 1st Edition 2010.
6. E.W. Golding and F. C. Widdis, "Electrical Measurements and measuring Instruments", fifth Edition, Wheeler Publishing, 2011.

Online Recourses:

1. <https://nptel.ac.in/courses/108/105/108105153/>
2. https://www.cdac.in/index.aspx?id=pe_pe_PEG_SMARTENERGY

ELECTRICAL MACHINES LABORATORY – I

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Prerequisites: Electrical Machines- I**Course Objectives:**

- To uncover the students to the operation of DC Generators.
- To know the operation of various types of DC Motors.
- To examine the performance of Single and Three Phase Transformers.

Course Outcomes: After successful completion of the course, the student will be able to:

- Start and control the Different DC Machines.
- Assess the performance of different machines using different testing methods
- Evaluate the performance of different Transformers using different testing methods
- Analyze the effect of different connections (Star–Delta, Delta–Star, Delta–Delta, Star–Star) on transformer voltage and current relationships.
- Model and simulate the performance of DC machines and transformers using modern software tools to validate experimental results.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To uncover the students to the operation of DC Generators	3	3	3	2	-	2	1	-	2	-	1	1
To know the operation of various types of DC Motors.	3	3	3	2	-	2	1	-	2	-	1	1
To examine the performance of Single and Three Phase Transformers	3	3	3	2	-	2	1	-	2	-	1	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Start and control the Different DC Machines	3	3	3	2	-	2	1	-	2	-	1	1
Assess the performance of different machines using different testing methods	3	3	3	2	-	2	1	-	2	-	1	1
Evaluate the performance of different Transformers Using different testing methods	3	3	3	2	-	2	1	-	2	-	1	1
Analyze the effect of different connections (Star–Delta, Delta–Star, Delta–Delta, Star–Star) on transformer voltage and current relationships.	3	2	2	2	-	1	1	-	1	-	1	2
Model and simulate the performance of DC machines and transformers using modern software tools to validate experimental results.	3	2	3	3	-	1	1	-	2	-	1	2

The following experiments are required to be conducted compulsory experiments:

1. Magnetization characteristics of DC shunt generator (Determination of critical field resistance and critical speed)
2. Load test on DC shunt generator (Determination of characteristics)
3. Load test on DC series generator (Determination of characteristics)

4. Hopkinson's test on DC shunt machines (Predetermination of efficiency)
5. Swinburne's test and speed control of DC shunt motor (Predetermination of efficiencies)
6. Brake test on DC compound motor (Determination of performance curves)
7. OC and SC Test on Single Phase Transformer
8. Three Phase Transformer: Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star)

In addition to the above eight experiments, at least any two of the experiments from the following list are required to be conducted:

1. Brake test on DC shunt motor (Determination of performance curves)
2. Load test on DC compound generator (Determination of characteristics.
3. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
4. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation)
5. Retardation test on DC shunt motor (Determination of losses at rated speed)
6. Speed control of DC shunt motor
7. Modeling of DC Machine using simulation tools.
8. Equivalent circuit of Transformer using simulation tools.

TEXT BOOKS:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

REFERENCE BOOKS:

1. Prithwiraj Purkait, Indrayudh Bandyopadhyay, "Electrical Machines", Oxford, 2017.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
4. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

EE308PC: ELECTRICAL MEASUREMENTS AND SENSORS LAB**B.Tech. II Year I Sem.****L T P C**
0 0 2 1**Prerequisites:** Electrical Circuits-I & II**Course Objectives:**

- To calibrate Watt, Energy and PF Meter and determination of three phase active & reactive powers.
- To determine unknown inductance, resistance, capacitance by performing experiments on D.C Bridges & A. C Bridges.
- To determine the ratio and phase angle errors of Instrument transformers.

Course Outcomes: After successful completion of the course, the student will be able to:

- Choose and test any measuring instruments.
- Find the accuracy of any instrument by performing experiments.
- Calculate the various parameters using different types of measuring instruments.
- Analyze and measure reactive power, displacement, and strain using LVDT, strain gauges, and bridge techniques for practical applications.
- Demonstrate and interpret the operation of sensors and dielectric testing equipment, and verify performance through modern calibration and phantom testing techniques.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To calibrate Watt, Energy and PF Meter and determination of three phase active & Reactive powers.	3	3	2	2	2	-	-	-	1	-	-	1
To determine unknown inductance, resistance, capacitance by performing experiments on DC Bridges & AC Bridges.	3	3	2	2	2	-	-	-	1	-	-	1
To determine the ratio and phase angle Errors of Instrument transformers	3	3	2	2	2	-	-	-	1	-	-	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Choose and test any measuring instruments	3	3	2	2	2	-	-	-	1	-	-	1
Find the Accuracy of any instrument by performing experiments	3	3	2	2	2	-	-	-	1	-	-	1
Calculate the various parameters using different types of measuring instruments	3	3	2	2	2	-	-	-	1	-	-	1
Analyze and measure reactive power, displacement, and strain using LVDT, strain gauges, and bridge techniques for practical applications.	3	2	2	3	2	-	-	-	1	-	-	2
Demonstrate and interpret the operation of sensors and dielectric testing equipment, and verify performance through modern calibration and phantom testing techniques.	3	2	3	3	3	-	-	-	1	-	-	2

The following experiments are required to be conducted as compulsory experiments:

1. Calibration and Testing of single-phase energy Meter.
2. Calibration of dynamometer power factor meter.
3. Crompton D.C. Potentiometer – Calibration of PMMC ammeter and PMMC voltmeter.
4. Kelvin's double Bridge – Measurement of resistance – Determination of Tolerance.
5. Dielectric oil testing using H.T. testing Kit.
6. Schering Bridge & Anderson Bridge.
7. Measurement of 3 - Phase reactive power with single-phase wattmeter.
8. Measurement of displacement with the help of LVDT.

In addition to the above eight experiments, at least any two of the experiments from the following list are required to be conducted:

1. Calibration LPF wattmeter– by Phantom testing.
2. Measurement of 3-phase power with single watt meter and two CTs.
3. C.T. testing using mutual Inductor – Measurement of % ratio error and phase angle of given CT by Null method.
4. PT testing by comparison – V. G. as Null detector – Measurement of % ratio error and phase angle of the given PT
5. Resistance strain gauge – strain measurements and Calibration.
6. Transformer turns ratio measurement using AC bridges.
7. Measurement of % ratio error and phase angle of given CT by comparison.
8. Demonstration of different sensors using trainer kit

TEXT BOOKS:

1. A. K. Sawhney, "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co. Publications, 2005.
2. Dr. Rajendra Prasad, "Electrical Measurements & Measuring Instruments", Khanna Publishers 1989.

REFERENCE BOOKS:

1. G. K. Banerjee, "Electrical and Electronic Measurements", PHI Learning Pvt. Ltd., 2nd Edition, 2016.
2. R. K. Rajput, "Electrical & Electronic Measurement & Instrumentation", S. Chand and Company Ltd., 2007.
3. S. C. Bhargava, "Electrical Measuring Instruments and Measurements", BS Publications, 2012.
4. Buckingham and Price, "Electrical Measurements", Prentice – Hall, 1988.
5. Reissland, M. U, "Electrical Measurements: Fundamentals, Concepts, Applications", New Age International (P) Limited Publishers, 1st Edition 2010.
6. E.W. Golding and F. C. Widdis, "Electrical Measurements and measuring Instruments", fifth Edition, Wheeler Publishing, 2011.

EE310SD: DESIGN OF ELECTRICAL SYSTEMS USING AUTO CAD**B.Tech. II Year I Sem.**

L	T	P	C
0	0	2	1

Course Objectives:

- To provide hands-on training in using Auto CAD for electrical design and drafting.
- To understand the principles of preparing electrical wiring diagrams and panel layouts.
- To enable students to design residential, commercial, and industrial electrical systems.
- To introduce students to symbols, standards, and practices in electrical CAD.

Course Outcomes: After successful completion of the course, the student will be able to:

- Apply Auto CAD tools to create electrical schematics and layouts.
- Design residential and commercial wiring systems as per standards.
- Develop and document substation and panel wiring drawings.
- Interpret electrical diagrams and create professional CAD documentation.
- Work on real-time electrical design problems using CAD tools.

Module I: Introduction to Auto CAD for Electrical Design Overview of Auto CAD interface and tools

- Layers, blocks, and annotation in Auto CAD
- Electrical symbols: IEC/ ANSI/ IS standards
- Drawing and modifying basic electrical elements

Lab Experiments:

- Creating simple electrical circuit diagrams using Auto CAD
- Use of layers and blocks for electrical layouts

Module II: House Wiring and Lighting System Design

- Design of single- line diagrams (SLDs)
- Lay out of internal wiring for residential buildings
- Load calculation and cable selection
- Earthing and protection system basics

Lab Experiments:

- Preparation of residential wiring layout
- Switch board and lighting plan for 1BHK/ 2BHK house

Module III: Commercial and Industrial Electrical Layouts

- Design of power circuits and lighting for commercial buildings
- Distribution board design and component placement
- Panel board and bus bar layout

Lab Experiments:

- Design and drafting of distribution system for a small commercial building
- Electrical room lay out with control panels

Module IV: Substation and Control Circuit Design

- Single-line diagram of substations
- Control circuit schematics
- Relay control and contact or wiring diagrams
- Cable routing and tray layout

Lab Experiments:

- Drawing of 11kV/ 440V substation SLD
- Panel wiring diagram for DOL/Star-Delta motor starter

Module V: Mini Project and Professional Practice

- Project planning, drawing standards, title block, and BOM
- Design and documentation of a small- scale electrical system
- Printing, plotting, and exporting drawings

Lab Activity:

- Mini-project : Design and documentation of electrical system for a small apartment, lab, or factory setup

Software Requirements:

- Auto CAD Electrical (Student or Institutional License)
- Optional: E-Plan, Draft Sight, or similar tools for advanced users

TEXTBOOKS:

1. K.B. Raina and S.K. Bhattacharya “Electrical Design Estimating and Costing” New Age International.
2. Prof.Sham Tickoo “Auto CAD Electrical 2023 for Electrical Control Designers” CAD/CIM Technologies.
3. Surjit Singh “Basic Electrical Engineering Drawing” Dhanpat Rai & Co.

REFERENCEBOOKS:

1. Frederic P. Hartwell and Herbert P. Richter “Practical Electrical Wiring” Park Publishing.
2. James A. Leach and Shawna Lockhart “Auto CAD 2023 Instructor” SDC Publications.
3. Ray C. Mullin and Phil Simmons “Electrical Wiring Residential” Cengage Learning.
4. IS732: Code of Practice for Electrical Wiring Installations.
5. National Electrical Code (NEC)–India.

Online Resources:

1. **Autodesk Knowledge Network:** <https://knowledge.autodesk.com>.
2. **NPTEL:** Basic Electrical Drawing and CAD-related modules (search under "Electrical Engineering").

ELECTRICAL MACHINES – II**B.Tech. II Year II Sem.****L T P C****3 0 0 3****Prerequisites:** Electrical Circuits-I & II and Electrical Machines-I**Course Objectives:**

- To deal with the detailed analysis of three-phase induction motors & Alternators.
- To understand operation, construction and types of single-phase motors and their applications.
- To introduce the concept of parallel operation of alternators.

Course Outcomes: After successful completion of the course, the student will be able to:

- Understand the concepts of rotating magnetic fields.
- Examine the operation of AC machines.
- Analyze performance characteristics of AC machines.
- Analyze regulation phenomena of AC machines
- Analyze performance characteristics of AC motors.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To deal with the detailed analysis of three phase induction motors & Alternators	3	3	3	2	-	2	1	-	2	-	1	1
To understand operation, construction and types of single-phase motors and their Applications.	3	3	3	2	-	2	1	-	2	-	1	1
To introduce the concept of parallel operation of alternators	3	3	3	2	-	2	1	-	2	-	1	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand the concepts of rotating magnetic fields	3	3	3	2	-	2	1	-	2	-	1	1
Examine the operation of AC machines	3	3	3	2	-	2	1	-	2	-	1	1
Analyse performance characteristics of AC machines	3	3	3	2	-	2	1	-	2	-	1	1
Analyze regulation phenomena of AC machines.	3	3	2	3	-	1	1	-	1	-	1	1
Analyze performance characteristics of AC motors.	3	3	3	2	-	2	1	-	2	-	1	1

UNIT-I:

Three-Phase Induction Machines: Constructional details of cage and wound rotor machines- production of a rotating magnetic field - principle of operation - rotor EMF and rotor frequency - rotor reactance, rotor current and Power factor at standstill and during operation. Rotor power input, rotor copper loss and mechanical power developed and their inter relation. Torque equation-expressions for maximum torque and starting torque–torque-slip characteristics.

UNIT-II:

Characteristics of Induction Machines: Equivalent circuit - phasor diagram - crawling and cogging, No-load Test and Blocked rotor test –Predetermination of performance-Methods of starting and starting current and Torque calculations, Applications.

Speed Control Methods: Change of voltage, change of frequency, voltage/frequency, injection of an EMF into rotor circuit (qualitative treatment only)-induction generator-principle of operation.

UNIT-III:

Synchronous Generator (Alternator): Constructional Features of round rotor and salient pole machines – Armature windings – Integral slot and fractional slot windings; Distributed and concentrated windings – distribution, pitch and winding factors – E.M.F Equation. Harmonics in generated e.m.f. – suppression of harmonics – armature reaction - leakage reactance – synchronous reactance and impedance – phasor diagram – load characteristics.

UNIT-IV:

Regulation of Synchronous Generator: Synchronous impedance method, M.M.F. method, Z.P.F. method and A.S.A. methods – two reaction analysis – Determination of X_d and X_q (Slip test) Phasor diagrams – Regulation of salient pole alternators.

Parallel Operation of Synchronous Generator: Synchronizing alternators with infinite bus bars – synchronizing power torque – parallel operation and load sharing -Effect of change of excitation and mechanical power input.

UNIT-V:

Synchronous Motors: Theory of operation – phasor diagram – Variation of current and power factor with excitation – synchronous condenser – Mathematical analysis for power developed. - Hunting and its suppression – Methods of starting.

Single Phase Machines: Single phase induction motor – Constructional Features-Double revolving field theory – split-phase motors – AC series motor- Universal Motor- -Shaded pole motor and Applications.

TEXT BOOKS:

1. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
2. I.J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.

REFERENCE BOOKS:

1. Prithwiraj Purkait, Indrayudh Bandyopadhyay, “Electrical Machines”, Oxford, 2017.
2. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
4. A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.

Online Recourses:

1. <https://nptel.ac.in/courses/108/105/108105131/>
2. <https://nptel.ac.in/courses/108/106/108106072/>

POWER SYSTEMS - II**B.Tech. II Year II Sem.****L T P C**
3 0 0 3**Prerequisites:** Electrical Circuits- I & II and Power Systems-I**Course Objectives:**

- To study the performance of transmission lines and travelling waves.
- To understand the concept of voltage control, compensation methods and per unit representation of power systems.
- To know the Symmetrical components and fault calculation analysis.

Course Outcomes: After successful completion of the course, the student will be able to:

- Analyze the electrical parameters of overhead transmission lines, including inductance, capacitance, and mechanical aspects, and evaluate insulator types, potential distribution, and sag-tension characteristics for efficient power transmission
- Analyze the performance of short, medium, and long transmission lines using equivalent circuit models and ABCD constants, and evaluate corona phenomena, its effects, and methods to reduce associated losses and interference.
- Analyze transmission line performance and Apply load compensation techniques to control reactive power
- Understand the application of per unit quantities in power systems.
- Determine the fault currents for symmetrical and unbalanced faults.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study the performance of transmission lines and travelling waves.	3	3	3	2	-	2	1	-	2	-	1	1
To understand the concept of voltage control, compensation methods and per unit Representation of power Systems.	3	3	3	2	-	2	1	-	2	-	1	1
To know the, Symmetrical components and fault Calculation analysis	3	3	3	2	-	2	1	-	2	-	1	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Analyze the electrical parameters of overhead transmission lines, including inductance, capacitance, and mechanical aspects, and evaluate insulator types, potential distribution, and sag-tension characteristics for efficient power transmission.	3	3	2	3	-	1	1	-	2	-	1	1
Analyze the performance of short, medium, and long transmission lines using equivalent circuit models and ABCD constants, and evaluate corona phenomena, its effects, and methods to reduce associated losses and interference.	3	3	2	3	-	2	1	-	2	-	1	1

Analyze transmission line performance and apply load compensation techniques to control reactive power.	3	3	3	2	-	2	1	-	2	-	1	1
Understand the application of per unit quantities in power Systems.	3	3	3	2	-	2	1	-	2	-	1	1
Determine the fault currents for symmetrical and unbalanced faults.	3	3	3	2	-	2	1	-	2	-	1	1

UNIT - I:

Overhead Transmission Lines: Line conductors, Composite conductor's transposition, bundled conductors, Inductance and capacitance of single phase and three phase lines with symmetrical spacing, and effect of earth on capacitance, skin and proximity effects.

Overhead Line Insulators: Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, testing of insulators, Sag and Tension calculations.

UNIT-II:

Performance of Lines: Representation of lines, short transmission lines, medium length lines, nominal T and PI- representations, long transmission lines. The equivalent circuit representation of a long Line, A, B, C, D Constants, Ferranti Effect.

Corona: Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Advantages and Disadvantages of corona, interference between power and Communication lines.

UNIT-III:

Voltage Control & Power Factor Improvement: Introduction – methods of voltage control, shunt and series capacitors / Inductors, tap changing transformers, synchronous phase modifiers, power factor improvement methods.

Compensation In Power Systems: Introduction - Concepts of Load compensation – Load ability characteristics of overhead lines – Uncompensated transmission line – Symmetrical line.

UNIT-IV:

Per Unit Representation of Power Systems: The one-line diagram, impedance and reactance diagrams, per unit quantities, changing the base of per unit quantities, advantages of per unit system.

Travelling Waves on Transmission Lines: Production of travelling waves, open circuited line, short-circuited line, and line terminated through a resistance, line connected to a cable, Reflection and Refraction coefficients.

UNIT-V:

Symmetrical Components And Fault Calculations: Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks, fault calculations, sequence network equations, single line to ground fault, line to line fault, double line to ground fault, three phase fault, faults on power systems, faults with fault impedance, reactors and their location, short circuit capacity of a bus.

TEXT BOOKS:

1. C.L. Wadhwa, "Electrical Power Systems", New Age International Pub. Co, Third Edition, 2001.
2. D.P. Kothari and I.J. Nagrath, "Modern Power System Analysis", Tata Mc Graw Hill Pub. Co., New Delhi, Fourth edition, 2011.

REFERENCE BOOKS:

1. A. Chakrabarti, M.L. Soni, P.V. Gupta, U.S. Bhatnagar, “A Text book on Power System Engineering”, Dhanpat Rai Publishing Company (P) Ltd, 2008.
2. W.D. Stevenson, “Elements of Power system Analysis”, McGraw Hill International Student Edition.
3. John J. Grainger & W.D. Stevenson, “Power System Analysis”, McGraw Hill International, 1994.
4. Hadi Scadat, “Power System Analysis”, Tata Mc Graw Hill Pub. Co. 2002.

Online Recourses:

1. <https://nptel.ac.in/courses/108/102/108102047/>
2. <https://nptel.ac.in/courses/108/107/108107112/>

CONTROL SYSTEMS**B.Tech. II Year II Sem.**

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Prerequisites: Electrical Circuits- I & II and Electrical Machines-I**Course Objectives:**

- Understand the mathematical modeling of physical systems.
- Comprehend the representation of dynamical systems through input-output models, including transfer functions and state-space models.
- Understand the design of controllers and compensators to enhance the performance and stability of dynamical systems

Course Outcomes: After successful completion of the course, the student will be able to:

- Find the transfer function and state-space representation of linear time-invariant dynamical systems.
- Analyze the performance and stability of linear time-invariant systems in time domain.
- Analyze the performance and stability of linear time-invariant systems in frequency domain.
- Study classical controllers / compensators to improve the performance and stability of linear time-invariant systems.
- Develop state-space models of dynamic systems, solve state equations, and evaluate controllability and observability for system analysis and design.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand the mathematical modeling of physical systems.	3	3	3	3	3	-	-	1	-	-	2	2
Comprehend the representation of dynamical systems through input-output models, including transfer functions and state-space models.	3	3	3	3	3	-	-	1	-	-	2	2
Understand the design of controllers and compensators to enhance the performance and stability of dynamical systems	3	3	3	3	3	-	-	1	-	-	2	2

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Find the transfer function and state-space representation of linear time-invariant dynamical systems	3	3	3	3	3	-	-	1	-	-	2	2
Analyze the performance And stability of linear time-invariant systems in time domain	3	3	3	3	3	-	-	1	-	-	2	2
Analyze the performance And stability of linear time-invariant systems in time domain	3	3	3	3	3	-	-	1	-	-	2	2
Study the classical controllers / compensators to improve the performance and stability of linear time-invariant systems.	3	3	3	3	3	-	-	1	-	-	2	2
Develop state-space models of dynamic systems, solve state equations, and evaluate controllability and observability for system analysis and design.	3	3	3	3	3	-	-	1	-	-	2	2

UNIT - I:

Mathematical modeling of physical systems: Open-loop and Closed loop Systems, Concept of Feedback Control, Benefits of Feedback and Effects of feedback, Linear, Non-Linear, Time Variant and Time Invariant systems, Mechanical and Electrical Systems. Transfer function, Block-Diagram Techniques, Signal flow graph, Controller Components: DC Servo motors, AC Servomotors, Synchro's.

UNIT-II:

Time-Domain Analysis with Input-Output Models: Time response of first and second order systems for Standard test inputs. Analysis of standard Second order systems with step input, Types of System, Error, Analysis for Linear time Invariant Systems, Design specifications for second-order systems based on the Time- response.

Concept of Stability: Routh-Hurwitz Criteria. Relative Stability analysis, Root-Locus technique: Construction of Root-loci.

UNIT-III:

Frequency Domain Analysis: Introduction to frequency response, Relationship between time and frequency response, Concept of Bode plots and construction. Polar plots, Nyquist stability criterion. Relative stability using Nyquist criterion –gain and phase margin

UNIT-IV:

Classical Controllers and Compensators: Proportional, Integral and Derivative Controllers- PI, PD and PID controllers, Lead, Lag and Lead-Lag compensators (elementary treatment only).

UNIT-V:

State Variable Analysis: Concept of State, State variables and State model. State Representation, Transformation of State variables, Solution of state equations and Complete response of the Systems. Concept of controllability and observability.

TEXT BOOKS

1. I.J. Nagrath and M.Gopal, "Control Systems Engineering", New Age International, 2009.
2. B.C. Kuo, "Automatic Control System", Prentice Hall, 1995.
3. Norman S Nise, "Control Systems Engineering", Wiley, 2019 8th Edition.

REFERENCE BOOKS:

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
2. K.R. Varmah, "Control Systems", Mc Graw Hill Education, 2010.

Online Recourses:

1. <https://www.controleng.com>
2. <https://www.mathworks.com>
3. <https://nptel.ac.in/courses/108/102/108102043>

B. Tech. II Year II Sem.

L T P C
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Prerequisites: Electrical Machines-I**Course Objectives:**

- To understand the operation of Induction, Synchronous machines and Transformers.
- To study the performance analysis of Induction and Synchronous Machines through various testing methods.
- To analyze the performance of single and 3-phase transformers.

Course Outcomes: After successful completion of the course, the student will be able to:

- Assess the performance of different types of AC machines using different testing methods.
- Analyze the suitability of AC machines and Transformers for real word applications.
- Determine the performance of single and three-phase transformers.
- Analyze the characteristics of synchronous motors by obtaining V-curves and inverted V-curves, and determine direct and quadrature axis reactances of salient pole machines.
- Demonstrate special transformer connections (Scott connection) and validate machine performance using experimental and analytical methods.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the operation of Induction, Synchronous machines and Transformers	3	3	3	3	3	-	-	1	-	-	2	2
To study the performance analysis of Induction and Synchronous Machines through various Testing methods	3	3	3	3	3	-	-	1	-	-	2	2
To analyse the performance of single and three-phase phase transformer	3	3	3	3	3	-	-	1	-	-	2	2

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Assess the performance of different types of AC machines using different Testing methods	3	3	3	3	3	-	-	1	-	-	2	2
Analyse the suitability of AC machines and Transformers for real word applications	3	3	3	3	3	-	-	1	-	-	2	2
Determine the performance of single and three-phase transformers	3	3	3	3	3	-	-	1	-	-	2	2
Analyze the characteristics of synchronous motors by obtaining V-curves and inverted V-curves, and determine direct and quadrature axis reactances of salient pole machines.	3	3	3	3	3	-	-	1	-	-	2	2
Demonstrate special transformer connections (Scott connection) and validate machine performance using experimental and analytical methods.	3	3	3	3	3	-	-	1	-	-	2	2

The following experiments are required to be conducted as compulsory experiments:

1. Sumpner's test on a pair of single-phase transformers
2. No-load & Blocked rotor tests on three phase Induction motor
3. Regulation of a three –phase alternator by synchronous impedance & m.m.f. methods
4. 'V' and 'Inverted V' curves of a three—phase synchronous motor.
5. Equivalent Circuit of a single-phase induction motor
6. Determination of X_d and X_q of a salient pole synchronous machine
7. Brake test on three phase Induction Motor
8. Regulation of three-phase alternator by Z.P.F. and A.S.A methods

In addition to the above experiments, at least any two of the following experiments are required to be conducted from the following list:

1. Separation of core losses of a single-phase transformer
2. Efficiency of a three-phase alternator
3. Parallel operation of Single-phase Transformers
4. Measurement of sequence impedance of a three-phase alternator.
5. Scott Connection of transformer

TEXT BOOKS:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

REFERENCE BOOKS:

1. Prithwiraj Purkait, Indrayudh Bandyopadhyay, "Electrical Machines", Oxford, 2017.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
4. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004

B. Tech. II Year II Sem.

L T P C
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Course Objectives:

- Understand system representations like transfer function and state space, and assess system dynamic response.
- Evaluate system performance using both time and frequency domain analyses, identifying methods to Enhance performance.
- Study controllers and compensators to improve system performance based on the assessments from time And frequency domain analyses.

Course Outcomes: After successful completion of the course, the student will be able to:

- Improve system performance by skillfully selecting appropriate controllers and compensators tailored To specific applications.
- Apply diverse time domain and frequency domain techniques to effectively assess and enhance system performance.
- Demonstrate the application of various control strategies to different systems such as power systems and electrical drives, showcasing adaptability and versatility in control applications.
- Perform stability analysis of linear time-invariant systems using Bode, Root Locus, and Nyquist plots with simulation tools.
- Implement PID control for temperature and speed control applications and develop state-space models and PLC-based motor control using simulation and hardware.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand system representations like transfer function and state space, and assess system dynamic Response.	3	3	3	3	3	-	-	1	-	-	2	2
Evaluate system performance using both time and frequency domain analyses, identifying methods to enhance performance.	3	3	3	3	3	-	-	1	-	-	2	2
Study controllers and compensators to improve system performance basedon the assessments from time and frequency domain analyses	3	3	3	3	3	-	-	1	-	-	2	2

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Improve system performance by skillfully selecting appropriate controllers and compensators tailored to specific applications.	3	3	3	3	3	-	-	1	-	-	2	2
Apply diverse time domain and frequency domain techniques to effectively assess and enhance system performance.	3	3	3	3	3	-	-	1	-	-	2	2
Demonstrate the application of various control strategies to different systems such as power systems and electrical drives, showcasing adaptability and versatility in	3	3	3	3	3	-	-	1	-	-	2	2

control applications.												
Perform stability analysis of linear time-invariant systems using Bode, Root Locus, and Nyquist plots with simulation tools.	3	3	3	3	3	-	-	1	-	-	2	2
Implement PID control for temperature and speed control applications and develop state-space models and PLC-based motor control using simulation and hardware.	3	3	3	3	3	-	-	1	-	-	2	2

The following experiments are required to be conducted as compulsory experiments:

1. Time response of Second order system
2. Characteristics of Synchro's
3. Effect of feedback on DC servomotor
4. Transfer function of DC motor
5. Transfer function of DC generator
6. Lag and lead compensation–Magnitude and phase plot
7. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using simulation tools.
8. State space model for classical transfer function using simulation tools.

In addition to the above experiments, at least any two of the following experiments are required to be conducted from the following list:

1. Characteristics of AC servo motor
2. Temperature controller using PID
3. Effect of P, PD, PI, PID Controller on a second order systems
4. (a) Simulation of P, PI, PID Controller.
(b) Linear system analysis (Time domain analysis, Error analysis) using suitable software
5. Programmable logic controller– Study and verification of truth tables of logic gates, simple Boolean expressions, and application of speed control of motor.
6. Design of Lead-Lag compensator for the given system and with specification using suitable software

TEXT BOOKS:

1. M. Gopal, “Control Systems: Principles and Design”, Mc Graw Hill Education, 1997.
2. B.C. Kuo, “Automatic Control System”, Prentice Hall, 1995.

REFERENCE BOOKS:

1. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
2. I.J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009.

EE410SD: PCB DESIGN

B.Tech. II Year II Sem.

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Course Objectives:

- To understand the basics of PCB types, materials, and design standards.
- To gain hands-on experience with PCB layout software tools.
- To develop skills in schematic capture, component placement, routing, and Gerber generation.
- To fabricate and test a simple single-layer PCB.

Course Outcomes: After successful completion of the course, the student will be able to:

- Understand the design and fabrication process of PCBs.
- Design schematic diagrams and convert them to PCB layouts.
- Apply routing and layout techniques using EDA tools.
- Generate Gerber files and perform DRC/ERC effectively.
- Fabricate, assemble, and test basic single-layer PCBs.

Module I: Fundamentals of PCB Design

- Types of PCBs: Single-layer, Double-layer, Multilayer
- PCB materials and manufacturing process
- PCB design rules and standards (IPC standards)
- Introduction to EDA tools (e.g., KiCad, Eagle, Altium, EasyEDA)

Lab Activity:

- Exploring the user interface of PCB design software
- Setting up design rules

Module II: Schematic Design

- Creating circuit schematics using PCB CAD tools
- Component library management
- Electrical rule checking (ERC)
- Netlist generation

Lab Activity:

- Designing a basic power supply or LED flasher circuit
- Performing ERC and generating netlist

Module III: PCB Layout and Routing

- Importing netlist to layout editor
- Footprint assignment and component placement
- Manual vs auto-routing
- Design Rule Check (DRC)

Lab Activity:

- Placing components and routing for the schematic designed earlier
- Performing DRC and correcting errors

Module IV: PCB Output Files and Fabrication

- Generating Gerber files, drill files, and BOM
- Understanding layers (Top, Bottom, Soldermask, Silkscreen)
- PCB printing, photoresist method, and etching
- Introduction to SMD and through-hole assembly

Lab Activity:

- Generate Gerber files and preview using Gerber viewer
- Fabricate a basic single-layer PCB (simulation or actual lab process)

Module V: Mini Project and Testing

- Assembling components on fabricated PCB
- Soldering and desoldering techniques
- Continuity testing and troubleshooting
- Mini-project: Design a simple power supply, logic gate trainer, or timer circuit

Lab Activity:

- Complete mini project: From schematic to testing of PCB

TEXT BOOKS:

1. Walter C. Bosshart “Printed Circuit Board Design and Technology” Tata McGraw Hill
2. Clyde F. Coombs “Printed Circuit Boards: Design and Technology”: McGraw-Hill
3. Peter Dalmaris “PCB Design Using KiCad 6”

REFERENCE BOOKS:

1. *Kraig Mitzner* “Complete PCB Design Using OrCAD Capture and PCB Editor”
2. *James Angus* “**Electronic Product Design**”

IPC Standards:

1. IPC-2221: Generic Standard on Printed Board Design
2. IPC-7351: Generic Requirements for Surface Mount Design

Software Tools (Free/Open Source Recommended):

1. **KiCad** (Open-source)
2. **EasyEDA** (Online tool)
3. **Eagle CAD** (Free for education)
4. **LTSpice / Tinkercad** for circuit simulation (optional)