II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	EE301PC	Electromagnetic 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 Systems-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.	EE309PC	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**	**08**	**21**

II YEAR II SEMESTER

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 Systems-II	3	0	0	3
4.	EE404PC	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.	EE409PC	Digital Electronics Lab	0	0	2	1
10.	EE410SD	PCB Design	0	0	2	1
		Total Credits	**15**	**0**	**10**	**20**

Member Secretary

Chairman

II YEAR I SEMESTER SYLLABUS

EE301PC: ELECTROMAGNETIC FIELDS

B.TECH. II YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE301PC	PCC	3	0	0	3

Prerequisite: Mathematics & Physics

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

1. Understand the basic laws of electromagnetism and their applications.
2. Analyze time varying electric and magnetic fields.
3. Understand the propagation of EM waves.

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 Circuital 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:

Time Varying Fields and Maxwell's Equations: Faraday's laws of 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. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
3. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
4. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.

WEB REFERENCES:

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/

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EE302PC: ELECTRICAL MACHINES – I

B.TECH. II YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE302PC	PCC	3	0	0	3

Prerequisite: Electrical Circuits -I & II

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

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

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) – EMF 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 EMF - critical field resistance and critical speed. Performance Characteristics of shunt, series and compound generators and applications.

UNIT: II	DC Motors and Testing of DC Machines

Principle of operation – Back EMF. - 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 and Testing of Transformers

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- predetermination of efficiency and regulation-separation of losses test.

UNIT: V	Parallel operation of Transformers

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, Revised Edition, 2021.
   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.

WEB REFERENCES:

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/

Member secretary **Chairman**

EC303PC: ELECTRONIC DEVICES AND CIRCUITS

B.Tech. II Year I Sem **L T P C**

3 0 0 3

Course Overview: This course introduces fundamental semiconductor devices and their behavior, including diodes, BJTs, and FETs. It covers their characteristics, applications, and the analysis of basic electronic circuits. The course also explores rectifiers, voltage regulation, amplifier design, and advanced semiconductor technologies like FinFETs and CNTFETs. Emphasis is placed on developing a strong foundation for analog circuit design and understanding modern device technologies in electronics.

Course Outcomes: By the end of this course, students will be able to:

CO1: Analyze the electrical characteristics and models of semiconductor diodes and apply them in rectifier and clipping circuits.

CO2: Evaluate the operation and configurations of Bipolar Junction Transistors (BJTs) and analyze their input and output characteristics.

CO3: Design appropriate biasing networks for BJTs and determine the operating point for amplifier applications.

CO4: Analyze transistor amplifier circuits using h-parameter models and assess performance for various configurations.

CO5: Analyze the structure, working, and characteristics of JFETs, MOSFETs, and advanced devices like FinFETs and CNTFETs, and compare modern device technologies.

Course Articulation Matrix

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	1	1	-	-	-	-	-
CO2	3	3	2	2	1	-	-	-	-	-	-
CO3	3	3	3	2	1	-	-	-	-	-	-
CO4	3	3	3	2	2	-	-	-	-	-	1
CO5	3	3	2	2	2	1	-	-	-	-	2

Syllabus:

UNIT - I:

Diode Characteristics and Applications: PN junction diode — I-V characteristics, Diode resistance and capacitance, Diode models (Ideal, Simplified, Piecewise Linear), Rectifiers – Half-wave, Full-wave (Center-tap and bridge), Capacitor filter for rectifiers, Clippers and clampers, Zener diode – I-V characteristics and voltage regulation.

UNIT - II:

Bipolar Junction Transistor (BJT): Structure and working principle of BJT, Current components and transistor action, Configurations: Common Base (CB), Common Emitter (CE), Common Collector (CC), Input and output characteristics, Determination of h-parameters from transistor characteristics.

UNIT - III:

BJT Biasing: Need for biasing and stabilization, Load line and operating point, Biasing techniques: Fixed bias, Collector-to-base bias, Voltage divider bias, Stability factors and thermal runaway

UNIT - IV:

Transistor Amplifiers: Transistor as a small-signal amplifier, h-parameter equivalent circuit, CE, CB, CC amplifier analysis using h-parameters, Approximate CE model – with and without emitter bypass capacitor.

UNIT - V:

Special Purpose Diodes: Principle of Operation of – SCR, Tunnel Diode, Varactor Diode, Photo Diode, Solar Cell, LED and Schottky Diode

Field Effect Transistors and Advanced Devices: JFET: Structure, operation, and characteristics, MOSFET: Enhancement and Depletion modes – Structure, operation, and characteristics, Advanced Devices: FinFETs3D structure, Scaling advantages, CNTFETs - Structure, ballistic transport, fabrication, Comparison: CMOS vs. FinFET vs. CNTFET.

TEXT BOOKS:

1. Millman, Jacob, and Christos C. Halkias. *Electronic Devices and Circuits*. Tata McGraw-Hill, 1991.
2. Boylestad, Robert L., and Louis Nashelsky. *Electronic Devices and Circuit Theory*. Pearson, 11th ed., 2013.
3. Sedra, Adel S., and Kenneth C. Smith. *Microelectronic Circuits*. Oxford University Press, 7th ed., 2014.

REFERENCE BOOKS:

1. Bell, David A. *Electronic Devices and Circuits*. Oxford University Press, 5th ed., 2008.
2. Neamen, Donald A. *Electronic Circuit Analysis and Design*. McGraw-Hill, 2nd ed., 2001.
3. Salivahanan, S., and N. Suresh Kumar. *Electronic Devices and Circuits*. McGraw-Hill Education, 4th ed., 2017.
4. Razavi, Behzad. *Fundamentals of Microelectronics*. Wiley, 2nd ed., 2013.
5. Taur, Yuan, and Tak H. Ning. *Fundamentals of Modern VLSI Devices*. Cambridge University Press, 2nd ed., 2009.

EE304PC: POWER SYSTEMS – I

B.TECH. II YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE304PC	PCC	3	0	0	3

Prerequisite: Electrical Circuits -I & II

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

1. Understand the operation of conventional and renewable electrical power generating stations
2. Evaluate the power tariff methods and Economics associated with power generation
3. Analyze the operations of AIS & GIS and Distribution systems

UNIT: I Generation of Electric Power

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

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):

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):

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	AC Distribution

AC 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 AC 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 Text book 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. W. D. Stevenson, "Elements of Power System Analysis", 4th Edition, McGraw Hill, 1984.
4. V. K. Mehta and Rohit Mehta, "Principles of Power Systems", S. Chand & Company Ltd, New Delhi, 2004.

WEB REFERENCES:

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
3. https://onlinecourses.nptel.ac.in/noc20_ee67/preview

Member secretary **Chairman**

EE305PC: ELECTRICAL MEASUREMENTS AND SENSORS

B.TECH. II YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE305PC	PCC	2	0	0	2

Prerequisite: Electrical Circuits-I & II, Analog Electronics and Electromagnetic Fields

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

1. Understand different types of measuring instruments, their construction, operation and characteristics and identify the instruments suitable for typical measurements.
2. Apply the knowledge about transducers and instrument transformers to use them effectively.
3. Apply the knowledge of smart and digital metering for industrial applications.

UNIT: I Introduction to Measuring Instruments:

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 of range of Electrostatic Voltmeters.

UNIT: II Potentiometers & Instrument Transformers

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

UNIT: III Measurement of Power & Energy

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 RSS meter. Three phase energy meter – trivector meter, maximum demand meters (Qualitative approach).

Unit: IV	DC & AC Bridges

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 and Smart Instruments

Sensors- Classification of transducers- Temperature sensors- Proximity sensor- Pressure sensor- IR sensors- Motion detection sensors- Ultrasonic sensors- Rotor Position Sensors, Operation of Strain Gauge- Thermocouples, construction and working of LVDT, Piezo electric transducers, photovoltaic, photo conductive cells, and photo diodes-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.

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. S. C. Bhargava, "Electrical Measuring Instruments and Measurements", BS Publications, 2012.
3. Reissland, M. U, "Electrical Measurements: Fundamentals, Concepts, Applications", New Age International (P) Limited Publishers, 1st Edition 2010.
4. E.W. Golding and F. C. Widdis, "Electrical Measurements and measuring Instruments", fifth Edition,Wheeler Publishing, 2011.

WEB REFERENCES:

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

Member secretary **Chairman**

MS306HS: INNOVATION AND ENTREPRENEURSHIP

B.Tech. II Year I Sem. **L T O P**

2 0 0 2

Course Objectives:

1. To familiarize on the basic concepts of innovation, entrepreneurship and its importance.
2. To Identify and analyze the process of problem-opportunity identification, market segmentation, and idea generation techniques.
3. To initiate prototype development and understand minimum viable product.
4. To develop initial Business and financial planning and Go-to-Market strategies
5. To impart knowledge on establishing startups, venture pitching and IPR

Course Outcomes:

1. Understand the entrepreneurship and the entrepreneurial process and its significance in economic development.
2. Assess the problem from an industry perspective and generate solutions using the design thinking principles.
3. Assess market competition, estimate market size, and develop a prototype.
4. Analyze Business and financial planning models and Go-to-Market strategies.
5. Able to build a start-up, register IP and identify funding opportunities.

Unit I: Fundamentals of Innovation and Entrepreneurship

Innovation: Introduction, need for innovation, Features, Types of innovations, innovations in manufacturing and service sectors, fostering a culture of innovation, planning for innovation.

Entrepreneurship: Introduction, types of entrepreneurship attributes, mindset of entrepreneurial and intrapreneurial leadership, Role of entrepreneurs in economic development. Woman Entrepreneurship, Importance of on-campus startups. Understanding to build entrepreneurial mindset, attributes and networks individuals while on campus.

Core Teaching Tool: Simulation, Game, Industry Case Studies (Personalized for students – 16 industries to choose from), Venture Activity.

Unit II: Problem and Customer Identification

Identification of gap, problem, analyzing the problem from a industry perspective, real-world problems, market and customer segmentation, validation of customer problem fit, Iterating problem-customer fit, Competition and Industry trends mapping and assessing initial opportunity, Porter's Five Force Model.

Idea generation, Ideation techniques: Brainstorming, Brain writing, Round robin, and SCAMPER, Design thinking principles, Mapping of solution to problem.

Core Teaching Tool: Several types of activities including: Class, game, Gen AI, 'Get out of the Building' and Venture Activity.

Unit III: Opportunity assessment and Prototype development

Identify and map global competitors, review industry trends, and understand market sizing: TAM, SAM, and SOM. Assessing scope and potential scale for the opportunity. Understanding prototyping and Minimum Viable Product (MVP). Developing a prototype: Testing, and validation.

Core Teaching Tool: Venture Activity, no-code Innovation tools, Class activity

Unit IV: Business & Financial Models

Introduction to Business Model and types, Lean Canvas Approach: 9-block lean canvas model, building lean canvas for your startup. Business planning: components of Business plan- Sales plan, People plan and financial plan, Financial Planning: Types of costs, preparing a financial plan for profitability using a financial template, understanding the basics of Unit economics, Economies of Scale and analyzing financial performance. Go-To-Market (GTM) approach — Selecting the Right Channel, creating digital presence, and building customer acquisition strategy.

Core Teaching Tool: Founder Case Studies – Sama and Securely Share; Class activity and discussions; Venture Activities.

Unit V: Startups and IPR

Startup requirements, building founding team members and mentors, pitch preparation, start-up registration process, funding opportunities and schemes, institutional support to entrepreneurs, startup lifecycle, documentation, legal aspects in startup, venture pitching readiness, National Innovation Startup Policy (NISP) and its features.

Patents, Designs, Patentability, Procedure for grants of patents. Indian Scenario of Patenting, International Scenario: International cooperation on Intellectual Property. Patent Rights: Scope of Patent Rights. Copyright, trademark, and GI. Licensing and transfer of technology.

Core Teaching Tool: Expert talks; Cases; Class activity and discussions; Venture Activities.

Suggested Readings:

1. John R Bessant, Joe Tidd, Innovation and Entrepreneurship, 4E, Wiley, Latest Edition.
2. Ajay Batra, The Stratup Launch Book- A Practical Guide for Launching Customer Centric Ventures, Wiley, 2020. (For Core Teaching Tool).
3. Entrepreneurship Development and Small Business Enterprises, Poornima M Charantimath, 3E, Pearson, 2018.
4. D.F. Kuratko and T.V. Rao, Entrepreneurship: A South-Asian Perspective, Cengage Learning, 2013.
5. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition.
6. NISP -Brochure inside pages - startup_policy_2019.pdf

EE307PC: ELECTRICAL MACHINES - I LAB

B.TECH. II YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE307PC	PCC	0	0	2	1

Prerequisite: Electrical Machines - I

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

1. Start and control the Different DC Machines.
2. Assess the performance of different machines using different testing methods
3. Evaluate the performance of different Transformers using different testing methods

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 (Predetermination of efficiency)
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:

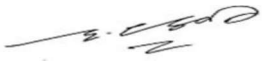
1. Brake Test on DC shunt motor (Determination of performance curves)
2. Load Test on DC compound generator (Determination of characteristics).
3. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
4. Load Test on Single Phase Transformer (Calculate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



Member secretary **Chairman**

EE308PC: ELECTRICAL MEASUREMENTS AND SENSORS LAB

B.TECH. II YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE308PC	PCC	0	0	2	1

Prerequisite: Electrical Circuits –I & II

Course Objectives:

1. To calibrate Watt, Energy and PF Meter and determination of three phase active & reactive powers.
2. To determine unknown inductance, resistance, capacitance by performing experiments on DC Bridges & AC Bridges.
3. To determine the ratio and phase angle errors of Instrument transformers.

Course Outcomes: Upon completing this course, the student will be able to

1. Choose and test any measuring instruments.
2. Find the accuracy of any instrument by performing experiments.
3. Calculate the various parameters using different types of measuring instruments.

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 DC Potentiometer – Calibration of PMMC ammeter and PMMC voltmeter.
4. Kelvin's double Bridge – Measurement of resistance – Determination of Tolerance.
5. Dielectric testing of oil using HT 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. S. C. Bhargava, "Electrical Measuring Instruments and Measurements", BS Publications, 2012.
3. Reissland, M. U., "Electrical Measurements: Fundamentals, Concepts, Applications", New Age International (P) Limited Publishers, 1st Edition 2010.
4. E.W. Golding and F. C. Widdis, "Electrical Measurements and Measuring Instruments", fifth Edition, Wheeler Publishing, 2011.

Member secretary **Chairman**

EC309PC: ELECTRONIC DEVICES AND CIRCUITS LAB

B.Tech. II Year I Sem. **L T P C**

0 0 2 1

Course Overview:

This laboratory course aims to provide hands-on experience and simulation-based learning of semiconductor devices and basic electronic circuits. Students will analyze the characteristics and applications of diodes, BJTs, and FETs, design rectifiers and amplifiers, and simulate modern electronic circuits using software tools. The course bridges theoretical concepts with practical implementation, developing foundational skills essential for analog electronics and circuit analysis.

Course Outcomes (COs): By the end of this course, students will be able to:

CO1: Analyze the I–V characteristics of semiconductor devices such as diodes, BJTs, and FETs.

CO2: Design and evaluate basic rectifier, clipper, clamper, and voltage regulation circuits.

CO3: Demonstrate biasing techniques for BJTs and determine their operating point using DC load line analysis.

CO4: Design and analyze transistor amplifier circuits in various configurations using h-parameter models.

CO5: Simulate and interpret electronic circuits using appropriate simulation tools.

Course Articulation Matrix

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	1	-	-	-	-	-	-
CO2	3	3	3	2	1	1	-	-	-	-	-
CO3	3	3	2	2	1	-	-	-	-	-	-
CO4	3	3	3	2	1	-	-	-	-	-	1
CO5	2	2	2	3	3	-	-	-	-	-	2

List of Experiments

A. Hardware-Based Experiments (7):

1. Study the I–V characteristics of a PN junction diode in forward and reverse bias to determine cut-in voltage and dynamic resistance.

2. Examine the reverse bias characteristics of a Zener diode and demonstrate its application as a voltage regulator under varying conditions.
3. Design and analyze half-wave and full-wave rectifiers (center-tap and bridge) with and without capacitor filters to evaluate ripple factor and output voltage.
4. Implement clipper and clamper circuits to observe waveform shaping through positive, negative, and biased configurations.
5. Plot the input and output characteristics of a BJT in common emitter configuration to determine input/output resistance and current gain.
6. Design and test fixed bias and voltage divider bias circuits to establish a stable operating point for a BJT amplifier and study DC load line behavior.
7. Construct and analyze a Common Base (CB) configuration of a BJT to study input-output characteristics and determine current gain (α) and input/output resistance.

B. Software-Based Simulation Experiments (7):

1. Simulate a full-wave bridge rectifier with capacitor filter to analyze waveform smoothing and ripple reduction in DC power supply design.
2. Simulate a Zener diode-based voltage regulator to study voltage stabilization against varying supply voltages and load resistances.
3. Simulate a common emitter amplifier with and without emitter bypass capacitor to analyze the effect on voltage gain and signal amplification.
4. Simulate BJT operation as a switch and small-signal amplifier to understand its dual functionality in digital and analog applications.
5. Simulate the output and transfer characteristics of a JFET to determine parameters such as pinch-off
6. voltage, drain resistance, and transconductance.
7. Simulate the characteristics of a MOSFET and design a CMOS inverter to study digital switching behavior and low-power logic design.
8. Simulate the transfer and output characteristics of an enhancement-mode NMOS transistor to analyze threshold voltage, drain current, and switching behavior.

Hardware Requirements:

1. Regulated DC Power Supply (0–30V)
2. Function Generator
3. Digital Multimeter
4. Cathode Ray Oscilloscope (CRO) or DSO
5. Breadboards and Connecting Wires
6. Resistors, Capacitors, Diodes (1N4007, Zener Diodes)
7. BJTs (e.g., BC107, 2N2222), JFETs (e.g., J201), MOSFETs (e.g., IRF540N)
8. Trainer Kits (optional but preferred for ease)

Software Requirements (Any one of the listed tools or equivalent):

1. LTSpice (Free from Analog Devices)
2. NI Multisim (Academic License or Student Version)
3. Proteus Design Suite (Simulation and PCB Design)
4. TINA-TI (Free from Texas Instruments)
5. PSPICE for TI or OrCAD Lite
6. Windows PC or Laptop with minimum 4GB RAM and i3 processor or better

EE310SD: DESIGN OF ELECTRICAL SYSTEMS USING AUTOCAD

B.TECH. II YEAR I SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE310SD	-	0	0	2	1

Prerequisite: --

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

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

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

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

Lab Experiments:

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

Module II: House Wiring and Lighting System Design

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

Lab Experiments:

- Preparation of residential wiring layout
- Switchboard 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 busbar layout

Lab Experiments:

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

Module IV: Substation and Control Circuit Design

- Single-line diagram of substations
- Control circuit schematics
- Relay control and contactor 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:

- AutoCAD Electrical (Student or Institutional License)
- Optional: E-Plan, DraftSight, or similar tools for advanced users

TEXT BOOKS:

1. K.B. Raina and S.K. Bhattacharya "Electrical Design Estimating and Costing" New Age International.
2. Prof. Sham Tickoo "AutoCAD Electrical 2023 for Electrical Control Designers" CADCIM Technologies.
3. Surjit Singh "Basic Electrical Engineering Drawing" Dhanpat Rai & Co.

REFERENCE BOOKS:

1. Frederic P. Hartwell and Herbert P. Richter "Practical Electrical Wiring" Park Publishing.
2. James A. Leach and Shawna Lockhart "AutoCAD 2023 Instructor" SDC Publications.
3. Ray C. Mullin and Phil Simmons "Electrical Wiring Residential" Cengage Learning.
4. IS 732: Code of Practice for Electrical Wiring Installations.
5. National Electrical Code (NEC) – India.

WEB REFERENCES:

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

II YEAR II SEMESTER SYLLABUS

MA401BS: NUMERICAL METHODS AND COMPLEX VARIABLES

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Mathematics courses of first year of study.

Course Objectives: To learn

1. Expressing periodic function by Fourier series and a non-periodic function by Fourier transforms
2. Various numerical methods to find roots of polynomial and transcendental equations.
3. Concept of finite differences and to estimate the value for the given data using interpolation.
4. Evaluation of integrals using numerical techniques
5. Solving ordinary differential equations of first order using numerical techniques.
6. Differentiation and integration of complex valued functions.
7. Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
8. Expansion of complex functions using Taylor's and Laurent's series.

Course outcomes: After learning the contents of this paper, the student must be able to

1. Express any periodic function in terms of sine and cosine.
2. Find the root of a given polynomial and transcendental equations.
3. Estimate the value for the given data using interpolation
4. Find the numerical solutions for a given first order ODE's
5. Analyze the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems.
6. Taylor's and Laurent's series expansions in complex function.

UNIT-I: Fourier Series & Fourier Transforms **8 L**

Fourier series – Dirichlet's Conditions – Half-range Fourier series – Fourier Transforms: Fourier Integral Theorem (Only statements), Fourier Sine and Cosine transforms (Elementary illustrations)

UNIT-II: Numerical Methods-I **10 L**

Solution of polynomial and transcendental equations: Bisection method – Iteration Method – Newton-Raphson method and Regula-Falsi method. Finite differences: forward differences – backward differences – central differences – symbolic relations – Interpolation using Newton's forward and backward difference formulae – Lagrange's method of interpolation.

UNIT-III: Numerical Methods-II **10 L**

Numerical integration: Trapezoidal rule - Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.

Ordinary differential equations: Taylor's series – Euler's method – Runge-Kutta method of fourth order for first order ODE.

UNIT-IV: Complex Differentiation **10 L**

Differentiation of Complex functions – Analyticity – Cauchy-Riemann equations (without proof) – Harmonic Functions — Finding harmonic conjugate — Milne-Thomson method — Elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT-V: Complex Integration **10 L**

Line integral – Cauchy's theorem – Cauchy's Integral formula – Zeros of analytic functions – Singularities – Taylor's series – Laurent's series. Residues – Cauchy Residue theorem (All theorems without Proof).

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36^{th} Edition, 2010.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.

REFERENCE BOOKS

1. Murray R. Spiegel, Ph.D., Seymour Lipschutz, Ph.D., John J. Schiller, Ph.D., Dennis Spellman, Ph.D., Complex Variables (Schaum's outline).
2. M. K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical methods for Scientific and Engineering Computations, New Age International publishers.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9^{th}Edition, John Wiley &Sons, 2006.
4. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7^{th} Edition, Mc-Graw Hill, 2004.

EE402PC: ELECTRICAL MACHINES – II

B.TECH. II YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE402PC	PCC	3	0	0	3

Prerequisite: Electrical Circuits-I &II and Electrical Machines -I

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

1. Understand the concepts of rotating magnetic fields.
2. Examine the operation of AC machines.
3. Analyze performance characteristics of AC machines.

UNIT: I	Three Phase Induction Machines:

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

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):

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 — EMF Equation. Harmonics in generated EMF — suppression of harmonics — armature reaction - leakage reactance — synchronous reactance and impedance — phasor diagram — load characteristics.

Unit: IV	Regulation of Synchronous Generator

Regulation of Synchronous Generator: Synchronous impedance method, MMF method, ZPF method and ASA methods — two reaction theory– Determination of Xd and Xq (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:

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.
   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.

WEB REFERENCES:

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

Member secretary **Chairman**

EE403PC: POWER SYSTEM – II

B.TECH. II YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE403PC	PCC	3	0	0	3

Prerequisite: Electrical Circuits - I & II and Power Systems – I

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

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

UNIT: I	Overhead Transmission Lines and Insulators

Overhead Transmission Lines: Line conductors, Composite conductors 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

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, and 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

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:

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, line terminated through a resistance, line connected to a cable, Reflection and Refraction coefficients.

UNIT: V	Symmetrical Components and Fault Calculations

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, "Generation, Distribution and Utilization of Electrical Energy", 3rd Edition, New Age International, 2009.
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", 4th Edition, McGraw Hill, 1984.
3. John J. Grainger & W.D. Stevenson, "Power System Analysis", Mc Graw Hill International,1994.
4. Hadi Sadat, "Power System Analysis", Tata Mc Graw Hill Pub. Co. 2002.

WEB REFERENCES:

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

Member secretary **Chairman**

EE404PC: DIGITAL ELECTRONICS

B.Tech. II Year II Sem. **L T P C**

3 0 0 3

Prerequisites: Electronic Devices and Circuits

Course Objectives:

- To learn fundamental concepts of digital system design and common forms of number representations and their conversions.
- To implement and design logical operations using combinational logic circuits and sequential logic circuits.
- To understand the semiconductor memories and programmable logic devices.

Course Outcomes: After learning the contents of this paper the student must be able to

- Understand the working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.
- Implement the given logical problems using programmable logic devices.

Course Objectives	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
To learn fundamental concepts of digital system design and common forms of number representations and their conversions	2	1	3	2	1	1	1	1	3	2	1	3
To implement and design logical operations using combinational logic circuits and sequential logic circuits	2	1	3	2	1	1	1	1	3	2	1	3
To understand the semiconductor memories and	2	2	3	3	2	2	2	1	1	1	3	1

programmable logic devices												

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Understand the working of logic families and logic gates	2	2	3	3	1	2	3	3	1	1	1	1
Design and implement Combinational and Sequential logic circuits	2	2	1	2	3	1	2	2	2	1	1	1
Implement the given logical problems using programmable logic devices	3	2	2	2	2	2	2	1	1	1	1	1

UNIT - I:

Fundamentals of Digital Systems and Logic Families: 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'sand Two's complements arithmetic.

UNIT - II:

Combinational Circuits-I: Standard representation for logic functions, K-map representation and simplification of logic functions using K- map, Minimization of logical functions, Don't care conditions, Multiplexer, De-Multiplexer

UNIT - III:

Combinational Circuits-II: Adders, Subtractors, Carry look ahead adder, Digital comparator, Parity checker/generator, Code converters, Priority encoders, Decoders/Drivers for display devices, Q-M method of function realization.

UNIT - IV:

Sequential Circuits: Introduction to flip-flops, SR, JK, T and D type's flip-flops, Shift registers, Conversion of flip-flops, Ring counter, Ripple (Asynchronous) counters, Synchronous counters.

UNIT - V:

Semiconductor Memories and Programmable Logic Devices: Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read-only memory (ROM), ROM types, Read and write memory (RAM) types, Programmable logic array, Programmable array logic, Field Programmable Gate Array (FPGA).

TEXT BOOKS:

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.

REFERENCE BOOKS:

1. R.S. Sedha, "A Textbook of Digital Electronics", S. Chand, 2005
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.

EE405PC: CONTROL SYSTEMS

B.TECH. II YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE405PC	PCC	3	0	0	3

Prerequisite: Electrical Circuits-I & II and Electrical Machines-I

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

1. Find the transfer function and state-space representation of linear time-invariant dynamical systems.
2. Analyze the performance and stability of linear time-invariant systems in both time and frequency domains.
3. Study classical controllers/compensators to improve the performance and stability of linear time- invariant systems.

UNIT: I — **Mathematical modelling of physical systems**

Mathematical modelling 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-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**

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:**

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:

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", McGraw Hill Education, 2010.

WEB REFERENCES:

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

Member secretary **Chairman**

MA406PC: COMPUTATIONAL MATHEMATICS LAB

(Using Python/MATLAB software)

B.Tech. II Year II Sem. **L T P C**

0 0 2 1

Pre-requisites: Matrices, Iterative methods and ordinary differential equations

Course Objectives: To learn

- Solve problems of Eigen values and Eigen Vectors using Python/MATLAB.
- Solution of Algebraic and Transcendental Equations using Python/MATLAB
- Solve problems of Linear system of equations
- Solve problems of **First-Order ODEs Higher order linear differential equations with** constant coefficients

Course outcomes: After learning the contents of this paper, the student must be able to

- Develop the code to find the Eigen values and Eigen Vectors using Python/MATLAB.
- Develop the code find solution of Algebraic and Transcendental Equations and Linear system of equations using Python/MATLAB
- Write the code to solve problems of **First-Order ODEs Higher order linear differential equations with** constant coefficients

*** Visualize all solutions Graphically through programmes**

UNIT - I: Eigen values and Eigenvectors: **6P**

Programs:

- Finding real and complex Eigen values.
- Finding Eigen vectors.

UNIT-II: Solution of Algebraic and Transcendental Equations **6P**

Bisection method, Newton Raphson Method

Programs:

- Root of a given equation using Bisection method.
- Root of a given equation Newton Raphson Method.

UNIT-III: Linear system of equations: **6P**

Jacobi's iteration method and Gauss-Seidal iteration method

Programs:

- Solution of given system of linear equations using Jacobi's method
- Solution of given system of linear equations using Gauss-Seidal method

UNIT-IV: First-Order ODEs **8P**

Exact and non-exact equations, Applications: exponential growth/decay, Newton's law of cooling.

Programs:

- Solving exact and non-exact equations
- Solving exponential growth/decay and Newton's law of cooling problems

UNIT-V: Higher order linear differential equations with constant coefficients **6P**

Programs:

- Solving homogeneous ODEs
- Solving non-homogeneous ODEs

TEXT BOOKS:

1. MATLAB and its Applications in Engineering, Rajkumar Basal, Ashok Kumar Geo, Manoj Kumar Sharma, Pearson publication.
2. Kenneth A. Lambert, The fundamentals of Python: First Programs, 2011, Cengage Learnings.
3. Think Python First Edition, by Allen B. Downey, Orielly publishing.
4. Introduction to Python Programming, William Mitchell, Povel Solin, Martin Novak et al., NCLab Public Computing, 2012.
5. Introduction to Python Programming, ©Jacob Fredslund, 2007.

REFERENCE BOOKS:

1. An Introduction to Python, John C. Lusth, The University of Alabama, 2011.
2. Introduction to Python, ©Dave Kuhlman, 2008.

EE407PC: ELECTRICAL MACHINES - II LAB

B.TECH. II YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE407PC	PCC	0	0	2	1

Prerequisite: Electrical Circuits – I

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

1. Assess the performance of different types of AC machines using different testing methods.
2. Analyze the suitability of AC machines and Transformers for real word applications
3. Determine the performance of single and three-phase transformers.

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 & MMF 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 Xd and Xq of a salient pole synchronous machine
7. Brake Test on three phase Induction Motor
8. Regulation of three-phase alternator by ZPF and ASA 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.

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EE408PC: CONTROL SYSTEMS LAB

B.TECH. II YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE408PC	PCC	0	0	2	1

Prerequisite:

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

1. Improve system performance by skilfully selecting appropriate controllers and compensators tailored to specific applications.
2. Apply diverse time domain and frequency domain techniques to effectively assess and enhance system performance.
3. Demonstrate the application of various control strategies to different systems such as power systems and electrical drives, showcasing adaptability and versatility in control applications.

The following experiments are required to be conducted compulsory experiments:

1. Time response of Second order system
2. Characteristics of Synchro's
3. Effect of feedback on DC servo motor
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 eight experiments, at least any two of the experiments from the following list are required to be conducted

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", McGraw 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

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EE409PC: DIGITAL ELECTRONICS LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Prerequisites: Analog Electronics & Digital Electronics

Course Objectives:

- To learn basic techniques for the design of digital circuits and number conversion systems.
- To implement simple logical operations using combinational logic circuits.
- To design combinational logic circuits, sequential logic circuits.

Course Outcomes: After learning the contents of this paper the student must be able to

- Understand the working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.
- Analyze different types of semiconductor memories.

Course Objectives	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
To learn basic techniques for the design of digital circuits and number conversion systems	3	2	3	1	1	1	3	1	2	1	2	3
To implement simple logical operations using combinational logic circuits	3	3	3	2	2	1	3	1	2	2	2	3
To design combinational logic	2	2	1	2	2	1	3	1	2	2	2	3

circuits, sequential logic circuits												

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Understand the working of logic families and logic gates	2	2	2	3	3	2	1	1	3	3	3	3
Design and implement Combinational and Sequential logic circuits.	2	1	3	1	2	3	3	1	3	2	2	3
Analyse different types of semiconductor memories	1	1	2	1	1	3	3	1	3	3	3	3

List of Experiments:

1. Realization of Boolean Expressions using Gates
2. Design and realization logic gates using universal gates
3. Generation of clock using NAND/NOR gates
4. Design a 4 – bit Adder / Subtractor
5. Design and realization a 4 – bit gray to Binary and Binary to Gray Converter
6. Design and realization of a 4-bit pseudo random sequence generator using logic gates.
7. Design and realization of an 8-bit parallel load and serial out shift register using flip-flops.
8. Design and realization Asynchronous and Synchronous counters using flip-flops
9. Design and realization 8x1 using 2x1 mux
10. Design and realization 2-bit comparator
11. Verification of truth tables and excitation tables
12. Realization of logic gates using DTL, TTL, ECL, etc.,

TEXT BOOKS:

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.

REFERENCE BOOKS:

1. R.S. Sedha, “A Textbook of Digital Electronics”, S.Chand, 2005
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.

EE410SD: PCB DESIGN

B.TECH. II YEAR II SEMESTER

Course Code	Category	Hours/Week			Credits
		L	T	P	C
EE410PC	PCC	0	0	2	1

Prerequisite:

Course Objectives:

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

Course Outcomes: Upon completing this course, the student will be able to

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

Module I: Fundamentals of PCB Design

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

Lab Activity:

1. Exploring the user interface of PCB design software
2. Setting up design rules

Module II: Schematic Design

1. Creating circuit schematics using PCB CAD tools
2. Component library management
3. Electrical rule checking (ERC)
4. Netlist generation

Lab Activity:

1. Designing a basic power supply or LED flasher circuit
2. Performing ERC and generating netlist

Module III: PCB Layout and Routing

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

Lab Activity:

1. Placing components and routing for the schematic designed earlier

2. Performing DRC and correcting errors

Module IV: PCB Output Files and Fabrication

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

Lab Activity:

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

Module V: Mini Project and Testing

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

Lab Activity:

1. 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)*

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