Department of Electrical and Electronics Engineering
Birla Institute of Technology, Mesra, Ranchi - 835215 (India)

Institute Vision

To become a Globally Recognized Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research and technological service to the National needs.

Institute Mission

- To educate students at Undergraduate, Post Graduate, Doctoral and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching and learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

Department Vision

To become an internationally recognized centre of excellence in academics, research and technological services in the area of Electrical and Electronics Engineering and related inter-disciplinary fields.

Department Mission

- Imparting strong fundamental concepts to students and motivate them to find innovative solutions to engineering problems independently
- Developing engineers with managerial attributes capable of applying latest technology with responsibility
- Creation of congenial atmosphere and excellent research facilities for undertaking quality research by faculty and students
- To strive for more internationally recognized publication of research papers, books and to obtain patent and copyrights
- To provide excellent technological services to industry

Program Educational Objectives (PEO)

1. To develop capability to understand the fundamentals of Science and Electrical & Electronics Engineering for analysing the engineering problems with futuristic approach.
2. To foster a confident and competent graduate capable to solve real life practical engineering problems
   fulfilling the obligation towards society.
3. To inculcate an attitude for identifying and undertaking developmental work both in industry as well as in academic environment with emphasis on continuous learning enabling to excel in competitive participations at global level.
4. To nurture and nourish effective communication and interpersonal skill to work in a team with a sense of ethics and moral responsibility for achieving goal.

Program Outcomes (PO)

A graduate shall

a) Be competent in applying basic knowledge of science and engineering for the purpose of obtaining solution to a multi-disciplinary problem
b) Gain skilful knowledge of complex engineering problem analysis
c) Be able to design system components and processes meeting all applicable rules and regulations
d) Be proficient in arriving at innovative solution to a problem with due considerations to society and environment
e) Be capable of undertaking suitable experiments/research methods while solving an engineering problem and would arrive at valid conclusions based on appropriate interpretations of data and experimental results
f) Continually upgrade his/her understanding and become masterly at modern engineering and soft tools and apply them along with other appropriate techniques and resources
g) Exhibit understanding of societal and environmental issues (health, legal, safety, cultural etc) relevant to professional engineering practice and demonstrate through actions, the need for sustainable development
h) Be committed to professional ethics, responsibilities and economic, environmental, societal, and political norms.
i) Demonstrate appropriate inter-personal skills to function effectively as an individual, as a member or as a leader of a team and in a multi-disciplinary setting
j) Be able to comprehend and write effective reports and design documentations; give and receive clear instructions; make effective presentations and communicate effectively and convincingly on complex engineering issues with engineering community and with society at large.
k) Be conscious of financial aspects of all professional activities and shall be able to undertake projects with appropriate management control and control on cost and time.
l) Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.

Graduate Attributes

1. **Engineering Knowledge**: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, research literature and analyze complex engineering problems
   reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
4. **Conduct investigations of complex problems** using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
5. **Modern Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of
   engineering practice.
9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering
    community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of engineering and
    management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning**: Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

COURSE INFORMATION SHEET

Course code: EE 201
Course title: Electrical Measurement and Instrumentation
Pre-requisite(s): Basic knowledge of Mathematics, Basic knowledge of Natural and Engineering Physics, Basic knowledge of Electrical circuits, Basic knowledge of Laplace transform, Basic knowledge of digital electronics and communication
Co- requisite(s):
Credits: L: 3 T: 0 P: 0

Class schedule per week:
Class: B. Tech
Semester / Level: IV
Branch: EEE
Name of Teacher:

Course Objectives

This course enables the students:

A.	To outline the students an idea of calibration, standards, different errors, static and dynamic performance characteristics.
B.	To explain the operating principle of different analog and digital instruments used for electrical parameter measurement
C.	To classify and outline the operation and construction of various a.c. and d.c. bridges for measurement and display devices.
D.	To state the basic principle of commonly available transducers and their uses for measuring different electrical or non-electrical variables.

Course Outcomes

After the completion of this course, students will be:

1.	Identify and analyse errors and state the static and dynamic characteristics of instruments.
2.	Explain the working of different analog instruments (PMMC, Moving iron, electrodynamometer type) and their use for measuring voltage, current, power, phase and frequency.
3.	Show how to balance and design different bridge networks to find the value of unknown components.
4.	State the working of digital instruments, display devices and recorders.
5.	Reproduce the different working principles of transducers and also design transducers for measurement of non-electrical quantities.

Syllabus:

EE 201 ELECTRICAL MEASUREMENT AND INSTRUMENTATION

Module – I

Introduction: Definition of measurement, Generalized input-output configuration of measuring instruments and instrumentation systems. Performance characteristics (static and dynamic), Accuracy, Precision, Types of error, Statistical analysis, Standards of measurement. Systems of units. Fundamental and derived units. Dimensions. (5)

Module – II

Instruments: Basic requirement of a measuring instrument. Introduction to D' Arsonval galvanometer, Construction and principle of Moving coil, Moving iron, Induction types of instruments, Measurement of voltage, current and power, phase, frequency, Range extension including current and potential transformers. Digital voltmeter, vector voltmeter, Vector Impedance meter and Q-meter. (10)

Module – III

Bridge: DC bridges for measurement of resistance Wheatstone bridges, Kelvin's double bridges and AC bridges for measurement of L, R, C & M, Maxwell's bridges, Anderson's bridges, Wien's bridges. Measurement of frequency, localization of cable fault. Potentiometers: DC and AC potentiometers, Principles, Standardization and application. (9)

Module – IV

Oscilloscopes: CRT, Construction, Basic CRO circuits, Block diagram of a modern oscilloscope, Y-amplifiers, X-amplifiers, Triggering, Oscilloscopic measurement. Special CRO's: Dual trace, Dual beam, Sampling oscilloscope, Storage CROs. Display Devices & Recorders: Digital display, LED, LCD, Strip chart recorder, X-Y recorder. (10)

Module – V

Transducers: Classification, Inductive, Resistive and Capacitive transducers, Analog and Digital Transducers with applications. Hall effect, Piezo Electric, Photovoltaic transducer. Measurement of temperature and pressure. (6)

Text books:

1.Helfrick and Cooper - Modern Electronics Instrumentation and Measurement, Pearson Education, New Delhi.
2. Sawhney A.K. - Electrical & Electronic Measurement and Instrumentation, Dhanpat Rai & Son's

Reference books:

1. Patranabis D – Sensors and Transducers, Wheeler, 1996.
2. Kalsi - Electronics Instrumentation, TMH Publication, New Delhi.
3. Deoblin – Measurement Systems.
4. Patranabis D – Principles of Industrial Instrumentation, TMH Publication, New Delhi, 1976.
5. Golding- Electrical Measurement, Wheeler Publication.

Gaps in the syllabus (to meet Industry/Profession requirements): Signal generators and signal analysers, Data acquisition system.

POs met through Gaps in the Syllabus: a,b, c,e, f, i, j, k,l

Topics beyond syllabus/Advanced topics/Design: Process Measurement and Control

POs met through Topics beyond syllabus/Advanced topics/Design: a, b, c, e, i, j, k, l

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure:

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	60
Assignment / Quiz (s)	15

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√	√		
End Sem Examination Marks	√	√	√	√	√
Assignment				√	

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes:

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
1	3	3	3	1	3	2	1	1	3	3	2	3
2	3	3	2	NA	2	2	NA	NA	2	3	2	3
3	3	3	3	NA	3	2	NA	NA	2	3	2	3
4	3	3	3	NA	2	3	1	NA	2	3	1	3
5	3	3	2	2	3	2	1	1	3	2	2	3

< 34% = 1, 34-66% = 2, > 66% = 3

Mapping Between COs and Course Delivery (CD) methods			
CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1& CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2 & CD8
CD3	Seminars	CO3	CD1 & CD8
CD4	Mini projects/Projects	CO4	CD1& CD8
CD5	Laboratory experiments/teaching aids	CO5	CD1 & CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EE 203
Course title: Electric Energy Generation and Control
Pre-requisite(s): Basic knowledge about working of alternator and electric power systems
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3 Classes per week
Class: B. Tech
Semester / Level: III
Branch: EEE
Name of Teacher:

Course Objectives
This course enables the students:

A.	To enumerate the energy generation scenario and understand the principle of operation of different types of power generation systems.
B.	To relate the structure and principles of the controls related to electrical power generating stations.
C.	To outline power generation from renewable energy sources and assess impact of such non-polluting energy conversion systems.
D.	To compare salient features of different generating stations and substantiate sustainable and economic generation.

Course Outcomes:
After the completion of this course, students will be able to:

1.	Outline the significance of various components of the power generation plants and explain the principle of their operation for bulk energy generation.
2.	Apply the basic knowledge of electric power generation as well as control related to real and reactive power for load-frequency and voltage control.
3.	Outline the significance of Nuclear and Diesel power plants.
4.	Contrast and choose non-conventional energy sources for sustainable energy generation.
5.	Assess and integrate different power generation systems for interconnected operation.

Syllabus:

Module – I: Overview of Power Generation Scenario and Thermal Power Stations
Overview of power generation scenario from thermal, hydro and nuclear and non-conventional sources. Selection of site for a thermal station, layout, main components, boiler, economizer, air preheater, super heater, reheater, condenser, feed heater, cooling powers, FD and ID fans, Coal handling plant, water treatment plant, Ash handling plant, Types of boilers and theirs characteristics, Steam turbines, and their characteristics, governing system for thermal stations.

Module – II: Hydro Electric Stations
Selection of site, layout, classification of hydro plants, general arrangement and operation of a hydro - plant, governing system for hydel plant, types of turbines.

Module – III: Nuclear Power Station
Nuclear reaction for nuclear power, nuclear fuels, feasibility of a nuclear power station, layout, main part of a nuclear station, nuclear reactor classification, control system for nuclear power station, Safety of nuclear power reactor.

Module – IV: Diesel Electric Station
Site selection, layout, main components, choice and characteristics of diesel engines, diesel engines, diesel plant efficiency and heat balance, maintenance.

Module – V: Non-conventional Sources of Energy
Solar: Operating principles. Photovoltaic cell concepts. Cell, module, array. Series and parallel connections. Maximum power point tracking, Wind: Operating principles, types of wind turbines, Bio-Mass, Tidal.

TEXT BOOKS:

- Power Plant Engineering - PK Nag TMH publications, 2nd Edition.
- A Textbook on Power System Engg. – A Chakravarti, ML Soni, PV Gupta and U.S. Bhatnagar, Dhanpat Rai & Co., New Delhi, 2nd Edition.

REFERENCE BOOKS:

- Elements of Electrical Power Station Design-MV Deshpande, Pitman and Sons Ltd.
- Electric Power Generation, Transmission and Distribution - S.M. Singh, Prentice Hall of India, Delhi.
- Generation, Distribution and Utilization of Electrical Power – C.L. Wadhwa, New Age Publications

Course Evaluation: Individual assignment, Seminar before a committee, Theory (Quiz and End semester) examinations

Gaps in the syllabus (to meet Industry/Profession requirements):

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure:

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination	25
End Semester Examination	50
Quiz (s)	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Semester Examination	√	√	√		
End Semester Examination	√	√	√	√	√
Quiz (s)	√	√	√	√	√
Assignment	√	√	√	√	√

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	3	3	1	3	1	1	1				2
CO2	3	3	3	1	3	1	1	1				2
CO3	3	3	3	3	3	1	2	2		1	1	2
CO4	3	3	3	1	3		1	1		1	1	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2

3= High, 2=Medium, 1=Low

Course Delivery Methods:

CD	Course Delivery methods
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Industrial visits/in-plant training
CD5	Self- learning such as use of NPTEL materials and internets
CD6	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Mapping Between COs and Course Delivery (CD) methods	
Course Outcome	**Course Delivery Method**
CO1	CD1, CD2, CD3, CD5
CO2	CD1, CD2, CD3, CD5
CO3	CD1, CD2, CD3, CD5
CO4	CD1, CD2, CD3, CD5
CO5	CD1, CD2, CD3, CD5

COURSE INFORMATION SHEET

Course code: EC203
Course title: Digital System Design
Pre-requisite(s): Basics of Electronics & Communication Engineering
Co- requisite(s):
Credits: L: 3 T:0 P:0 C:3
Class schedule per week: 3
Class: B. Tech
Semester / Level: III/02
Branch: ECE
Name of Teacher:

Course Objectives

This course enables the students to:

1.	Understand the basics of the digital electronics.
2.	Apply the knowledge of digital electronics to construct various digital circuits.
3.	Analyse the characteristics and explain the outputs of digital circuits.
4.	Evaluate and asses the application of the digital circuits.
5.	Design digital machine for simple computing and control.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Explain the concept of digital electronics.
CO2	Apply the knowledge to produce digital electronics circuits.
CO3	Analyse and categorize digital circuits.
CO4	Justify the uses of different digital circuits.
CO5	Schematize and demonstrate simple computing machines.

SYLLABUS:

Module – 1:
Basics of Digital Electronics: Number representation, Binary number system, Number base conversion, Octal, Hexadecimal and BCD codes, binary Arithmetic, Logic gates, Introduction to VHDL and Verilog, VHDL Models, Logic Families: TTL, ECL, and CMOS Logic Circuits, Logic levels, voltages and currents, fan-in, fan-out, speed, power dissipation. Comparison of logic families.

Module – 2:
Simplification of Boolean functions: Boolean Algebra, Basic theorems and Properties, De Morgan's theorem, Canonical & Standard forms, Simplification of Boolean function using Karnaugh map, POS & SOP simplification, Prime implicant, NAND and NOR implementation.

Module – 3:
Design of Combinational Circuits: Analysis and design procedure, Parity Generators and Checkers, Adders, Subtractors, Look ahead carry, Adder, 4-bit BCD adder/subtractor, Magnitude comparator, Decoders, Encoders, Multiplexers, De-multiplexers, , Design of 1 bit ALU for basic logic and arithmetic operations.

Module – 4:
Design of Sequential Circuits and Memories: Basic Latch, Flip-Flops (SR, D, JK, T and Master-Slave), Triggering of Flip Flops, Synchronous and asynchronous counters, Registers, Shift Registers, Memories and Programmable Logic design, Types of memories, Memory Expansion and its decoding, Programmable Logic Arrays (PLA), Programmable Array Logic (PAL)

Module – 5:
Design of simple computing machines: SAP-I concepts with stress on timing diagrams, Microinstructions, Fetch and Execution cycle variable machine cycle, Hardware control Matrix, Macroinstructions, Microprogramming, Bus concepts, Multiplexed Minimum system. Pipelining concepts.

Books recommended:

Textbooks:

1. "Digital Design", Morris Mano and Michael D. Ciletti ,5th edition PHI
2. "Digital System Design using VHDL", Charles H Roth, Thomson Learning

Reference books:

1. Digital computer Electronics AP Malvino, 3rd Edition Mc Graw Hill

Gaps in the syllabus (to meet Industry/Profession requirements): Hands-on-practical on microprocessor trainer Kit

POs met through Gaps in the Syllabus: N/A

Topics beyond syllabus/Advanced topics/Design: N/A

POs met through Topics beyond syllabus/Advanced topics/Design: N/A

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	1	1			3		3
CO2	3	3	2	3	3	3	2			3		3
CO3	3	3	2	3	3	3	2			3		3
CO4	3	3	2	3	3	2	2			3		3
CO5	3	3	2	3	3	2	2			3		3

< 34% = 1, 34-66% = 2, > 66% = 3

Mapping between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD6, CD7
CO2	CD1, CD2, CD3, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD2, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD6, CD7

COURSE INFORMATION SHEET

Course code: EE205
Course title: CIRCUIT THEORY
Pre-requisite(s): Basics of Electrical Engineering
Co- requisite(s): Mathematics
Credits: 4 L:3 T:1 P:0
Class schedule per week: 04
Class: B. Tech
Semester / Level: 02
Branch: EEE
Name of Teacher:

Course Objectives:
This course enables the students to:

A. list the Properties and discuss the concepts of graph theory
B. solve problems related to network theorems
C. illustrate and outline the Multi- terminal network in engineering
D. select and design of filters

Course Outcomes:
After the completion of this course, students will:

1. be able to solve problems related to DC and AC circuits
2. become adept at interpreting network analysis techniques
3. be able to determine response of circuits consisting of dependent sources
4. analyse linear and non-linear circuits
5. be able to design the filters with help of electrical element

Syllabus:

Module – I
Network Topology: Definition and properties, Matrices of Graph, Network Equations &Solutions: Node and Mesh transformation; Generalized element; Source transformation; Formulation of network equations; Network with controlled sources; Transform networks; Properties of network matrices; Solution of equations; Linear time-invariant networks; Evaluation of initial conditions; Frequency and impedance scaling.

Module – II
Network Theorem: Substitution theorem, Tellegen's theorem, Reciprocity theorem; State space concept and State variable modelling.

Module – III
Multi-terminal Networks: Network function, transform networks, natural frequency (OCNF and SCNF); Two-port parameters, Equivalent networks.

Module – IV
Elements of Network Synthesis: Positive real function, Reactance functions, RC functions,
RL Network, Two-port functions, Minimum phase networks.

Module – V
Approximation: Filter specifications; Butterworth approximation; Chebyshev approximation; Frequency transformation; High pass; Band pass; all pass and notch filter approximation.

Text Books:

1. V.K. Aatre, Network Theory & Filter Design, New Age International Pvt. Ltd., New Delhi. (T1)
2. M.S. Sukhija, T.K.Nagsarkar, Circuits and Networks, Oxford University Press, 2nd ed., New Delhi.(T2)

Reference Books:

1. M.E. Van Valkenberg, Introduction to Modern Network Synthesis, John Wiley & Sons (1 January 1966) (R1)
2. Balabanian, N. and T.A. Bickart, "Electric Network Theory", John Wiley & Sons, New York, 1969. (R2)
3. C. L. Wadhwa, Network Analysis and Synthesis, New Age International Pvt. Ltd., New Delhi(R2)

Gaps in the syllabus (to meet Industry/Profession requirements):

i. Practical aspects and demonstration of electrical and non-electrical systems

POs met through Gaps in the Syllabus:

a) Demonstrate appropriate inter-personal skills to function effectively as an individual, as a member or as a leader of a team and in a multi-disciplinary setting (POi)
b) Be able to comprehend and write effective reports and design documentations; give and receive clear instructions; make effective presentations and communicate effectively and convincingly on complex engineering issues with engineering community and with society at large. (POj)
c) Be conscious of financial aspects of all professional activities and shall be able to undertake projects with appropriate management control and control on cost and time. (POk)
d) Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career. (POl)

Topics beyond syllabus/Advanced topics/Design:

i. Design of filter using operational amplifier

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure:

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Mid Sem Examination Marks	25
End SemExamination Marks	50
Assignment	05
Quiz (s)	20

Assessment Compoents	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Mid Sem Examination Marks	√	√	√		
End Sem Examination Marks	√	√	√	√	√
Assignment				√	√

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes:

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	3	3	2							1	1	1
2	3	3	3	2	1					1	1	1
3	3	3	3	3	2	2				1	1	1
4	3	3	3	3	3	3				2	2	2
5	3	3	3	2	2	3	3	3	3	1	3	3

CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1
CD2	Tutorials/Assignments	CO2	CD1
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EE102
Course title: ELECTRICAL ENGINEERING LABORATORY
Pre-requisite(s): Physics, Fundamentals of Mathematics and Electrical Engineering.
Credits: L T P
0 0 3
Class schedule per week: 3

Course Overview: Concepts of measuring instruments, AC RLC series parallel circuit operation, resonance, KVL and KCL, circuit theorems, 3-phase star and delta connections, measurement of low and high resistance of D.C. machine, measurement of power by three voltmeter, three-ammeter methods, measurement of power of 3-phase induction motor by two-wattmeter method.

Course Objectives

This course enables the students:

A.	To describe student's practical knowledge of active and passive elements and operation of measuring instruments
B.	To demonstrate electrical circuit fundamentals and their equivalent circuit models for both 1-φ and 3-φ circuits and use circuit theorems
C.	To establish voltage & current relationships with the help of phasors and correlate them to experimental results
D.	1. To conclude performance of 1 – Φ AC series circuits by resonance phenomena 2. To evaluate different power measurement for both 1-φ and 3- φ circuits

Course Outcomes

After the completion of this course, students will be able to:

1.	classify active and passive elements, explain working and use of electrical components, different types of measuring instruments;
2.	illustrate fundamentals of operation of DC circuits, 1-φ and 3- φ circuits and also correlate the principles of DC, AC 1-φ and 3- φ circuits to rotating machines like Induction motor and D.C machine.;
3.	measure voltage, current, power, for DC and AC circuits and also represent them in phasor notations;
4.	analyse response of a circuit and calculate unknown circuit parameters;
5.	recommend and justify power factor improvement method in order to save electrical energy.

LIST OF EXPERIMENTS:

1. **Name: Measurement of low & high resistance of DC shunt motor**
   Aim: (i) To measure low resistance of armature winding of DC shunt motor
   (ii) To measure high resistance of shunt field winding of DC shunt motor

2. **Name: AC series circuit**
   Aim: (i) To obtain current & voltage distribution in AC RLC series circuit and to draw phasor diagram
   (ii) To obtain power & power factor of single-phase load using 3- Voltmeter method and to draw phasor diagram

3. **Name: AC parallel circuit**
   Aim: (i) To obtain current & voltage distribution in AC RLC parallel circuit and to draw phasor diagram
   (ii) To obtain power & power factor of single-phase load using 3- Ammeter method and to draw phasor diagram

4. **Name: Resonance in AC RLC series circuit**
   Aim: (i) To obtain the condition of resonance in AC RLC series circuit
   (ii) To draw phasor diagram

5. **Name: 3 phase Star connection**
   Aim: (i) To establish the relation between line & phase quantity in 3 phase star connection
   (ii) To draw the phasor diagram

6. **Name: 3 phase Delta connection**
   Aim: (i) To establish the relation between line & phase quantity in 3 phase delta connection
   (ii) To draw phasor diagram

7. **Name: 3 phase power measurement**
   Aim: (i) To measure the power input to a 3-phase induction motor using 2 wattmeter method
   (ii) To draw phasor diagram

8. **Name: Self & mutual inductance**
   Aim: To determine self & mutual inductance of coils

9. **Name: Verification of Superposition, Thevenin's and Reciprocity theorem**
   Aim: (i) To verify Superposition theorem for a given circuit
   (ii) To verify Thevenin's theorem for a given circuit

10. **Name: Verification of Norton's, Tellegen's and Maximum Power transfer theorem**
    Aim: (i) To verify Norton's theorem for a given circuit
    (ii) To verify Maximum Power transfer theorem for a given circuit

Gaps in the syllabus (to meet Industry/Profession requirements)

1. Application of principles of magnetic circuits to electrical machines like transformers, generators and motors
2. Visualize Phase sequence

POs met through Gaps in the Syllabus: a, b, c, g

Topics beyond syllabus/Advanced topics/Design

1. Assignment: Simulation of electrical circuits with dependent/independent sources by various techniques (Mesh current/Node Voltage/Thevenin's theorem/Norton's theorem/Maximum power transfer theorem etc.) using MATLAB/PSIM/C++ softwares
2. Active/reactive power calculation for 3 – Φ circuits

POs met through Topics beyond syllabus/Advanced topics/Design: e, f, i, j, k

Mapping of lab experiment with Course Outcomes

Experiment	Course Outcomes				
	1	**2**	**3**	**4**	**5**
1	3	3	3	2	
2	3	3	3	3	2
3	3	3	3	3	2
4	3	3	3	3	2
5	3	3	3	1	
6	3	3	3	1	
7	3	3	3	2	2
8	3	3	3	3	
9	3	3	3	2	
10	3	3	3	2	

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Mini projects/Projects
CD4	Laboratory experiments/teaching aids
CD5	Self- learning such as use of NPTEL materials and internets
CD6	Simulation

Course Evaluation:

Daily individual assessment through viva:	20
Regular evaluation of fair and rough copy:	15+5=20
Regularity/Punctuality:	10
Assignment:	10
Practical examinations:	20
End sem Viva-voce :	20
TOTAL:	**100**

Mapping of Course Outcomes onto Course Objectives

Course Outcome #	Course Objectives			
	A	**B**	**C**	**D**
1	3	3	3	3
2	3	3	3	3
3	3	3	3	3
4	3	3	3	3
5	2	3	3	3

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	3	3	3	3	3	1	3	3	3	3	3	3
2	3	3	3	2	2	2	2	3	3	3	3	3
3	3	3	3	2	2	2	2	2	3	3	2	3
4	3	3	3	3	3	1	2	2	3	3	2	2
5	3	3	3	3	3	2	3	3	3	3	3	3

Mapping of Course Outcomes onto Program Educational Objectives

Course Outcome #	Program Educational Objectives			
	1	**2**	**3**	**4**
1	3	3	2	2
2	3	3	3	
3	3	3	3	2
4	3	3	3	
5	3	3	2	2

Mapping Between COs and Course Delivery (CD) methods

Course Outcome	Course Delivery Method
CO1	CD1, CD2, CD4, CD5
CO2	CD1, CD4, CD5
CO3	CD1, CD3, CD4, CD5, CD6
CO4	CD1, CD2, CD4, CD5
CO5	CD4, CD5

Course Delivery (CD) methods		Program Outcomes (PO)											
		PO A	PO b	PO C	PO D	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CD1	Lecture by use of boards/LCD projectors	2	1	1	2	3	1						
CD2	Tutorials/ Assignments	2	2	2	2	3	3			3	3	1	2
CD3	Seminars												
CD4	Mini projects/Projects												
CD5	Laboratory experiments/teaching aids	3	3	3	3	3	1		2	3	2	2	3
CD6	Industrial/guest lectures												
CD7	Industrial visits/in-plant training												
CD8	Self- learning such as use of NPTEL materials and internets	3	3	3	3	3	3	2	3	2	3	2	2
CD9	Simulation	3	3	3		3	3			2	2		

COURSE INFORMATION SHEET

Course code: EC204
Course title: Digital System Design Lab
Pre-requisite(s): Basics of Electronics & Communication Engineering
Co- requisite(s):
Credits: L:0 T:0 P:3 C:1.5
Class schedule per week: 03
Class: B. Tech
Semester / Level: III/ 02
Branch: ECE
Name of Teacher:

Course Objectives

This course enables the students to:

1.	Understand the basics of logic gates, input, output, power supply and gates IC's.
2.	Apply the knowledge of digital electronics to construct combinational and sequential circuits.
3.	Analyse controlled digital circuits with different Boolean function.
4.	Evaluate combinational/sequential circuits and memories.
5.	Translate real world problems into digital logic formulations using VHDL.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Describe the knowledge of basic logic gates and their design using universal gates.
CO2	Demonstrate the working of combinational and sequential circuits.
CO3	Integrate and experiment with controlled digital circuits.
CO4	Appraise combinational/sequential circuits and memories.
CO5	Schematize, simulate and implement combinational and sequential circuits to solve real world problems using VHDL systems.

SYLLABUS

List of experiments:

1. Design and implement a controlled CMOS Inverter.
2. To study and verify the truth table of NAND and EX-OR gate using IC 7400.
3. Design and implement SEVEN segment display unit.
4. Design and verify half adder and full Adder circuits using gates and IC 7483.
5. Design and implement a 3:8 Decoder.
6. Design and implement 8:3 priority encoder.
7. Design a 4-bit magnitude comparator using combinational circuits.
8. Design and implement 8:1 multiplexer and 1:4 demultiplexer.
9. Design ALU with functions of ADD, SUB, INVERT, OR, AND. XOR, INC, DEC and CMP.
10. Design and verify decade Counter.
11. Design a ROM (8X4) using decoder, gates and diodes.
12. Design of pre settable up/down counter.

Implement all the above experiments using VHDL platform and verify.

Books recommended:

Textbooks:

1. "Digital Design", Morris Mano and Michael D. Ciletti ,5th edition PHI
2. "Digital System Design using VHDL", Charles H Roth, Thomson Learning

Reference books:

2. Digital computer Electronics AP Malvino, 3rd Edition Mc Graw Hill

Gaps in the syllabus (to meet Industry/Profession requirements):

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Quiz(zes)	10
Viva	20

Semester End Examination	% Distribution
Examination Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	1	1	1		3		3
CO2	3	3	3	3	3	1	1	1		3		3
CO3	3	3	3	3	3	1	1	1		3		3
CO4	3	3	3	3	3	1	1	1		3		3
CO5	3	3	3	3	3	1	1	1		3		3

< 34% = 1, 34-66% = 2, > 66% = 3

Mapping between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD3, CD6, CD7
CO2	CD1, CD3, CD6, CD7
CO3	CD1, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD3, CD6, CD7

4th SEMESTER NEW COURSE STRUCTURE
Based on CBCS & OBE model
B.Tech. in Electrical and Electronics Engineering

COURSE INFORMATION SHEET

Course code: EE 251
Course title: DC Machines & Transformers
Pre-requisite(s): Basics of Electrical Engineering
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. E.
Semester / Level: IV/2
Branch: EEE
Name of Teacher:

Course Objectives:

This course enables the students:

A.	To explore the basic principles of transformer and dc machines and analyse comprehensively their steady –state behaviours
B.	To examine characteristic of static and dynamic dc machines
C.	A technique to draw armature winding of dc machine and magnetic circuit of transformer in order to evaluate their performance
D.	To design and recommend low cost and high-performance machines which finds application in modern industries, homes and offices

Course Outcomes:

After the completion of this course, students will be:

1.	State and explain working principle, constructions as well as steady- state behaviour of an ac static and dc machines
2.	Interpret the different transformer and dc machines
3.	Identify, formulate and solve problems related to power transformer and dc machines
4.	Specify, interpret data, design an electrical machine and make a judgment about the best design in all respect
5.	Aspire for developing career with specialization in areas of electric machine drives, recognize the need to learn, to engage and to adapt in a world of constantly changing electric machine technology

Syllabus:

Module – I

Single Phase Transformers: Introduction to transformer, Basic Principle of operation, Classification, Rating, Construction of single phase transformer and Practical considerations, transformer winding, Ideal and physical transformers, EMF equation, transformation ratio, Phasor diagram, Performance analysis, Equivalent circuit, Losses and efficiency, Condition for maximum efficiency, Determination of equivalent circuit parameters by O.C. and S.C. tests, Per-unit calculation, Voltage regulation, all day efficiency. [8]

Module – II

Three Phase Transformer: Advantage, Principle of operation, Connections of 3-phase transformer, Transformer vector grouping, Open delta connection, Three phase to two phase conversion (Scott connection) and six phase conversion, three winding transformer, rating. OC & SC Test, Polarity test, Sumpner's back to back test. Parallel operation and Load sharing in single & three phase transformer.

Different types of transformers: Autotransformer- construction, working, advantage & disadvantage and application. Power transformers, Distribution transformers, Instrument transformers, Tap changing transformers, Pulse Transformer, Welding Transformer. Transformer cooling, grounding, maintenance, and rating. [8]

Module – III

Basic Concept of Rotating Machines: Electromagnetism**,** Electromagnetic induction, Flux Linkage, Force on a conductor in a magnetic field & between two current carrying conductor, statistically & dynamically induced EMF,

Magnetomotive Force (MMF), Classification of Rotating Machines, Electromagnetic Torque, Constructional parts of DC machines and their function. Armature Winding, Ring winding, Drum Winding, type of DC machine Winding, Principle of DC Generator and its operation, EMF generated in DC Generator, Principle of DC Motor. [8]

Module – IV

DC Generators: Types of DC Machines, EMF equation, Losses in DC Generator, Power Stages, Efficiency, Condition for maximum efficiency, Armature reaction, Compensating winding, Inter-poles, Process of Commutation, Reactance Voltage, Methods of improving commutation, equalizer rings, Method of excitation, Characteristics of DC Generators- Magnetization, Process of voltage build-up of shunt generator, Internal and external characteristics, voltage regulation, Critical resistance and Critical speed, Parallel operation of DC generators, Applications of DC Generators. [8]

Module – V

DC Motors: Basic equation for voltage, Back EMF, Power, condition for maximum power, armature Torque, Rotational losses, and speed of DC Motors. Operating characteristics of DC Motors – speed –back emf & flux, Torque-current, Speed-current and Torque-speed characteristics. Speed regulation, Speed control of DC motors, Starters for DC Motors, Electric Breaking. Testing of DC machines: Break test, Swinburne's, Hopkinson's and Series field tests, Retarding or Running Test. Calculation of efficiency. Applications of DC Motors, Special DC motors, Brushless DC Motor. [8]

Text books:

1. I. J. Nagrath, D.P. Kothari, Electric Machines, 4th Edition, TMH, New Delhi, 2014.
2. P. S. Bimbhra, Electrical Machines, Khanna Publishers, New Delhi, 7th Edition 2014.

Reference books:

1. A. E. Fitzgerald, Charles Kingsley, Stephen D. Umans; Electric Machinery, McGraw Hill Education (India) Pvt. Ltd., Noida, 6th Edition, 2003.
2. Alexander Suss Langsdorf; Theory of Alternating Current Machinery, McGraw-Hill, New York 1955.
3. Smarajit Ghosh, Electrical Machines; Pearson, New Delhi, 2nd Edition, 2012.

Gaps in the syllabus (to meet Industry/Profession requirements):

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design: Design of Electrical Machines

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination Marks	25
Quiz (s)	20 (10x2)
Teacher Assesment	05
End Semester Examination Marks	50

Indirect Assessment –

1. Student Feedback of Faculty
2. Student Feedback of Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes:

Course Outcome #	Program Outcomes											
	a	**b**	**c**	**D**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	3	3	3	3	3	2	1			1		1
2	3	3	3	3	3	3	1			1	1	1
3	2	2	3	3	2	3	1	1	1	1	1	2
4	3	3	3	3	3	3	1	2	2	2	2	2
5	3	3	3	3	3	3	3	3	3	3	3	3

Mapping Between COs and Course Delivery (CD) methods			
CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1
CD2	Tutorials/Assignments	CO2	CD1
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EE253
Course title: Engineering Electromagnetics
Pre-requisite(s): Electric drives
Co- requisite(s): Vector analysis, co-ordinate geometry, applied mathematics (differential equation),

Credits:	L:	T:	P:
	3	1	0

Class schedule per week: 04
Class: B.Tech
Semester / Level: 2nd / 4
Branch: EEE
Name of Teacher:

Course Objectives:

The course objective is to provide students with an ability to:

A.	Understand the basic laws (including Maxwell's equations & boundary conditions) in Electrostatics and Magnetostatics;
B.	Interpret the characteristics of EM waves in free-space, conductors & dielectrics (with an emphasis on time-varying Maxwell's equations and boundary conditions), with Reflection and Refraction phenomenon of EM waves at different media interfaces;
C.	Describe the TE & TM wave propagation in guided mediums;
D.	Visualize the source & structure of wave propagation (antennas & radiation).
E.	Design simple antenna and evaluate its radiation efficiency.

Course Outcomes:

At the end of the course, the student will be able to:

1.	Understand basic laws of static electric fields & steady magnetic fields and along with time-varying Maxwell's equation in different forms (differential and integral);
2.	Apply the method of images & method of separation of variables to electrostatic boundary value problems;
3.	Examine the wave propagation phenomena in different media and its interfaces, while associating its significance to reflection and refraction of EM waves;
4.	Analyze the nature of electromagnetic wave propagation in guided medium related to microwave applications;
5.	Evaluate the source of radiations: the antenna, its radiation patterns and different parameters.

SYLLABUS:

EE253 ENGINEERING ELECTROMAGNETICS

Module – I

Electrostatic and Magnetostatic Energy, Forces and Torques: Electrostatic energy: Electrostatic forces and torques in terms of stored electrostatic energy. Magnetic energy: Magnetic forces and torques in terms of stored magnetic energy.

Module – II
Electrostatic Boundary-Value Problems: Introduction, Maxwell's Equation for static and time varying fields, Poisson's and Laplace's equations. Boundary conditions. Uniqueness theorem. Solution of one-dimensional Laplace's and Poisson's equations.

Module – III
Plane Electromagnetic Waves: Wave equations. Helmholtz equations. Plane waves. Propagation of uniform plane waves in dielectric and conducting media. Polarization of plane waves.

Module – IV
Reflection and Refraction of Plane Waves: Electromagnetic boundary conditions. Reflection of normally and obliquely incident plane waves from perfect conductor and dielectric. Total reflection. Total transmission.

Module – V
Radiation and Antennas: Introduction. Scalar and vector potentials. Retarded potentials. Radiation from elemental electric dipole. Antenna pattern and antenna parameters. Thin linear antennas.

Text Book:

1. Cheng, D.K., "Field and Wave Electromagnetics", Pearson Education (Singapore) Pte. Ltd., 2nd Edn., 1989.
2. Hayt, W.H., J.A. Buck, "Engineering Electromagnetics", Tata Mc Graw Hill.

Reference Book:

1. Edward C. Jordan & Keith G. Balmain, "Electro-magnetic waves & Radiating System", PHI.
2. Deepak Sood, "Field & Wave, A Fundamental Approach", University Science Press.
3. S. C. Matapatra, Sudipta Mahapatra, "Principles of Electromagnetics", Tata McGraw Hill.
4. Matthew Sadiku, "Principles of Electromagnetics", Oxford University Press.
5. A. R. Harish, M. Sachidananda, "Antennas & Wave Propagation", Oxford University Press.

Gaps in the syllabus: Simulation based analysis of electromagnetic wave pattern
POs met through Gaps in the Syllabus: PO (e)
Topics beyond syllabus/Advanced topics/Design: Assignment: Simulate Hertzian Dipole antenna
POs met through Topics beyond syllabus/Advanced topics/Design: PO (e)

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination Marks	25
Quizzes	20
Independent teacher's assessment	5
End Semester Examination Marks	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Semester Examination Marks					
Quizzes					
End Semester Examination Marks					
Independent teacher's assessment					

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

1. MAPPING I: (Course Objectives & Outcomes)

Course Objectives / Outcomes	1.	2.	3.	4.	5.
A.	3	2	2	2	1
B.	3	3	2	2	2
C.	3	3	2	2	2
D.	3	3	3	2	2
E.	3	3	3	3	3

2. MAPPING II: (CO vs PO)

TABLE NO.1

Course Code and name EE211 ENGG. ELECTROMAGNETICS Course Outcomes/POs	a	b	c	d	e	f	g	h	i	j	k	l
1.	3	3	3	3	3	1	1	1	1	1	1	1
2.	3	3	3	3	3	2	2	1	1	1	1	1
3.	3	3	3	3	3	2	2	2	2	1	1	1
4.	3	3	3	3	3	3	2	2	2	2	2	2
5.	3	3	3	3	3	3	3	3	3	3	2	2

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	60
Assignment	15

Indirect Assessment

1. Student Feedback on Course Outcome

TABLE NO.2

Course Outcomes	Student Feedback Percentage on Course Outcome
CO1	
CO2	
CO3	
CO4	
CO5	

TABLE NO.3

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Mid Sem Examination Marks **(25%)**					
Quizzes (20%)					
Teacher's Assessment/ Assignment Attendance/etc (**5%)**					
End Sem Examination Marks **(50%)**					

TABLE NO.4

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Direct (60%)					
Indirect (40%)					
Total					

3. <u>Mapping between COs and Course Delivery (CD) methods:</u>

Table 4–Submitted in SAR (Self-Assessment	
CD	**Course Delivery methods**
CD1	Lecture by use of boards/LCD projectors/OHP
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training
CD8	Self- learning such as use of NPTEL materials and
CD9	Simulation

Table 5	
Course Outcome	Course Delivery Method
CO1	CD1, CD8
CO2	CD1, CD8
CO3	CD1, CD8
CO4	CD1, CD2, CD8
CO5	CD1, CD2, CD8

COURSE INFORMATION SHEET

Course Code: EE252
Course Title: ELECTRICAL MACHINE LABORATORY – I
Designation: Compulsory Course
Pre-requisite: Fundamental of Electrical Machines (Transformer and DC Machines), Electrical Measurement

Contact Hours:	**L**	**T**	**P**	**C**
	0	**0**	**3**	**2**

Course Evaluation: Progressive Evaluation (Class performance, Lab. Record, Viva) and End Semester Evaluation (Viva-voce and performance).
Class schedule per week: 03
Class: B.Tech
Semester / Level: 4th/ 2
Branch: EEE
Name of Teacher:

Course Objectives:

This course enables the students:

1. to the basic fundamentals related to the principle, construction and operation of Transformer and DC Machines and to give them experimental skill.
2. to measure the performance of a transformer and DC Machines by conducting various tests and to calculate the parameters.
3. to basic skills needed to test and analyse the performance leading to design of electric machines.
4. to work in a group and evaluate the results to prepare the report.

Course Outcomes:

Upon completion of this course, the student will:

1. Able to recognize various types of Transformer and DC Machines, detail of name plate data of the machines and sketches the various connection diagrams involving these machines
2. Describe the features and working principle of transformers, DC Machine and starters.
3. Able to perform experiments which are necessary to determine the parameters and the performance characteristics of the transformer and dc machines.
4. Analyse the experimental results and write the report.
5. Able to work in the field of operation, control and maintenance in a group as well as individual.

List of the Experiments:

1. **Experiment No. 1**

Name: Study of Transformers
Object: To study the construction and operational details of 1-phase, 3-phase and auto transformers.

2. **Experiment No. 2**

Name: Study of D.C. Machines and Starters
Object: To study the construction and operational details of D.C. Machines and Starters (3 points & 4 Points Starters)

3. **Experiment No. 3**

Name: O.C and S.C. Test of a Single-Phase Transformer
Object: a) To find equivalent circuit parameters
b) To find different types of losses and efficiency
c) To draw the OCC and SCC

4. **Experiment No. 4**

Name: Load test of Single-Phase Transformer
Object: a) To perform load test at unity power factor
b) To calculate the voltage regulation and efficiency

5. Experiment No. 5

Name: Magnetization Characteristic of separately Excited D.C. Generator
Object: To plot Magnetization curve (E Vs. I_f) for different values of speed

6. Experiment No. 6

Name: Load test of a D.C. Series Generator
Object: a) To Study how the terminal voltage of a DC series generator varies with load current at constant rated speed
b) To draw the external Characteristics

7. Experiment No. 7

Name: Load test of a D.C. Shunt Generator
Object: Plot the following Characteristics
a) Terminal voltage vs. load current
b) Field current vs. load current
c) Internal or total Characteristics

8. Experiment No. 8

Name: Load test of a D.C. Shunt Motor
Object: Plot the following Characteristics
a) Speed vs. BHP and torque Vs. BHP
b) Current and efficiency vs. BHP
c) Speed vs. torque

9. Experiment No. 9

Name: Speed Control of a D.C. Shunt Motor
Object: Plot the following Characteristics
a) Speed vs. armature voltage (field current being constant)
b) Speed vs. field current (armature voltage being constant)

10. Experiment No. 10

Name: Swinburne's Test
Object: To conduct Swinburne's test on D.C. Shunt machine and determine its efficiency while operating as (i) Motor and (ii) Generator

References:

1. The performance and design of DC machines by A.E. Clayton
2. Theory of AC machines by A. S. Langsdorf,
3. Laboratory experiments on electrical machines by C. K. Chanda & A. Chakraborty, Dhanpat Rai & Co., New Delhi
4. Laboratory manual for electromechanics by S. S. Murty, B.P. Singh C. S. Jha and D. P. Kothari, Wiley Eastern Ltd., Delhi.

Gaps in the syllabus (to meet Industry/Profession requirements): Maintenance and troubleshooting of Electrical Machine, Special Machines and Drives

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design: Electrical Drives

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Evaluation	40

Asseessment Compoents	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√	√	√	√
End Sem Examination Marks	√	√	√	√	√

Indirect Assessment –

1. Student Feedback

Mapping between Course Objectives and Course Outcomes:

Course Objectives	Course Outcomes				
	i	ii	iii	iv	v
1	√	√	√		√
2		√	√	√	√
3	√		√	√	√
4			√	√	√

Mapping between CO and PO

Course Outcomes	Programme Outcomes											
	a	b	c	d	e	f	g	h	i	j	K	l
1	3	1			2	2	1				1	
2	3	2	1	1	3		1					1
3		3	2	2	3	2						
4	2	3	3	1		2				3	2	
5		3	1		3	1		2	3		1	1

Course Delivery methods
Lecture by use of boards/LCD projectors
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Mapping Between COs and Course Delivery (CD) methods	
Course Outcome	**Course Delivery Method**
CO1	CD1, CD2, CD3, CD4, CD5
CO2	CD1, CD2, CD4, CD5
CO3	CD1, CD2, CD5
CO4	CD1, CD5, CD6
CO5	CD1, CD5, CD6

COURSE INFORMATION SHEET

Course code: EE 202

Course title: Electrical Measurement and Instrumentation Lab

Pre-requisite(s): Knowledge of Physics, Electrical Circuits, Measurement and Instrumentation

Credits:	L	T	P
	0	0	3

Class schedule per week: 03

Course Objectives:

This course enables the students:

A	To state the procedures of measurement of low, medium and high resistances
B	To outline the working of display devices like CRO, recorders and plotters.
C	To explain testing on dc bridge (Wheatstone bridge) for finding fault location and ac bridge, perform experiment on Energy meter and Range extension of ammeter and voltmeter
D	To list the different types of transducers and their use in measurement of speed, force, displacement, temperature and light intensity.

Course Outcomes:

After the completion of this course, students will be able to:

1	Show proper use of measurements on a variety of physical quantities with accuracy.
2	Explain the basic principles of measurement and experimental methods for measuring mechanical and electrical quantities with the use of transducers
3	Reproduce his acquaintance with the use of AC and DC bridges and display devices.
4	Outline the various methods of measurement of resistances.
5	Design techniques using knowledge of measurement of electric quantities.

Syllabus

LIST OF EXPERIMENTS

Experiment No. 1

Name: Wheatstone bridge

Objective: Measurement of medium range resistance using Wheatstone bridge

Experiment No. 2

Name: Kelvin Double Bridge

Objective: Measurement of low resistance by Kelvin Double Bridge method.

Experiment No. 3

Name: Loss of charge method

Objective: Measurement of high resistance using Loss of charge method.

Experiment No. 4
Name: Localization of cable fault
Objective: Determination of location of point of fault in a cable.

Experiment No. 5
Name: Breakdown voltage of transformer oil
Objective: Measurement of breakdown voltage of transformer oil

Experiment No. 6
Name: Maxwell's Inductance - Capacitance Bridge
Objective: Measurement of coil constant using Maxwell's Inductance - Capacitance Bridge.

Experiment No. 7. (a)
Name: Linear Variable Differential Transformer (LVDT)
Objective: Measurement of linear displacement using LVDT.

Experiment No. 7. (b)
Name: Strain Gauge
Objective: Measurement of strain by the use of strain gauge.

Experiment No. 8
Name: Energy meter
Objective: Calibration of single phase Energy meter

Experiment No. 9
Name: Speed Measurement using Stroboscope
Objective: Measurement of speed of a rotating element (DC motor) using stroboscope.

Experiment No. 10
Name: Study Experiment

1. Objective: Study of recorders and plotters like Strip chart recorders, X- Y recorders and Magnetic tape recorders.
2. Objective: Study of CRO and applications of CRO for measurement of voltage, current, phase and frequency for sinusoidal, square and triangular waveforms.
3. Objective: Determination of characteristics of optical transducers such as Photovoltaic cell, Photoconductive cell, Photo transistor cell and Pin photodiode.
4. Objective: Determination of characteristics of thermal transducers such as RTD (Resistance Temperature Detector), IC Temperature sensor and NTC (Negative temperature coefficient) Thermistor

Books recommended:

Text book: A Course in Electrical & Electronics Measurement and Instrumentation, A. K. Sawhney, Dhanpat Rai & Sons

Reference book: Electrical Measurements and Measuring Instruments, Rajendra Prasad, Khanna Publishers, Delhi – 6.
Electrical Measurement, Golding, Wheeler Publication.

Gaps in the syllabus (to meet Industry/Profession requirements):Extra experiments givenabove can be added

POs met through Gaps in the Syllabus : POs a, b, c, e, f, i, j, l

Topics beyond syllabus/Advanced topics/Design: Process measurement and control.

POs met through Topics beyond syllabus/Advanced topics/Design: POs a, b, c, d, e, f, i, j, k, l

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation Marks	60
End Sem Examination Marks	40

Assessment Components	CO1	CO2	CO3	CO4	CO5
Progressive Evaluation Marks	√	√	√	√	√
End Sem Examination Marks	√	√	√	√	√

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
1	3	3	2	1	2	2			1	3	2	3
2	3	3	3	2	3	2	1	1	2	3	2	3
3	3	3	3		3	2		1	1	3	2	3
4	2	3	3		2	1			2	2	1	3
5	2	3	3	1	3	2	1		2	3	1	3

Mapping Between COs and Course Delivery (CD) methods				
CD	**Course Delivery methods**		**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		CO1	CD5 & CD8
CD2	Tutorials/Assignments		CO2	CD4, CD5 & CD8
CD3	Seminars		CO3	CD5 & CD8
CD4	Mini projects/Projects		CO4	CD4, CD5 & CD8
CD5	Laboratory experiments/teaching aids		CO5	CD4, CD5 & CD8
CD6	Industrial/guest lectures			
CD7	Industrial visits/in-plant training			
CD8	Self- learning such as use of NPTEL materials and internets			
CD9	Simulation			

Mapping between course objective and course outcome

Course objective	Course outcomes				
	i.	ii.	iii.	iv.	v.
1.	3			3	1
2.	3		3		2
3.	2	1	3		1
4.	3	3	1	1	3