Course No	Course Name	L-T-P-Credits	Year of Introduction
EE202	**Synchronous and Induction Machines**	3-1-0-4	2016

Prerequisite : NIL

Course Objectives

To give exposure to the students about the concepts of alternating current machines including the Constructional details, principle of operation and performance analysis.

To learn the characteristics of induction machines and to learn how it can be employed for various applications.

Syllabus

Alternators – basic principle, constructional details, armature windings, armature reaction, voltage regulation and determination of regulation by different methods; parallel operation of alternators and synchronization; Synchronous motors – principle, performance and power relations; synchronous induction motors.

Induction motors – basic principle, rotating magnetic field, constructional details, mechanical power and torque, performance analysis, starting methods, braking, testing, equivalent circuit and circle diagrams; single phase induction motors.

Induction generator – principle of operation.

Expected Outcome

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

1. identify alternator types, and appreciate their performance
2. determine the voltage regulation and analyse the performance of alternators
3. describe the principle of operation of synchronous motor and different applications.
4. describe the principle of operation of 3-phase induction motors and select appropriate motor types for different applications.
5. analyse the performance of 3-phase induction motors
6. familiarize with principle of operation and application of 1 -phase induction motors.

Text Book

1. Bimbra P. S., *Electrical Machinery*, 7/e, Khanna Publishers, 2011.
2. Nagrath J. and D. P. Kothari, *Theory of AC Machines*, Tata McGraw Hill, 2006.

Reference Books

1. Say M. G., *The Performance and Design of A. C. Machines*, C B S Publishers, New Delhi, 2002.
2. Fitzgerald A. E., C. Kingsley and S. Umans, *Electric Machinery*, 6/e, McGraw Hill, 2003.
3. Langsdorf M. N., *Theory of Alternating Current Machinery*, Tata McGraw Hill, 2001.
4. Deshpande M. V., *Electrical Machines*, Prentice Hall India, New Delhi, 2011.
5. Charles I. Hubert, Electric Machines, Pearson, New Delhi 2007
6. Theodore Wilde, *Electrical Machines, Drives and Power System*, Pearson Ed. Asia 2001.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Alternators - basic principle, constructional features of salient pole type and cylindrical type alternators, advantages of stationary armature, turbo-alternator. Armature winding – types of armature winding- single layer, double layer, full pitched and short pitched winding,	8 hours	15%

	slot angle, pitch factor and distribution factor – numerical problems. Effect of pitch factor on harmonics – advantages of short chorded winding, EMF Equation – numerical problems. Harmonics in generated EMF – suppression of harmonics.		
II	Performance of an alternator – Causes for voltage drop in alternators – armature resistance, armature leakage reactance – armature reaction, synchronous reactance, synchronous impedance, experimental determination – phasor diagram of a loaded alternator. Voltage regulation – EMF, MMF, ZPF and ASA methods – numerical problems.	9 hours	15%
FIRST INTERNAL EXAMINATION			
III	Theory of salient pole machine – Blondel's two reaction theory – direct axis and quadrature axis synchronous reactances – phasor diagram and determination of X_d and X_q by slip test. Parallel operation of alternators – necessity of parallel operation of alternators, methods of synchronisation– dark lamp method and bright lamp method, synchroscope, Synchronising current, synchronising power, synchronising torque. Effects of changing excitation of alternators, load sharing of two alternators in parallel operation.	9 hours	15%
IV	Synchronous motor – construction and principle of synchronous motor, methods of starting. Effects of excitation on armature current and power factor, v-curve and inverter v-curve, load angle, torque and power relationship, phasor diagram, losses and efficiency calculations. Three phase induction motor – constructional features, slip ring and cage types. Theory of induction motor with constant mutual flux, slip, phasor diagram, expression for mechanical power and torque, torque-slip characteristics, starting torque, full load and pull out torque, equivalent circuit.	9 hours	15%
SECOND INTERNAL EXAMINATION			
V	Circle diagrams – tests on induction motors for determination of equivalent circuit and circle diagram.	10 hours	20%

	Cogging, crawling and noise production in cage motors – remedial measures. Double cage induction motor – principle, torque-slip curves. Starting of induction motors – types of starters – DOL starter, autotransformer starter, star-delta starter, rotor resistance starter – starting torque and starting current-numerical problems. Braking of induction motors – plugging, dynamic braking and regenerative braking (no numerical problems). Speed control – stator voltage control, V/f control, rotor resistance control.		
VI	Induction generator – principle of operation, grid connected and self excited operation, comparison of induction generator with synchronous generators. Synchronous induction motor – principle of operation. Single-phase induction motor – double field revolving theory, equivalent circuit, torque slip curve. Types of single phase induction motor – split phase, capacitor start, capacitor start and run types. Principle of shaded pole motor – applications.	10 hours	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN (End semester exam)

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering modules I&II

Student has to answer any 2 questions: (2 x 10) =20

Part C: 3 questions uniformly covering modules III&IV

Student has to answer any 2 questions: (2 x 10) =20

Part D: 3 questions uniformly covering modules V&VI

Student has to answer any 2 questions: (2 x 10) =20

Note: Each question can have maximum of 4 sub questions, if needed.

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE204	Digital Electronics and Logic Design	2-1-0-3	2016

Prerequisite : Nil

Course Objectives

To impart knowledge about digital logic and to gain the ability to design various digital circuits

Syllabus

Review of Number Systems and Codes, Digital Logic, Combinational Logic Circuits, Data Processing Circuits, Arithmetic Circuits, Flip-Flops, Registers, Counters, DACs and ADCs, Design of synchronous Sequential Circuits, Introduction to HDL.

Expected outcome.

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

1. Familiar with various number systems and Boolean algebra
2. design and analyse any digital logic gate circuits and Flip flop based systems.
3. Familiar with combinational circuits
4. gain the capability of implementing various counters,
5. describe the operation of ADC and DAC circuits
6. acquire basic knowledge on VHDL

Text Book:

1. Floyd T.L, Digital Fundamentals , 10/e, Pearson Education, 2011

2. C.H.Roth and L.L.Kimney Fundamentals of Logic Design, 7/e, Cengage Learning, 2013

References:

1. Donald P Leach, Albert Paul Malvino and GoutamSaha., Digital Principles and Applications, 8/e, by Mc Graw Hill
2. Mano M.M, Logic and Computer Design Fundamentals, 4/e, , Pearson Education.
3. Tocci R.J and N.S.Widmer, Digital Systems, Principles and Applications, 11/e, , Pearson Education.
4. John F. Wakerly, Digital Design: Principles and Practices, 4/e, , Pearson, 2005
5. Taub & Schilling: Digital Integrated Electronics, McGraw Hill,1997

Data Book (Approved for use in the examination):Nil

Course Plan			
Module	**Contents**	**Hours**	**Sem.ExamMarks**
I	Number Systems and Codes : Binary, Octal and hexadecimal conversions- ASCII code, Excess -3 code, Gray code, Error detection and correction - Parity generators and checkers – Fixed point and floating point arithmetic. Binary addition and subtraction, unsigned and signed numbers, 1's complement and 2's complement arithmetic.	**7 hours**	15%
II	TTL logic and CMOS logic - Logic gates, Universal gates - Boolean Laws and theorems, Sum of Products method, Product of Sum method – K map representation and simplification(upto four variables) - Pairs, Quads, Octets, Dont care conditions.	**7 hours**	15%
FIRST INTERNAL EXAMINATION			
III	Combinational circuits: Adders _ Full adder and half adder – Subtractors, halfsubtractor and fullsubtractor – Carry Look ahead adders – ALU(block diagram only). Multiplexers, Demultiplexers, Encoders, BCD to decimel decoders.	**7 hours**	15%
IV	Sequential circuits: Flip-Flops, SR, JK, D and T flip-flops, JK Master Slave Flip-flop, Conversion of flip-flops, Registers -SISO,SIPO, PISO, PIPO. Counters : Asynchronous Counters – Modulus of a counter – Mod N counters.	**8 hours**	15%
SECOND INTERNAL EXAMINATION			
V	Synchronous counters: Preset and clear modes, Counter Synthesis: Ring counter, Johnson Counter, Mod N counter, Decade counter. State Machines: State transition diagram, Moore and Mealy Machines – Design equation and circuit diagram.	**7 hours**	20%
VI	Digital to Analog conversion – R-2R ladder, weighted resistors. Analog to Digital Conversion - Flash ADC, Successive approximation, Integrating ADC.	**8 hours**	20%

	Memory Basics, Read and Write, Addressing, ROMs, PROMs and EPROMs, RAMs, Sequential Programmable Logic Devices - PAL, PLA, FPGA (Introduction and basic concepts only) Introduction to VHDL, Implementation of AND, OR, half adder and full adder.		
END SEMESTER EXAM			

QUESTION PAPER PATTERN (End semester exam)

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering modules I&II

Student has to answer any 2 questions: (2 x 10) =20

Part C: 3 questions uniformly covering modules III&IV

Student has to answer any 2 questions: (2 x 10) =20

Part D: 3 questions uniformly covering modules V&VI

Student has to answer any 2 questions: (2 x 10) =20

Note: Each question can have maximum of 4 sub questions, if needed.

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE206	MATERIAL SCIENCE	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

To impart knowledge in the field of material science and their applications in electrical engineering

Syllabus:

Conducting materials- properties-applications- Semi conductor materials- properties-applications-Magnetic materials-classification-alloys of iron-ferrites-Dielectric materials-polarization-solid, liquid and gaseous insulators-Dielectric breakdown-superconductors-solar energy materials-Spectroscopy-micropscopy-magnetic resonance-nanomaterials

Expected Outcome:

After the completion of the course student will be able to:

1. Describe the characteristics of conducting and semiconducting materials
2. Classify magnetic materials and describe different laws related to them
3. Classify and describe different insulators and to explain the behaviour of dielectrics in static and alternating fields
4. Describe the mechanisms of breakdown in solids, liquids and gases
5. Classify and describe Solar energy materials and superconducting materials
6. Gain knowledge in the modern techniques for material studies

Text Book:

1. Dekker A.J : Electrical Engineering Materials, Prentice Hall of India
2. G K Mithal : Electrical Engg Material Science. Khanna Publishers.

References:

1. Tareev, Electrical Engineerin Materials, Mir Publications
2. Meinal A.B and Meinal M. P., Applied Solar Energy – An Introduction, Addisos Wesley
3. Nasser E., *Fundamentals of Gaseous Ionization and Plasma Electronics*, Wiley Series in Plasma Physics, 1971
4. Naidu M. S. and V. Kamaraju, *High Voltage Engineering*, Tata McGraw Hill, 2004
5. Indulkar O.S &Thiruvegadam S., An Introduction to electrical Engineering Materials, S. Chand
6. Agnihotri O. P and Gupta B. K, Solar selective Surface, John wiley
7. Seth. S.P and Gupta P. V, A Course in Electrical Engineering Materials, Dhanpathrai

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Conducting Materials: Conductivity- dependence on temperature and composition – Materials for electrical applications such as resistance, machines, solders etc. Semiconductor Materials: Concept, materials and properties- – Basic ideas of Compound semiconductors, amorphous and organic semiconductors- applications. Dielectrics: Introduction to Dielectric polarization and classification –Clausius Mosotti relation- Behavior of dielectric in static and alternating fields	8	15%
II	Insulating materials and classification- properties- Common insulating materials used in electrical apparatus-Inorganic,	6	15%

	organic, liquid and gaseous insulators- capacitor materials- Electro-negative gases- properties and application of SF6 gas and its mixtures with nitrogen Ferro electricity.		
FIRST INTERNAL EXAMINATION			
III	Dielectric Breakdown: Mechanism of breakdown in gases, liquids and solids –basic theories including Townsend's criterion, Streamer mechanism, suspended particle theory, intrinsic breakdown, electro-mechanical breakdown- Factors influencing Ageing of insulators- Application of vacuum insulation- Breakdown in high vacuum-Basics of treatment and testing of transformer oil .	7	15%
IV	Magnetic Materials: Origin of permanent magnetic dipoles- Classification of magnetic materials -Curie-Weiss law- Properties and application of iron, alloys of iron- Hard and soft magnetic materials– Ferrites- Magnetic materials used in electrical machines, instruments and relays-	7	15%
SECOND INTERNAL EXAMINATION			
V	Superconductor Materials:-Basic Concept- types- characteristics-applications Solar Energy Materials: Photo thermal conversion- Solar selective coatings for enhanced solar thermal energy collection –Photovoltaic conversion – Solar cells -Silicon, Cadmium sulphide and Gallium arsenic – Organic solar cells.	7	20%
VI	Modern Techniques for materials studies: Optical microscopy – Electron microscopy – Photo electron spectroscopy – Atomic absorption spectroscopy – Introduction to Biomaterials and Nanomaterials	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN (End semester exam)

Part A: 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI. Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering modules I&II.
Student has to answer any 2 questions: (2 x 10) =20

Part C: 3 questions uniformly covering modules III&IV.
Student has to answer any 2 questions: (2 x 10) =20

Part D: 3 questions uniformly covering modules V&VI.
Student has to answer any 2 questions: (2 x 10) =20

Note: Each question can have maximum of 4 sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
EE208	MEASUREMENTS AND INSTRUMENTATION	3-1-0-4	2016

Prerequisite : Nil

Course Objectives

To develop understanding of various electrical measuring instruments and instrumentation devices

Syllabus

Measurements standards, errors in measurements, operating torques, classification of electrical meters, Measurement of voltage, current, resistance, power, energy, high voltage and high currents. Magnetic measurements, ac potentiometers, ac bridges, CRO, Transducers

Expected Outcomes:

After the completion of the course student will be able to:

1. Compare different types of instruments-their working principles, advantages and disadvantages.
2. Explain the operating principles of various ammeters, voltmeters and ohm meters
3. Describe wattmetrs and energy meters
4. Describe different flux and permeability measurements methods
5. Identify different AC potentiometers and bridges,
6. Understand the working and applications of cathode ray oscilloscope
7. Identify the transducers for physical variables and to describe operating principle

Text Book:

1. Sawhney A.K., A course in Electrical and Electronic Measurements & instrumentation, DhanpatRai .
2. J. B. Gupta, A course in Electrical & Electronic Measurement & Instrumentation., S K Kataria& Sons
3. Kalsi H. S., Electronic Instrumentation, 3/e, Tata McGraw Hill, New Delhi, 2012

References:

1. Golding E.W., Electrical Measurements & Measuring Instruments, Wheeler Pub.
2. Cooper W.D., Modern Electronics Instrumentation, Prentice Hall of India
3. Stout M.B., Basic Electrical Measurements, Prentice Hall
4. Oliver & Cage, Electronic Measurements & Instrumentation, McGraw Hill
5. E.O Doebelin and D.N Manik, Doebelin's Measurements Systems, sixth edition, McGraw Hill Education (India) Pvt. Ltd.
6. P.Purkait, B.Biswas, S.Das and C. Koley, Electrical and Electronics Measurements and Instrumentation, McGraw Hill Education (India) Pvt. Ltd.,2013

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	General principles of measurements – measurement system-measurement standards – characteristics - errors in measurement-calibration of meters- significance of IS standards of Instruments. Classification of meters - operating forces - essentials of indicating instruments - deflecting, damping, controlling torques. Ammeters and voltmeters - moving coil, moving iron, constructional details and operating, principles shunts and multipliers – extension of range.	9	15%
II	Measurement of resistance: measurement of insulation resistance - loss of charge method, measurement of earth resistance. Measurement of power and energy: Dynamometer type wattmeter – 1-phase and 3-phase power measurement – 1-phase and 3-phase energy meters (induction type) – electronic energy meter, TOD meter.	10	15%

FIRST INTERNAL EXAMINATION			
III	Introduction to high voltage and high current measurements: Measurement of high DC voltages - measurement of high AC voltages - electrostatic voltmeters – sphere gaps - DC Hall effect sensors - high current measurements. Study of Phasor Measurement Units (PMU). Current transformers and potential transformers – principle working, ratio and phase angle errors – numerical problems, Clamp on meters.	9	15%
IV	Magnetic Measurements: Measurement of flux and permeability - flux meter - hall effect Gaussmeter - BH curve and permeability measurement - hysteresis measurement- ballistic galvanometer – principle- determination of BH curve - hysteresis loop. Lloyd Fisher square — measurement of iron losses Measurement of rotational speed using proximity sensors and optical sensors.	9	15%
SECOND INTERNAL EXAMINATION			
V	DC & AC potentiometers - General Principle - calibration of ammeter, voltmeter and wattmeter using potentiometer. AC Bridges: Maxwell's bridge- Schering bridge and Wien's bridge Oscilloscopes – Basic principle of signal display - Block diagram and principle of operation of general purpose CRO - vertical deflecting system - horizontal deflection system - basic sweep generator - XY mode and Lissajous patterns - applications of CRO - dual trace oscilloscope. digital storage oscilloscope	9	20%
VI	Transducers - Definition and classification - common transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain and temperature - basic principles and working of LVDT, electromagnetic and ultrasonic flow meters, piezoelectricforce transducer, load cell, strain gauge- bridge configuration for four strain gauges, RTD, Thermistors, thermocouple, Need for instrumentation system, data acquisition system.	9	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN (End semester exam)

Part A: 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering modules I&II
Student has to answer any 2 questions: (2 x 10) =20

Part C: 3 questions uniformly covering modules III&IV
Student has to answer any 2 questions: (2 x 10) =20

Part D: 3 questions uniformly covering modules V&VI
Student has to answer any 2 questions: (2 x 10) =20

Note: Each question can have maximum of 4 sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
EE232	Electrical Machines Lab - I	0-0-3-1	2016

Course Objectives

To learn the working and testing methods of DC machines and transformers.

List of Exercises/Experiments:

Part A – DC Machines

1. Open circuit characteristics of DC shunt generator
   Objectives:
   a) Predetermine the OCC at different speeds
   b) Determine the critical field resistance
   c) Obtain maximum voltage built up with given shunt field resistance
   d) Obtain critical speed for a given shunt field resistance
2. Load test on DC shunt generator
   Objectives:
   a) Determine the external & internal characteristics
   b) Deduce the armature reaction curve
3. Load test on DC compound generator
   Objectives:
   a) Determine the external characteristics cumulative compound condition
   b) Determine the external characteristics differential compound condition
4. Brake test on DC shunt motor
   Objectives:
   Plot the following characteristics
   i) Efficiency Vs Output
   ii) Line current Vs Output
   iii) Speed Vs Output
   iv) Speed Vs Torque
   v) Line current Vs Torque
5. Brake test on DC series motor
   Objectives:
   Plot the following characteristics
   i) Efficiency Vs Output
   ii) Line current Vs Output
   iii) Speed Vs Output
   iv) Speed Vs Torque
   v) Line current Vs Torque
6. Swinburne's test on a DC shunt machine
   Objectives:
   Predetermine the armature current and percentage efficiency when the machine operates as a motor and as a generator for various load conditions and plot efficiency Vs output curves.
7. Hopkinson's test on a pair of DC machines
   Objectives:
   Determination of the efficiency of the given dc shunt machine working as a motor and

generator
under various load conditions.

8. Retardation test on a DC machine

Objectives:

a) Separation of hysteresis, eddy current, friction &windage losses
b) Find the moment of inertia of the rotating system

9. Separation of losses in a DC shunt motor

Objectives:

a) Separation of hysteresis, eddy current, friction &windage losses
b) Plot the losses vs speed curves

Part B – Transformers

10. O.C. & S.C. tests on the single phase transformer

Objectives:

Predetermination of the following

a) Efficiency at different load conditions and different power factors
b) Regulation at different load conditions and different power factors
c) Equivalent circuit referred to HV and LV sides
d) UPF load at which efficiency is maximum
e) Power factors at which regulation is maximum and zero
f) Regulation vs. power factor curves

11. Load test on the single phase transformer

Objectives:

a) Determination of the efficiency at different load conditions and unity power factor
b) Determination of the regulation at different load conditions and unity power factor
c) Plot efficient vs. output & regulation Vs output curves

12. Separation of losses in a single phase transformer

Objectives:

Separate the hysteresis & eddy current losses at different voltages & different frequencies keepingV/f constant & plot losses vs. frequency curves. Hence

i) Separate the hysteresis & eddy current losses at normal voltage & different frequencies &
plot losses vs. frequency curves
ii) Separate the hysteresis & eddy current losses at normal frequency & different voltages &
plot losses vs. voltage curves.

13. Sumpner's test

Objective:

a) Predetermination of efficiency at different load conditions and power factors
b) Predetermination of regulation at different load conditions and power factors
c) Plot efficiency vs. output & regulation vs. power factor curves
d) Obtain the equivalent circuit referred to LV & HV sides

14. Scott connection of single phase transformers

Objectives:

Determine the efficiency at different load conditions when

a) Main transformer alone loaded
b) Teaser transformer along loaded
c) both transformers loaded under balanced conditions
d) both transformers loaded under unbalanced conditions
e) Plot efficiency vs. output curves for each case.

15. Parallel operation of single phase transformers

Objectives:

a) To determine the load sharing of each transformer by their equivalent impedances

b) To verify the load sharing by actual measurements

16. Three phase connection of single phase transformers

Objectives:

a) Determine the polarity of single phase transformers

b) Connect three single phase transformers in star-star configuration

c) Connect three single phase transformers in star-delta configuration

d) Determine the transformation ration in the above cases

17. O.C. & S.C. tests on the Three phase transformer

Objectives:

Predetermination of the following

a) Efficiency at different load conditions and different power factors

b) Regulation at different load conditions and different power factors

c) Equivalent circuit referred to HV and LV sides

18. Load Test on V connected Transformers

Objectives:

Connect two single phase transformers in V-V connection and conduct a load test to plot the efficiency curve.

Out of the above experiments, minimum twelve experiments should be done in lab taking at least six experiments from both Part A and Part B.

Expected outcome:

After the successful completion of the course, the students will be able to test and validate DC generators, DC motors and transformers

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

1. Analyse the characteristics of different dc generators
2. Separate the losses in dc motors
3. Analyse the performance of different types of dc motors
4. Determine the performance characteristics of single phase transformers
5. Compare the performance of transformers in different modes of operations and connections

Text Book:

1. Bimbra P. S., *Electrical Machinery*, 7/e, Khanna Publishers, 2011.
2. Theraja B. L., *A Textbook of Electrical Technology*, S. Chand & Company, New Delhi, 2008.

Course No.	Course Name	L-T-P - Credits	Year of Introduction
EE234	CIRCUITS AND MEASUREMENTS LAB	0-0-3-1	2016

Course Objectives

To develop measurement systems for various electrical circuits and systems and to use different transducers for measurement of physical variables.

List of Exercises/Experiments : (18 experiments are listed, out of which 12 experiments are mandatory).

1. Verification of Superposition Theorem in dc circuits.
2. Verification of Thevenin's Theorem in dc circuits.
3. Determination of impedance, admittance, power factor and real/reactive/ apparent power drawn in RLC series/parallel circuits.
4. 3-phase power measurement using one wattmeter and two-wattmeter method.
5. Determination of B-H curve, μ-H curve and μ-B curve of an iron ring specimen.
6. Measurement of voltmeter and ammeter resistances using Wheatstone's bridge and Kelvin's double bridge and extension of range of voltmeters and ammeters
7. Measurement of self/ mutual inductance and coupling co-efficient of iron cored coil and air-cored coil.
8. Calibration of meters and measurement of unknown resistance using slide- wire potentiometer.
9. Calibration of single phase energy meter by direct and phantom loading at various power factors.
10. Calibration of 3-phase energy meter using standard wattmeter.
11. Calibration of wattmeter using Vernier dial potentiometer
12. Measurement of capacitance using Schering Bridge.
13. Extension of instrument range by using Instrument transformers(CT and PT)
14. Characteristics of Thermistor, RTD, and Thermocouple
15. Characteristics of LVDT.
16. Characteristics of strain gauge/ Load cell.
17. Measurement of energy using electronic Energy meter/TOD meter
18. Current measurement using Clamp on meter

Expected Outcome:

After the completion of the course student will be able to:

1. Analyze RLC circuits and coupled circuit to obtain the voltage -current relations
2. Verify DC netwok theorems by setting up various networks
3. Calibrate the single phase and three phase energy meter at various power faqctors
4. Measure power in a single and three phase circuits by various methods
5. Determine magnetic characteristics of iron ring specimen
6. Measure high and low resistances using various bridges
7. Use Electronic energy meter, TOD meter and clamp on meter

Text Book:

1. Sawhney AK: A course in Electrical and Electronic Measurements & instrumentation, Dhanpat Rai .
2. J B Gupta : A course in Electrical & Electronic Measurement & Instrumentation., S K Kataria & Sons
3. Kalsi H. S., Electronic Instrumentation, 3/e, Tata McGraw Hill, New Delhi, 2012