Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE201	CIRCUITS AND NETWORKS	3-1-0-4	2016

Prerequisite: Nil

Course Objectives:

To learn about various techniques available to solve various types of circuits and networks

To gain the capability to synthesize a circuit for a particular purpose.

Syllabus AC Circuit Analysis(Steady State AC Analysis), Network topology, Transient analysis,

Laplace transform– properties , Transformed circuits, Two port networks, Symmetrical two port reactive networks as filters, Network functions, Network Synthesis

Expected outcome.

Ability to solve any DC and AC circuits

Ability to apply graph theory in solving networks

Ability to apply Laplace Transform to find transient response

Ability to synthesize networks

Text Book:

1. Hayt and Kemmerly :Engineering Circuit Analysis, 8e, Mc Graw Hill Education , New Delhi, 2013.
2. Sudhakar and Shyam Mohan- Circuits and Networks: Analysis and Synthesis, 5e, Mc Graw Hill Education,

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

References:

1. Siskand C.S : Electrical Circuits ,McGraw Hill
2. Joseph. A. Edminister: Theory and problems of Electric circuits, TMH
3. D Roy Chaudhuri: Networks and Systems, New Age Publishers
4. A . Chakrabarti : Circuit Theory (Analysis and Synthesis),Dhanpat Rai &Co
5. Valkenberg : Network Analysis ,Prentice Hall of India
6. B.R. Gupta: Network Systems and Analysis, S.Chand & Company ltd

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Network theorems – Superposition theorem – Thevenin's theorem – Norton's theorem – Reciprocity Theorem – Maximum power transfer theorem – dc and ac steady state analysis – dependent and independent sources	9 hours	15%
II	Network topology – graph, tree, incidence matrix – properties of incidence matrix – fundamental cut sets – cut set matrix – tie sets – fundamental tie sets – tie set matrix – relationships among incidence matrix, cut set matrix & tie set matrix – Kirchoff's laws in terms of network topological matrices – formulation and solution of network equations using topological methods	9 hours	15%

FIRST INTERNAL EXAMINATION			
III	Steady state and transient response – DC response & sinusoidal response of RL, RC and RLC series circuits	**9 hours**	15%
IV	Application of Laplace transform in transient analysis – RL, RC and RLC circuits (Series and Parallel circuits) – step and sinusoidal response Transformed circuits – coupled circuits - dot convention - transform impedance/admittance of RLC circuits with mutual coupling – mesh analysis and node analysis of transformed circuits – solution of transformed circuits including mutually coupled circuits in s-domain	**10 hours**	15%
SECOND INTERNAL EXAMINATION			
V	Two port networks – Z, Y , h, T parameters – relationship between parameter sets – condition for symmetry & reciprocity – interconnections of two port networks – driving point and transfer immittance – T-π transformation.	**9 hours**	20%
VI	Network functions–Network synthesis-positive real functions and Hurwitz polynomial-synthesis of one port network with two kinds of elements-Foster form I&II-Cauer form I&II.	**8 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
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
EE203	ANALOG ELECTRONICS CIRCUITS	3-1-0-4	2016

Prerequisite : Nil

Course Objectives

- To impart an in depth knowledge in electronic semiconductor devices & circuits giving importance to the various aspects of design & analysis.
- To provide knowledge about different types amplifier & oscillator circuits and their design.
- To provide a thorough understanding of the operational amplifier circuits and their functions.

Prerequisites: Nil

Syllabus Diode clipping and clamping circuits and Zener voltage regulators, BJT biasing, AC Equivalent Circuit of BJT and CE amplifier analysis, Biasing of JFET and MOSFET, Frequency response of BJT and FET amplifiers, Power amplifiers using BJT, Feedback amplifiers &Oscillator Circuits

Operational Amplifier basics and OP-AMP Circuits, Wave form generation using Op-Amp, Multivibrators using Timer IC 555.

Expected outcome: Upon successful completion of the course the students will be able to

1. Design biasing scheme for transistor circuits
2. Model BJT and FET amplifier circuits
3. Choose a power amplifier with appropriate specifications for electronic circuit applications
4. Design & analyse oscillator circuits using BJT
5. Choose Operational amplifier(OPAMP) for specific applications including waveform generation.
6. Design & implement analog circuits using OPAMPs

Text Book:

1. Malvino A. and D. J. Bates, Electronic Principles 7/e, Tata McGraw Hill, 2010.
2. Boylestad R. L. and L. Nashelsky, Electronic Devices and Circuit Theory, 10/e, Pearson Education India, 2009.
3. Choudhury R., Linear Integrated Circuits, New Age International Publishers. 2008.

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

References:

1. Floyd T. L., Fundamentals of Analog Circuits,, Pearson Education, 2012.
2. Robert T. Paynter and John Clemons, Paynter's Introductory electronic devices & circuits, Prentice Hall Career & Technology, New Jersey.
3. Bell D. A., Electronic Devices and Circuits, Prentice Hall of India, 2007.
4. Millman J. and C. C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw-Hill, 2010.
5. Streetman B. G. and S. Banerjee, Solid State Electronic Devices, Pearson Education Asia, 2006.
6. Gayakward R. A., Op-Amps and Linear Integrated Circuits, PHI Learning Pvt. Ltd., 2012.

Course Plan			
Module	**Contents**	**Hours**	**Sem.ExamMarks**
I	**Diode Circuits**: Diode clipping circuits - Single level and two level clippers - Clamping circuits – Design of Zener Voltage Regulators. **Bipolar Junction Transistors** : Review of BJT characteristics- Operating point of a BJT – Factors affecting stability of Q point and DC Biasing – Biasing circuits: fixed bias, collector to base bias, voltage division bias and self bias. (Derivation of stability factors for Voltage Divider Biasing only) –Bias compensation using diode and thermistor. Low frequency equivalent circuit of BJT. Common Emitter amplifier - AC Equivalent Circuit – Role of coupling and emitter bypass capacitors – h parameter model of BJT -Amplifier gains and impedances calculations using h equivalent circuit.	9 hours	15%
II	**Field Effect Transistors** : Review of JFET and MOSFET construction, working and characteristics- Biasing a JFET and MOSFET using voltage divider bias–- CS and CD amplifiers – small signal models-FET as switch and voltage controlled resistance. **Frequency response of Amplifiers** : Miller's Theorem-BJT Internal Capacitances at high frequency operations-High frequency analysis of CE Amplifier using hybrid Pi Model -Low Frequency Response of Common Emitter amplifier -– CE High frequency response-Gain bandwidth product- ––Low and High Frequency response of FET amplifiers	9 hours	15%
FIRST INTERNAL EXAMINATION			
III	**Multistage amplifiers** : Direct, RC, transformer coupled amplifiers – **Power amplifiers using BJT** : Class A, Class B and Class AB and class C- Conversion efficiency and distortion in power amplifiers. **Feedback Amplifiers**- Effect of positive and negative feedbacks- Basic feedback topologies and their properties	**8 hours**	15%
IV	**Oscillators** : Bark Hausen's criterion – RC oscillators (RC Phase shift oscillator and Wein Bridge oscillator) –LC oscillators (Hartley and Colpitt's)- Derivation of frequency of oscillation for the above mentioned oscillators- Crystal oscillator.	**8 hours**	15%

	Operational Amplifiers: Review of Operational Amplifier basics - Analysis of fundamental differential amplifier- Properties of ideal and practical Op-Amp - Gain, CMRR and Slew rate of IC 741 and LM 301– Drift and frequency compensation in OP Amps- Open loop and Closed loop Configurations-Concept of virtual short and its relation to negative feedback		
SECOND INTERNAL EXAMINATION			
V	**OP-AMP Circuits** : Review of inverting and non-inverting amplifier circuits- Summing and difference amplifiers, Differentiator and Integrator circuits- Logarithmic amplifier- Half Wave Precision rectifier - Instrumentation amplifier. Comparators: Zero crossing and voltage level detectors, Schmitt trigger.	8hours	20%
VI	**Wave form generation using Op-Amps**: Square, triangular and ramp generator circuits using Op-Amp - Effect of slew rate on waveform generation. **Timer 555 IC** : Internal diagram of 555 IC– Astable and Monostable multivibrators using 555 IC. **Oscillator circuits using Op-amps** : RC Phase shift oscillator, Wein Bridge oscillator, LC Oscillators- (Derivation not required) - Crystal oscillator.	8 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
EE205	DC MACHINES AND TRANSFORMERS	3-1-0-4	2016

Prerequisite : Nil

Course Objectives

To give exposure to the students about the concepts of direct current machines and transformers, including their constructional details, principle of operation and performance analysis.

Syllabus:

Electromagnetic principles for Machines, electrodynamic equations and their solution, Magnetic Circuits for Machines, construction of DC machines, DC generators, DC motor, Transformers - single phase and three phase, Construction of single phase and three phase transformers, losses and efficiency, equivalent circuit, testing. Transformer connections.

Expected outcome.

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

1. identify dc generator types, and appreciate their performance
2. describe the principle of operation of dc motor and select appropriate motor types for different applications.
3. analyse the performance of different types of dc motors
4. describe the principle of operation of single phase transformers
5. analyse the performance of single phase transformers
6. familiarize with the principle of operation and performance of three phase ransformers.

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. Fitzgerald A. E., C. Kingsley and S. Umans, *Electric Machinery*, 5/e, McGraw Hill, 1990.
2. Langsdorf M. N., *Theory of Alternating Current Machinery*, Tata McGraw Hill, 2001.
3. Abhijith Chakrabarti, Sudipta Debnath, Electrical Machines, McGraw Hill Education, New Delhi 2015.
4. Deshpande M. V., *Electrical Machines*, Prentice Hall India, New Delhi, 2011.
5. Theodore Wilde, *Electrical Machines, Drives and Power System*, Pearson Ed. Asia 2001.

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

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Electromagnetic principles for Machines Electro dynamical equations and their solution – rotational motion system – mutually coupled coils – construction of DC machines – energy conversion in rotating electrical machines – eddy currents and eddy current losses – flux distribution curve in the airgap – armature windings – lap and wave windings – selection criteria – equalizer rings – dummy coils.	9 hours	15%
II	DC generators – EMF equation – methods of excitation – separately and self excited – shunt, series, compound – armature reaction – effects of armature reaction – demagnetizing & cross magnetizing ampere-turns – compensating windings – interpoles – commutation – methods to improve commutation – voltage build-up – no load	9 hours	15%

	characteristics – load characteristics – losses and efficiency – power flow diagram – parallel operation – applications of dc generators.		
FIRST INTERNAL EXAMINATION			
III	DC motor – principle of operation – back emf – classification – torque equation – losses and efficiency – power flow diagram – performance characteristics of shunt, series and compound motors – starting of dc motors – necessity and types of starters – speed control – methods of speed control – testing – Swinburne's test – Hopkinson's test – separation of losses – retardation test – applications of dc motors.	9 hours	15%
IV	Transformers – principle of operation – types and construction, core type and shell type construction, dry type transformers, cooling of transformers – ideal transformer – transformation ratio – dot convention – polarity test – practical transformer – kVA rating – equivalent circuit – phasor diagram.	9 hours	15%
SECOND INTERNAL EXAMINATION			
V	Transformer losses and efficiency – voltage regulation – OC & SC test – Sumpner's test – all day efficiency Autotransformer – saving of copper – current rating and kVA rating of autotransformers, parallel operation of single phase transformers, necessary and desirable conditions of parallel operation, on load and off load tap changers.	9 hours	20%
VI	3-phase transformer – 3-phase transformer connections – Δ-Δ, Y-Y , Δ-Y , Y-Δ, V-V – vector groupings Yy0, Dd0, Yd1, Yd11, Dy1, Dy11 – Scott connection – three winding transformer – tertiary winding – percentage and per unit impedance – parallel operation of three phase transformers.	9 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
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
EE207	COMPUTER PROGRAMMING	2-1-0-3	2016

Course Objectives

To impart knowledge about programming in C

To learn basics of PYTHON.

Syllabus Introduction to Programming, Basic elements of C, Control statements in C, Arrays and Strings, Functions, Storage classes ,Structures and Pointers, File Management in C, Introduction to Python

Expected outcome. 1. Ability to design programs using C language
2. Ability to develop simple programs using Python

Text Book:1)E. Balaguruswamy, *Programming in ANSI C*, Tata McGraw Hill, New Delhi
2) John V Guttag, Introduction to Computation and programming using Python, PHI Learning, New Delhi.

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

References:

1. P. Norton, *Peter Norton's Introduction to Computers*, Tata McGraw Hill, New Delhi
2. Byron S. Gottfried, Programming with C, Schaun Outlines –McGraw Hill.
3. Ashok Kamthane, Programming with ANSI & Turbo C- Pearson education
4. K.R Venugopal and S.R Prasad, Mastering C - Tata McGraw Hill
5. Kelley, Al & Pohl, *A Book on C- Programming in C*, 4th Ed,, Pearson Education

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	**Introduction to Programming**: Machine language, assembly language, and high level language. Compilers and assemblers. Flow chart and algorithm – Development of algorithms for simple problems. **Basic elements of C:** Structure of C program –Keywords, Identifiers, data types, Operators and expressions – Input and Output functions	5hours	15%
II	**Control statements in C:** *if, if-else, while, do-while and for statements, switch, break, continue, go to, and labels. Programming examples.*	7 hours	15%
	FIRST INTERNAL EXAMINATION		
III	**Arrays and Strings**: Declaration, initialisation, processing arrays and strings– two dimensional and multidimensional arrays –application of arrays. Example programs.	7 hours	15%
IV	**Functions :** Functions – declaring, defining, and accessing functions –parameter passing methods – – passing arrays to functions , Recursion . **Storage classes** – extern, auto, register and static. Example programs.	7 hours	15%
	SECOND INTERNAL EXAMINATION		

V	**Structures** – declaration, definition and initialization of structures, unions **Pointers**: Concepts, declaration, initialization of pointer variables, Accessing a Variable through its Pointer Chain of Pointers, Pointer Expressions, Pointer Increments and Scale Factor, Pointers and Arrays, examples	**8 hours**	20%
VI	**File Management** – File operations, Input/Output Operations on Files, Random Access to Files ,File pointer. **Introduction to Python** :Basic Syntax, Operators, control statements, functions-examples.	**8hours**	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 code	Course Name	L-T-P - Credits	Year of Introduction
EE209	Electrical Technology	3-1-0 -4	2016

Prerequisite : Nil

Course Objectives

- To understand about the network Elements, types of networks & analysis of complex circuits using Mesh current & Nodal voltage method.
- To impart knowledge on the solution methods of AC and DC circuits.
- To understand the working principle and characteristics of all electrical machines

Syllabus

Types of Networks- mesh current & Nodal voltage method for DC and AC circuits-Basics of Circuit theorems-AC circuits- RLC circuits- series and parallel resonance-Three phase circuits- Power measurements in three phase circuits-DC machines construction – working- EMF equation – Characteristics of DC shunt and series motor and generator-Starters- Concept of transformers-EMF equation- concept of rotating magnetic field- working principle of induction motors-special machines and their application.

Expected outcome.

i. Understand the circuit analysis and theorems.
ii. Understand the concept of three phase RLC circuits.
iii. Get knowledge in construction and working of dc machines
iv. Get knowledge in special machines and their applications.
v. Understand the construction and working of induction machines.

Text Book:

1. Theraja B.L., Theraja A.K. *A Text Book of Electrical Technology*, Vol.II "AC & DC Machines", publication division of Nirja construction & development (p) Ltd., New Delhi, 1994.

2. Sudhakar, A. and Shyam Mojan, S.P. *Circuits and Networks Analysis and Synthesis*, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 1994.

References:

1. Raina K.B., Bhattacharya S.K. *Electrical Design Estimating & Costing*, New Age International P Ltd.,2001.

2. Muthusubramanian R & Ayyappan K, *Circuit Theory*, Anuradha Publishign Pvt Ltd., Tamil Nadu 1999.

3. Arumugam & Premkumar, *Electric Circuit Theory*, Khanna Publishers. 2002

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**BASICS OF CIRCUIT ANALYSIS** Types of Networks – Sources transformation – Star – Delta transformation – formation of matrix equation and analysis of circuits using mesh current & Nodal voltage method for DC and AC circuits.	10	15%
II	**BASICS OF CIRCUIT THEOREMS** Thevenin's theorem – Norton's theorem – superposition theorem – maximum power transfer theorem – statement, illustration & application to DC circuits.	9	15%

FIRST INTERNAL EXAMINATION			
III	**AC CIRCUITS:** Review of Basic concepts – solution of RLC circuit – power – power factor and energy relation – series resonance – parallel resonance – Q factor – bandwidth. Three phase star-delta connections – characteristic equations – phasor diagrams – solution of 3-phase balanced circuits & unbalanced circuits – Three phase power measurement suing watt meters	10	15%
IV	**DC MACHINES:** Review of constructional details – Working principle of DC generator – EMF equation – No load & load characteristics of shunt generator – working principle of DC motor – back emf – equations for torque & power – characteristics of shunt, series & compound motors – Necessity of starters and their types— power stages – efficiency.	9	15%
SECOND INTERNAL EXAMINATION			
V	**TRANSFORMERS** Construction – working principle – emf equation & voltage regulation – vector diagram **3-PHASE INDUCTION MOTORS** Production of rotating magnetic field – torque equation, torque – slip characteristics – power stages and efficiency – simple problems – starters & methods of speed control (quantitative treatment only).	10	20%
VI	**SPECIAL MACHINES / APPLICATIONS** (Qualitative treatment only) Working principle of single phase induction motor – capacitor start & capacitor run motors – Universal motor – stepper motor – servomotor - Synchronous motor Selection of motors with justifications for the following services, *Machine tools *Washing machine *Cranes *WetGrinder *Steel mills * Mixie *Hoist *Electric traction	9	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS

8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS

5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions

(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS

4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions

(2 x15 = 30 marks)

Course code	Course Name	L-T-P -Credits	Year of Introduction
EE212	ELECTRICAL TECHNOLOGY AND SAFETY	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To understand the concepts in the working of electrical generator, motor, and transformer .
- To learn the basic function of electrical switch gear.
- To make the students acquire a sound knowledge in fundamentals of electrical safety
- To impart some fundamentals about the safety provisions in Indian Electricity Act and Rules.

Syllabus

Construction and Principle of operation of DC Generator - Dc motor - Induction motor – Alternator - Synchronous motor –Transformer - Protective Relays -Types -Circuit breaker - Arc phenomenon - Protection against over voltages –Lightning –Grounding -Types. Electric shock - effects and its prevention - Safety during installation of plant and equipment - Hazardous zone - Electrical safety in Residential, Commercial and Agricultural Installations - Hazards of static electricity - Safety provisions in Indian Electricity act and Rules.

Expected outcome

- At the end of this course, the students will have exposed to fundamentals of electrical machines and gained idea about electrical safety.

References

- V.K Mehta, Rohit Mehta. "Principles of Electrical Machines". S Chand Publishers
- W.Fordham Cooper. "Electrical safety Engineering" Butterworth and company London
- S.L. Uppal : A Textbook of Electrical Engineering, Khanna Publishers, Delhi
- H. Cotton : Electrical Technology, Wheeler Publishing Company
- Indian Electricity Act and Rules, Government of India.
- S. Rao, and H.L. Saluja : Electrical Safety, Fire Engineering and Safety Management, Khanna Publishers, Delhi
- M.G. Say : Electrical Earthing and Accident prevention, Newnes, London, 1954
- V.K Mehta, Rohit Mehta. "Principles of Power System".S Chand Publishers
- *Accident Prevention Manual for Industrial Operations* : National Safety Council, Chicago.
- www.osha.gov

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Construction and Principle of operation of d.c machines – e.m.f equation of a generator – Types of dc generator – losses – Condition for maximum efficiency–Armature Reaction– Compensating winding-characteristics of shunt, series and compound generators –Critical field resistance and critical speed– Parallel operation. Dc Motor Characteristics–speed control.	6	15%
II	Synchronous machines – types – e.m.f equation – winding factors – armature reaction and leakage resistance. Synchronous motor – methods of starting – applications. Induction Motors –		15%

	Construction and principle of operation – equivalent circuit – Torque – slip characteristics – method of starting – applications.	7	
FIRST INTERNAL EXAMINATION			
III	Construction and Principle of operation of single phase transformers – e.m.f equation – phase diagrams – equivalent circuit–Tests–regulation – losses and efficiency. Protective relays – Requirement of relay – types of protection – classification – distance relay, differential relay, state relays.	7	15%
IV	Circuit breakers – function of switch gear – arc phenomenon – initialization of an arc– Methods of Arc Extinction–Types–Arc voltage –restriking voltage and recovery voltage. Fuses – Characteristics– types –selection – advantages and disadvantages – MCB and ELCB. Faults in power systems – causes – types. Protection against over voltages– causes–Lightning–Lightning arrester.	7	15%
SECOND INTERNAL EXAMINATION			
V	Grounding – neutral grounding – solid grounding – resistance grounding – arc suppression coil grounding. Equipment grounding for safety – Human safety aspects – effect of current and voltage on human beings – typical V-I characteristics of skin – Electric shocks and their prevention– Medical Analysis of shock. Insulation – classes of insulation – FRLS insulation – continuity test.	7	20%
VI	Safety during installation of plant and equipment. Safe sequences in installation – risk during installation. Safety during testing and commissioning. Test on relays – protection and interlock systems for safety. Hazardous zones – classification of hazardous zones. Fire prevention and fire fighting in power stations, Substations-causes of initiation of fire-Fire Extinguishing Techniques. Electrical safety in Residential, Commercial and Agricultural Installations – Case study. Hazards of static electricity. Safety provisions in Indian Electricity Act & Rules.	8	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Duration: 3 Hours

Part – A: 5 MARK QUESTIONS

There will be two questions from module 2 and module 3 and one question each from remaining modules (8x5 = 40 marks)

PART B: 10 MARK QUESTIONS

5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions

(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS

4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions

(2 x15 = 30 marks)

Course code	Course Name	L-T-P-Credits	Year of Introduction
EE214	ELECTRICAL TECHNOLOGY AND INSTRUMENTATION	3-0-0-3	2016

Prerequisites: Nil

Course Objectives:

- To impart understanding of the basic working principles of DC and AC machines.
- To impart understanding of the basic principles of instrumentation and its applications.

Syllabus:

DC Generator- Load Characteristics; DC Motors- Speed & Torque, Performance Characteristics; 3ph Induction Motors-Torque Equation, Characteristics; Alternators- Construction; Regulation- Transformers, Regulation Efficiency; Instrumentation- Calibration, Errors; Transducer Classification.

Expected Outcome:

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

i. Understand the basic working principle, construction, types, performance characteristics and applications of DC generators, DC motors and induction motors.
ii. Understand the basic working principle, construction, types, EMF equation, voltage regulation, EMF, MMF methods to determine the voltage regulation of alternators.
iii. Understand the basic working principle, construction, types, equivalent circuit, losses, efficiency, regulation and applications of transformers and predetermine their efficiency by conducting OC and SC.
iv. Understand the basic principles of instrumentation, measurement standards and types of errors in instruments and measurements and its applications.

Text Books:

- Dr. P. S. Bimbra; Electrical Machinery; Khanna Publishers.
- J. B. Gupta; Theory and principles of Electrical Machines; S. K.Kataria and Sons Tex.

Reference Books:

- A.K.Sawhney; Electrical and Electronic Measurements and Instrumentation; DhanpatRai.
- Alexander Langsdorf A. S.; Theory of AC Machinery; Mc-Graw Hill.
- James.W.Dally, William.F. Riley, Kenneth G. McConnell; Instrumentation for Engineering Measurement.
- Say M.G.; Performance and Design of AC Machines; ELBS.
- William D. Cooper, A.D. Helfrick; Electronic Instrumentation and Measurement Techniques; Prentice Hall.

Course Plan

Module	Content	Hours	Sem. Exam Marks
I	**D.C. Generator:** O.C.C. ; Condition for Self Excitation; Field Critical Resistance; Critical Speed; Load Characteristics of	7	15%

	Generators; *Losses*; Power Flow Diagram; Efficiency, Condition for Maximum Efficiency; *Applications*.		
II	**D.C. Motors:** Back EMF; Speed and Torque Equation; Starting, Testing of D.C. Motors, Brake Test; Swinburne's Test; Performance and operating characteristics of Shunt, Series and Compound Motors; *Applications.*	7	15%
FIRST INTERNAL EXAM			
III	**Three Phase Induction Motor**: Production of Rotating Magnetic Field; Torque Equation; Torque Slip Characteristics, Equivalent Circuit; *Application*. Single Phase Induction Motor: Different Types; *Application.*	7	15%
IV	**Alternators**: *Construction Details*, Type; EMF Equation (Winding Factor need not be derived); Synchronous Impedance; Regulation by EMF and MMF Method.	7	15%
SECOND INTERNAL EXAM			
V	**Transformer**: *Construction*, *Working*, *Types*, EMF Equation, No Load Current; Equivalent Circuit; Phasor Diagram, Regulation, Efficiency, Determination of Regulation and Efficiency from O.C. and S.C. tests; *Cooling of Transformer*; Applications.	7	20%
VI	**Introduction to Instrumentation and its Applications:** Classification of Instruments; Standards and Calibration; Errors in Instruments and Measurements; Classification of Transducers; Strain Gauges; *L.V.D.T. (Linear Variable Differential Transformer)*, Mc.Leod Gauge, Pirani Gauge, Hot-wire Anemometers; Constant Temperature and Constant Current Methods.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

PART A

- Answer all 8 questions of 3 marks each.
- 1 question each from modules I to IV and 2 questions each from modules V & VI.

PART B

- Answer any 2 full questions out of 3 for each module.
- Each question from module I to IV carries 6 marks.
- Each question from module V & VI carries 7 marks.
- Each full question can have maximum of 4 sub questions, if needed.

Course code	Course name	L-T-P-Credits	Year Of Introduction
EE216	ELECTRICAL ENGINEERING	3-0-0-3	2016

Prerequisite : Nil

Course objectives

To introduce the fundamental concepts of transformer, alternator, DC machine, induction motor and indicating instruments

Syllabus

Transformers- Principle of operation & different types, DC generator, DC Motor, Alternators in detail, Concepts of three phase Induction motor and types, Principle of Indicating instruments.

Expected outcome

The students will

i. Get the basic idea of Electrical engineering.
ii. Be able to differentiate between the types of motors and transformers
iii. gain information about the function of various measuring instruments and using them

Text Books

1. E. Hughes, Electrical & Electronic Technology, 8th ed., Pearson Education, Delhi, 2002.
2. B.L. Theraja and A.K. Theraja, AC and DC machines Volume II

Reference books

1. Del Toro V, Electrical engineering fundamentals, 2/e. Prentice Hall India. Eastern Economy Edition. 1998.
2. E. W. Golding and F. G. Widdis, Electrical Measurements and Measuring Instruments, 5th ed., AH Wheeler & Company, Calcutta, 1993.
3. H. Cotton, Advanced Electrical Technology, Sir Isaac Pitman and Sons, London, 1974

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Transformers- Principle of operation - emf equation - Phasor diagram - Equivalent circuit - OC and SC tests – Basic principles of auto transformer and three phase transformer	5	15%
II	DC Generator – E.M.F equation- Armature reaction – Commutation - interlopes – power flow diagram – losses and efficiency – voltage regulation – parallel operation – load sharing	8	15%
	FIRST INTERNAL EXAMINATION		
III	DC Motor- back E.M.F. – speed equation – torques – performance characteristics – power flow diagram losses and efficiency – starter- two point and three point – swinburns test – thyristor control of series and shunt motor.	8	15%
IV	Alternator- Rotating field - Frequency effect of distribution of winding - emf equation – Basic principles of	6	15%

	synchronous motor – Losses and Efficiency - Torque equation - Starting methods - induction motor - Constructional features - Principle of operation of 3 phase induction motor – Vector diagram and equivalent circuits - Starting and speed control of squirrel cage and wound rotor induction motor		
SECOND INTERNAL EXAMINATION			
V	Three phase Induction motor- types – torque equations- torque slip and torque speed characteristics- power flow diagram – efficiency – equivalent circuit- induction generator Special machines – single phase FHP motor starting methods- double field revolving theory-types and applications – stepper motor –classifications and applications – servomotors – classifications and applications –shaded pole motors –applications	6	20%
VI	Principle of Indicating instruments- moving coil, moving iron and dynamometer type instruments- Extension of range of voltmeter and ammeter - Measurement of 3 phase power by two wattmeter method – Principle and working of Induction type energy meter- DC slide wire, potentiometer.	9	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3 Hours

Part A
Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions
(15 x 2 = 30 marks)

Part B
Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.
(15 x 2 = 30 marks)

Part C
Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 20 marks and may have not more than four sub divisions.
(20 x 2 = 40 marks)

Course No.	Course Name	L-T-P - Credits	Year of Introduction
EE231	ELECTRONIC CIRCUITS LAB	0-0-3-1	2016

Course Objectives

To design and develop various electronic circuits using discrete components and OPAMPs.

List of Exercises/Experiments : (Out of 18 experiments listed, 12 experiments are mandatory.

1.Study & Use of CRO: Measurement of current voltage, frequency and phase shift.
2.Half wave and Full wave (Centre-tapped and bridge) Rectifiers with and without filters- Calculation of Ripple factor, Rectification efficiency, and % regulation.
3. Clipping circuits using diodes
4. Clamping circuits using diodes
5. RC coupled amplifier using BJT in CE configuration- Measurement of gain, input and output impedance and frequency response
6. JFET amplifier- Measurement of voltage gain, current gain, input and output impedance
7.Design and testing of simple zener voltage regulators
8.OPAMP circuits – Design and set up of inverting and non-inverting amplifier, scale changer, adder, integrator, differentiator
9. Precision rectifier using Op-amps
10.Phase shift oscillator using OPAMPs.
11.Wein's Bridge oscillator using OPAMPs.
12.Waveform generation – Square, triangular and sawtooth wave form generation using OPAMPs.
13. Basic comparator and schmitt trigger circuits using Op-amp
14. Design and testing of series voltage regulator using zener diode
15. Astable and monostable circuit using 555 IC
16. RC phase shift oscillator using BJT
17.Introduction to circuit simulation using any circuit simulation software.
18. Introduction to PCB layout software

Expected outcome.

The student should be able to design and implement various electronic circuits using BJTs and OPAMPs.

Text Book/References:

1. Malvino A. and D. J. Bates, Electronic Principles 7/e, Tata McGraw Hill, 2010.
2. Boylestad R. L. and L. Nashelsky, Electronic Devices and Circuit Theory, 10/e, Pearson Education India, 2009.
3. Choudhury R., Linear Integrated Circuits, New Age International Publishers. 2008.
4. Millman J. and C. C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw-Hill, 2010.

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
EE233	PROGRAMMING LAB	0-0-3-1	2016

Course Objectives

To impart knowledge and develop skills in programming

List of Exercises/Experiments : (Minimum 12 exercises/experiments are mandatory)

1. At least four simple programs using input output statements (example: area of rectangle, circle, etc)
2. At least four Simple programs using decision statements (Example: Even or odd, pass or fail)
3. At least four Programs using Control statements and decision statements (Example maximum, minimum of a given set of numbers, hcf, lcm)
4. Program to add n numbers
5. Programs to print patterns
6. Program to check whether a number is prime
7. program to generate Fibonaacii series
8. Array manipulation (searching, insertion and sorting)
9. Few programs using pointers
10. Functions Pass by value Pass by reference
11. Recursive functions (example: Fibonaacii series and factorial)
12. String manipulation – compare, copy, reverse operations
13. Matrix operations: addition multiplication, determinant and inverse
14. Reading from a file and writing to a file Merging and appending of files.
15. Solution of algebraic and transcendental equations: Bisection, Newton- Raphson method- comparison
16. Introductory programs using Python
17. Function calls in Python

Expected outcome. 1. Ability to design programs using C language
2. Ability to develop simple programs using Python

References:

1. E. Balaguruswamy, *Programming in ANSI C*, Tata McGraw Hill, New Delhi
2. Kernighan, Brian W., and Dennis M. Ritchie. *The C programming language*. Vol. 2. Englewood Cliffs: prentice-Hall, 1988.
3. Introduction to computation and programming using Python, John V. Guttag, PHI Learning, New Delhi
4. Downey, Allen, Jeffrey Elkner, and Chris Meyers. *How to think like a computer scientist: learning with python*. John Wiley 2015.
5. Lambert, Kenneth. Fundamentals of Python: first programs. Cengage Learning, 2011.

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

Course code	Course Name	L-T-P - Credits	Year of Introduction
EE235	Electrical Technology lab	0-0-3-1	2016

Prerequisite : EE209 Electrical technology

Course Objectives

- To impart working knowledge on electrical circuits, A C machines, DC machines and transformers.

List of Exercises/Experiments : (Minimum 10 experiments are mandatory)

1. Verification of Thevenin's theorem
2. Verification of Norton's theorem
3. Verification of Superposition theorem
4. Verification of Maximum power transfer theorem
5. Power measurement in 3 phase balanced circuits
6. Power measurement in 3 phase unbalanced circuits
7. Load test on DC shunt motor
8. Load test on DC series motor
9. Speed control of DC shunt motor
10. Open circuit characteristics of DC series motor.
11. Open circuit characteristics of dc shunt motors
12. Swinburne's test and separation of losses in DC machine.
13. Load test on single phase transformer
14. Load test on 3-phase induction motor
15. No load test on 3- phase induction motors.

List of major equipment

DC shunt motor, DC series motor, DC series motor, single phase transformer, 3-phase induction motor, Watt meters, Ammeters, voltmeters, Tachometers.

Expected outcome.

- On completion of this lab course, the students will be able to understand the concept of electric circuits and the performance characteristics of electrical machines.

Text Book:

Theraja B.L., Theraja A.K. *A Text Book of Electrical Technology*, Vol.II "AC & DC Machines", publication division of Nirja construction & development (p) Ltd., New Delhi.

Course code	Course Name	L-T-P -Credits	Year of Introduction
EE236	ELECTRICAL TECHNOLOGY AND SAFETY LAB	0-0-3-1	2016

Prerequisite: EE212 Electrical technology and safety

Course Objectives

- To provide practical experience for verifying circuit theorems.
- To expose the students on the operation of Dc motors, Induction motors, transformer and give them experimental skill.

List of Experiments:

1. Verification of Kirchhoff's Laws
2. Verification of Superposition Theorem.
3. Measurement of power in an A.C circuit by 3 ammeter and 3 voltmeter method
4. Load test on d.c series motor
5. Speed characteristics of d.c shunt motor
6. Regulation of Transformer
7. Load characteristics of 3 phase induction motor
8. Study of protective relays and circuit breakers
9. Study of insulation testing and ground testing
10. Study of B.H curve on C.R.O
11. Study about cardio pulmonary resuscitation(CPR)

Expected outcome

- At the end of this course, the students will have exposed to the fundamentals of electric circuit theorem and the working of various electrical machines.

Text Books

- V.K Mehta,Rohit Mehta. "Principles of Electrical Machines".S Chand Publishers
- S.L. Uppal : A Textbook of Electrical Engineering, Khanna Publishers, Delhi
- H. Cotton : Electrical Technology, Wheeler Publishing Company