Shivaji University Kolhapur
Structure for Electrical Engineering Programme
From SE to BE
To be implemented from 2014-15

Semester III

Sr. No	Category	Course Title	L	T	P	Contact Hours	Marks			
							Theory	T W	POE	Total
1	BS	Engg. Maths III	4			4	100			100
2	ES	Electrical Engineering Materials and Energy Conversion	3	1		4	100	25		125
3	ES	Analog Electronic Engineering	4		2	6	100	25	50	175
4	ES	Electromagnetic and Electrical Circuits	4	1*	2	7	100	75*		175
5	EE	Measurements and Instruments	4		2	6	100	25	50	175
6	EE	Programming in C	1		2	3		50		50
			20	2	8	30	500	200	100	800

* 25 marks for tutorials in Electromagnetic and 50 marks for laboratory in Electrical Circuits

Semester IV

Sr. No	Category	Course Title	L	T	P	Contact Hours	Marks			
							Theory	T W	POE	Total
1	EE	DC Machines and Transformer	4		2	6	100	25	50	175
2	EE	Power Electronics	4		2	6	100	25	50	175
3	EE	Power Systems I	4		2	6	100	50		150
4	EE	Network Analysis and Synthesis	4			4	100			100
5	EE	Control System I	4		2	6	100	50		150
6	EE	Electrical Generation Transmission and Utilization	1		2	3		50		
			21		10	31	500	200	100	800

Category
HS- Humanity and Social Science, BS- Basic Science, ES- Engineering Science EE- Electrical Engineering, MC- Mandatory Course,

Semester V

Sr. No	Category	Course Title	L	T	P	Contact Hours	Evaluation Scheme			
							Theory	TW	POE	Total
1	EE	Digital Electronics and Microcontroller	3		2	5	100	25		125
2	EE	AC Machines	4		2	6	100	25	50	175
3	EE	Power Systems II	4		2	6	100	25	50	175
4	EE	Control System II	4		2	6	100	25		125
5	EE	Signals and Systems	3	1		4	100	25		125
6	EE	Software tools for Electrical Engineers			2	2		75		75
			18	1	10	29	500	200	100	800

Semester VI

Sr. No	Category	Course Title	L	T	P	Contact Hours	Marks			
							Theory	T W	POE	Total
1	EE	Advanced Electrical Measurements	4			4	100	25		125
2	EE	Communication Systems	3		2	5	100	25		125
3	EE	Electrical Machine Design	3	1	2	6	100	50	50	200
4	EE	Power System III	4		2	6	100	25		125
5	EE	Electrical Drives	4		2	6	100	25	50	175
6	EE	Electrical Workshop			2	2		50		50
			18	1	10	29	500	200	100	800

Note:-During vacation from 3rd year to 4th Year the candidate should undergo minimum 3 weeks training in any Industry and submit its report along with presentation to the department immediately after commencement of Next Semester (VII semester)

Semester VII

Sr. No	Category	Course Title	L	T	P	Contact Hours	Marks			
							Theory	T W	POE	Total
1	EE	Industrial Training						50		50
2	ES	Economics for Engineers	2			2		50(IT)		50
3	EE	Advanced Switchgear and Protection	4		2	6	100	25	50	175
		Digital Signal Processing	3		2	5	100	25		125
4	EE	Computer Methods in Power Systems	4		2	6	100	50		150
5	EE	Elective I	4			4	100			100
6	EE	Seminar			2	2		50		50
7	EE	Project Phase I			4	4		50	50	100
			17		12	29	400	300	100	800

* ‘IT’ Internal Test to be conducted at Institute – Paper at University Level

Semester VIII

Sr. No	Category	Course Title	L	T	P	Contact Hours	Marks			
							Theory	T W	POE	Total
1	ES	Law for Engineers	2			2		50(IT)		50
2	EE	HVDC Systems	4		2	6	100	25	50	175
3	EE	EHVAC	4			4	100			100
4		Electrical Generation and Utilization	4		2	6	100	25		125
5	EE	Elective II	4		2	6	100	50		150
6	EE	Project Phase II			6	6		100	100	200
			18		12	30	400	250	150	800

Elective I
1. Embedded Systems
2. High Voltage Engineering
3. Non Conventional Energy sources and Applications
4. Advanced Relaying
5. Computational Electromagnetic
6. Industrial Automation and SCADA

Elective II
1. FACTS
2. Wavelet Transforms and Multirate Signal Processing
3. Applications of Fuzzy Systems and Neural Network in Electrical Enginering
4. Restructured Power Systems
5. Power Quality and Harmonics

Shivaji University Kolhapur
Semester III
S. E. Electrical I
1. Engineering Mathematics III

Scheme of Instructions			Scheme of Examination	
Lectures	4		Theory	100
Tutorial	--		Term work	--
Laboratory	--		POE	--
Total	4		Total	100

Section – I

Unit 1 Linear Differential Equations: [8]

1.1 Linear Differential Equations with constant coefficients Definition, Complementary function and Particular integral (without method of variation of Parameters).

1.2 Applications of Linear Differential Equations with constant coefficients to Electrical systems.

Unit 2 Vector Differential Calculus: [6]

2.1 Differentiation of vectors

2.2 Gradient of scalar point function and Directional derivative

2.3 Divergence of vector point function and Solenoidal vector fields.

2.4 Curl of a vector point function and Irrotational.

Unit 3. Probability Distributions: [6]

3.1 Random variable

3.2 Binomial Distribution

3.3 Poisson Distribution

3.4 Normal Distribution

SECTION – II

Unit 4 Laplace Transform: [9]

4.1 Definition, Transforms of elementary functions, Properties of Laplace transform.

4.2 Transforms of derivatives and Integral.

4.3 Inverse Laplace transforms formulae.

4.4 Inverse Laplace transforms by using partial fractions and Convolution theorem.

4.5 Solution of Linear differential equation with constants coefficients by Laplace transforms method.

4.6 Heaviside Unit step Function, Dirac-delta function, and Periodic function.

Unit 5 Fourier series: [5]

5.1 Definition, Euler's Formulae.

5.2 Functions having points of discontinuity

5.3 Change of interval

5.4 Expansion of odd and even periodic functions

5.5 Half range series.

Unit 6 Fourier Transforms: [6]

6.1 Fourier Transforms.

6.2 Fourier Sine and Cosine Transforms

6.3 Inverse Fourier, Sine and Cosine Transforms.

6.4 Complex form of Fourier Integral

General Instructions:

1. For the term work of 25 marks, batch wise tutorials are to be conducted. The number of students per batch should be as per university pattern for practical batches.
2. Minimum number of assignments should be 8 covering all topics.

Nature of Question paper:

1. There will be two sections carrying 50 marks each.
2. Each section should have three questions having internal option.

Reference Books:

1. A text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar & P. N. Wartikar , Vidyarthi Griha Prakashan, Pune.
2. Higher Engineering Mathematics by Dr. B. S. Grewal (Khanna Publication Delhi.)
3. Advanced Engineering Mathematics by Erwin Kreyszig.
4. Advanced Engineering Mathematics, by H. K. Das (S. Chand Publication.)
5. Advanced Engineering Mathematics, by Merle C. Potter (OXFORD University Press)

2. Electrical Engineering Materials and Energy Conversion

Scheme of Instructions			Scheme of Examination	
Lectures	4		Theory	100
Tutorial	--		Term work	25
Laboratory	--		POE	--
Total	4		Total	125

Unit No.	Description		Contact Hours
Unit 1	**Conductive materials**:		07
		General properties and specifications of conductor materials; free electron theory of Metals, Relaxation time, collision time and mean free path, joule's law, factors affecting resistively. Thermal conductivity of metals-Wiedemann Franz law, Properties of high conductive materials (Copper, Brass, Bronzes, and Aluminum), Conductor-bimetals: solders, Materials of high resistively; alloys for use in electrical resistance, precision electrical measuring instruments, arc lamps and electric furnaces. Different types of fuses, fusing current and fuse ratings, materials used for highly loaded metal contacts. Electrical carbon materials: characteristics of different carbon brushes and graphite brushes, Superconductivity.	
Unit 2	**Insulating materials**:		05
		General properties of insulating materials (structure, composition). Dielectric gases. Liquid insulating materials. Solid insulating materials, insulating materials for electrical devices. Insulation measurement (Electric strength of liquid) Thermal classification of insulating material.	
Unit 3	**Magnetic Materials**:		07
		Magnetic parameters (Permeability, magnetic susceptibility, Magnetic moment, Magnetization,). Classification of magnetic materials, Ferromagnetic behavior below critical Temperature, Spontaneous Magnetism and Weiss Theory of Ferromagnetism, Ferromagnetic Materials at high temperature, , Ferromagnetic material, Magnetic materials for electrical devices, Soft magnetic materials, Hard magnetic material.	

Unit 4	**Dielectrics**:		06
		Different types of dielectric materials and their classification, dielectric as an electric field medium. Dielectric properties of insulators in static fields: Dielectric parameters, mechanism of polarization, ionic polarization, orientational polarization, internal field in solids and liquids, , Dielectric losses,	
Unit 5	**Principles of Electro-mechanical Energy Conversion:**		10
		-Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems (defining energy & Co-energy) , Singly Excited Systems; determination of mechanical force, mechanical energy, torque equation , Doubly excited Systems; Energy stored in magnetic field, electromagnetic torque , Generated emf in machines; torque in machines with cylindrical air gap	
Unit 6	**Materials for direct Energy conversion devices**:		07
		Solar cells, MHD generations, Fuel cells, thermoelectric generator, Thermo ionic converters.	
Text/Reference Books			
	1	Electrical Engineering Materials, A.J. Dekker, PHI.	
	2	Materials Science for Electrical & Electronics Engineers, Ian P. Jones, Oxford	
	3	Electrical Properties of Materials, L. Solymar & D. Walsh, Oxford	
	4.	Introduction to material science for engineers, J.K. Shackelford & M.K. Muralidhara, Pearson	
	5.	A course in Electrical Engineering Materils, S.P. Seth, P.V. Gupta, Dhanpat Rai & Sons.	

3. Analog Electronic Engineering

Scheme of Instructions			Scheme of Examination	
Lectures	4		Theory	100
Tutorial	--		Term work	25
Laboratory	2		POE	50
Total	6		Total	175

Course Objectives

- Understand various semiconductor devices.
- Describe BJT & JFET operation.
- Classify feedback amplifiers & analyze various oscillators.
- List ideal Op-Amp characteristics & explain configurations.
- Explain Op-Amp applications.
- Describe applications of 555 timer.

Unit No.	Description		Contact Hours
Unit 1	**APPLICATIONS OF SEMICONDUCTOR DEVICES**		12
		Introduction to diode and its characteristics, LED, LCD characteristics, Photo diode, Tunnel diode, Schotkky diode, - Photo voltaic cell - Rectifiers: HWR, FWR, DBR, filters, Regulators (series and shunt), SMPS.	
Unit 2	**SMALL SIGNAL ANALYSIS**		10
		Introduction to transistor and its characteristics- Transistor as a switch - Operating point of a BJT - Bias stability - Thermal runaway - Use of a heat sink- Biasing circuits for transistors - Hybrid model – Evaluation of H- parameters – Cascade – Darlington connection - JFET and MOSFET	
Unit 3	**FEED BACK AMPLIFIERS**		06
		Feedback amplifiers – Barkhausen criterion- Stability –Distortion - Voltage /current, series / shunt feedback amplifiers - Operation and analysis of RC phase shift, Wienbridge, Hartely, colpitts and crystal oscillators.	
Unit 4	**OP-AMP FUNDAMENTALS & CHARACTERISTICS**		06
		Ideal op-amp characteristics-Non ideal characteristics- DC characteristics – Input bias current-Input offset voltage- Input offset current- Thermal drift- AC characteristics- Frequency response- Frequency compensation- Slew rate. Op-amp pin diagram. configurations – Open loop & Feedback Modes- Inverting and Non Inverting Modes	

Unit 5	**OP-AMP IC741 APPLICATIONS**		10
		General applications: Summing amplifier - Difference amplifier - Voltage follower - Differentiator - Integrator –Sample and hold circuit- Multiplier- Instrumentation amplifier **Precision Op-amps:** Definition- Applications- Precision rectifiers-Clipper- Clamper. **Waveform generators:** Comparator-Applications-Schmitt Trigger-Square, triangular, sine wave generators.	
Unit 6	**SPECIAL IC APPLICATIONS**		06
		IC 555: Timer functional diagram-Monostable mode-Astable mode- Schmitt trigger – Applications	
Text/Reference Books			
	1	**"Electronic Devices and Circuit Theory",** Robert L. Boylestad and Louis Nashelsky, PHI/Pearson Eduication. 9TH Edition.	
	2	"**Analog Electronics Circuits: A Simplified Approach"**, U.B. Mahadevaswamy, Pearson/Saguine, 2007.	
	3	**"Op-amps & Linear Integrated Circuits",** Gayakwad .R A, Prentice Hall of India, New Delhi, 2009.	
	4.	**"*Electronic Devices and Circuits"*,**David A.Bell, Prentice Hall of India Private Limited, New Delhi, 2007.	
	5.	**"*Electronic Principles"*,** Malvino, Tata McGraw Hill, 6th edition,2000.	
	6.	**Operational amplifiers and linear IC's,** David A Bell, Oxford University Press, 2010.	
	7.	**Op Amps and Linear Integrated Circuits-Concepts and Applications,** James M.Fiore,Cengage Learing,2009.	

4. Electromagnetic and Electric Circuits

Scheme of Instructions			Scheme of Examination	
Lectures	4		Theory	100
Tutorial	1		Term work	25+50
Laboratory	2		POE	
Total	7		Total	175

* Tutorial will be on Unit 1 to 3 and Laboratory on unit 4 to 6

Course Objectives

- Understand Basic concepts of field and circuit theory.
- Understand relation between fields and circuits.
- Define Maxwell's equations.
- Understand Wave propagation..
- Apply network Theorems to various electric circuits.
- Develop techniques to analysis circuit in time domain and frequency domain.

Unit No.	Description		Contact Hours
Unit 1	**Vector Analysis**		07
		Vectors and vector calculus. Gradient, divergence and curl of a vector. Coordinate systems and Transformations, line surface and volume integral.	
Unit 2	**Electrostatics**		07
		Coulomb's law, Electric field intensity due to point Charge, line charge, surface charge and volume charge distribution, Electric flux density, Gauss's law and Divergence theorem, Energy, potential energy and work done, potential gradient, dipole and its electric field, dipole movement, energy density in electrostatic field	
Unit 3	**Steady Magnetic Field and Maxwell's Equations**		10
		Current and Current Density, Biot Savert's law and its vectorial form, Magnetic field due to infinitely long current carrying conductor, magnetic field on the axis of circular loop , Ampere's circuital law, Application to co-axial cable. Curl operator, Magnetic flux density, Stoke's theorem. Scalar and vector magnetic potential, Energy stored in magnetic field, boundary conditionsMaxwell's Equations for time varying fields, Displacement Current Density, Equation of Continuity, Uniform Plane Waves in free space	
Unit 4	**Circuit Fundamentals**		08
		Classification of circuits, sources and signals, standard signals, source transformations. Network topology, graph matrices, formulation and solution of circuit equations based on graph theory using different analysis techniques- circuit, cut set and mixed. Concept of duality. Mesh and Node Analysis	

Unit 5	**Network theorems and their applications**		08
		Superposition, reciprocity, Thevenin, Norton, Maximum power transfer, Millman, Substitution, Compensation and Tellegan's theorem. Analysis of circuits subject to periodic and non-periodic excitations using Fourier series and Laplace transforms.	
Unit 6	**Concept of free and forced response of circuits**		08
		. Time constants and Transient response under d. c. and a. c. excitation. Analysis of magnetically coupled circuits. Analysis of circuits with dependent sources.	
Text/Reference Books			
	1	Elements of Electromagnetic, Mathew N.O. Sadiku, 4th edition, Oxford university	
	2	Engineering Electromagnetic, W.H. Hyat & J.A. Buck, 7th Edition, TMH	
	3	Electromagnetic, J. Administer, Shaum Outline series	
	1	Desoer & Kuh, " Basic Circuit theory", McGraw Hill.	
	2	Van Valkenberg , "Network Analysis", PHI.	
	3	Valkenberg & Kinariwala , "Linear Circuits", PHI.	
	4.	Trick , "Introduction to circuit Analysis", Wiley.	
	5.	Roy Choudhary , "Networks & systems", Wiley.	
	6.	Lawrence P. Huelsman, " Basic Circuit Theory", PHI	
	7.	A. Sudhakar Mohan ,"Circuit & Networks", TMH	

5. Measurements and Instruments

Scheme of Instructions			Scheme of Examination	
Lectures	4		Theory	100
Tutorial	--		Term work	25
Laboratory	2		POE	50
Total	6		Total	175

Course Objectives

C – I **To Discuss** the basic concepts of measurements and different measuring instruments.

C – II **To Identify** errors in the instruments.

C – III **To Solve** the numerical on range extension of meters and different circuit parameters.

C – IV **To Demonstrate** digital and advance instruments.

C – V **To Examine** theoretically the performance of CT's and PT's.

C – VI **To Discuss** the contemporary issues in Instrumentation and Measurements.

Unit I: Fundamentals of Measurement

Qualities of Measurements - Performance characteristics(static, dynamic), Types of Error, errors and their compensation (numerical), Type of Uncertainties, uncertainty measurement method (direct method and comparison method) Various Standards, Electrical standards.**Measuring Instruments** - Absolute and secondary instruments, types of Secondary Instruments: indicating, integrating, and recording, analog & digital Ammeter and Voltmeter theory: Essentials of indicating instruments deflecting, controlling and damping systems. Construction, working principle, torque equation, advantages and disadvantages of Moving Iron (MI) (attraction and repulsion), Permanent Magnet Moving Coil (PMMC)& Dynamometer type instruments.

Range Extension: Multi range ammeter and voltmeter (Analog & Digital), shunts, multipliers (Numerical: calculation of current divider circuit, Voltmeter, series resistor technical realization of a multi range voltmeter, calculation of series resistance), DMM. [8Hrs]

Unit II :Measurement of Resistance, Inductance & Capacitance

Measurement of low, medium and high resistance, Wheatstone Bridge, Kelvin's Double Bridge, (Numericals), Ammeter-Voltmeter method, Megger, Earth tester for earth resistance measurement. Sources and detectors for a.c. Bridge, general Equation for bridge at balance. Maxwell's Bridge, Hay's Bridge, Anderson's Bridge, Schering Bridge, Wien's Bridge, The Owen Bridge.(Numericals). [10Hrs]

Unit III :Measurement of Power& Energy

Low power factor wattmeter. Active & reactive power measurement in three phase system for balanced and unbalanced load using two wattmeter method & one wattmeter method.Construction, working principle, torque equation, errors and adjustments of single phase conventional (induction type) energy meter, Calibration of energy meter. Digital Energy Meter, block diagram and operation of electronic energy meter. Three phase energy meters. [6Hrs]

Unit IV : Oscilloscope & Transducers

Block diagram &working of CRO &Digital Storage Oscilloscopes.Transducers: Introduction, classification, basic requirements for transducers. Selection of Transducer, Electrical transducer, Resistive transducer, Resistive position transducer, Resistance thermometer, inductive transducer, Pressure inductive transducer, capacitive transducer(pressure), High pressure measurement using electric methods, low pressure measurement by McLeod gauge and Pirani gauge,Piezzo-electric & photo electric transducer, temperature transducers.[10Hrs].

Unit V :Level and Displacement measurement

Introduction and importance of level measurement, level measurement methods: mechanical, hydraulic, pneumatic, electrical, nucleonic and ultrasonic. LVDT & RVDT – construction, working, application, null voltage, specifications, advantages, disadvantages, effect of frequency on performance. Strain Gauge: Introduction, definition of strain, types of strain gauge: Wire strain gauge, foil strain gauge, semiconductor strain gauge etc; their construction, working, advantages and disadvantages. [8 Hrs]

Unit VI :Recent developments in Instrumentation and Measurements

Wave Analysers& Harmonic Distortion, Power Analyser, Computer aided measurements, Fibre Optic Transducers, Microsensors, Smart Sensors, Virtual Instrumentation. Instrument Transformers: Construction, connection of CT & PT in the circuit, advantages of CT / PT over shunt and multipliers for range extension of MI Instruments, transformation ratio, turns ratio, nominal ratio, burden, ratio and phase angle error.(Descriptive treatment only), [6Hrs]

Text Books:

1. Instrumentation: Measurement and Analysis, 3rd ed., Nakra&Chaudhari, Tata McGraw Hill, New Delhi.
2. Electronic Instrumentation, 3rded, H. S. Kalsi, McGraw Hill Eduction (India).
3. Measurement andInstrumentation Principles, 3rd ed., Butterworth-Heinemann, A division of Reed Educational and Professional Publishing Ltd.

Reference Books:

1. Electrical Measurement & Measuring Instruments, Fifth edition, by E. W. Golding & Widdies, A. H. Wheeler & Co. Ltd.
2. A Course in Electrical and Electronic measurements & Instrumentation – by A. K. Sawhney, DhanpatRai& Sons.
3. A Course in Electronic and Electrical measurements and Instrumentation by J. B. Gupta, S. K. Kataria& Sons.
4. Electonic measurement and instrumentation by Dr. Rajendra Prasad, Khanna Publisher, New Delhi.
5. Introduction to Measurements and Instrumentation by Anand, PHI Publication.
6. Electronic Instruments & Measurement Techniques, by W.D. Cooper, Prentice Hall International.

6. Programming in C

Scheme of Instructions			Scheme of Examination	
Lectures	1		Theory	
Tutorial	--		Term work	50
Laboratory	2		POE	--
Total	3		Total	50

Course Objectives:

1) To develop logic based reasoning
2) To tackle and convert a given problem statement into a flowchart and an algorithm
3) To develop decision making capability in using appropriate programming construct such as different looping and branching statements, arrays and string handling function, various means of input and output operation
4) To teach a bottom up method of software development using user defined function.

Unit- I Basic of Programming Planning Concept (4)

Program Planning Concepts Algorithm; Advantages of Generalized Algorithms; How to Make Algorithms Generalized; Avoiding Infinite Loops in Algorithms – By Counting , By using a Sentinel Value; Different ways of Representing an Algorithm – As a Program, As a Flow chart, As a Pseudo code; Need for Planning a Program before Coding; Program Planning Tools – Flowcharts, Structure charts , Pseudo codes; Importance of use of Indentation in Programming; Structured Programming Concepts – Need for Careful Use of "Go to" statements, How all programs can be written using Sequence Logic, Selection Logic and Iteration (or looping) Logic, functions.

Unit-II C Programming Fundamental (4)

Problem formulation, Problem Solving, Introduction to 'C' programming fundamentals, structure of a 'C program compilation and linking processes Constants, Variables Data Types Expressions using operators in 'C, Managing Input and Output operations , Decision Making and Branching Looping statements , solving simple scientific and statistical problems.

Unit-III Array and string (2)

Arrays (Initialization, Declaration, One dimensional and Two dimensional arrays), String (String operations, String Arrays), Simple programs, sorting, searching, matrix operations.

Unit-IV Functions and Pointer (2)

Function (definition of function, Declaration of function, Pass by value, Pass by reference, Recursion) Pointers (Definition, Initialization, Pointers arithmetic, Pointers and arrays), Example Problems.

Unit -V Structures and Unions **(2)**

Introduction need for structure data type, structure definition, Structure declaration, Structure within a structure, Union (Programs using structures and Unions, Storage classes, Pre-processor directives)

Unit –VI Additional Features of C **(2)**

Enumeration, Command Line Parameter, Macros Preprocessor, File Handling in MATLAB/ Microcontroller with C codes

TERM WORK: - Minimum TEN Programs covering all topics with one Small Project.

Course outcomes:

1) Understand basic terminology used in computer programming
2) Write, compile and debug program in C language.
3) Design programs involving decision structures, loops and function.

REFERENCES:

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Byron S Gottfried, " Programming with C", Schaum‟s Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007
4. Nadini S.Sidnal 'C programming Laboratory' Wiley India pvt. Ltd.
5. Rudra Pratap "Getting started with MATLAB" Oxford

Shivaji University Kolhapur
Semester IV
S. E. Electrical II
1. DC Machines and Transformer

Scheme of Instructions			Scheme of Examination	
Lectures	4		Theory	100
Tutorial	--		Term work	25
Laboratory	2		POE	50
Total	6		Total	175

Course Objectives:

1. To expose the students to the concepts of DC machines, SingleTransformers, three phase transformer and their industrial applications
2. To set a firm and solid foundation in Electrical machines with strong analytical skills and conceptual understanding of theorems and analysis methods in D.C. Machines and A.C. machines.
3. To impart industry oriented learning.

1. **ELECTROMECHANICAL ENERGY CONVERSION PRINCIPLE**:, Singly Excited Magnetic System and Doubly Excited Magnetic system. Physical concept of torque production; Electromagnetic torque and Reluctance torque. Concept of General terms pertaining to Rotating Machines: Electrical & Mechanical degree, Pole pitch, Coil, Generated EMF in full pitched coil, Generated EMF in a short pitched coil, EMF polygon, Distribution factor, Pitch factor. MMF produced by Distributed Windings, MMF of a coil, MMF of single phase distributed Winding, MMF waveform of Commutator machines **(6-Hr)**
2. **DC.MACHINES** :Construction of D.C. machines, commutator and brush arrangement, EMF equation, torque equation, armature winding and its types, armature reaction: Demagnetization and cross magnetization ampere turns, principle of compensation, compensating winding, methods to minimize the effect of armature reaction, Process of commutation, Methods to improve commutation, concept of Motoring, types of motor, Concept of back emf, characteristics of d.c. motors, Method of speed controls, concept of braking of DC separately excited motors (Rheostatic, Regenerative and plugging). Parallel and series operation of motor, starter for shunt and series motor, Design of grading of resistance of starters, testing: Losses and efficiency, Brake load test, Swinburne test, Hopkinson's test, Retardation test, field test. Application of Generator and Motor. **(14-hr)**

3. **TRANSFORMER – SINGLE PHASE:** Review of EMF equation, Equivalent Circuit and Phasor diagram of Transformer. Voltage Regulation of Transformer: - Voltage Regulation, Condition for Zero Voltage Regulation, Condition for Maximum Voltage Regulation. Transformer Losses and Efficiency - Losses, Efficiency, Condition for Maximum Efficiency, Energy Efficiency, All day Efficiency, Separation of Hysteresis and Eddy current losses Testing of Transformer: - Polarity Test, Load Test, Review of OC and SC test, Sumpner's Test, Impulse test. Autotransformer:- Autotransformer Working, Advantages of Autotransformer over Two winding Transformer, Disadvantages Parallel Operation: No load Operation, On load Operation:- Equal Voltage Operation and Unequal Voltage Operation Introduction to High Frequency Transformer, Pulse Transformer, Isolation Transformer and its applications. **(10-hrs)**

4. **3-PHASE TRANSFORMER**: Determination of polarity and connections (star/star, star/delta, delta/star, star/zigzag, delta/zigzag, open delta), Phasor group's performance of transformers: heat run test, sumpners test, Equivalent delta. Effect of unbalanced loading, Production of Harmonics in Transformer and its suppression, 3 phase to 2 phase transformation, Scott connection 3 phase to 6 phase connections, Double star and Double delta, 3 winding transformer: Parameter estimation, application, Parallel operation of Transformers, Introduction to Tap changing transformer and its function. **(8-hrs)**
5. **SPECIAL TRANSFORMERS:** Potential transformer, Current transformer, Pulse transformer, Audio frequency transformer, Grounding transformer, Pulse transformer **(2-hrs)**

Term work:

1. Term work shall consist of minimum eight experiments, assignments (min two)
2. The distribution of marks for term work shall be as follows:
   2.1 Laboratory work (Experiments) **: 10 marks**
   2.2 Assignments : **10 marks**
   2.3 Attendance (Theory and Practical) **: 05 marks**
   The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

LIST OF EXPERIMENTS:

1) O.C.C of Separately excited DC generator
2) Load Test on DC Shunt Motor
3) Load Test on DC SeriesMotor
4) Load Test on DC Compound Motor
5) Speed Control of DC shunt Motor (Armature and Field Control)
6) Swinburne's Test
7) Hopkinson's Test
8) Field's Test
9) O.C & S.C. Test on 1Φ Transformer
10) Sumpner's Test on 1Φ Transformer
11) Separation of iron loss into hysteresis and eddy current loss components in a1Φ

Transformer

12) Load Test on 1Φ Transformer and 3-phase Transformer

13) Parallel operation of 1Φ

14) Scott connection

15) Equivalent Delta test or Heat run Test for three phase transformer.

Books Recommended:

Text Books:

1. Bimbhra P.S., *Electric Machinery* , Khanna Publisher,

2. Bimbhra P.S., *Generalized Machine Theory*, Khanna Publisher,

3. Kothari D.P, Nagrath I.J., *Electric Machines*, TMH Publishcations

4. A.E. Fitzgerald, Kingsly, Stephen., *Electric Machinery,* Tata McGraw Hill

5. Umanand L, Bhat S.R., "*Design of Magnetic Components for Switched mode Power Converters*", Wiley Eastern Ltd.

Reference Books:

1. M.G. Say and E. O. Taylor, *Direct current machines*, Pitman publication

2. Ashfaq Husain, *Electric Machines*, Dhanpat Rai and co. publications

3. M.V. Deshpande, *Electric Machines*, PHI

4. Smarajit Ghosh, *Electric Machines*, PEARSON

5. P.K. Mukherjee & S. Chakrabaryt, *Electrical Machines*, Dhanpat Rai Publication.

6. Irving L Koskow, *Electric Machinery & transformer*, 2nd Edition, Prentice Hall India

7. Alexander S Langsdor*, Theory of Alternating Current Machinery,*, Tata Mc Graw Hill Edition.

8. Bhag S. Guru and H.R. Hiziroglu, *Electric Machinery & Transformers,* 3rd Edition, Oxford University press.

9 R.K. Srivastava, *Electrical Machines,* Cengage Learning

2. Power Electronics

Scheme of Instructions			Scheme of Examination	
Lectures	4		Theory	100
Tutorial	--		Term work	25
Laboratory	2		POE	50
Total	6		Total	175

Course Objectives: The aim of this course is to familiarize the student with the characteristics of modern power semiconductor devices, which are used as switches to perform the power conversions from ac-dc, dc-dc, dc-ac and ac-ac; Both the fundamental principles and in depth study of operation, analysis and design of various power converters; and recent applications of power electronics.

Unit-I: Power Semiconductor Devices

Power Diodes – working, characteristics, types, ratings, reverse recovery characteristics, series-parallel operation, applications of Power diodes. SCR-basic structure, working, static and switching characteristics, types, ratings, reverse recovery characteristics, Gate characteristic, turn on methods, series-parallel operation, protection, triggering circuits, applications of SCR, GTO, MOSFET, IGBT, Device structure, static characteristic, dynamic characteristic, ratings, applications of GTO, MOSFET and IGBT; TRIAC-structure, static characteristics, different modes of operations, applications of TRIAC. (06)

Unit-II: Rectifiers

Single phase Half wave with R, RL load, Single phase and Three phase full bridge rectifier with R, RL and RLE load, mathematical expressions, issue of harmonics, applications of diode rectifiers, Numericals expected. (03)

Unit-III: Single Phase Converter

Single phase fully controlled and half controlled converters - Continuous and discontinuous mode of conduction, analysis with R,RL, RLE load, expressions for average output voltage, RMS, TUF, THD, Ripple factor, Modes of operation in the voltage-current plane, operation as an inverter, Dual converter, Simultaneous and non-simultaneous control, Effect of source inductance, harmonics analysis, Numericals expected. (04)

Unit-IV: Three Phase Converter

Three phase half wave converter, R, RL, RLE load, expressions for average output voltage, RMS, TUF, THD, Ripple factor, DC magnetization of the input transformer, harmonics analysis Three phase fully controlled and half controlled converters with R, RL, RLE load, expressions for average output voltage, RMS, TUF, THD, Ripple factor, displacement factor, Inverter mode of operation, harmonic analysis, Effect of source inductance, Three phase dual converters, applications of controlled converters and dual converters. Numericals expected. (05)

Unit- V: Cycloconverters

Single phase to single phase cycloconverter with R and RL load, Three phase to Single phase cycloconverter, Three phase to three phase 3 and 6 pulse converter, circulating and non circulating mode, applications of cycloconverters. (05)

Unit-VI: DC to DC converter

Classification, Principle of working of Step-down Chopper, Step-up Chopper, Analysis, voltage control methods, Morgan Chopper, Jones Chopper, multiphase choppers. Zero voltage switching and Zero current switching (05)

Unit-VII: Inverters

Voltage source inverters, Single phase and three-phase- six step (120/180 degree mode of operation), thyristorised bridge circuits, output waveforms for R and R-L loads, harmonic analysis, PWM techniques-Single, Multiple and Sinusoidal PWM, applications of VSI, Current Source Inverter, advantages, applications of CSI, Multilevel inverter (08)

Text books:

1. Power Electronics Circuits, Devices, and Application, M.H. Rashid, 2nd Edition, Prentice Hall of India, New Delhi, 1999.
2. Power Electronics, P.S. Bimbhra, 3rd , Edition, Khanna Pub., New Delhi, 1999.
3. Power Electronics, M.D. Singh and K.B. Khanchandani, Tata Mc-Graw-Hill, New Delhi, 1998.
4. SPICE for Power Electronics and Electric Power (Electrical and Computer Engineering): Muhammad H. Rashid, Hasan M. Rashid, Second Edition Prentice Hall of India, New Delhi.
5. Ned Mohan, Robbins,Undeland,"Introduction to power electronics" john Willey & Sons.
6. B.K. Bose," Power electronics and drives" Pearson publication.

List of experiments:

1. SCR/TRIC/ DIAC/ MOSFET/IGBT Characteristics.
2. Triggering circuits/phase control.
3. Single phase FW bridge converter feeding DC motor.
4. Three Phase Converter (Half Wave and Full wave bridge).
5. Dual Converter.
6. Cycloconverter feeding Resistive load.
7. Jones/ Morgan Chopper.
8. Single phase / three phase Inverter with Resistive/Induction Motor load.
9. Simulation of Converter / Chopper using SPICE/MATLAB.
10. Simulation of PWM Inverter using SPICE/MATLAB.
11. Simulation of multilevel inverter using SPICE/MATLAB.

S.E. (Electrical Engineering)

3. Power System I

Scheme of Instructions			Scheme of Examination	
Lectures:	04 Hours/Week		Theory	100
Tutorial	----		Term work	50
Laboratory	2		OE	
Total	6		Total	150

Course Objectives

C – I To explain the generation of Electric Energy by different sources

C – II To describe the basic structure of power system and its components

C – III To explain Distribution system with classification

C – IV To discuss the overhead transmission line and Underground cables

C – V To describe the importance and equipments used to improve the power factor.

C – VI To explain Economic Aspects of Power Generation

1. Generation of Electric Energy and Power System Components (08 Hrs)

Schematic/ Block diagram of Hydro power plant, Thermal power plant, Nuclear power plant and Diesel power plants and their working. Basic structure of an AC power system, Distribution voltage level, Sub-transmission level, Single line diagram. Brief Description of Power system elements such as Synchronous Machine, Transformer, Bus bar, Circuit Breaker, isolator, CT, PT.

2. Distribution Systems (06 Hrs)

Classification of Distribution Systems, AC Distribution- Primary and Secondary Distribution systems, Overhead and Underground systems, Connection scheme of distribution system, Radial system, Ring main system, Interconnected systems, feeders and distributors, AC distribution calculations,

3. Overhead Transmission Lines and Underground Cables (10 Hrs.)

Types of conductors- Hard drawn copper, hard drawn aluminum, steel cored aluminum, ACSR, SSC,AAC, Smooth Body ACSR, Expanded ACSR, ACAR, bundled conductor, Resistance, inductance and capacitance for single and double circuit lines, skin effect and proximity effect.

Main components of over head lines, conductor materials, line supports, Types of line supports, insulators, types of insulators, potential distribution over suspension insulators, string efficiency, methods of improving string efficiency. Corona, factors affecting corona, important terms, advantages and disadvantages of corona, methods of reducing corona effect, sag in over head lines and sag calculations.

Construction and classification of cables for single and three phase service, Methods of laying underground cables.

4. Characteristics and Performance of Transmission Line: (10 Hrs.)

Short, medium and long lines, Voltages and currents at sending and receiving end of line, ABCD constants, Sending end and receiving power circle diagrams, universal power circle diagram, voltage and current waves, surge impedance loading of transmission line, Complex Power flow through transmission line, Power transmission capability, Ferranti effect, tuned power lines, methods of voltage control, voltage regulators, tap changing transformers, booster transformers, synchronous phase modifiers,.

5. Power Factor Improvement: (08 Hrs.)

Causes and disadvantages of Low power factor, power factor improvement Equipments-using Static capacitors, synchronous condensers, phase advancers, Calculation of Power factor correction; Importance of power factor improvement, Most economical power factor derivation. .

6. Economic Aspects of Power Generation (06 Hrs.)

Load curve, load duration and integrated load duration curves-load, demand, diversity, capacity, Utilization and plant use factors- Numerical Problems. Costs of Generation and their division into Fixed, Semi-fixed and Running Costs. Desirable Characteristics of a Tariff Method.-Tariff Methods: Flat Rate, Block-Rate, two-part, three –part, and power factor tariff methods

Note: Numericals are expected on units

Term work:

Term work should consist of following:

1. Minimum 2 drawing sheets based on above theory
2. Minimum 8 experiments based on above theory using softwares like MATLAB, MiPower, PSIM, EMTP, and ETAP.
3. Hand written Technical Report (after visiting sub-station):

   Technical report should consist of following theoretical and practical aspects of Sub-stations

   Type of Sub-station and it's location,

   Major components of sub-station and their functions with single line diagram,

   Different Bus bar arrangements (Single and Duplicate bus bar Systems) Ratings and make of sub-station equipment

Text Books

1. Modern Power System Analysis by I. J. Nagrath, D. P. Kothari, 3rd Edition, Tata McGraw Hill Publishing Co. Ltd., 2003.

2. Power System Analysis and Design by J.D.Glover and M.Sarma, 3rd Edition, Brooks/ Cole Publishing, 2002.

3. Electric Power Systems by Weedy B M, Cory B J,John Wiley Publication, latest edition

4. Power System Analysis by Grainger John J and W D Stevenson Jr. McGraw Hill, 1994

5. Power System Analysis by Hadid Sadat, McGraw Hill International, latest edition

Additional Reading:

[1] M.V. Deshpande , Elements of power station design , Tata Mc Graw Hill

[2] Electrical Power Systems by C.L.Wadhawa New age International (P) Limited, Publishers 1997. D.H.Bacon, Engineering Thermodynamics, London butterworth

[3] P. K. Nag, Power plant Engineering - stream & nuclear, Tata Mc Graw Hill

[4] Fredrick T. Morse. Power plant Engineering , east west press private Ltd

[5] Mahesh Varma : Power plant Engineering , Metrolitan book Co Pvt Ltd

[6] George W. Sutten (Editor) : Direct Energy Conversion , Latur university, Electronics series Vol-3, Mc Graw hill

[7] Electrical Power Generation, Transmission and Distribution by S.N.Singh., PHI, 2003

[8] Electrical India Magazine

4. Network Analysis and Synthesis

Scheme of Instructions			Scheme of Examination	
Lectures	3		Theory	100
Tutorial	--		Term work	--
Laboratory	--		POE	--
Total	3		Total	100

UNIT-I] INTRODUCTION [8 Hours]

Development of circuit concept, Conventions for describing networks, Dot conventions for coupled circuits, Network equations, Duality, General & particular solutions, Initial conditions in networks.

UNIT-II] NETWORK THEORAMS (Applications to ac networks): **[6 Hours]**

Superposition Theorem, Norton's Theorem, Thevenin's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Millman's Theorem

UNIT-III] TRANSFORM ANALYSIS [8 Hours]

Laplace transformation revisited, Solution by Laplace transformation, Waveform synthesis, Initial & Final value theorems, Convolution integral, Convolution as summation, Fourier analysis of networks.

UNIT-IV] NETWORK FUNCTION [8 Hours]

Concept of complex frequency, poles & zeros, Network functions for one port & two port, Restrictions on poles & zero locations for driving point & transfer functions, two port parameters, Relation between parameter sets.

UNIT-V] NETWORK SYNTHESIS [10 Hours]

Reliability of one port networks, Positive real functions (PRFs), Properties of PRF, Hurwitz polynomials, Realization of LC, RC, RL driving point impedance & admittance functions, Elements of two port network synthesis.

UNIT-VI] FILTER SYNTHESIS [04 Hours]

Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T section, Pie section, terminating half section. Pass bands and stop bands. Design of constant-K, m derived filters. Composite filters

TEXT/REFERENCE BOOKS:

1 M.E. Van Valkenburg, "Network Analysis", Prentice Hall of India

2 A.Chakrabarti, "Circuit Theory" Dhanpat Rai & Co.

3 C.L Wadhwa, "Network Analysis and Synthesis" New Age International Publishers, 2007.

4 D.Roy Choudhary, "Networks and Systems" Wiley Eastern Ltd.

5 Donald E. Scott: "An Introduction to Circuit analysis: A System Approach" McGraw Hill

5. Control Systems I

Scheme of Instructions			Scheme of Examination	
Lectures	4		Theory	100
Tutorial	--		Term work	50
Laboratory	2		POE	--
Total	5		Total	150

Course Objective: 1. To learn modeling of different physical systems.

2. Study of different transfer function finding techniques.
3. Analyzing behavior of systems using Root locus, bode plot, Routh-Hurwitz criteria etc.
4. Study of state space.

UNIT 01: MODELING AND REPRESENTATION OF CONTROL SYSTEM AND TRANSFER FUNCTION. (09 Hrs)

History of control system, Laplace transform review, Transfer function of electrical, mechanical, thermal, hydraulic system, Electrical circuits analogs, Block dia. Representation and reduction, types of feedback systems, signal flow graph, Mason's gain rule, SFG.

UNIT 02: TIME DOMAIN ANALYSIS AND STABILITY CONCEPT (10Hrs)

Response of first and second order system, general second order system, response with additional pole and zeros, steady state error for unity feedback system , static error constants and systems type, steady state error specifications, Routh criteria for stability.

UNIT 03: SERVO COMPONENETS (08 Hrs)

Error detectors ,Potentiometer, synchros, optical rotary encoders, DC and AC Servomotors, stepper motor, gear trains, A C and DC tacho-generators, Transfer function and applications of these.

UNIT 04: ROOT LOCUS (06 Hrs)

Definition of root locus, Rules for plotting root loci, Root contour, stability analysis using root locus, effect of addition of pole and zero.

UNIT05: FREQUENCY RESPONSE TECHNIQUE (08 Hrs)

Bode plot, Nyquist criterion, stability, gain margin, phase margin by Nyquist diagram and bode plot, Determination of transfer function from bode plot.

UNIT 06: STATE SPACE CONCEPT (07Hrs)

State space representation, phase variable form, converting transfer function to state space and vice versa, Canonical form, companion form, Jordan Canonical form, Solution of state equations. Concept of controllability and observability, eigen values and stability.

Reference Book:

1. Control System Engineering, Norman S. Nise, John willey and Sons, 4th edition, 2004.
2. Control System Engineering, I.J. Nagrath and M. Gopal, Anshan publication, 5th edition, 2008.
3. Modern Control Engineering, K. Ogata, Eastern Economy, 4th edition 2002.
4. Control System principles and design, M.Gopal, Tata Mc Graw Hill, 3rd edition, 2008.

Electrical Generation Transmission and Utilization

Scheme of Instructions			Scheme of Examination	
Lectures	1		Theory	
Tutorial	--		Term work	50
Laboratory	2		POE	--
Total	3		Total	50

Visit 1:The students are expected to visit Electrical Generating Units (Hydro/Thermal/Nuclear) understand the Working Principle. Capacity, Voltage Level, Metering and Record, Planning

Visit 2: The students are expected to visit Electrical Substation understand different Transmission and distribution electrical Aparatus, Capacity, Voltage Level, Metering and Record, Planning

Visit 3: The students are expected to visit an Industry understand the Electrical Utilization of the Industry, Different types of Loads, Manufacturing Processes, Tariff, Power Factor Correction Techniques, Energy Audit

Visit reports to be submitted for assessment after the visit.

Equivalence

Old Course Title	**Revised Course Title**
Engineering Mathematics-III	Engg. Maths III
Generation & Its Economics	Electrical Engineering Materials and Energy Conversion
Analog Electronics	Analog Electronic Engineering
Electrical Circuit Analysis	Electromagnetic and Electrical Circuits
Electrical Measurement	Measurements and Instruments
Advanced C - programming	Programming in C
DC Machines and Transformers	DC Machines and Transformer
	Power Electronics
	Power Systems I
	Network Analysis and Synthesis
	Control System I
	Environmental Studies
Introduction to Pspice & MATLAB	Circuit Simulation
Signals and Systems	
A.C. Machines	
Industrial Management and Economics	
Digital Systems and Microprocessors	
Introduction to advanced packages (LABVIEW)	