DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY LONERE

ELECTRICAL ENGINEERING DEPARTMENT

Structure and syllabus

Of

Final Year B. Tech. (Electrical Engineering)

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY LONERE

ELECTRICAL ENGINEERING DEPARTMENT

Structure Of Final year B. Tech. (Electrical Engineering)

V II Semester

Course Code	Course Name	Teaching Scheme			Evaluation Scheme					Credits
		L	P	T	Int	MSE	ESE	TW	Pr/OR	
EEL701	Controlled Drives	3	0	1	20	20	60	-	-	4
EEL702	Power system modeling and Analysis	3	0	1	20	20	60	-	-	4
EEL703	Elective-IX	3	0	0	20	20	60	-	-	3
EEL704	Elective-X	3	0	0	20	20	60	-	-	3
EEP705	Controlled Drives Lab	0	2	0	-	-	-	25	25	1
EEP706	Power system modeling and Analysis Lab	0	2	0	-	-	-	25	25	1
EEP707	Seminar	0	2	0	-	-	-	25	25	4
EEP708	Project Phase-I	0	2	0	-	-	-	25	25	6
EET709	Industrial Training	0	0	0	-	-	-	25	25	1
	TOTAL	12	08	02	80	80	240	125	125	27

Elective-Ix: HVDC Transmission and Facts, Advanced Instrumentation 3 Special Purpose Electrical Machines

Elective-X 1. Digital Signal Processing. 2 Entrepreneurship Development, 3. Engineering System Design optimization

VIII Semester

Course Code	Course Name	Teaching Scheme			Evaluation Scheme					Credits
		L	P	T	Int	MSE	ESE	TW	Pr/OR	
EEL801	Electrical Utilization	3	0	1	20	20	60	-	-	4
EEL802	High Voltage Engineering	3	0	1	20	20	60	-	-	4
EEL803	Elective-XI	3	0	0	20	20	60	-	-	3
EEL804	Elective-XII	3	0	0	20	20	60	-	-	3
EEP805	Electrical Utilization Lab	0	2	0	-	-	-	25	25	1
EEP806	High Voltage Engineering Lab	0	2	0	-	-	-	25	25	1
EEP807	Project Phase-II	0	4	0	-	-	-	50	50	8
	TOTAL	16	08	02	80	80	240	100	100	24

Elective-Xi: 1. Energy Audit and Conservation 2. Power Quality Issues 3. Microcontroller and Interfacing

Elective-Xii: 1.Introduction to Power System Components Modeling 2. Advanced Power Electronics

3. Advanced Control Systems

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Semester VII

EEL 701 CONTROLLED DRIVES

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	EEL 501: Electrical machine-II, EEL603: Power electronics	
Course Outcome	To understand concept of electric drive and their control. To analyze different control techniques on control of industrial drives To select/ recommend suitable drive for particular application for industry	
Unit	Contents	Contact Hrs
1	Introduction : Advantages of Electrical Drives, Parts of Electrical drive, Choice of Electric drives Dynamics of Electrical drives: fundamental torque equations, multiquadrant operation, nature and classification of load torques, steady state stability, concept of load equalization in drives	8
2	Control of Electrical Drives : Modes of operation: Steady state, Acceleration, Deceleration, Drive classification. Closed loop control of drives : Current limit control, torque control, speed control, position control, Control of multi motor drives, speed sensing, current sensing, Classes of motor duty & criteria for selection of motor	6
3	DC Motor Drives : Review of basic characteristics of DC motors, Single phase drives : Single phase half wave converter drives, semi converter drives, Full converter drives, Dual converter drives. Three phase drives : Three phase half wave drives, semiconverter drives, full converter drives, dual converter drives, DC-DC converter drives : Principle of Rheostatic and regenerative braking control, combined control, two and four quadrant DC-DC converter fed drives. Introduction to closed loop control of DC drives.	6
4	Induction Motor Drives : Review of starting, braking and speed control of three phase induction motors, Stator voltage control, Rotor voltage control, frequency control, Voltage and frequency control, Current control, Closed loop control of Induction motors, Principle of Scalar and Vector control of Induction motor, Multiquadrant operation of induction motor drives fed from Voltage Source Inverters. Static rotor resistance control method, static slip power recovery control-Static Scherbius drive and Static Kramer drive.	6
5	Synchronous Motor Drives : Review of starting, pull in and braking of Synchronous motor Static variable frequency control for Synchronous motors Load commutated inverter fed Synchronous motor drive, Introduction to closed loop control of Load commutated inverter fed Synchronous motor drive	6
6	Drives for Specific Applications : Textile Mill: various stages and drive requirements, control of ac motors for controlling torque. Steel Rolling Mill : reversing and continuous hot and cold rolling mills, Drive requirements, motors for mill drive. Cement mill : Stages in cement production, requirements of mill motors, Kiln drives, crusher drives, fan/blower drives, compressor drive. Sugar Mill : Requirements for various drive motors, selection of motors for various processes.	7
	Ref Books: 1. Dubey G. K., "Fundamentals of Electrical Drives", Narosa Publishing house 2. De N. K., Sen P. K., "Electric Drives", Prentice Hall of India 3. Vedam Subramanyam, "Electrical Drives and Control", TMH Publications	

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EEL 702 POWER SYSTEM MODELING AND ANALYSIS

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit:4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	EEL 502: Power System-II	
Course Outcome	To obtain mathematical models of power system components. To conduct power flow, fault and stability analysis using models. To analyze the power system dynamic performance. To understand the effect of excitation control.	
Unit	Contents	Contact Hrs
1	Modeling of Power system components: Transmission lines, Power transformer, Phase shifting transformer, Tap changing transformers, Synchronous Machine, Lighting arresters, Loads	8
2	Power Flow Analysis: Solution of Power flow equation by Gauss Seidal and Newton Raphson method, Decoupled load flow, Fast decoupled load flow (FDLF).	6
3	Fault Analysis by Computer methods: Programmable method for formulating [Z] – sequence fault impedance matrix, general fault analysis equation, line current calculation	6
4	Transient Stability: Solution of Swing equation using classical model, application of equal area creation on point by point solution	6
5	Power system Dynamic Performance: Effects of various types of disturbance parameters and controls on stability	6
6	Effect of excitation control and turbine governing. Augmentation of stability of conventional methods	7
	Ref Books: 1. Gross C. A., 'Power System Analysis' McGraw Hill 2. Arrilaga J., 'Computerised Power system Analysis' McGraw Hill 3. Foud Anderson, 'Power system control dynamics' McGraw Hill 4. Kaushik, 'Computerised Power system Analysis' McGraw Hill 5. Padiyar K. R., 'Power system dynamics, ' New Age International	

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EEL 703.Elective-IX-1. DIGITAL SIGNAL PROCESSING

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Signals and systems network analysis and synthesis.	
Course Outcome	To study different signals, systems, design procedure for filters. To understand time domain and frequency domain of systems. To analyses system signals and digital filter structure. To design digital filter for engineering application.	
Unit	Contents	Contact Hrs
1	Introduction to signals and systems Discrete time signals and systems, Z-transforms, structures for digital filters, design procedures for FIR and IIR filters. Frequency transformations: linear phase design; DFT. Methods for computing FFT. Noise analysis of digital filters, power spectrum estimation. Signals and signal Processing: characterization & classification of signals, typical Signal Processing operations, example of typical Signals, typical Signal Processing applications.	8
2	Time Domain Representation of Signals & Systems- Discrete Time Signals, Operations on Sequences, the sampling process, Discrete-Time systems, Time-Domain characterization of LTI Discrete-Time systems, state-space representation of LTI Discrete-Time systems, random signals	6
3	Transform-Domain Representation of Signals-The Discrete-Time Fourier Transform, Discrete Fourier Transform, DFT properties, computation of the DFT of real sequences, Linear Convolution using the DFT. Z-transforms, Inverse z transform, properties of z-transform, transform domain r epresentations of random signals. Transform-Domain Representation of LTI Systems: the frequency response, the transfer function, types of transfer function, minimum-phase and maximum-Phase transfer functions, complementary transfer functions, Discrete-Time processing of random signals	6
4	Digital Processing of Continuous-Time Signals - sampling of Continuous Signals, Analog Filter Design, Anti-aliasing Filter Design, Sample-and Hold circuits, A/D & D/A converter, Reconstruction Filter Design.	6
5	Digital Filter Structure - Block Diagram representation, Signal Flow Graph Representation, Equivalent Structures, bone FIR Digital Filter Structures, IIR Filter Structures, State-space structure, all pass filters, tunable IIR Digital filters. cascaded Lattice realization of IIR and FIR filters, Parallel all pass realization of IIR transfer function, Digital Sine-Cosine generator.	6
6	Digital Filter Design: Impulse invariance method of IIR filter design, Bilinear Transform method of IIR Filter Design, Design of Digital IIR notch filters, FIR filter Design based on truncated fonner sens, FIR filter design based on Frequency Sampling approach	7
	Ref Books: 1. Proakis J.G., and Manolakis, Introduction to DSP, PHI, 2007 2. Sanjit K. Mitra, “Applications DSP a Computer based approach”, TMH, 2006	

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EEL 703.ELECTIVE-IX-2. ENTREPRENEURSHIP DEVELOPMENT

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite		
Course Outcome	To select right entrepreneurship filed. To write feasible report. To understand organization setups and behaviors. To understand different financial sources for enreprenurship.	
Unit	Contents	Contact Hrs
1	Entrepreneurship: Aim, alternative to seeking jobs, promote self employment and accelerate industrialization, EDP in India & Maharashtra (An over view), Institutions promoting entrepreneurship, their objective and mode of functioning.	8
2	Motivation: Requirements and constraints: Affiliation, power achievement, goal setting, financial and carrier risks and rewards, sources of information, where to go? for what? Entrepreneurship, personality, creativity and other qualities.	6
3	Selecting the right Entrepreneurship field: Search, and scanning , small scale, medium scale industries, manufacturing / transporting / consultancy for selecting product for development, manufacturing	6
4	Feasibility report: Market survey, right infrastructure, location and government subsidies, sources of technology, recruiting right people, identifying customers, finding out competitors, preparation of feasibility report, project report.	6
5	Organizational set- ups: Advantage and limitations of proprietorship, partner ship co – operatives, private limited and public limited company, management in small scale firms, entrepreneurial skills, advertising, selling and scales promotion, sale forecast	6
6	Financial: Seed money, sources of finance, different financing institutions, different taxes and duties from government, certain do's and don'ts for successful entrepreneur	7
	Ref Books: 1. A Handbook for new entrepreneurship – Entrepreneurship Development Institute of India, Ahmedabad 2. G. S. Batra, "Entrepreneurship and Small scale Industries", Deep & Deep Publications Pvt. Ltd 3. Banga, Sharma, "Industrial Organization and Management"	

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EEL 703.ELECTIVE-IX-3. ENGINEERING SYSTEM DESIGN OPTIMIZATION

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite		
Course Outcome	To understand different level optimization problem formulation. To study novel methods in optimization. To understand and develop genetic algorithm for engineering problems.	
Unit	Contents	Contact Hrs
1	Introduction- Optimization problem formulation, optimization algorithms, applications and examples, different optimization methods available	8
2	Single Variable optimization-Optimization criteria, bracketing methods – Exhaustive search method, bound phase method; Region Elimination methods – Fibonacci search method, Golden search method; Gradient based methods – Newton Raphson method, Bisection method; Root finding using optimization technique	6
3	Multi objective optimization- Optimization criteria, Different search methods, Unidirectional search, Direct search method – Evolutionary optimization method, Powell‟s conjugate direction method; Gradient based methods – Newton‟s method and Variable metric method.	6
4	Specialized Methods- Integer programming, Geometric programming, simulated annealing, Global optimization using - steep descent method, simulated annealing.	6
5	Genetic algorithms and evolutionary approaches-Differences and similarities between genetic algorithms and traditional techniques, operators of GA‟s, Computer program for simulated annealing, Newton Raphson method, Evolutionary optimization method.	6
	Ref Books: 1. Kalyanmoy Deb, “Optimization for Engineering design”, Prentice Hall, India, 2005. 2. Kalyanmoy Deb, “Multi objective optimization using Evolutionary algorithms”, John Wiley, 2001	

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EEL 704.ELECTIVE-X-1. HVDC TRANSMISSION AND FACTS

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Power System-II, Power Electronics	
Course Outcome	To understand importance, configuration and types of HVDC transmission. To analyst the operation of HVDC converter, system control and protection. To understand the concept of FACTS, their role, type and functionality. To analyze the operation of static series and shunt compensator.	
Unit	Contents	Contact Hrs
1	DC Power Transmission Fundamentals: Introduction, Economics of Dc Power transmission, comparison with AC system, Types of DC links, major components of converter station, planning of HVDC system.	8
2	HVDC converter: Choice of converter configuration, analysis of Gratz circuit with and without overlap, working of converter as rectifier and inverter, equivalent circuit for HVDC link	6
3	HVDC System Control: Principles of DC link control, converter control characteristics, firing angle control, current and extinction angle control, Starting and stopping of HVDC link	6
4	Converter Faults and Protection: Types of faults-commutation failure, Arc through, Misfire, short circuit in bridge, Over current and over voltage protection, Detection of line faults, Principle of DC circuit interruption, DC brakers, Types and characteristics of DC brakers, effects of proximity of AC and DC transmission lines	6
5	FACTS Concept and General System Considerations:- Transmission Interconnections, Flow of Power in an AC System, Loading Capability limits, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, Relative Importance of Controllable Parameters, Basic types of FACTS Controllers, Description and Definitions of FACTS Controllers, Benefits from FACTS Technology, Comparison between HVDC & FACTS	6
6	Static Shunt Compensators: Objective of shunt compensation, Methods of Controllable Var Generation, Static Var Compensators: SVC and STATCOM, Comparison of SVC and STATCOM, Static Var Systems (SVS) Static Series Compensation: Objective of series compensation, Variable Impedance Type Series Compensators, Switching Converter Type Series Compensators	
	References 1. Padiyar K. R., "HVDC Power Transmission Systems", New Age international 2. Kimbark, " HVDC Transmission", John Willey And Sons. 3. Hingorani N. G., " Understanding FACTS", IEEE Press 2001 4. Yong Hua Song, ' Flexible AC transmission systems (FACTS)'IEEE Press	

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EEL 704.Elective-X-2. ADVANCED INSTRUMENTATION

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Electrical Measurements and instrumentation	
Course Outcome	To understand the construction and operation principles of virtual instruments, data acquisition systems. To understand different operating systems and their components. To study and design different interface components.	
Unit	Contents	Contact Hrs
1	Introduction: Introduction to Intelligent Instrumentation: Historical Perspective, current status, software based instruments	8
2	Virtual Instrumentation: Introduction to graphical programming, data flow & graphical programming techniques, advantage of VI techniques, VIs and sub-VIs loops and charts , arrays, clusters and graphs, case and sequence structures, formula nodes, string and file I/O, Code Interface Nodes and DLL links.	6
3	Data Acquisition Methods: Analog and Digital IO, Counters, Timers, basic ADC designs, interfacing methods of DAQ hardware, software structure, use of simple and intermediate VIs. Use of Data Sockets for Networked Communication and Controls	6
4	PC Hardware Review & Instrumentation Buses: Structure, timing, interrupts, DMA, operating system, ISA, PCI, USB, PCMCIA buses. IEEE488.1 & 488.2 Serial	6
5	Interfacing -RS232C, RS422, RS423, RS485; USB, VXI, SCXI, PXI, ZigBee, AMI, Net metering, PLCC, Multifunction Metter,	6
	Ref Books: 1. G.C. Barney, „Intelligent Instrumentation", Prentice Hall, 1995. 2. A.S. Moris, „Principles of Measurement & Instrumentation", Prentice Hall, 1993. 3. S. Gupta , J.P. Gupta, „PC interfacing for Data Acquisition & Process Control", ISA, 4. Gary Johnson, „Lab VIEW Graphical Programming", II Edition, McGraw Hil 1997.	

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Elective704. X.3. SPECIAL PURPOSE ELECTRICAL MACHINES

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Electrical Machines-I Control Systems-II	
Course Outcome	To study design and operating principle of stepper motor, hysteresis motor, eddy current devices , linear motors, Tacho generators, synchro and synchro transformers.	
Unit	Contents	Contact Hrs
1	Stepper Motor: Basic principle of working of stepper motor, Classification of stepper motor into: I) Variable reluctance stepper motor II) Single stack & multi-stack reluctance motors III) Permanent magnet & operated Stepper motor IV) Hybrid D.C. Stepper motors V) Electro hydraulic stepper motors VI) Linear stepper motors. Theory of operation of stepper motors & their characteristics, Terminology's related to stepper motors, Driving circuits & applications of stepper motors, Relative merits as a control device.	8
2	Hysteresis Motors: Magnetic field production & nature of torque, Applications. Reluctance Motors: F. H. P. Reluctance motors, switched reluctance motors, Principle of working & operation, Applications. Control Motors: BLDC motor And its control, Construction of F. H. P. Induction two-phase servomotors, production of torque, Torque-speed curves-characteristics & features-dynamic equations, Methods of control, Applications. Numerical on DC and AC servos.	6
3	Eddy Current Devices: Construction & operation of eddy current couplings & dynamometers, merits & limitations.	6
4	Tacho-Generators: Basic requirements of tacho-generators, Ideal characteristics, classification. I) D.C. Tacho Generators: Output characteristics, Deviation from no-load Characteristics, Dead-zone, Tooth ripples, Temperature effect, Accuracy class. II) Induction Tacho-generators: Operating principle, Output characteristics, Equivalent circuit, Reasons for deviation from desired characteristics, Corrective means, Advantages. III) A. C. Tacho-generators: Construction & operation, Output characteristics, Non-linearities & tooth ripples, Advantages over other tacho-generators. Dynamic characteristics of tacho-generators, Applications of tacho-generators	6
5	Synchro & Synchro Transformers: Different types of single phase & threephase synchros, Differential synchros, Synchro-indicators, Their constructional features, Characteristics & applications, Synchrotransformers principle, Characteristics error, applications of synchrotransformers.	6
6	Linear Motors: Construction, Theory of operation of a linear induction motor, System with two-dimensional & three dimensional field patterns, Performance of linear induction motors, Effect of variation in the air gap, Effect of width & thickness of the reaction plate, Thrust of linear induction motors, Applications.	7
	Ref Books: 1. Bhimbhra P. S., 'Electrical Machine and Power Electronics' Tata-McGraw Hill Publication. 2. Ogata K., 'Modem control Engineering', Prentice Hall	

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EEL705. Controlled Drives Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Pr/oral: 25 Marks

Pre requisite	Basic electronics engineering, basic electronics engineering	
Course Objective	To get hands on experience of use of power electronic components/ ckts	
Course Outcome	1. Understand characteristics of power electronic switches 2. To understand application of different switches as circuit component. 3. To use the power electronic circuitry for different applications.	
Expt No	Title of Expt	
1	Characteristics of MOSFET/IGBT	
2	Determination of latching and Holding current	
3	Study of commutation circuits	
4	AC phase control using SCR	
5	Study of semi converter and full converter	
6	Study of series/parallel inverter	
7	Study of jones chopper	
8	Speed control of DC motor using converter	
9	Speed control of DC motor using chopper	
10	Study of industrial drive mechanism. Workshop/ small scale industry	

EEL706. Power system modeling and Analysis Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Pr/oral: 25 Marks

Pre requisite	Power system –I, Power System-II	
Course Objective	To study and understand various power system components and their performance	
Course Outcome	Understand various power system components and their performance	
Expt No	Title of Expt	
1	To study inductance of a transmission line	
2	To study capacitance of a transmission line	
3	Different types of equipment used in power station	
4	Components of power system	
5	Study of transmission line	
6	Different types of substation	
7	Determination of ABCD parameters	
8	To plot a circle diagram	

EEL707. Seminar

Teaching scheme:
Contact hours : 2 hrs
Total credit: 4

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Oral: 25 Marks

Seminar shall be on state of the art topic of student's own choice based on relevant specialization approved by an authority. Student should deliver seminar on the state of the art topic in front of the external examiners/internal examiners, staff and student colleagues. Prior to presentation student should carry the details of literature survey form standard references such as international journals and periodicals, recently published reference books etc. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and Head of the department/institute. The assessment shall be based on selection of topic its relevance to present context, report documentation and presentation skills.

EEL708. Project Phase-I

Teaching scheme:	Examination Scheme:
Contact hours : 2 hrs	Continuous Assessment (T/W): 25 Marks
Total credit: 6	Oral: 25 Marks

The assignment should encompass the hardware and engineering computation software such as MATLAB, PSCAD, ETAP etc. techniques/tools introduced in the concerned subjects and should prove to be useful for the UG program in the relevant field with moderate to high complexity..

EEL709. Industrial Training

Teaching scheme:	Examination Scheme:
Contact hours : 0 hrs	Continuous Assessment (T/W): 25 Marks
Total credit: 1	Oral: 25 Marks

The evaluation of industrial training completed in previous semester

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Semester VIII

EEL 801. ELECTRICAL UTILIZATION

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	POEMD Electrical machines-ii	
Course Outcome	To review basics of electric motor characteristics and components. To review use of electrical energy for different applications like electrolytic process, heating, welding, lighting and traction. To analyze the suitable study of characteristics of traction motors.	
Unit	Contents	Contact Hrs
1	Industrial Utilization of Electric Motors: Review of nature of mechanical load, Matching of speed torque characteristics of load & motor, Starting condition of the load & calculation of starting time for motors, Standard loading at motors load equalization, Control devices, Pilot devices via push buttons, Limit switches, Float switches, Pressure switches, Thermostats, Plugging switches, Contactor relays & solenoid values, Simple line diagrams using above devices, Applications of electrical motors in textiles mills, Mines cranes, Lifts, Excavators, Marine drives pumps, Refrigerators & air conditioning	8
2	Electrolytic Processes: Faradays laws of electrolysis, Application of electrolysis, Like Electroplating, Anodizing electrical polishing & electroextraction, Accumulators & cell, Types & construction, Charging & discharging, recent trends in manufacturing of batteries.	6
3	Illumination: Requirement of good lighting, Classification of light fitting & luminaries, Factor to be considered for design of indoor & outdoor lighting scheme, Design procedure for factory lighting, flood lighting & street lighting.	6
4	Electrical Heating: Advantages of electrical heating, Resistance heating, Design of heating element in resistance oven, Control of temperature in resistance oven, Electric arc furnaces, Induction furnaces, Dielectric heating. Electric Welding: Electric arc welding & Resistance welding, Modern welding techniques like Ultrasonic & Laser welding	6
5	Electric Traction: Different systems of traction, Advantages & disadvantages, Systems of track electrification, Speed-time curve, Tract effort, Adhesive weight, Coefficient of adhesion, Specific energy consumption, Power supply arrangements, Current collecting systems	6
6	Desirable characteristics of traction motors, Suitable motors for traction, Control of D.C. traction motors, Shunt transition, Bridge transition, Regenerative braking, Study of performance, operation & metering system, D.C. & A. C. transition.	7
	References 1. Taylor E. O., 'Utilisation of Electical Enginering', Longman. 2. Partab H. P., 'Art & Science of Utilisation of Electical Enginering' Dhanpat Rai Public 3. Gupta J. B., 'Utilization of Electric Power & Electric Traction' S. K. Kataria & Sons. 4. Uppal S. L., 'Electrical Power', Khanna Book Publication.	

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EEL 802. HIGH VOLTAGE ENGINEERING

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Power system I, Power system II	
Course Outcome	To study conduction and breakdown in gases and liquids To study the lightening phenomenon. To understand the methods and measurement of high voltage generation and measurement. To know different testing and standards in HV	
Unit	Contents	Contact Hrs
1	Conduction & breakdown in gases: Gases as insulation media, ionization processes, Townsend's current growth equation, current growth in presence of secondary processes, Townsend's criterion for breakdown in electronegative gases, time lags for breakdown, Streamers theory, Paschen's law, breakdown in non-uniform fields and corona discharge, corona under positive & negative polarities, glow & arc discharge, considerations in using gases for insulation purpose.	8
2	Conduction & breakdown in liquid dielectrics: Pure and commercial liquids, breakdown in pure and commercial liquids, theories of breakdown in liquids. Breakdown in solid dielectrics: Intrinsic, electromechanical & thermal breakdown, chemical, electrochemical deterioration, treeing, tracking, internal discharges, breakdown in composite insulation, properties of solid insulators & other materials used in practice. Insulating materials: In power transformers, rotating machines, circuit breakers, cables, power capacitors & other equipments.	6
3	Over voltage due to lightening phenomenon: propagation of lightning voltage & current waves on transmission lines, reflection & transmission of traveling wave at junction, system control of over voltage due to switching protection of transmission lines against over voltage. Insulation co-ordination, surge diverters, equipment insulation level & co-ordination of substations.	6
4	Generation of high voltages & currents: generation of a) high d. c voltage b) power frequency high alternating voltage c) high frequency a. c. d) impulse voltages Standard impulse waves shapes and it's equation, multistage impulse generator, matrix circuit, generation of switching surges, tripping & control of impulse generators, generation of impulse currents	6
5	Measurement of high voltages & currents: Measurement of high d. c., power frequency a. c., high frequency a. c., & impulse current, measurement of resistivity, dielectric constant & loss factor, partial discharges measurement, radio interference measurement	6
6	I. E. C. & IS codes for high voltage tests on electrical appliances & power apparatus & electrical motors, non- destructive testing, testing of insulators, bushings, isolators, circuit breakers, cables, transformers, surge diverter, layout of high voltage laboratories & test facilities.	7
	References 1. Kamaraju V. & Naidu M. S., 'High Voltage Engineering', Tata-McGraw Hill 2. C. L. Wadhwa, "High Voltage Engineering", New Age International Pvt. Ltd 3. Subir Ray, "An Introduction to High Voltage Engineering", Prentice_Hall of India Pvt.	

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EEL 803. Elective-XI-1 Smart Grid Design and Analysis

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Power System-II, Power Eelctronics	
Course Outcome	To understand structure of power system and its operation. To develop power system components modelling	
Unit	Contents	Contact hrs.
1	**Introduction to Smart Grid:** What is Smart Grid? Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions – Comparison of Traditional Power Grid and Smart Grid – New Technologies for Smart Grid – Advantages – Indian Smart Grid – Key Challenges for Smart Grid.	
2	**Smart Grid Architectural Designs:** Smart grid – power system enhancement – communication and standards - General View of the Smart Grid Market Drivers - Stakeholder Roles and Function - Measures - Representative Architecture - Functions of Smart Grid Components-Wholesale energy market in smart grid-smart vehicles in smart grid.	9
3	**Smart grid communications and measurement technology** Communication and Measurement - Monitoring, Phasor Measurement Unit (PMU), Smart Meters, Wide area monitoring systems (WAMS)- Advanced metering infrastructure- GIS and Google Mapping Tools.	8
4	**Performance analysis tools for smart grid design:** Introduction to Load Flow Studies - Challenges to Load Flow in Smart Grid and Weaknesses of the Present Load Fl ow Methods - Load Flow State of the Art: Classical, Extended Formulations, and Algorithms –Load flow for smart grid design-Contingencies studies for smart grid.	9
5	**Stability analysis tools for smart grid:** Voltage Stability Analysis Tools-Voltage Stability Assessment Techniques-oltage Stability Indexing-Application and Implementation Plan of Voltage Stability in smart grid-Angle stability assessment in smart grid-Approach of smart grid to State Estimation-Energy management in smart grid.	10
6	**Renewable energy and storage** Renewable Energy Resources-Sustainable Energy Options for the Smart Grid-Penetration and Variability Issues Associated with Sustainable Energy Technology-Demand Response Issues-Electric Vehicles and Plug-in Hybrids-PHEV Technology-Environmental Implications-Storage Technologies-Grid integration issues of renewable energy sources.	9
References	1. James Momoh, "Smart Grid: Fundamentals of design and analysis ", John Wiley & sons Inc, IEEE press 2012. 2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, " Smart Grid: Technology and Applications", John Wiley & sons inc, 2012. 3. Fereidoon P. Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2012. 4. Clark W.Gellings, "The smart grid: Enabling energy efficiency and demand response", Fairmont Press Inc, 2009.	

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY LONERE
ELECTRICAL ENGINEERING DEPARTMENT

EEL 803. ELECTIVE-XI -2. ADVANCED POWER ELECTRONICS

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Power Electronics	
Course Outcome	To understand the design and control of DC to Dc, DC to AC, AC to AC converters and advanced power supply devices. To analyses the application of advanced power electronic devices in industry.	
Unit	Contents	Contact Hrs
1	D.C. to D.C. Converter: Classification of choppers. Principle of operation, steady state analysis of class A chopper, step up chopper, switching mode regulators: Buck, Boost, Buck-Boost, Cuk regulators. Current commutated and voltage commutated chopper	9
2	A.C. to A.C. Converter: Classification, principle of operation of step up and step down cycloconverter. Single phase to single phase cycloconverter with resistive and inductive load. Three phase to single phase cyclo converter: Half wave and full wave. Cosine wave crossing technique. Three phase to three phase cyclo converter. Output voltage equation of cyclo converter.	9
3	D.C. to A.C. Converter: Classification, basic series and improved series inverter, parallel inverter, single phase voltage source inverter, steady state analysis, Half bridge and full bridge inverter: Modified Mc Murray and Modified Mc Murray Bedford inverter, voltage control in single phase inverters, PWM inverter, reduction of harmonics, current source inverter, three phase bridge inverter	9
4	Power Supplies: Switched mode D.C. and A.C. power supplies. Resonant D.C. and A.C. power supplies	9
5	Applications: Dielectric and induction heating. Block diagram of D.C. and A.C. motor speed control	9
	References: 1. Jacob, Michael Power Electronics: Principles & Application, Vikas Publishing House 2. M.H. Rashid, Power Electronics : Circuits, devices and applications , PHI. 3. Ned Mohan, Tore M. Undeland, William P. Robbins, Power Electronics : Converters, Applications and 4. Design , John Wiley & Sons. 5. P.S. Bimbhra, „Power Electronics“ , Khanna Publishers. 6. M. Ramamoorthy An Introduction to Thyristors and their applications East-West Press. 7. M.D. Singh and K.B. Khanchandani, Power Electronics, Tata McGraw-Hill. 8. A.K. Gupta & L.P. Singh, Power Electronics and Introduction to Drives Dhanpat Rai P	

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY LONERE
ELECTRICAL ENGINEERING DEPARTMENT

EEL 803. ELECTIVE-XI -3. ADVANCE CONTROL SYSTEMS

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Control Systems-I	
Course Outcome	To analyze continuous and discontinuous systems. To study different stability theorem for nonlinear systems. To design and analyze a optimal and adaptive control system.	
Unit	Contents	Contact Hrs
1	State Space Analysis of Continuous System: Review of state variable representation of continuous system, conversion of state variable models to transfer function and vice-versa, solution of state equations and state transition matrix, controllability and observability, design of state observer and controller	8
2	Analysis of Discrete System: Discrete system and discrete time signals, state variable model and transfer function model of discrete system, conversion of state variable model to transfer function model and vice-versa, modelling of sample hold circuit, solution of state difference equations, steady state accuracy, stability on the z-plane and Jury stability criterion, bilinear transformation	6
3	Stability: Lyapunov‟s stability theorems for continuous and discrete systems, methods for generating Lyapunov function for continuous and discrete system, Popov‟scriterion.	6
4	Non linear Systems: Types of non linearities, phenomena related to non -linear systems. Analysis of non linear systems-Linearization method, second order non-linear system on the phase plane, types of phase portraits, singular points, system analysis by phaseplane method, describing function and its application to system analysis.	6
5	Optimal Control: Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization.Pontryagin‟s Minimum Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation, Riccati equation and its solution.	6
6	Adaptive Control: Introduction, modal reference adaptive control systems, controller structure, self tuning regulators	7
	Reference Books: 1. M.Gopal, “Digital Control and State variable Methods”, Tata Mc Graw Hill 2. Ajit K.Madal, “Introduction to Control Engineering: Modeling, Analysis and Design” New Age International. 3. D.Landau, “Adaptive Control”, Marcel Dekker Inc. 4. S.Rajasekaran & G.A.Vjayalakshmi Pai, “Neural Networks,Fuzzy Logic and Genetic Alogorithms: Synthesis and Applications” Prentice Hall of India. 5. Donald E. Kiv, “Optimal Control Theory: An Introduction” Prentice Hall 6. B.C. Kuo, “Digital Control Systems” Sounders College Publishing 7. C.H.Houpis and G.B.Lamont, “Digital Control Systems: Theory, Hardware, Software”, Mc Graw Hill	

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY LONERE
ELECTRICAL ENGINEERING DEPARTMENT

EE804. ELECTIVE-XII 1. ENERGY AUDIT AND CONSERVATION

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Electrical Machines, Power Electronics Power system	
Course Outcome	To revive energy scenario, energy sources, energy utilization and energy efficiency. To understand different terms and types of energy audit. To identify energy conservation measures in different sector To prepare energy audit reports.	
Unit	Contents	Contact Hrs
1	Sources of Energy: Energy resources, Stored & running resources, Non-conventional energy sources, Necessity of conserving resources	8
2	Energy In Industries: Energy inputs in industry, Comparison of various energy inputs, Use of electric energy in industries for motive power, Heating (Space, Furnace, Water), Lighting, Air conditioning, Welding, Energy efficiency of the apparatus in above energy conversion processes, Energy efficient design of above processes	6
3	Energy In Non-industrial Sector: Different forms of energy used in agricultural, commercial, domestic & municipal sectors	6
4	Energy Audit: Audit, A prerequisite for energy conservation, Principles of energy audit, Measurement & measuring devices, Analysis of data, Flow diagram, its use, ABC analysis	6
5	Energy Conservation In Utilities: Energy conservation in generation, transmission, distribution & utilization, Demand side energy management, Energy efficient lighting system, Energy efficient drives-Critical study & analysis of certain case studies	6
6	Economics of Energy Conservations: Energy Conservation: Energy conservation using energy audit data, Principles of energy conservation in industrial, commercial, domestic, agricultural & municipal sectors, Planning, Implementation & monitoring of energy conservation project, payback period calculations	7
	References: 1. Sukhatme S.P., 'Solar Energy : Principles of thermal collection and storage' Tata-McGraw Hill 2. Keth & Fecher, 'Energy Efficiency Handbook' CRC Publication 3. Sinha H. P., 'Power System-I' Khanna Publication	

804. ELECTIVE-XII 2. POWER QUALITY ISSUES

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Electrical Machines, Power Electronics Power system	
Course Outcome	To understand PQ issues To study PQ standards. To understand PQ causes and mitigation methods.	
Unit	Contents	Contact Hrs
1	Power Quality Issues: Definition, classification of power quality disturbances. Power quality issues, Sources of disturbance. Effect on the operation of equipments.	8
2	IEC & IEEE standards, guidelines and recommendations. Voltage sag, swell, interruption, transients, flickers. Guidelines & recommended practices	6
3	Harmonics distortions: Harmonics in power systems, Sources, standards, effect on equipment and systems, audio and video communication systems, standards and indices	6
4	Causes and conventional methods to minimize the effect of harmonics	6
5	Monitoring: Fourier transforms for voltage, current and power. Measurements, Event recorders, Error measurement, power quality analysis	6
6	Power Quality Mitigation: Harmonic filters, active filters, phase multiplication, power conditioners etc	7
	References 1. Hayatt G. T., 'Electric Power Quality' Stars in Circle Publication 2. Arrilaga J.,Watson N. R., " Power quality assessment", John Willey And Sons 3. Arrilaga J. " Power system Harmonics Analysis", John Willey And Sons IEEE-519, IEC 61000, IEE IEEE-519, IEC 61000, IEEE 1159 standards	

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY LONERE
ELECTRICAL ENGINEERING DEPARTMENT

804. ELECTIVE-XII 3. MICROCONTROLLER AND INTERFACING

Teaching scheme:
Theory: 3 hrs
Total Credit:3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Digital electronics, Microprocessor	
Course Outcome	To review construction and operational features of microcontroller. To develop instruction set of codes for 8051 To develop programing for timer/ counter To develop algorithm for interfacing with real world examples.	
Unit	Contents	Contact Hrs
1	8051 Microcontroller: Introduction, Internal Architecture and other details of the chip, compare microcontrollers vs microprocessors	8
2	Instruction set of microcontroller 8051.	6
3	Addressing modes of 8051 microcontroller, programming techniques and assembly language programming.	6
4	Timer/Counter mode operation and Programming, Interrupts of 8051 microcontroller and programming	6
5	Real World Interfacing – I : Interfacing of LCD, ADC, sensors	6
6	Real World Interfacing – II : Interfacing of stepper motor, Keyboard, DAC	7
	References 1. Mazidi M. A., Mazidi J. G., ‘ 8051 Microcontroller and Embedded Systems’, Pearson Education 2. Ayala K. J.., 8051 ‘ Microcontroller: Architecture, Programming and Applications, Penram International	

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY LONERE
ELECTRICAL ENGINEERING DEPARTMENT

EEL805. Electrical Utilization Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Pr/oral: 25 Marks

Pre requisite	Electrical Machines, Power electronics	
Course Objective	.To get Aquent with different control devices and different process used in industry	
Course Outcome	To study and understand different control devices and different process used in industry	
Expt No	Title of Expt	
1	To study different control devices	
2	Study of relay and solenoid valves	
3	Resistance and temperature control in induction furnaces	
4	Temperature control I dielectric heating process	
5	To study ultrasonic and laser welding techniques	
6	To design illumination scheme for library	
7	To study the faradays law of electrolysis	
8	Regenerative breaking of induction motor	
9	To study the performance operation and metering system of AC/DC locomotives	

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY LONERE
ELECTRICAL ENGINEERING DEPARTMENT

EEL806. High Voltage Engineering Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Pr/oral: 25 Marks

Pre requisite	Power system , Measurement and instrumentation	
Course Objective	To make students acquainte with high voltages tests and measurements.	
Course Outcome	Get acquainted with high voltages tests and measurements.	
Expt No	Title of Expt	
1	Breakdown of solid insulation by point to point	
2	Breakdown of solid insulation by point to plate	
3	Breakdown of solid insulation by plate to plate	
4	Breakdown of liquid as an insulation medium	
5	Breakdown of air as dielectric medium	
6	Calibration of spear gap for measurement of High Voltage	
7	Study of Townsend's ionization Coefficient	
8	Different test on power frequency Transformer	