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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Revised Syllabus of

Final Year

B.E. [Electrical, Electronics and

Power Engineering]

[Effective from 2009-10 & onwards]

Scheme of Instruction and Examination for Final year Bachelor of Engineering in Electrical ,Electronics & Power Engineering.
BE(EEP) PART-I

Sr.no.	Subject	Teaching Scheme (Hours / week)			Examination Scheme (Marks)			
		Theory	Practical	Total	Paper	TW	Pract/oral	Total
1	Power system dynamics and stability	4	2	6	100	50		150
2	Industrial drives and controls	4	2	6	100		50	150
3	Micro controller Application	4	2	6	100		50	150
4	Power system protection	4	2	6	100		50	150
5	Elective I:-	4		4	100			100
i	High voltage Engineering							
ii	Renewable energy sources							
iii	Industrial automation							
	Project Part-I		2	2		50		50
	Total of Part -I	**20**	**10**	**30**	**500**	**100**	**150**	**750**

BE(EEP) PART-II

Sr.no.	Subject	Teaching Scheme (Hours / week)			Examination Scheme (Marks)			
		Theory	Practical	Total	Paper	TW	Pract/oral	Total
1	Power system operation and control	4	2	6	100		50	150
2	EHVAC & DC Transmission	4	2	6	100	50		150
3	Electrical power quality	4	2	6	100	50		150
4	Elective II :-	4	2	6	100		50	150
i	Digital signal Processing							
ii	Electrical System planning and Design							
iii	Flexible AC transmission system							
5	Project Part-II		6	6		50	100	150
	Total of Part –II	**16**	**14**	**30**	**400**	**150**	**200**	**750**

Chairman, (B.O.S.)
Electrical
Electronics&Power

(2)

Power System Dynamics & Stability

Teaching Scheme:	Examination scheme:
Theory: 4 Hr./ Week	Theory: 100 marks
Practical: 2 Hr/week	Pract.Exam.: 50 Marks

Introduction: Brief review of synchronous machine equations and parameters, concept of steady state, transient and dynamic stability. [4 hrs]

Modeling of synchronous machine: Modeling of synchronous machine, the stability problem, power angle equation, node elimination techniques. [6 hrs]

The swing equation : Formulation of swing equation, point by point solution of the swing equation, one machine connected to infinite bus, critical clearing angle and time; equal area criteria's for stability and its application to one machine infinite bus and two finite machines problems, concept of multi machine system; effect of type of fault, grounding, reclosing on transient stability limit. [14 hrs]

Steady state stability: Steady state stability limit, methods to determine steady state stability limit. Clarke diagram for two machine series reactance system, Extension of Clarke diagram to cover any reactance network, Clarke diagram for two machine system with resistance. [8 hrs]

Excitation System: Simplified view of excitation control, typical excitation configurations, and voltage regulator, exciter build-up, excitation system response on stability. [4 hrs]

Methods to improve stability: Small signal angle instability, damping and synchronizing torque analysis, mitigation using power system stabilizers, and supplementary modulation control of FACTS devices. [4 hrs]

Term work:

Writing computer programs related to the topics of the above using MATLAB or any other software.

Text Books:

1. Power System engineering by I.J. Nagrath and D.P. Kothari; Tata Mc-Graw hill.
2. Power System stability Vol. I, II and III by Edward Wilson Kimbark; John Wiley.
3. Power System control and stability by P.M. Andreson and A.A. Found; The IOWA state university press.

Reference Books:

1. Power system stability Vol. I And II by Crary S.B. John Wiley- New York
2. Power System stability and Control by P. Kunder; Mc-Graw hill- New York
3. Power System dynamics and stability by P. Sauer and M.A. Pal, Prentice hall

INDUSTRIAL DRIVES AND CONTROLS

Teaching Scheme:	Examination scheme:
Theory : 4 Hr./ Week	Theory: 100 marks
Practical: 2 Hr/week	Pract.Exam.: 50 Marks

(10 hours)

1. **Fundamentals of electric drives** - block diagram of an electric drive - parts of electric drives - dynamics of electric drives - torque equations - speed torque conventions - loads with rotational motion - loads with translational motion - components of load torque - load equalization - control of electrical drives - closed loop control - current limit control - speed sensing - current sensing - phase locked loop speed control

(12 hours)

2. **DC motor drives** - constant torque and constant power control - single phase controlled rectifiers with motor loads - fully controlled and half controlled rectifier fed dc drives - continuous and discontinuous operation - Four quadrant operation - three phase controlled rectifier fed dc drives - dual converter fed control - chopper fed dc drives - closed loop speed control schemes - solar and battery powered drives - braking of dc drives

(10 hours)

3. **Three phase induction motor drives** - AC voltage controlled drives - variable frequency control - VSI fed induction motor drive - operation with field weakening - CSI controlled induction motor drives - slip power recovery scheme - rotor resistance control - single phase induction motor drives - PWM drives

(10 hours)

4. **Synchronous motor and brushless dc motor drives.** Operation from fixed frequency supply- variable frequency control - VSI and CSI fed drives- self-controlled synchronous motor drives employing cycloconverter - brushless dc motor drives for servo applications

Text /Reference books:

1. Ned Mohan et al, Power Electronics: Converters, Applications, and Design, John Wiley & Sons. Inc., 2nd Edition, 1995.
2. G.K Dubey, Fundamentals of electric Drives., 2nd Edition, Narosa Publishing Company, 1994/1995 .
3. S.K.Pillai, Electric Drives, University Press India, 1993
4. William and Hulley, Power Electronic devices and motor control, 2nd Edition, 1995.
5. Werner Leonhard, Control of electrical drives, Springer, 1995.

List of Experiments:

1. Speed control of dc motor using dc chopper.
2. Speed control of dc motor using single- phase converter.
3. Speed control of dc motor using 3- phase converter.
4. Speed control of single- phase induction motor using ac regulator.
5. Inverter fed three-phase induction motor drive.
6. Simulation of Chopper fed DC drive
7. Simulation of DC drive using single phase converter
8. Simulation of three phase IM drive.

9. Simulation of four quadrant DC drive

NOTE : 1. At least 4 experiments have to be performed, remaining 4 experiments from above list have to be studied using simulation tools like PSCAD or MATLAB SIMULINK or any other tool.

MICROCONTROLLER APPLICATIONS

Teaching Scheme	Examination scheme
Theory : 4 hrs/ week	Paper : 100 marks
Practical :- 2 hrs/ week	Pract/oral : 50 marks

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1) Realization of microcontroller using 16 bit processor and peripherals.

1. Advanced Processors : 16 bit processor Intel 8086 microprocessor : Architecture addressing modes, instruction set assembly language programming. [10]
2. Input and output operations, memory organization, interfacing of peripheral devices like 8255, stepper motor, LED etc. [6]
3. Multiprocessor System: Queue status and lock facility of 8086 based multiprocessor systems coprocessor configurations 8087 coprocessor: concept, architecture, instruction set, programming with arithmetic processor. [4]

2) Embedded Microcontroller :

1. Introduction, Evolution, Architecture, comparison with microprocessor, Selection of a microcontroller MCS51 Family 8051 pin description, connections, ports and memory organization, Addressing modes. Instruction, Interrupts, Timer/ Counters [12]
2. Real world interfacing such as LED, ADC, DAC stepper motor, sensors. [4]
3. Overview of Atmel Microcontrollers 89CXX, internal architecture, programming of microchip. Few applications to electrical Engg. such as pulse width measurement, frequencies, counter etc. [4]

Text / Reference books:

1) Ajay Deshmukh, Microcontrollers, TMH
2) Myke Predko, Programming and customizing the 8051 microcontroller, Tata McGraw Hill New Delhi.
3) Badri Ram Advanced microporcessor and interfacing TMH.
4) Barry B. Brey, The Intel microprocessor 8086 to Pentium architecture programming and interfacing.
5) M.A. Mazidi & G.M. Mazidi, The 8051 microcontroller and Embedded System 3rd Indian reprint person education.
6) Embedded microcontroller, Intel Manual.
7) Intel data handbook for MCS96 family
8) Kenneth Ayala, 8051 microcontroller, IInd edition pen ram International
9) Online reference www.microchip.com
10) Microcontrollers: Architecture, programming, interfacing & system design 1st edition by Kamal, Pearson Education.
11) Embedded microcontrollers 1st edition by Morton, Pearson Education

Practical Examination:

The practical examination will be of three hours duration will consist of one experiment conducted during the course and an oral examination based on syllabus.

Term work:

Term work will consist of record of at least 8 experiments.

1. Study of 8086 microprocessor kit.
2. Execution of simple programs (Data tranxer, arithmetic, logical operations)
3. Interfacing of 8255 to 8086.
4. Interfacing of LED, LCD display to 8086
5. Interfacing of stepper motor to 8086
6. Study of 8051 microcontroller
7. Interfacing of 8255 to 8051
8. Interfacing of stepper motor to 8051
9. Interfacing of ADC/ DAC to 8051
10. Interfacing of LED/ LCD display to 8051
11. Execution of simple programs with 8051

Power system protection

Teaching scheme:
Th. lect: 4 hrs/wk
Practical: 2hrs/wk

Examination scheme:
Th. Paper: 100 marks
Pr/oral: 50 marks

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1 Introduction:
Protective schemes, desirable qualities of protective relaying, definations and terms used in relaying, C.T., P.T., summation transformers. (4 hrs)

2 Relays:
Classification of relays, construction, working principle, characteristics and application of electromagnetic relay, relay setting, different types of relays- induction type earth fault relay, directional relay, distance relay, differential relay, Tran slay relay, negative sequence relay & electro-thermal relay, introduction to static relay & computer based relaying.
(10 hrs)

3 Protective schemes
Alternator: Stator faults, unbalanced loading, overloading, prime mover failure, over voltage, restricted earth fault protection, rotor fault protection, merz- price earth fault protection.
Transformers: Harmonic restraint, over current & unrestricted earth fault, restricted earth fault, frame leakage protection, Buchholz relay, Merz- Price protection.
Induction motor: Protective circuits for single phasing preventor, ground fault, phase fault & phase reversal protection.
Protection schemes for feeder, Busbar & transmission lines using Differential, Distance (Impedence) & Carrier current protection.
(10 hrs)
Protection against lighting: Protection of power station & substation against direct strokes, protection of transmission lines against direct strokes, protection against traveling waves, rod gap lightning arresters, L.A. ratings, locations & effect of cables, surge absorber, Peterson coil
(4 hrs)

4 Circuit breaker:
Arc phenomenon- Arc formation, Arc interruption, Different arc interruption theories, current zero interruption, recovery voltage, Restriking voltage , Arc voltage, Active recovery voltage in a 3 phase circuit. Rate of rise of Restriking Voltage RRRV.
Resistive switching, current chopping, interruption of capacitive current. (4 hrs)
Classification of circuit breakers: Construction & working principle of air break, air blast, Minimum oil, sf6, Vaccum circuit breakers, MCB, ELCB,
Rating & selection of C.B., standard ratings & applications of circuit breakers.
(8 hrs)

Text books:
1. Switchgear & protection by Sunil S. Rao.

2. Power system engineering by A.C. Chakraborti, Soni Gupta Bhatnagar.
3. Power system protection & switchgear by Badri Ram, D.N. Vishwakarma.
4. Fundamentals of power system protection by V.G. Paithankar & S.R. Bhide.

Reference books:

1. Switchgear & protection by Ravindranath & M. Chander.
2. The art & science of protective relaying by C.R. Mason.

Term work:

Term work shall consist of record of minimum eight experiments from the following.

1. Study & use of relay testing kit
2. Characteristics of over current relay
3. MCB, ELCB testing & characteristics
4. Differential protection of transformer
5. Differential protection of alternator
6. Restricted earth fault protection of alternator
7. Negative sequence protection of alternator
8. Ground fault protection of induction motor
9. Single phase preventer of induction motor
10. Three phase induction motor protection
11. Distance protection of transmission line
12. Study of air circuit breaker
13. Study & application 30c+ 1e/f directional relay
14. Study & application of definite time under/over voltage relay.

ELECTIVE-I
HIGH VOLTAGE ENGINERING

Teaching scheme:
Th. lect: 4 hrs/wk

Examination scheme:
Th. Paper: 100 marks

1Conduction and break down in gases:

Gases as insulating media, ionization process & current growth, Townsend criterion for breakdown, determination of alpha & gamma, streamer theory of break down in gases, paschen's law, breakdown in non uniform field & corona discharges, practical consideration in using gases for insulation purposes, breakdown in vaccum.

Conduction & breakdown in pure liquid & commercial liquid. Breakdown in solid dielectrics. Classification of breakdown, solid dielectric used in practice & applications of insulating materials in electrical & electronic equipments (8 Hrs)

2 Generation of high voltages & currents:

Generation of high d.c.voltages, Van De Graff generator, electrostatic generators, Generation of high alternating voltages: cascade transformers, resonant transformers.

Generation of impulse voltages & currents: circuits for producing impulse waves, multistage impulse generators, tripping and control of impulse generators, sphere-gaps for measurement of high d.c., a.c. & impulse voltages (8 Hrs)

3 Measurement of high voltage & currents:

Measurement of high DC voltage , measurement of high ac & impulse voltages, measurement of high AC , DC & impulse current, CRO for impulse voltage & current.
(4 Hrs)

4 Over voltage phenomenon & insulation co-ordination:

Natural causes for over voltages, switching over voltages & power frequency, over voltages in power system, protection of transmission line against over voltages & protective devices, economic considerations for insulation co-ordination, optimization of EHV levels.
(6 Hrs)

5 Transmission line surges:

Evaluation of surge impedence, velocity of propogation, representation of forward & reflected wave & their resultant at any instant, reflections from the line terminated with resistance at the end of an open line, line short circuited at receiving end, line terminated with an inductance, capacitance. (6 Hrs)

6 Testing of electrical apparatus:

Measurement of dielectric constant & loss factor, transformer ratio arm bridge, high voltage scherring bridge, introduction to partial discharge measurement, routine type tests & destruction type tests, testing with HVDC , impulse, high voltage a.c. with high frequency for insulators, bushings, circuit breakers & cables, transformers. (8 Hrs)

Textbooks:

1. IIigh voltage engineering by Naidu & Kamraju.
2. High voltage engineering by C.L. Wadhwa.
3. High voltage Engg.(translated)by M.P.Chourasia

Reference books:

1. .High voltage technology by L.L.Alston, Oxford university press.
2. High voltage Engg. By E. Kuffel, M.Abdullah, Pergamon press, Newyork.
3. High voltage Engg fundamentals by E. Kuffel, W.S.Zaengel ,Pergamon press, New York
4. High voltage measurement techniques by Adolf .J. Schwab, MIT press, England.

RENEWABLE ENERGY SOURCES

Teaching scheme:
Th. lect: 4 hrs/wk

Examination scheme:
Th. Paper: 100 marks

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1 Solar photovoltaic systems: Introduction, Solar cell fundamentals, Solar cell characteristics, Solar cell classification, solar cell: module, panel, & array construction. Maximizing the solar PV output & load matching, maximum power point tracker (MPPT) Balance of system components, solar PV systems and solar PV applications.

2 Wind energy: Introduction, origin of winds, nature of winds, wind turbine siting, major applications of wind power, basics of fluid mechanics, wind turbine aerodynamics, wind turbine types & their construction, wind energy conversion systems (WECS) , wind diesel hybrid system, effects of wind speed & grid condition(system integration), environmental aspects, wind energy programme in India.

3 Biomass energy: Introduction, photosynthesis process, biofuels, biomass resources, biomass conversion technologies, urban conversion, biomass gasification, biomass to ethanol production, biogas production from waste biomass, biomass energy programme in India.

4 Geothermal energy: Introduction, applications, origin & distribution of geothermal energy, types of geothermal resources, exploration & development of geothermal resources, environmental consideration and geothermal energy in India.

5 Ocean energy: Introduction, tidal energy, wave energy, ocean thermal energy.

6 Emerging technologies: Introduction, fuel cell, hydrogen energy, small hydro resources.

7 Miscellaneous non-conventional technologies: Introduction, magneto hydrodynamic (MHD) power conversion, thermoelectric power conversion, thermionic power conversion.

Text books:

1. Renewable energy sources & conversion technology (Tata McGraw hill publications).
2. Energy technology from non conventional renewable & conventional. By Sunil S. Rao & B.B. Parulekar.(Khanna publication)
3. Non conventional energy by A.B. Desai, New Age Publications.

Reference books:

1. Renewable energy sources & their environmental impact by Abbasi S.A.
2. Non conventional energy resources by Chavan D.S.& Shrivastava S.S., New Age International.
3. Wind & solar power system by Patel M.R., CRC Press.
4. Solar energy by George .H.P. & J. Prakash. (Tata McGraw hill publications).

ELECTIVE-I

INDUSTRIAL AUTOMATION

Theory: 04 Hr./ weeks Th. Exam –100 marks

Topic 1: (8 Hrs)
Introduction, definition of automation, concepts of hierarchy of automation like **i)** Operation Automation [to automate only one operation.], **ii)** Machine Automation [combination of more than one operations], **iii)** Process Automation [combination of one or more than one machines], **iv**) Factory Automation [combination of one or more than one processes],
v) System Automation [independent or combinations of automations of non-technical operations like accounts, stores or, Material and, human resource etc.], **vi)** Industrial automation [all above types linking with corporate MIS (management information system) system].

Topic 2: (8 Hrs)
Types of general Automation methods or schemes,[conceptual]
i) Discrete process control. ii) Batch process control iii) Continuous process control. Technologies used for Automation a) Traditional control system, its features, merits and de-merits, b) Distributed control system, its features, merits and de-merits, c) System of Supervisory control and data acquisition, its features, merits and de-merits,

Topic 3: (4 hrs)
Basic SCADA functionality: The conceptual introduction of fundamental features embedded with the SCADA control as per the following order.

a) Flexible and open architecture,
b) MMI Alarm Handling and Trending,
c) Access Control
d) Automation Logging
e) Archiving
f) Report Generation
g) Interfaces to H/W and S/W Types of interfaces

i) Command-line interfaces, ii) Graphical user interfaces, iii) Web-based user interfaces,
Operational interfaces: i) Batch interface ii) Gesture interfaces iii) Reflexive user interfaces. iv) Tactile interfaces v) Tangible User Interface vi) Text user interfaces vii) Touch interface

Topic 4: (4 hrs)
SCADA Hardware: Hardware Architecture, Properties and Functions of Software, Configuration of SCADA system.

Topic 5: (4 hrs)
Basic control system cycle, Process Control Requirements Identification methodology, purchasing principles, process control block diagram – identification of elements and Inputs / out puts.

Topic 6: (8 Hrs)
Analog and digital processing: Data representation, ON – OFF control, Analog control, Digital Control, Introduction to Programmable Logic Controller [PLC], Ladder Diagrams, PID controllers

Topic 7: (4 Hrs)

Units, Standards, Process Control Drawings, Statistics.

EXPERIMENTS USING PLC/SCADA

- PLC supply, input, output wiring scheme development & testing.
- Study of digital inputs, outputs, Analog Inputs, outputs.
- Pump Control for Overhead Water Tank Level maintenance.
- Timer function application Study
- Counter function application Study
- Speed Measurement of Motor.
- Speed Control Of Induction Motor from SCADA,PLC through VFD.
- Measurement of voltage, current, PF, Power & Energy.
- Study Of Ladder Diagram logic programming.
- Study Of function blocks & their applications in logic programming.

Text Book: 1.Process control and instrumentation technology —Author: Curtis D. Johnson. Seventh Edition. --- Person Education. New –Delhi
2. 'Process Control' –Author :Peter Harriot Tata McGraw-Hill
3. 'Process System analysis and Control'- Author Donald R Coughnour McGraw-Hill, 1991.
4. 'Process dynamics and control'- Author D E Seborg, T F Edger --- John Wiley, 1989
5. 'Programmable Logic Devices and logic Controllers' ---Enrique Mandado, Jorge Marcos, Serafin A Perrez ---Prentice-Hall, 1996
6. 'Distributed Computer Control for Industrial Automation'
   - Dobrivoje Popovic, Vijay P Bhatkar,
   - Marcel Dekker INC, 1990

References Books:

1 LIPTAK: Instrumentation Engineering Handbook, Chilton Book Company
2.POPOVIC & BHATKAR: Distributed Computer Control for Industrial Automation
3.KRISHNA KANT: Computer Based Industrial Control, PHI
4.DCS Manuals of Allen Bradley, ABB, Honeywell
5.Manuals for Field bus System

Power system operation & control

Teaching scheme:
Th. lect: 4 hrs/wk
Practical: 2hrs/wk

Examination scheme:
Th. Paper: 100 marks
Pr/oral: 50 marks

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1 Economic operation:
Characteristics of hydro & thermal power plants, incremental rate theory, IPC curves and constraints in economic scheduling. (4 hrs)

2 Distribution of load between generator units in power station: Transmission loss as a function of plant generation. (Two plants only). Co-ordination of incremental production costs & incremental transmission loss for optimum economy.
Calculation of loss coefficients(two plants) , optimum scheduling of generation between different parts considering transmission loss, concepts & significance of penalty factor & cost of received power at load end. (10 hrs)

3Methods of loading hydro power plant, steam power plants: Economic loading of combined thermal & hydro power plants, short term & long term hydro thermal co-ordination, elementary treatment of optimal power flow without & with inequality constraints. (6 hrs)

Automatic generation control:
Governor mechanism & its control, mathematical model of governor, generator load, analysis of load frequency control of an isolated power system, steady state response, dynamic response, control area, single area, two area system, load frequency control, real power balance for load changes.
Flat tie line & flat frequency control, tie line bias control, basis for selection of bias factor generation rate constant(GRC) ,discrete integral controller for AGC, AGC in a restructured power system. (12 hrs)

4 Automatic voltage control:
AVR, excitation system, reactive power control, reactive power compensation in transmission line, compensating equipments, shunt & series compensation. (4 hrs)

5 Automatic load dispatch:
Function, operation, requirements, power system communications, SCADA system for P.S. operation & control. (4 hrs)

Text books:

1. Power system analysis & stability by S.S. Wadhera
2. Modern power system analysis Nagrath & Kothari
3. Generation of electrical energy by B.R.Gupta

Reference books:

1. Electrical power system by D.Das
2. Power system analysis operation & control by Abhijit Chakrabarti & Sunita Halder.

Term work shall consist of:

1. Assignment on economic load sharing between gen units, transmission loss & stability etc.
2. A report on visit to load dispatch centre.
3. Computer programming based on above syllabus(minimum two).

EHVAC & HVDC TRANSMISSION

Teaching scheme:
Th. Lect: 4 hrs/wk
Practical: 2hrs/wk

Examination scheme:
Th. Paper: 100 marks
Term work: 50 marks

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1 Transmission line trends & preliminaries: **[6]**

Standard transmission voltages, Average values of line parameters, power handling capacity & line loss, giant power pools & requirements of lines, cost of transmission lines & equipments, mechanical consideration in line performance.

2 Calculation of line & ground parameters: **[4]**

Resistance, capacitance & inductance of EHV line configuration, properties of bundle conductors.

3 Voltage gradient of conductors: **[6]**

Electrostatics, field of sphere gap, field of line charges & their properties, change potential relations for multi conductor lines, surface voltage gradients on conductors, distribution of voltage gradient on sub conductors of bundle gradient factors & their use.

4 Electrostatic fields of EHV lines: **[6]**

Electric shocks & threshold currents, capacitance of long object, calculation of electrostatic field of AC lines, effect of electrostatic field on human, animals & plants.
Electromagnetic interference

5 Causes of over voltages: **[6]**

lightning, switching & power frequency over voltages, traveling waves on lines, reflection of waves, protection against over voltages, earthing & insulation co-ordination, layout of switching & terminal station for EHV transmission.

Control of active & reactive power sources: **[2]**

Shunt compensation, problems associated with series & shunt compensation.

6 HVDC transmission: **[10]**

Comparison of AC & DC transmission, typical point to point HVDC transmission schemes, apparatus used & its function, terminal station layout, operation of converter as rectifier & inverter, equivalent circuit of converter, operating chart of converter, control of current , voltage, active & reactive power in HVDC system, harmonics & its control, protection of lines & terminal equipments, multi terminal HVDC system, advantages & disadvantages, possible applications, operating principle.

Term work:

A) Term work shall consist of simulation of HVDC systems using MATLAB/ PSCAD/ ETAP software.
B) Lay out of switching & terminal station for EHV transmission.

Textbook:

1. EHVAC transmission Engg. By Rakesh Das Begamudre, Wiley Eastern Company.
2. EHVAC & HVDC transmission engineering & practices by S.Rao.
3. HVDC power transmission by K.R. Padiyar.

Reference books:

1. DC transmission vol.1 by E.W. Kimbark.
2. Power transmission by direct current by E. Ulhman.
3. Electrical power system by Weedy.

ELECTRICAL POWER QUALITY

Teaching Scheme:
Theory 4 Hr/ Week
Practical: 2 Hr/ Week

Examination Scheme:
Theory Exam: 100 Marks
Term work: 50 Marks

Chapter-I Introduction: [6]
Understanding Power quality, Definitions, Growing concerns to PQ, Evaluation procedure, General classes of PQ disturbances, Causes and effects of power quality disturbances

Chapter –II Power Qulaity Disturbances: [12]

a) Voltage sags and interruptions, causes and effects, estimation of voltage sag performance, principle of protection and solutions.
b) Transient overvoltages, sources causes and effects, Principle of OV protection, solutions.
c) Long duration voltage variations, principle of regulating voltage, devices for voltage regulation, flicker, flicker sources and mitigation, quantifying flicker.

Chapter –III Harmonics: [10]
Harmonic distortion, Harmonic sources, effect of HD, voltage V/s current harmonics, active, reactive, voltamp power under nonsinusoidal condition, harmonic indices (THD, TDD), Principles for harmonic control, devices for harmonic control, interharmonics, IEEE 519 std.

Chapter-IV Wiring And Grounding: [4]
Reasons for grounding, wiring and grounding problems and solutions.

Chapter – V Power Quality Monitoring: [8]
Monitoring considerations, site survey, monitoring quantity, monitor location, PQ measuring instruments, assessment of PQ measurement data, IEEE 1159 std.

References books :
1. Power Quality – R.C. Duggan
2. Power system harmonics –A.J. Arrillga
3. IEEE std. 519, 1159.

Term Work: Term work consists of 4 experiments from the list based on MATLAB/ PSCAD simulation and two experiments based on use of monitoring instruments.
List of Experiments:

1. Generation of different types of PQ disturbances.
2. Simulation of mitigation device for voltage sag.
3. Simulation of mitigation device for overvoltage/ transients.
4. Simulation of harmonic producing load and filter.
5. Study of harmonics in UPS.
6. Site survey for PQ analysis using PQ monitoring instruments.

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ELECTIVE-II

DIGITAL SIGNAL PROCESSING

Teaching Scheme:	**Examination scheme:**
Theory: 4 Hr/ Week	**Theory Exam.: 100 Marks**
Practical: 2 Hr/ Week	**Pract/oral Exam: 50 Marks**

1. DISCRETE-TIME SIGNALS: Signal classifications, frequency domain representation, time domain representation, representation of sequences by Fourier transform, properties of Fourier transform, discrete time random signals, energy and power theorems. [6]

2. DISCRETE-TIME SYSTEMS: Classification, properties, time invariant system, finite impulse Response (FIR) system, infinite impulse response (IIR) system. [5]

3. SAMPLING OF TIME SIGNALS: Sampling theorem, application, frequency domain representation of sampling, reconstruction of band limited signal from its samples. Discrete time processing of continuous time signals, changing the sampling rate using discrete time processing. [8]

4. Z-TRANSFORM: Introduction, properties of the region of convergence, properties of the Z-transform, inversion of the Z-transform, applications of Z-transform. [5]

5. BASICS OF DIGITAL FILTERS: Fundamentals of digital filtering, various types of digital filters, design techniques of digital filters: window technique for FIR, bi-linear transformation and backward difference methods
for IIR filter design, analysis of finite word length effects in DSP, DSP algorithm implementation consideration.
Applications of DSP. [10]

6. MULTIRATE DIGITAL SIGNAL PROCESSING: Introduction to multirate digital signal processing, sampling rate conversion, filter structures, multistage decimator and interpolators, digital filter banks. [6]

TEXT BOOKS :

1. Digital Signal Processing : Proakis and Manolakis; PHI
2. Digital Signal Processing: Salivahanan, Vallavaraj and Gnanapriya;TMH

REFERENCE BOOKS:

1. Digital Signal Processing: Alon V. Oppenhelm;PHI
2. Digital Signal processing(II-Edition): Mitra, TMH
3. Digital Signal processing (II-Edition): Ifeachor, Pearson publications.
4. Master in MATLAB -7 (1st edition) by Hanselman ,Pearson publications.
5. MATLAB & its applications in Engg. (1st edition) by Bansal.

DIGITAL SIGNAL PROCESSING LAB

LIST OF EXPERIMENTS:

Perform the experiments using MATLAB:

1. To represent basic signals (Unit step, unit impulse, ramp, exponential, sine and cosine).
2. To develop program for discrete convolution.
3. To develop program for discrete correlation.
4. To understand stability test.
5. To understand sampling theorem.
6. To design analog filter(low-pass, high pass, band-pass, band-stop).
7. To design digital IIR filters (low-pass, high pass, band-pass, band-stop).
8. To design FIR filters using windows technique.
9. To design a program to compare direct realization values of IIR digital filter
10. To develop a program for computing parallel realization values of IIR digital filter.
11. To develop a program for computing cascade realization values of IIR digital filter
12. To develop a program for computing inverse Z-transform of a rational transfer function.]

NOTE: At least eight experiments have to be performed in the semester.

ELECTIVE-II

Electrical System Planning and Design.

Theory: 04 Hr./ weeks — Th. Exam –100 marks
Practical: 2Hrs/ week — Prct. Exam.: 50 marks

Topic 1: Design of simple Electrical circuits: **[4]**
Introduction, simple light and fan circuits, System of connection of appliances and accessories, solved examples on light and fan circuits, introduction of simple alarm circuits without and with relays.

Topic 2: Design and Drawing of Panels. **[8]**
Introduction, Design conditions, Power circuits installations, Control circuit installations, Program circuit installations, BUS bar and Accessories mounting conditions and Tolerances. Isolation of control devices / circuits, from other circuits, Mounting of CTs, PTs.

Topic 3: Design of Illumination Schemes **[4]**
Introduction, Terminology in Illumination, laws of illumination, Various types of Light sources, Practical lighting schemes

Topic 4: Substations **[8]**

Introduction, Types of substations, Out door substations- pole mounting type, Indoor substations – floor mounting type.

Topic 5: Electrical installations for different types of Buildings and small industries. **[8]**
Electrical installations for commercial buildings, Electrical installations for small industries. PFC and APFC panel installations.

Topic 6: Motor control circuits. **[8]**
Starting of 3-phase squirrel cage induction motors, starting of multi speed squirrel cage motors, starting of wound rotor motors, starting of synchronous motors. Stopping of motors. Contactor-Relay logic control circuit components and wiring scheme,ferruling,relay boards, connector boards etc.

Text Book: - 1.Electrical Design —Author: K.B.Raina , S.K. Bhattacharya
-- New Age international (P) Ltd Publishers. New –Delhi, Benglore.

Reference books : Hand book of Electrical Engineering by Siemens (I) Ltd,
Book of Electrical Design Procedure By – Fowler Jr. –English Longman.

Term Work:

Elect.system.design.

lab.work:

1.six drawing sheets based on problems on each topic.

2. Two designs of drawings simulation on computer using software.

ELECTIVE-II

Flexible AC Transmission Systems. [FACTS]

Theory: 04 Hr./ weeks
Practical: 2Hrs/ week

Th. Exam –100 marks
Pract. exam: 50 marks

Topic 1: Fact Concept and general System Considerations. [4]

Introduction, Transmission inter connections, Power flow in parallel paths, Power flow in Meshed System. What limits the loading capacity?, Relative Importance of Controllable parameters.

Topic 2: FACT controllers. [8]

Introduction, Basic types, relative importance of different types of controllers, Shunt connected controllers, Series connected controllers, combined series and parallel controllers, Other controllers.

Topic 3: Static Shunt Compactors : SVC and STATCOM [4]

Introduction, Objectives of shunt compensation, Methods of controllable Var generation, Static Var compensators SVC and STATCOM Comparison between SVC and STATCOM Static Var systems.

Topic 4: Static series Compensators: GCSC,TSSC,TCSC and SSSC. [8]

Introduction, Objectives of series compensation, Variable impedance type Series compensators, Switching converter type series compensators.

Topic 5: Static voltage and phase angle Regulators: TCVR and TCPAR [8]

Introduction, Objectives of voltage and phase angle Regulation, approaches to Thyristor Controlled Voltage and phase angle Regulators. Switching converter based voltage and phase angle regulators, hybrid phase angle regulators.

Topic 6: Concepts of UPFC, IPFC, NGH-SSR damping scheme and thyristor controlled Braking Resistor and application of FACTS. [8]

Text Book: - 1.Understanding FACTS —Author: Narain G. Hingorani and Laszlo Gyugyi -- IEEE Press, Standard Publishers Distributors –Delhi, 110006