Solapur University, Solapur.

Department of Electrical and Electronics Engineering

Proposed Structure of B.E. Electrical and Electronics Engineering

W.E.F. Academic Year 2012-13

B. E. (Electrical and Electronics Engineering) Part-I

Sr No	Subject	Teaching Scheme			Examination Scheme				
		L	P*	T	TH	TW	POE	OE	Total
1	Industrial drives and control	4	2	---	100	25	25	--	150
2	Engineering Economics & Industrial Management	3	---	1	100	--	----	--	100
3	Instrumentation Techniques	4	2	---	100	25	25	---	150
4	Power system II	4	2	---	100	25	---	25	150
5	Elective-I	3	--	1	100	25	---	--	125
6	Industrial Training Evaluation	---	---	---	---	25	----	--	25
7	Project& Seminar	----	4	--	--	50	--	--	50
	Total	18	10	2	500	175	50	25	750

B.E. (Electrical and Electronics Engineering) Part-II

Sr No	Subject	Teaching Scheme			Examination Scheme				
		L	P *	T	TH	TW	POE	OE	Total
1	Switchgear & Protection	4	2	---	100	25	--	25	150
2	Electrical Machine Design	4	2	--	100	25	---	25	150
3	FACTS	4	--	1	100	25	--	--	125
4	Elective –II	4	--	1	100	25	--	--	125
5	Project	---	8	---	---	100	---	100	200
	Total	16	12	2	400	200	--	150	750

1) The batch size for practical's/tutorials should be of 15 students. On forming the batches, if the strength of remaining students exceeds 7, then a new batch may be formed.
2) Vocational Training to (be evaluated at B.E. Part-I) of minimum 15 days should be completed in any vacation after S.E. Part-II but before B.E. Part-I & the report should be submitted in B.E. Part-I.
3) Project group should consist of Maximum4 students.

Elective-I	**Elective-II**
1.High Voltage Engineering	1. HVDC
2.EHVAC	2.Computer Aided Power system Design
3.Renewable Energy Sources	3.Power System Dynamics &Stability
4.Energy Conservation & Auditing	4. Electrical Installation testing & maintenance
5.Embeded System	5.Artificial Neural Networks

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-I

1. INDUSTRIAL DRIVES & CONTROL

Teaching Scheme: **Examination Scheme:**
Lectures: 4 Hours /Week **Paper: 100 Marks**
Practical: 2 Hours/Week **T.W.: 25 Marks**
POE: 25 Marks

SECTION-I

1. Introduction to Electrical drives: (4hrs)
Block diagram of electrical drives, Advantages of Electrical drives, Types of the electrical drives, parts of electrical drives, criteria for selection, selection of motor rating for various types of duty ratio.

2. Dynamics of Electrical Drives: (5hrs)
Fundamental torque equation, speed, torque, multi-quadrant operation, classification of load torques. Steady state and transient stability of electric drives.

3. Characteristics & Control of Electrical Drives: (5 hrs)
Basic relations, Basic characteristics, Modified speed torque characteristics of D.C. Shunt and series motor, steady state characteristics of 3 phase induction motor, and synchronous motor

4. D.C. Motor Drives: (10hrs)
Methods of D.C. motor starting, braking and speed control, single phase and three phase full controlled and half controlled converter fed D.C. drives. Multi-quadrant operation of separately excited D.C. shunt motor, dual converter fed D.C. drives, converter control of D.C. series motor, Chopper controlled d. c. shunt motor drives, Single quadrant and multi-quadrant operation of D.C. shunt motor and Chopper control of series motor, performance and stability of variable speed D.C. drives Regenerative breaking the D.C. series motor.

SECTION-II

5. Induction Motor Drives: (10hrs)
Stator voltage control of 3 phase induction motor by A.C. regulator, VSI fed 3 phase induction motor speed control. Cyclo-convertor fed 3 phase induction motor speed control, variable frequency control by CSI, closed loop speed control, current regulated VSI control, comparison between VSI and CSI. Braking and multi quadrant operation of VSI controlled induction motor drives. Analysis of inverter fed induction motor using harmonics, equivalent circuit, Harmonic Torque and losses with inverter fed induction motor drives

6. Slip Ring Induction Motor Drives:(4hrs)
Chopper controlled resistance in rotor circuit, slip power recovery using Cascade converter, Static Sherbius drive.

7. Synchronous motor and Brushless D.C. Motor Drives: (6hrs)
VSI fed synchronous motor drives, Variable frequency control of multiple Synchronous motor drives, Brush less D.C. Motor drives.

8. Special Drives:(4hrs)
Stepper motor drives, switched reluctance motor drives, Torque equation, converter circuit for motor, operation of solar and battery operated drives

TERM WORK
It should consist of minimum 8 experiments based on above syllabus the following list is given for reference.

List of Experiments:

1) Study of torque-speed characteristics of separately excited DC motor from single phase full converter.
2) Study of torque-speed characteristics of armature voltage controlled of separately excited DC motor from single phase full converter
3) Study of torque-speed characteristics of separately excited DC motor from three phase full converter
4) Study of torque-speed characteristics of DC series motor using chopper.
5) Three phase induction motor speed control using slip power recovery scheme.
6) *f to V* Control of induction motor.
7) Open loop speed control of separately excited DC motor using chopper at high frequency.
8) Three phase induction motor speed control using rotor resistance control
9) Simulation of chopper fed DC drive using MATLAB/SIMULINK.
10) Simulation of variable frequency induction motor drive using MATLAB/SIMULINK
11) Simulation of three phase converter fed separately excited DC motor control using MATLAB/SIMULINK.
12) Simulation of single phase converter fed separately excited DC motor control using MATLAB/SIMULINK.

Recommended Books:-

1) Fundamentals of Electrical Drives. By Gopal. K. DubeyNarosa Publication
2) Power Electronics convertor application. By N. Mohan T.M. Udeland and W.P.Robbins John Willey & Sons
3) Electrical Drives-concept and application By VedamSuryaVanshi
4) Advanced Power Electronics & A.C. Drives By B.K. Bose
5) Analysis of Thyristor Power Controlled Motors By S.K. Pillai

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-I

2.ENGINEERING ECONOMICS & INDUSTRIAL MANAGEMENT

Teaching Scheme:
Lectures: 3 Hours /Week
Tutorial: 1 Hour/Week

Examination Scheme:
Paper: 100 Marks

SECTION-I

1. Basics of Economics: (6 hrs)
Economics, Economics applied to industries, Payback period, Value Engineering, Make& Buy decisions, Economic lot batch size, cost control & cost ration

2. Business Organization: (6 hrs)
Forms/Types of Business organizations, Proprietorship, Partnership, Private & Public Joint stock company, Organization structure & Characteristics, Line & Staff

3. Indian Economy: (6hrs)
Infrastructure in Indian Economy, Energy, power, Science & Technology, sector comparative study of five year plans of Indian Economy for electrical sector

SECTION-II

4. Management :(8 hrs)
Functions of Management, Planning, organizing, staffing, directing, controlling, project planning & acquisition, characteristics of project, project proposal process, project planning Tools, Management Information systems (MIS)

5. SSI & Entrepreneurship :(8hrs)
Small Scale Industries: Definition of SSI, Classification, Advantages, Industrial Policies, Steps and procedure for setting SSI, facilities to SSI Entrepreneurship: definition, types, functions and qualities. Entrepreneurial Vs managerial Style, Locations and layout , phases in industrial project

6. Industrial Acts & Safety :(4 hrs)
Indian Factory Act, The Indian Electricity Acts and rules, Industrial Safety

Recommended Books:-

1. Industrial Organization &Engg. Economics ByT.R.Banga, S.C.Sharma (Khanna Publishers)
2. Indian Economy By RuddarDatt, K.P.M. Sundharum(S.Chand Publishers)
3. Industrial Engg& Management by O.P. Khanna, Dhanpatrai& Co, 9th edition
4. Managing Engg. & Technology - Daniel Babcock, PHI, 3rd Edition
5. The Electricity Rules, 2005 Professional Book Publishers, 2008-Edition

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-I

3: INSTRUMENTATION TECHNIQUES

Teaching Scheme:
Lectures: 4 Hours /Week
Practical: 2 Hours/Week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks
POE: 25 Marks

SECTION-I

1. Introduction: (4hrs)
Instrumentation system block diagram and function of each block, Brief idea of static characteristics of measuring devices accuracy, precision, errors, uncertainties, linearity, resolution

2. Transducers :(8 hrs)
Definition, classification of transducers, various types of transducers, variable parameter transducers, selection criteria, Transducers for measurement of displacement, velocity, acceleration, strain, pressure temperature, vibration, flow, angular velocity & torque

3. Signal Conditioning: (8 hrs)
Chopper stabilized amplifier, Instrumentation amplifier, isolation & programmable gain amplifier, active filters, frequency response of 1st order and 2nd order filter, practical comparators, modulators demodulators, sine & other waveform generation, sample and hold circuit, frequency to voltage & voltage to frequency converter

4. Data Transmission: (4 hrs)
General telemetering system, types of telemetering system, different methods of modulation.

SECTION-II

5. Data conversion and acquisition: **(8hrs)**
Principles and working of different types of ADC and DAC, Data acquisition systems, Sample and hold circuit, frequency to voltage, voltage to frequency and current to voltage converter.

6. I/O Devices & Displays: (8hrs)
Analog display, oscillograph, strip chart, X-Y recorders, Tape recorders, storage Oscilloscope, Digital input and output devices, LCD, 7 segment display

7. Programmable Logic Controller: (4 hrs)
Introduction to PLC hardware, CPU memory i/p and o/p, explanation of ladder diagram Logic, types of PLC system.

8. Applications of Transducers: (4 hrs)
Instrumentation set up for measurement of physical quantities using transducers studied in topic 2 above.

Recommended Books:

1. Electronic Instrumentation- by H.S. Kalsi, Tata McGraw Hill, 2nd edition
2. Electrical & Electronics Measurement – by A.K. Sawhney, DhanpatRai& Co (P) Ltd,
8th edition
3. Electrical and Electronic Measurement and Instrumentation by R K Rajput, S Chand
4. Instrumentation Devices & Systems – by Rangan, Mani, Sharma, Tata McGraw Hill,
2nd edition
5. Industrial Instrumentation and Control, S.K.Singh.

Term work:-

Term Work: Minimum 8 Experiments based on above syllabus. The following list is given for reference.

List of Experiments:-

1. Measurement of temperature using of RTD.
2. Use of thermistor in control circuit as a temperature compensator.
3. Use of thermocouple as a temperature sensing device.
4. Resistance stain gauge using unbalanced bridge circuit in weighing machine.
5. Use of LVDT transducer for measurement of displacement.
6. Measurement of speed by optical transducer.
7. Study of IC tester.
8. Use of Potentiometer as a transducer
9. Frequency response of active low-pass filter.
10. Frequency response of active high-pass filter.
11. Frequency response of active band-pass filter.
12. Measurement of water flow.

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-I

4: POWER SYSTEM II

Teaching Scheme: **Examination Scheme:**

Lectures: 4 Hours /Week **Paper: 100 Marks**

Practical: 2 Hours/Week **T.W.: 25 Marks**

OE: 25 Marks

SECTION-I

1. Symmetrical fault analysis :(4 hrs)

Short circuit transients on transmission line, short circuit currents and reactance of asynchronous Machine, Internal voltages of loaded Synchronous machine under transient conditions.

2. Symmetrical Components :(7 hrs)

Fundamentals of Symmetrical Components, sequence impedances and sequence networks of Synchronous machine, star connected loads, transmission lines and transformer.

3. Unsymmetrical fault analysis :(6 hrs)

Analysis of Single Line to Ground (LG) fault, Line-To-Line (LL) fault, Double Line-to-Ground (LLG) fault, one conductor open fault, two conductors open fault, Numericals expected.

4. Power System Control :(7 hrs)

Load frequency control (Single and two areas), modeling of Generator, Governor, prime mover, Load, Load frequency control and economic dispatch, Automatic generation control, Steady state analysis and dynamic response of an isolated power system, Automatic voltage control, and reactive power control.

SECTION-II

5. Optimal Power System Operation: (8 hrs.)

System constraints, Generator operating cost, Input-output and incremental fuel characteristics of a generating unit, optimal operation of generators on a bus bar, algorithm and flow chart for optimal power flow study, optimal unit commitment, spinning reserve, thermal and hydro constraints, Numericals expected.

6. Power System stability: (12 hrs.)

Dynamics of Synchronous machine, Swing equation for single machine connected to infinite bus, Steady state stability and transient state stability, Equal area criterion, Numerical solution of swing equation, factors affecting transient stability, methods for improving stability of system.

7. Power system Security: (4 hrs.)

Brief Introduction to- System state classification, Security analysis, Contingency analysis, Sensitivity factors.

Recommended Books:-

1. Modern Power System Analysis by I. J. Nagrath, D. P. Kothari, 3rd Edition, Tata McGraw Hill Publishing Co. Ltd., 2003
2. Electrical power System by Ashfaq Husain, CBS Publishers and Distributors, Fifth Edition 2007
3. Power System Analysis by Grainger John J and W D Stevenson Jr. McGraw Hill, 1994.
4. Power System Analysis by Hadi Sadat, McGraw Hill International, 1999.
5. Computer Methods in Power System Analysis - M.A. Pai

Term-Work:-Minimum 8 Experiments/ Drawing sheets based on above syllabus.

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-I

ELECTIVE –I
5.1: HIGH VOLTAGE ENGINEERING

Teaching Scheme: **Examination Scheme:**
Lectures: 3 Hours /Week **Paper: 100 Marks**
Tutorial: 1 Hour/Week **T.W.: 25 Marks**

SECTION-I

1. Electrostatic fields: (5 hrs)
Electrostatic stresses, Gas/vacuum as insulators, liquid breakdown, solid breakdown, estimation and control of electric stresses, surge voltages, their distribution and control

2. Conduction and break-down in gases :(6 hrs)
Gases as insulating media, ionization processes, Town ends growth equation, primary and secondary process, Towns ends criterion for break-down, Pascens law, break-down in non-uniform fields and corona discharges, post break-down phenomena and applications, practical considerations in using gases for insulation purposes

3. Conduction and break-down in liquid dielectric :(5 hrs)
Liquids as insulators, conduction and break-down in pure liquids, conduction and breakdown in commercial liquids

4. Break-down in solid dielectric :(5 hrs)
Intrinsic break-down, electromechanical break-down, thermal break-down, breakdowns of solid dielectrics in practice, break-down of composite insulation, solid dielectric used in practice

SECTION-II

5. Generation of high voltages and currents :(5 hrs)
Generation of HVDC/HVAC and impulse voltages, generation of impulse currents, tripping and control of impulse generators

6. Measurement of high voltage and currents :(6 hrs)
Measurement of high direct current voltages, measurement of high ac and impulse voltages, measurement of high dc, ac and impulse currents, CRO for impulse voltage and current

7. High voltage testing of electrical apparatus :(5 hrs)
Testing of insulators and bushings, testing of circuit breakers, testing of cables, testing of transformers, testing of surge diverters, radio interference measurements

8. Design, planning and layout of high voltage laboratories: (5 hrs)
Test facilities provided in high voltage laboratories, activity and studies in high voltage laboratories, classification of high voltage laboratories, size and ratings of high voltage laboratories, grounding of impulse testing laboratories

Term-work:-
It should consist of minimum 8 tutorials based on above syllabus.

Recommended Books:-

1. High Voltage Engineering by M S Naidu, V Kamraju Tata McGraw Hill publications New Delhi
2. High voltage insulation engineering by RavindraArora, Wolf Gang Mosch, New age international publishers ltd Wiley estern Ltd
3. High Voltage Engineering by C L Wadhwa, New age international publishers ltd
4. Introduction to High Voltage Engineering Pearson 1970 Kuffel E and Abdullah M,

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-I

ELECTIVE –I

5.2: EHVAC

Teaching Scheme: **Examination Scheme:**

Lectures: 3 Hours /Week **Paper: 100 Marks**

Tutorial: 1 Hour/Week **T.W.: 25 Marks**

SECTION-I

1. Introduction and calculation of line and ground parameters: (7 hrs)

Engineering aspects and growth of EHVAC, transmission line trends and preliminaries, power transferability, transient stability, transit stability limits, surge impedance loading, resistance, power loss, temperature rise properties of bundled conductors, inductance and capacitance, calculation of sequence and capacitance, line parameters for modes of propagation resistance and inductance of ground return.

2. Voltage gradient of conductors and I2R and corona loss: (7 hrs)

Charge potential relations for multi-conductor lines, surge voltage gradients on the conductor lines, surge voltage gradients on sub-conductors of bundle conductors, distribution of voltage gradients on sub-conductors of bundle, I^2R and corona loss, corona loss formula, charge voltage diagram with corona, attenuation of travelling waves due to corona loss, audible noise, corona pulses, their generation and properties.

3. Theory of travelling waves and standing waves: (6 hrs)

The wave at the power frequencies, differential and solution for general case, standing waves and natural frequencies, open ended line double exponential response, response to sinusoidal, excitation, line energization with trapped charge voltage, reflection and refraction of travelling waves.

SECTION-II

4. Lighting and lighting protections: (5 hrs)

Lighting strokes to lines, their mechanism, general principles of the lighting protections, problems, lower footing, resistance, lighting arrestors and protection characteristics, different arrestors and their characteristics, protection characteristic.

5. Over voltage in EHV system covered by switching operations:(6 hrs)

Over voltage, their types, recovery voltage and circuit breaks, Ferro-resonance over voltage and calculation of switching, switching surges, single phase equivalents.

6. Power frequency voltage control and over voltages: (6 hrs)

Generalized constants, charging currents, power circle diagram and its use, voltage control shunt and series component, sub-synchronous resonance in series capacitors compensated lines and static reactive compensating systems.

7. Insulation co-ordination :(3 hrs)

Insulation levels, voltage withstand levels of protected equipments and insulation condition based on the lighting.

Term-work

It should consist of minimum 8 tutorials based on above syllabus.

Recommended Books:

1) “High voltage engineering” Tata McGraw Hill publishing company-1982 Naidu M S andKamraju V.
2) “High voltage engineering” Khanna publishers New Delhi. Radzeving D K.
3) “High voltage technology” Oxford university press, 1968 Alston L L.
4) “ Travelling waves in transmission systems” John Wiley Dover 1963 Bewley L V.
5) Transient performance of electric power system. McGraw Hill book co.-1950 Rudenberg R.

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-I

ELECTIVE –I
5.3: RENEWABLE ENERGY SOURCES

Teaching Scheme: **Examination Scheme:**
Lectures: 3 Hours /Week **Paper: 100 Marks**
Tutorial: 1 Hour/Week **T.W.: 25 Marks**

SECTION-I

1. **Introduction to Energy Sources: (4 hrs)**
Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources.

2. **Solar Energy: (6 hrs)**
Flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond, solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings.

3. **Solar photovoltaic system: (6 hrs)**
Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system

4. **Wind Energy : (6 hrs)**
Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: Economic issues, recent development.

SECTION-II

5. **Energy from Biomass: (6 hrs)**
Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas.

6. **Geothermal Energy: (3 hrs)**
Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

7. **Energy from the ocean: (8 hrs)**
Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.

8. **Hydrogen Energy: (3 hrs)**
Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles

Term-work:
It should consist of minimum 8 tutorials based on above syllabus.

Recommended Books:

1. Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata Mc Graw Hill.
2. Kothari D.P., “Renewable energy resources and emerging technologies”, Prentice Hall of India Pvt. Ltd.
3. Rai G.D, "Non-Conventional energy Sources", Khanna Publishers.
4. Ashok V. Desai, "Nonconventional Energy", New Age International Publishers Ltd.

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-I

ELECTIVE –I

ENERGY CONSERVATION & AUDITING

Teaching Scheme: **Examination Scheme:**
Lectures: 3 Hours /Week **Paper: 100 Marks**
Tutorial: 1 Hour/Week **T.W.: 25 Marks**

SECTION-I

1 Energy Scenario: (6hrs)
Commercial and Non – commercial energy, primary energy resources, commercial energy production, final energy consumption, Indian energy scenario, Sectoral energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future.

2. Energy Conservation Act 2001 and related policies: (4hrs)

Energy conservation Act 2001 and its features, notifications under the Act, Schemes of Bureau of Energy Efficiency (BEE) including Designated consumers, State Designated Agencies, Electricity Act 2003, Integrated energy policy, National action plan on climate change.

3. Basics of Energy and its various forms: (4hrs)

Electricity basics – Direct Current and Alternative Currents, electricity tariff, Thermal Basics-fuels, thermal energy contents of fuel, temperature and pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity and heat transfer, units and conversion, Metric Ton Oil Equivalent conversions.

4. Energy Management & Audit: (6hrs)

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering, precautions, thermography, smart metering.

SECTION-II

5. Energy Action Planning: (5hrs)
Key elements, force field analysis, Energy policy purpose, perspective, contents, formulation, ratification, Organizing – location of energy management, top management support, managerial function, roles and responsibilities of energy manager, accountability. Human resource development techniques, Information system – designing barriers, strategies; Marketing and communicating – training and planning.

6. Financial Management: (6hrs)
Investment-need, appraisal and criteria, financial analysis techniques – simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs).

7. Project Management: (4hrs)

Definition and scope of project, technical design, financing, contracting, implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification.

8. Energy Monitoring and Targeting : (5hrs)

Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques ,energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS)

Term Work:

It should consist of minimum 8 tutorials based on above syllabus.

Recommended Books:-

1. Utilization of Electrical Energy by S.C. Tripathi
2. Generation of Electrical Energy by B.R. Gupta, S Chand, 1st Edition
3. Energy Management by Murphy
4. Bureau of energy efficiency by Shikha Arora, Professional book publishers.
5. Preparatory course material for Energy auditor & manager. Govt of India New Delhi

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-I

ELECTIVE –I

5.5. EMBEDED SYSTEM

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hours /Week	**Paper: 100 Marks**
Tutorial: 1 Hour/Week	**T.W.: 25 Marks**

SECTION-I

1. **Introduction to Embedded Computing : (5hrs)**
Overview, Characteristics of Embedding Computing Applications, Concept of Real time Systems, Challenges in Embedded System Design, Design Process Requirements, specifications, Architecture Design, Designing of Components, System Integration

2. **Embedded System Architecture: (8hrs)**
Instruction Set Architecture, CISC and RISC instruction set architecture, Basic Embedded Processor/Microcontroller Architecture, CISC Example 8051,RISC Example ARM, Harvard Architecture, PIC, Memory System Architecture, Caches, Virtual Memory, Memory Management Unit and Address Translation, I/O Subsystem, Busy-wait I/O, DMA, Interrupt driven I/O, Co-processors and Hardware Accelerators, Processor Performance Enhancement, Pipelining, Super-scalar Execution

3. **Designing Embedded Computing Platform: (7hrs)**
Bus Protocols, Bus Organization, Memory Devices and their Characteristics, RAM, ROM, UVROM, EEPROM, Flash Memory, DRAM, I/O Devices, Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Component Interfacing, Memory Interfacing, I/O Device Interfacing, Interfacing Protocols, Designing with Processors, System Architecture, Hardware Design, FPGA Based Design, Debugging Techniques, Manufacturing and Testing

SECTION-II

4. **Programming Embedded Systems: (8hrs)**
Program Design, Design Patterns for Embedded Systems, Models of Program, Control and Data flow Graph, Programming Languages, Desired Language Characteristics, Introduction to Object Oriented Programming, Data Typing, Overloading and Polymorphism, Multi-tasking and Task Scheduling, Timing Specifications, Run-time Exception handling, C for Programming embedded systems, Programming and Run-time Environment, Compiling, Assembling, Linking, Debugging, Basic Compilation Techniques, Analysis and Optimization of Execution Time, Analysis and Optimization of Energy and Power, Analysis and Optimization of Program Size, Program Validation and Testing

5. **Operating System: (8hrs)**
Basic Features of an Operating System, Kernel Features, Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System, Processes and Threads, Context Switching, Cooperative Multi-tasking, Pre-emptive Multitasking, Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault-Tolerant Scheduling, Inter-process Communication, Shared Memory Communication, Message-Based Communication, Real-time Memory Management, Process Stack Management, Dynamic Allocation, Synchronous and Asynchronous I/O, Interrupt Handling, Device Drivers, Real-time Transactions and Files, Evaluating and Optimizing Operating System Performance, Response-time Calculation, Interrupt latency, Time-loading, Memory Loading, Power Optimization Strategies for Processes

6. Embedded Control Applications: (4hrs)

Open-loop and Closed Loop Control Systems, Speed Control of motor, PID Controllers, Software

Coding of a PID Controller, PID tuning, Fuzzy Logic Controller, Application Examples of Washing

Machine, Automotive Systems and Air conditioner

Term Work:

It should consist of minimum 8 tutorials based on above syllabus.

Recommended Books:

1.Embedded System design : Peter Marwedel, Springer publication.
2.An Embedded Software Primer, David E. Simon Pearson Education, Asia Publication
3.ARM System developers guide designing & optimizing system software: Andrew N., Dominic Sloss, and Chris Wright.
4.Embedded System Design A Unified Hardware/ Software Introduction : Frank Vahid/ Tony Givargis ,Wiley publication
5.Embedded/ Real-Time Systems: Concepts, Design & Programming : Dr. KVKK Prasad,
Dreamtech Press

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-I

6. INDUSTRIAL TRAINING EVALUTION

Examination Scheme: T.W.: 25 Marks

Please see the structure of S.E., T.E., B.E.

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-I

7.PROJECT & SEMINAR

Teaching Scheme:	**Examination Scheme:**
Practical: 4 Hours/Week	**T.W.: 50 Marks**

1) Project group should consist of students not more than 5 students
2) All the students in the group should deliver seminars and at least one student from the group should deliver seminar based on project.
3) The group should submit a synopsis of the project to the department and a report based on seminars.
4) A group should complete the design of project in this semester.
5) The term work marks should be based on performance in seminar delivered and preparation of project work completed.

Solapur University, Solapur.

Department of Electrical and Electronics Engineering

Proposed Structure of B.E. Electrical and Electronics Engineering

W.E.F. Academic Year 2012-13

Sr No	Subject	Teaching Scheme			Examination Scheme				
		L	P*	T	TH	TW	POE	OE	Total
1	Industrial drives and control	4	2	---	100	25	25	--	150
2	Engineering Economics & Industrial Management	3	---	1	100	--	----	--	100
3	Instrumentation Techniques	4	2	---	100	25	25	---	150
4	Power system II	4	2	---	100	25	---	25	150
5	Elective-I	3	--	1	100	25	---	--	125
6	Industrial Training Evaluation	---	---	---	---	25	----	--	25
7	Project& Seminar	----	4	--	--	50	--	--	50
	Total	18	10	2	500	175	50	25	750

B.E. (Electrical and Electronics Engineering) Part-II

Sr No	Subject	Teaching Scheme			Examination Scheme				
		L	P *	T	TH	TW	POE	OE	Total
1	Switchgear & Protection	4	2	---	100	25	--	25	150
2	Electrical Machine Design	4	2	--	100	25	---	25	150
3	FACTS	4	--	1	100	25	--	--	125
4	Elective –II	4	--	1	100	25	--	--	125
5	Project	---	8	---	---	100	---	100	200
	Total	16	12	2	400	200	--	150	750

1) The batch size for practicals /tutorials should be of 15 students. On forming the batches, if the strength of remaining students exceeds 7, then a new batch may be formed.
2) Vocational Training to (be evaluated at B.E. Part-I) of minimum 15 days should be completed in any vacation after S.E. Part-II but before B.E. Part-I & the report should be submitted in B.E. Part-I.
3) Project group should consist of Maximum 4 students.

Elective-I	**Elective-II**
1.High Voltage Engineering	1. HVDC
2.EHVAC	2.Computer Aided Power system Design
3.Renewable Energy Sources	3.Power System Dynamics &Stability
4.Energy Conservation & Auditing	4. Electrical Installation testing & maintenance
5.Embeded System	5.Artificial Neural Networks

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-II

1. SWITCHGEAR & PROTECTION

Teaching Scheme:
Lectures: 4 Hours /Week
Practical: 2 Hours/Week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks
OE: 25 Mark

SECTION-I

1. Principles of circuit breaking: (8 hrs)
Initiation of arc, arc extinction, DC and AC circuit breaking, arc voltage and current waveforms in an AC circuits, Definition of transient recovery Voltage, rate of rise of TRV, expression for TRV for different values of arc resistance, current chopping, Theories of arc extinction, arc control devices, HRC fuse, Ratings and specifications of circuit breakers, making and breaking capacities, short circuit testing

2. Low Tension Switchgear: (6 hrs)
Different types of switchgear: Air circuit breaker (ACB): Construction and Working, Miniature Circuit Breakers (MCB) and Molded case circuit Breaker (MCCB) Contact shapes and material.

3. Medium and high tension Switchgear: (7 hrs)
Principle of arc quenching in: Air Blast circuit Breaker (ABCB), Bulk oil circuit breaker (BOCB), Minimum oil circuit breaker (MOCB), Vacuum Circuit breaker (VCB), SF6 circuit breaker

4. Isolator and Earth Blades: (3 hrs)
Types of Isolators, Voltage Capacity (manual and auto), Operations and Faults, Advantages, Purpose of earth Blades

SECTION-II

5. Protective relaying: (7 hrs)
Objective of protective relaying: Protective zones, Primary and backup protection, Desirable qualities Principle and characteristics of: Over current relays: Time setting, plug setting, IDMT relays, Directional relays, Distance relays resistance, reactance, impedance, MHO relays, Differential relays

6. Power system protection: (9 hrs)
Relevant protection for different type's earth faults Protection of transmission line and feeders Pilot wire relaying (Impedance, reactance and mho relays), Protection of Transformers, buchholz relay, Protection of generators, protection against loss of prime mover, and loss of excitation, field suppression, out of step relaying, Protection of induction motors against single phasing and over current Earth leakage circuit breakers, Meaning of carrier communication and carrier aided schemes for blocking and auto-reclosing

7. Types of Relays: (4 hrs)
Microprocessor based protective schemes (Block diagram and flow chart), Introduction to DSP based protection (only simple schemes, advantages etc), Static relays (Block Diagram for Over current, instantaneous, inverse, very inverse, IDMT relays), Electromagnetic, over current and directional relays

8. Over voltage Protection: (4 hrs)
Causes of over-voltages, Surge arrestor and absorbers, Metal oxide (Zno) arrestors, Insulation co-ordination in power system

Term work:
Term work shall consist of six practical/Drawing sheets and three assignments on the entire syllabus. The following list is given for reference.

Recommended Books:

1) Power System Protection and Switchgear: B.Ram and B.N. Vishwakarma
2) Switchgear and Protection: Sunil.S. Rao, Khanna Publications
3) Digital Protection: L.P.Singh
4) Switchgear and Protection: M.V. Deshpande

List of Experiments:

1) Drawing sheet showing construction of MOCB, ABCB, SF6 CB and Vacuum CB.
2) Drawing sheet for Generator and transformer protection schemes.
3) Study of construction and working of induction disc type relays.
4) Plotting of I α t characteristics of an IDMT over current or E/F relay.
5) Experimental study of working of a Directional over current relay.
6) Experimental realization of microprocessor based over current relay.
7) Experimental realization of microprocessor based impedance relay.
8) Experimental realization of microprocessor based Directional over current relay.

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-II

2. ELECTRICAL MACHINES DESIGN

Teaching Scheme:
Lectures: 4 Hours /Week
Practical: 2 Hours/Week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks
OE: 25 Marks

SECTION-I

1. Transformers: (3hrs)
Constructional details, core & shell types, Distribution & power transformers, Core & core materials, windings, Cooling of transformers, tank, transformer oil, cooling tubes conservators & breathers

2. Design of transformers: (7hrs)
Output equation, EMF per turn ratio of iron loss to copper loss, Yoke design for single phase & 3 phase transformers, Window dimensions, winding design, Transformer oil & specifications & insulation details, Tank & cooling tubes design, Resistance, leakage reactance of winding. calculation of no load current, equivalent circuit, performance characteristics

3. Three phase induction motors: (6hrs)
No load current, magnetizing current, loss component short circuit current, Resistance, leakage reactance equivalent circuit, Use of circle diagram to obtain performance figures, Calculation of torque, maximum torque, maximum output.

4. Design of 3 phase Induction Motor: (8 hrs)
Output equation, specific electric & magnetic loadings efficiency & power factor, Design of main dimensions, Stator core & winding design, Calculation of air-gap length, Design of squirrel cage rotor, rotor bar currents, elimination of harmonic torques, rotor slot insulation, end ring currents, area of end ring, Design of wound motor rotor, Rotor slot design, rotor stampings

SECTION-II

5. Single phase Induction Motors: (3hrs)
Types & constructional details, construction of stator, stator windings, rotor, starting switches, electrolytic capacitor

6. Single phase induction motors design: (9hrs)
Output equation, specific loadings, Main dimensions, Relative sizes of single phase & 3- phase induction motors, Design of stator, main winding, starting winding, nos, of stator slots, size of stator slot, stator teeth, stator core length of mean turn & air gap length, Design of rotor, numbers of rotor slots, Area of rotor bars, area of end rings, rotor core & teeth, rotor resistance MMF for air gap, saturation factor, Iron, friction & windage losses, Rotor resistance, leakage reactance calculations, Equivalent circuit, running performance, pull-out torque, Design of auxiliary winding for capacitor start/run motors, Length of mean turn, starting torque

7. Design of synchronous machine (Smooth cylindrical rotor): (6hrs)
Review of construction of water wheel & turbo alternators, Different parts & materials used for different parts, Choice of electric & magnetic loadings, Output equation, Determination of diameter & length, Length of air- gap & main dimensions, effect of short circuit ratio on machine performance.

8. Design of synchronous machine (Salient pole rotor): (6hrs)
Design of salient pole rotor, Sectional area & type of pole, pole height, damper winding, Design of field winding, Direct & quadrature axis synchronous reactance, MMF for magnetic circuit, Estimating full load field mmf.

TERM WORK –
It should consist of minimum 8 Drawing sheets.

Recommended Books:
1. A course in Electrical Machine Design – by A K Swahney, DhanpatRai& Sons, Delhi,

2. Design of Electrical Machine (DC & AC) - by V N Mittle, Standard Publishers & Distributors, Delhi,

3. Performance & Design of AC Machine- by M G Say,

4. Design & testing of Electrical Machine (2nd edition) - by M V Deshpande, A H Wheeler & Co, Allahabad,

5. Principles of Electrical Machine Design- by R K Agarwal, S K Kataria& Sons, Delhi,

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-II

3. FACTS

Teaching Scheme:
Lectures: 4 Hours /Week
Tutorial: 1 Hours/Week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks

SECTION-I

1. FACTS Concepts and General System Consideration: (6 hrs)
Introduction of the facts devices, its importance's in transmission Network, Power flow in AC System, Basic types of FACTS controller, Brief Description and Definition of FACTS controller

2. Static Shunt Compensator (SVC AND STATCOM): (14hrs)
Objectives of the shunt compensation, method of controller Var generation, static var compensators: SVC and STATCOM, Comparison between STATCOM and SVC

3. Static Series Compensator (GCSC and TSSC): (4 hrs)
Objectives of the series compensation, variable impedance type series compensation, switching converter type series compensators, chrematistics of series compensator

SECTION-II

4. **Static Series Compensator (TCSC AND SSSC): (5 hrs)**
Objectives of the series compensation, variable Impedance type series compensation, switching converter type series compensators, chrematistics of series compensator

5. Static Voltage and Phase Angle Regulator (TCVR and TCPAR): (5 hrs)
Objective of voltage and phase angle regulators, approaches to TCVR and TCPAR, Switching converter based voltage and phase angle regulators, Hybrid Phase Angle Regulators

6. Combined Compensator (UPFC and IPFC) & Harmonics: (14hrs)
UPFC - Basic operating principles, independent real and reactive power flow control, comparison of UPFC to series compensator and phase angle regulations, control structure, Basic control system for P and Q control PFC - Basic operating principles and characteristics, Control structure and applications Generalized and Multifunctional FACTS Controller, harmonics generated by FACTS and their mitigation, Different power quality problems that could be solved using flexible sub – systems.

Term work:
Term work shall consist of minimum eight tutorials based on above syllabus.

Recommended Books:
1. Understanding FACTS-Concepts and Technology of FACTS by Narain G Hingorani, Laszlo Gyugyi, Standard Publishers
2. FACTS Controller in Power Transmission and Distribution by K R Padiyar
3. Static Reactive power compensation By T.J.E. Miller, Jhonwiley& sons Newyork

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-II

ELCTIVE -II

4.1. HVDC

Teaching Scheme:
Lectures: 4 Hours /Week
Tutorial: 1 Hours/Week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks

SECTION-I

1. General Background: (8hrs)

Trends in transmission Voltages, Hierarchical Levels in transmission and distribution, Standard rated voltage of EHV-AC and HVDC, General aspects HVDC Transmission: Constitution of EHVAC and DC links, Kinds of DC links, HVDC projects in India and abroad, limitations and advantages of HVDC transmission over EHVAC, Layout of HVDC station.

2. Grid Control and Characteristics: (9hrs)

Grid control of thyristor, valve-Analysis with grid control with no overlap, overlap less than 60 degrees and overlap greater than 60 degrees. Basic means of control, Power reversal, manual control and its limitations-constant current versus constant voltage, desired features of control, actual control characteristics-constant minimum ignition angle, current and extinction angle controls – stability of control, power control and current limits.

3. Protection: (7hrs)

Disoperation of converters-short circuit on a rectifier – commutation failure, causes and remedies – Protection of HVDC system, d.c. rectors, damper circuits, Over current protection and over-voltage protection, clearing fault and reenergizing the line.

SECTION-II

4. Harmonics and Filters: (8hrs)

Characteristic and uncharacteristic harmonics-causes, consequences and suppression-Troubles caused by harmonics, Harmonic filters- Types, Location, series or shunt, sharpness of tuning.

5. Reactive Power Compensation: (8hrs)

Concept of reactive power compensation- reactive Power balance in HVDC substations-Effect of angle of advance and extinction angle on reactive power requirement of converters.

6. Multi-terminal DC Systems: **(8hrs)**

Introduction, Configurations and Types of MTDC Systems, Control and Protection of MTDC Systems

Term work:

Term work shall consist of minimum eight tutorials/ assignments based on above syllabus

Recommended Books:

1. Padiyar K. R., “HVDC Transmission systems” , 1st ED. Wiley Eastern Ltd. 1991.
2. Kimbark E. W. “HVDC Transmision, 1st ED. Wiley Eastern Ltd
3.Power Transmission by Direct Current : E. Usdimann Springer Verlag, Berlin Edn. 1975.
4.EHVAC and HVDC Transmission: S.S. RaoKhanna Pub. Delhi.

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-II

ELCTIVE -II

4.2. COMPUTER AIDED POWER SYSTEM DESIGN

Teaching Scheme:
Lectures: 4 Hours /Week
Tutorial: 1 Hours/Week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks

SECTION-I

1. Load flow Studies: (12 hrs)
Introduction, Network model formulation, Formulation of YBUS by singular transformation, Load flow problem, Gauss – Seidel method, Newton – Raphson method, Decoupled load flow method, Comparison of load flow methods, Control of voltage profile

2. Optimal system Operation: (12 hrs)
Introduction, Optimal operation of generators on a bus bar, optimal unit commitment. Reliability considerations, Optimum Generation scheduling, Optimal load flow solution, Optimal scheduling of hydrothermal system

SECTION-II

3 Automatic generation and voltage control: (10 hrs)
Introduction, Load frequency control (Single area case), Load frequency control and Economic dispatch Control, Two area load frequency control, Optimal (two area) load frequency control, Automatic voltage control, Load frequency control with generation rate constraints(GRCS), Speed governor dead band and its effects Digital LF controllers, Reactive power control

4 Power system stability and Power Quality : (14 hrs)
Introduction, Dynamic of synchronous machine, Power angle equation, Node elimination technique, Steady state stability, Transient stability, Equal area criterion Numerical equation of swing equation, Multi machine stability, Factors affecting transient stability Introduction, Harmonics in power supply, Defining quality of power

Term work:
Minimum Eight tutorials covering the syllabus.

Recommended Books:-

1 Modern Power Systems Analysis,TMH publication, sec. Ed. 1989 - Nagrath I. J. &KOthari

2 Electrical Power Systems, Wiley Eastern Ltd. 2nd.Ed. 1991 - Wadhawa C. L.,

3 Power System Analysis and Design, Thomson Asia Pvt. Ltd.2003 - Gupta B. R.,

4 Power System Analysis, TMH publication, 1st Ed. 2002 – Hadi Sadat

5 Computational methods for large spare Power System Analysis, An Object Oriented Approach,

Kluwer Academic publisher, New York 2001 - Soman S. A., Kharpade S. A. and ShubhaPandit,.

6 Power System Analysis and Design, Thomson Asia Pvt. Ltd. 2003 - Glower D. J.and Sharma

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-II

ELCTIVE -II

4.3. POWER SYSTEM DYNAMICS & STABILITY

Teaching Scheme:
Lectures: 4 Hours /Week
Tutorial: 1 Hours/Week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks

SECTION-I

1. Introduction: (8 hrs)
General basic concept of Power System Stability, States of operation & System Security, System Dynamics Problems, Review of Classical Model, System Model, Analysis of Steady State Stability & Transient Stability

2. Modeling and dynamics of Synchronous Machine: (16 hrs)
Synchronous Machine, Park's Transformation, Analysis of Steady State Performance, P. U. Quantities, Equivalent Circuit of Synchronous Machine. Excitation systems & Prime Mover Controllers: Simplified Representation of Excitation Control, Excitation Systems, Modeling, Std. Block Diagram, State Equations, Prime Mover Control System, Transmission Line & Load Modeling, SVC System Model, Synchronous Machine Model, System Simulation, Consideration of other Machine Models including SVC Model

SECTION-II

4. Small signal Stability: (8 hrs)
Single and multi-machine system, Damping and Synchronizing torque Analysis, Power System Stabilizers

5. Transient Stability and Voltage Stability: (16 hrs)
Transient Stability: Evaluation and Simulation, application of energy functions for direct stability evaluation, TS controllers. Voltage Stability: Introduction, affecting factors, analysis, comparison with angle stability

Recommended Books:-
1. Power System Dynamics – Stability & Control, K. R. Padiyar, BS Publications
2. I.J. Nagrath and M. Gopal, Control system engineering, Wiley Eastern Ltd, 3rd edition, 2000.
3. Benjamin C. Kuo, Automatic Control system, Prentice Hall of India Pvt Ltd.

Term work:
Term work shall consist of minimum eight tutorials based on above syllabus

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-II

ELCTIVE -II

4.4. ELECTRICAL INSTALLATION TESTING & MAINTENANCE

Teaching Scheme:
Lectures: 4 Hours /Week
Tutorial: 1 Hours/Week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks

SECTION- I

1. Tools, accessories: (6 hrs)

Tools, accessories and instruments required for installation, maintenance and repair work, Indian Electricity rules, safely codes causes and prevention of
accidents, artificial respiration, workmen's safety devices.

2.Installation of Transmission and Distribution Lines: (10 hrs)

Erection of steel structures, connectingof jumpers, tee-off points, joints and dead ends: crossing of roads, streets, power/telecommunication lines and railway crossings clearances: earthing of transmission lines and guarding, spacing and configuration of conductors, Arrangement for suspension and strain insulators, bird guards anti-climbing devices and danger plates. sizes of conductor earth wire and guy wires. Testing and Commissioning Laying of service lines earthing, provision of service fuses, installation of energy meters

3.Inspection and handling of transformers: (8 hrs)

Pole mounted substations, plinth mounted substation, busbars, isolation, voltage and current transformers, lightning arrestors, control and relay panels, HT/LT circuit breakers, LT switches, installation of power/distribution transformers, dehydration. Earthing system, fencing of yard, equipment foundations and trenches.

SECTION-II

4.Testing of various electrical equipment: (6 hrs)

Electrical motor, transformers, cables, generator and motor control centers, medium voltage distribution panels power control centers motor control, pre-installation checks, connecting and starting pre commissioning checks.

5. Maintenance: (12 hrs)

Types of maintenance, maintenance schedules, procedures, Maintenance of Transmission and Distribution System, danger notice, caution notice permit to work, arranging of shutdowns personally and temporary earths cancellation of permit and restoration of supply, Patrolling and visual inspection of lines – points to be noted during patrolling from ground: special inspections and night inspections, Location of faults using Meggar, effect of open or loose neutral connections provision of proper fuses on service lines and their effect on system, Transformer maintenance and points to be attended to in respect of various items of equipment, Checking of insulation resistance transformer oil level and BDV test of oil, measurement of earth resistance

6.Domestic installation : (6 hrs)

Introduction, testing of electrical installation of a building, testing of insulation resistance to earth testing of insulation and resistance between conductors continuity or open circuit test, short circuit test testing of earthing continuity location of faults IE rules for domestic installation

TERM WORK:
Minimum eight tutorials covering above syllabus. At least one visit to substation, repair shop, Testing division should be arranged and the students should submit a report of the visit.

Recommended Books:
1. Testing, Commissioning Operation and Maintenance of Electrical Equipment : S Rao, Khanna Technical Publication ,New Delhi

2. Preventive Maintenance of Electrical Apparatus : SK Sharotri, Katson Publishing House Ludhiana

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-II

ELCTIVE -II

4.5. ARTIFICIAL NEURAL NETWORKS

Teaching Scheme: **Examination Scheme:**
Lectures: 4 Hours /Week **Paper: 100 Marks**
Tutorial: 1 Hours/Week **T.W.: 25 Marks**

SECTION-I

1. Basics of ANN: **(6 hrs)**
Introductions, ANN, model of neural network, topologies, perceptions, basic learning rules- Supervised learning and unsupervised learning

2. **Feed Forward and Feedback Networks:** **(12 hrs)**
Multi layer Networks, delta rule, back propagation training, Hop field network, gradient hop field network, (discrete & continuous) transient response, Boltzman machine

3. **Application of ANN:** **(6 hrs)**
Applications to various field such as image & signal Processing, Control Systems etc.

SECTION-II

4. Fuzzy System: **(12 hrs)**
Fuzzy sets & membership, classical sets & fuzzy sets, Fuzzy relations, Fuzzification, &defuzzification, fuzzy logic & fuzzy system, fuzzy automata development of membership function

5. Fuzzy Arithmetic: **(6 hrs)**
Extension principle, fuzzy arithmetic, approximate methods of extension

6. Fuzzy Control System: **(6 hrs)**
Simple fuzzy controls, fuzzy in process control, fuzzy statistical process control.

Term work:
Term work shall consist of minimum eight tutorials based on above syllabus

Recommended Books:
1. Artificial Neural Network – B. Yegnanarayana PHI- 11th edition.
2. Fuzzy Logic with Engineering Application by Timothy J Ross, Wiley Student Edition
3. Neural Network-A Classroom Approach by Satish Kumar, Tata Mcgraw Hill
4. Fuzzy Logic_Intelligence, Control and Information by Jhon Yen, Reza Langari, Pearson
5. Introduction to Artificial Neural Networks – Jacek M. Zurada – Jaico publication
6. Fundamentals of Artificial Neural Networks – By mohamad H. Hassoun, PHI
7. Fuzzy logic with engineering application- Timothy J. Ross Willy publication second addition.
8. Fuzzy sets & fuzzy logic _ Theory & application – Jorge Klir / Bo Yaun- PHI

Solapur University, Solapur

B.E. Electrical & Electronics Engineering Part-II

5. PROJECT

Teaching Scheme:	**Examination Scheme:**
Practical: 8 Hours/Week	**T.W.: 100 Marks**
	O.E.: 100 Marks

A project group should complete the project of Hardware/Software (as applicable) and should submit to the Department at the end of semester. The project group should submit a report based on project work done by them including result analysis of the work done along with synopsis.