Solapur University, Solapur
Structure of B.E. (Electrical Engineering) Part-I &II
w.e.f. Acadamic Year 2010-2011

BE (Electrical Engg.) Part-I

Sr. No	Subject	Teaching Scheme				Examination Scheme				
		L	P	T	Total	T	TW	POE	OE	Total
1	Industrial Drives & Control	4	2	--	6	100	25	50	--	175
2	Microcontroller & Application	4	2	--	6	100	25	50	--	175
3	Electrical Machine Design	4	2	--	6	100	25	--	50	175
4	Power Plant Engg.	4	--	--	4	100	25	--	--	125
5	Elective-I	3	--	1	4	100	25	--	--	125
6	Industrial Training	--	--	--	--	--	25	--	--	25
7	Project Seminar-I	--	4	--	4	--	50			50
	Total	**19**	**10**	**1**	**30**	**500**	**200**	**100**	**50**	**850**

BE (Electrical Engg.) Part-II

Sr. No	Subject	Teaching Scheme				Examination Scheme				
		L	P	T	Total	T	TW	POE	OE	Total
1	FACTS	4	--	1	5	100	25	--	50	175
2	Switchgear Protection	4	2	--	6	100	25	--	50	175
3	Digital Signal Processing	4	2	--	6	100	25	--	--	125
4	Elective-II	4	--	1	5	100	25	--	--	125
5	Project Seminar-II	--	8	--	8	--	50	--	100	150
	Total	**16**	**12**	**2**	**30**	**400**	**150**	**--**	**200**	**750**

Elective-I

1. Design and Estimation of Electrical System
2. Biomedical Instrumentation
3. Mechatronics
4. EHVAC Transmission
5. High Voltage Engineering

Elective-II

1. Neural Network and Fuzzy logic
2. Embedded and Real time Systems
3. Power System Dynamics and Stability
4. HVDC Transmission
5. Computer Aided Power System Design

Note:-

1. Batch size for the Practical/Tutorial shall be of 15 students. On forming the batches, if the strength of remaining students exceeds 7, then a new batch shall be formed.
2. Project group shall not be more than 5 students.
3. Vacational Training (evaluated at B.E. Part-I) of minimum 15 days shall be completed in any vacation after S.E. Part-II but before B.E. Part-I & the report shall be submitted and evaluated in B.E. Part-I.

4. Industrial Visit should be arranged at semester I & semester II related to syllabus contents.
5. Appropriate Elective-I and Elective-II Subjects may be added when required.
6. Minimum strength of the students for the Electives should be 15.

Solapur University, Solapur
B.E. (Electrical Engineering) Part-I
1: INDUSTRIAL DRIVES AND CONTROL

Teaching Scheme:
Lectures: 4 Hour/ week
Practical: 2 Hour/ week

Examination Scheme:
Papers: 100 Marks
TW: 25 Marks
POE: 50 Mark

SECTION-I

1. **Introduction to Electrical drives :-** **(4 HRS)**
   Block diagram of electrical drives, Advantage of Electrical drives, Parts of Electrical drives. Selection of motor rating and converter rating

2. **Dynamics of Electrical Drives:-** **(5 HRS)**
   Dynamics of motor – load combination, Determination of moment of inertia, Steady state stability of an Electric drives, Transient stability of Electric drives.

3. **Characteristics of Motors:-** **(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:-** **(10 HRS)**
   Single phase, three phase fully loaded and half controlled converter fed D.C. motor drives. Duel converter fed D.C. motor drives and four quadrant drive system. Copper controlled dc shunt motor drives in single quadrant and multiquadrant operation chopper controlled dc series drives. Performance and stability of variable speed dc drives. Regenerative breaking of D.C. series motor

SECTION-II

5. **Induction Motor Drives:-** **(10 HRS)**
   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 multiquadrant 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:-** **(4 HRS)**
   Slip power recovery using cascade converter, in rotor circuit. Kramer speed control and scheribus drive. Chopper controlled resistance rotor circuit.

7. Synchronous motor and Brushless D.C. Motor Drives:- (6HRS)

VSI fed synchronous motor Drives, Variable frequency control of single and multiple Synchronous, motor Drives Brushless 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.

Recommended Books:-

1) Fundamentals of Electrical Drives. By Gopal. K. Dubey Narosa 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 Vedam SuryaVanshi
4) Advanced Power Electronics & A.C. Drives By B.K. Bose
5) Analysis of Thyristor Power Controlled Motors By S.K. Pillar

List of Experiments : -

Any 8 Experiments should be conducted -

1) 1- phase half controlled bridge D.C. Drive.
2) 3 - phase half controlled bridge D.C. motor Drive.
3) 3 - phase full controlled bridge D.C. drive.
4) Chopper controlled d.c. series motor drive.
5) Multi quadrant , chopper fed d.c. motor drive.
6) Inverter fed 3 - phase induction motor variable frequency drive.
7) 3 - phase cyclo – converter fed variable frequency induction motor drive.
8) Solid state scherbius Drive with slip power recovery scheme.
9) Solid state Kramer's Drive for 3 – phase induction motor.
10) CSI fed 3 - phase induction motor drive system.

Solapur University, Solapur
B.E. (Electrical Engineering) Part-I
2: MICROCONROLLER & APPLICATION

Teaching scheme:
Lecturers: 4 hrs/weeks
Practical: 2 hrs/weeks

Examination Scheme:
Theory: 100 Marks
TW: 25 Marks
POE: 50 Marks

SECTION-I

MCS 51 Microcontroller family:

1. Introduction to MCS 51 family, Architecture, Memory organization, Functional pin description, SFRs and various resources of MCS 51 **(5 Hrs)**

2. Addressing modes, Instruction set and Assembly language programming **(5 Hrs)**

3. Hardware overview: study of Port structure, interrupt structure, Timers, Serial port **(6 Hrs)**

4. Interfacing of following with MCS 51 microcontroller
Switches, LED, Relay, Buzzer, LCD display, Matrix keyboard, ADC 0809, DAC 0808,RTC DS1307 **(8 Hrs)**

SECTION –II

Microchip PIC microcontroller family

5. PIC Microcontrollers: overview and features **(2 Hrs)**

6. PIC 16F8XX Flash microcontrollers: Introduction, Architecture, Functional pin description, Various registers, Program memory and data memory organization, Input / output ports, Timers and Interrupts **(8 Hrs)**

7. Capture/ compare / PWM (CCP) Modules in PIC 16F877,
Master synchronous serial port (MSSP) module: SPI, I^2C . USART and ADC **(6 Hrs)**

8. Interfacing of following with PIC microcontrollers
Switches, LED, Relay, Buzzer, LCD display, Matrix keyboard, RTC DS1307 **(8 Hrs)**

Recommended Books:

1. The 8051 Microcontroller Architecture, programming and Applications by Kenneth Ayala Penram International (Third Edition)
2. Microcontrollers (Theory and Applications) by Ajay V. Deshmukh Tata MGH
3. The 8051 Microcontroller and Embedded systems by Muhammad Ali Mazidi Pearson Education Asia LPE (Second Edition)
4. Embedded Systems and Robotics by Subrata Ghoshal, Cengage Learning

5. 8051 Microcontrollers programming and practice by Mike Predcko
6. 8051 Microcontroller by I Stott, Mackenzie, Rathel & Phan – Fourth Edition – Pearson
7. Designing & Customizing of PIC Microcontrollers by Mike Predcko
8. Designs with PIC Microcontrollers by John B. Peatman Pearson Education Asia LPE
9. Datasheets of MCS 51 family microcontrollers
10. Datasheets of Microchip PIC family of Microcontrollers
11. Datasheets of RTC DS1307 from DALAS Semiconductor
12. PIC Microcontroller & Embedded Systems – Mazidi – Pearson Education
13. PIC Microcontroller-An Introduction to Software and Hardware Interfacing by Han-Way Haung, Cengage Learning

Term work:
Minimum 10 experiments of following with 5 Experiments on MCS 51 and
5 Experiments on Microchip PIC Microcontrollers. Use Assemblers for MCS 51 and MPLAB software for PIC Microcontrollers.

1. Arithmetic and Logic operations
2. Interfacing of Switches, LEDs and Buzzer.
3. Interfacing of Matrix Keyboard
4. Interfacing of LCD Display.
5. Interfacing of DAC 0808 and generation of various waveforms.
6. Interfacing of ADC 0809
7. Use of Timer for generation of time delays
8. Use of Timer as counter.
9. Interfacing of Serial RTC
10. Interfacing of Stepper motor.
11. Speed control of DC Motor.
12. Use of ADC of PIC Microcontrollers.
13. Use of Interrupts for any Application.
14. Serial communication.

Solapur University, Solapur
B.E. (Electrical Engineering) Part-I
3: ELECTRICAL MACHINE DESIGN

Teaching scheme:
Lecturers: 4hrs/weeks
Practical: 2hrs/we

Examination Scheme:
Theory: 100 Marks
TW: 25 Marks
OE: 50 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, Determinate of diameter & length, Length of air- gap & main dimensions, effect of short circuit ratio on machine performance, Rotor design

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, Design of turbo-generator, Estimation of length of air-gap,

TERM WORK –

It should consist of minimum 8 experiments.

Recommended Books:-

1. A course in Electrical Machine Design – by A K Swahney, Dhanpat Rai & 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 (2^{nd} 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 Engineering) Part-I
4: POWER PLANT ENGINEERING

Teaching Scheme:
Lectures: 4 Hours /Week

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

SECTION-I

1. **Fundamentals of power plant engineering:- (6 Hrs)**
   Review of thermodynamics cycles related to power plants, fuels and consumption, Layout of thermal, hydro, nuclear power station and power plant economics.

2. **Boilers and steam utilization:- (6 Hrs)**
   Boilers- types and classification, blow down and water treatment, energy conservation opportunities, boiler efficiency calculations, steam system, properties of steam, steam distribution.

3. **Non-conventional energy sources and utilization:- (6 Hrs)**
   Introduction, energy science, various energy sciences, energy technology, law of conservation of energy, facts and figures about energy, Indian and global energy sources, energy exploited, energy demand, energy planning, introduction to various non-conventional energy sources.

4. **Power plant economics and various load problems:- (6 Hrs)**
   Terms and factors, factors affecting power plant design, effect of power plant type on cost, effect of power plant type rates (tariffs or energy element) , effect of plant type on fixed elements, effect of plant type on customer elements, inventors profit, economics in plant selection, economics of power generation, load curves, ideal and realized load curves, effect of variable load on power plant design, effect of variable load on power plant operation.

SECTION-II

5. **Diesel generation system:- (4 Hrs)**
   General layout of diesel diesel plants, co-generation, need for cogeneration, technical option, factors influencing cogeneration choice, typical cogeneration parameters.

6. **Thermal and Hydro electric plants:- (8 Hrs)**
   Main equipment for the thermal power plant, coal handling and pulverizing, super heaters and re-heaters for boilers, Ash handling, condensers, cooling towers and ponds, preheating of water and air, heat balanced efficiency hydro electric plant, water power, advantages of hydro electric plant, Run off, steam flow, hydro

graph, flow duration curve, types of turbines, economics of small hydro s schemes.

7. Nuclear power plants:- (6 Hrs)

Introduction, general history and trends, the atomic structure, ethical problems in nuclear power generation, chemical and nuclear equation, nuclear fusion and fission, nuclear reactor, cost of nuclear power plants, site selection, nuclear power plant and economics, safety measures for nuclear power plants.

8. Pollution and its control:- (6 Hrs)

Environment pollution due to energy use, Environment pollution due to industrial trial emission, Environment pollution due to road transport, harmful effects emission, steps taken for and their impact, noise pollution and its control, green house gasses and its effect, fossile fuel pollution, pollution due to combustion of solid, liquid and gaseous fuels, radiation from nuclear power plants.

Term-work:-

Six assignments covering the topics mentioned in the above syllabus.

Recommended Books:-

1) Power plant engineering - P K Nag, Tata McGraw Hill Second edition
2) Power plant engineering - A K Raja, A P Shrivastava New age International.
3) Power station engineering and economics - McGraw Hills New York 1960 Skrotzki B G A and Vopat W W
4) Electrical power stations vol: I and II Campion and Hall London 1960 Car T N
5) Modern power station practice vol: I and II England 1971C E G B
6) Environmental aspects of site selection Joumal ASCE power division, June 1972 Dudley E F
7) Guide book for national certification examination for energy managers and energy auditors, Breau of energy efficiency – govt. of India.

Solapur University, Solapur
B.E. (Electrical Engineering) Part-I (Elective –I)
5.1 DESIGN AND ESTIMATION OF ELECTRICAL SYSTEM

Teaching Scheme
Lectures/Week: 3 Hours
Tutorials/Week: 1 Hours

Examination Scheme
Paper: 100 Marks
Term Work: 25 Marks

SECTION-I

1. Introduction:- **(4 HRS)**

Review of basic electrical engineering formula, Types of Electrical Projects, Different electrical systems in industrial/commercial/residential project, Activities of an Electrical Engineer as design/maintenance/ project engineer, Overview of Applicable IS/international standards and codes products and installations

2. Project Management:- **(4 HRS)**

Justifying project investments- Financial feasibility, Project Planning- QAP, WBS, Scheduling Logistics, Project Implementation, Project Management application software-Capabilities, Limitations, selection

3. Estimation & Tendering:- **(4 HRS)**

Project Engineering – different electrical drawings: Single Line Diagrams in detail, General equipment design/selection criteria, Estimation: importance, preparing rough and detailed estimates, Databases required for reasonably accurate estimates, underlying assumptions in estimates and sensitivity analysis,
Tender documents and tendering procedure

4. Power Distribution System:- **(5 HRS)**

Different distribution systems and selection criteria, Temporary and permanent power supply-Electrical load- size, LF, DF, future estimates
Transformers- Types of transformers and transformer sizing, Design consideration and selection criteria, Magnetic Material, Winding, Other Accessories, Power factor improvement, Sub-station equipment options, Future trends

5. Distribution Switchgear- HT/LT:- **(4 HRS)**

Different types and their selection, Switchboards, MCCs, Control Scheme, Mimics, PLCs, Process Controllers, Electronic Instrumentation
Protection-Upstream & Downstream co-ordination and Discrimination: Protection Relays, Metering, Instrument Transformers, Future Trends

SECTION-II

6. Cables:- **(3 HRS)**

Different types and their classification, Types of installations per IS/IEE, Conductor sizing, Insulation selection, Cable Management systems-conduit sizing, trenches,

Trays, Cable installations, cable terminations, cable accessories, Cable and Bus bars, Future Trends

7. Emergency Power Supply:- (4 HRS)

Types of power emergencies- power breakdown, fire, DG Sets- Sizing, Selection Criteria, Batteries-types, sizing, selection criteria,
UPS, Future Trends

8. Motors:- (4 HRS)

Selection criteria, Energy efficient motors, Variable speed drives,
Design consideration and selection criteria for induction motors-
Magnetic Material, Winding, Other Accessories, Future Trends

9. Energy Audit:- (3 HRS)

Why energy audit? Broad outlines of energy audit, Recommendation of energy audit- Financial justification, Implementing recommendations-retrofitting of energy efficient devices, Energy Management Systems- SCADA, BMS (Building Management Systems), Future Trends

10. Special Electrical Installations:- (3 HRS)

Computer Installations, Communications- EPABX, Internet, video conferencing, Fire Protection & Extinguishing, Security Systems,
Elevators, CC/MA TV,PA/Audio

11. Lighting System and Illumination:- (4 HRS)

Different types of light sources and their application, Average lumen method of interior lighting system, Design consideration and recommendation for domestic, commercial and industrial applications (concept only)

Term-work:-

The term work will consist of at least 6 assignments

Recommended Books:-

1. Thumann A., Introduction to Efficient Electrical Systems Design, Fairmont Press, 2nd Ed. 1999.
2. Kushare B. E., Handbook on energy efficient motors, International Copper Promotion Council (India) 1st Ed. 2002.
3. Sawhney A. K. “A course in Design of Electrical Machines” Dhanpat Rai & Sons, New Delhi, 1996.
4. Valia A., Designing with Light- A Lighting Handbook, Lighting Systems, 2002.

Solapur University, Solapur
B.E. (Electrical Engineering) Part-I (Elective-I)
5.2 BIOMEDICAL INSTRUMENTATION

Teaching scheme:
Lecturers: 3Hrs/Weeks
Tutorial: 1Hrs/Weeks.

Examination Scheme:
Theory: 100 Marks.
TW: 25 Marks.

SECTION-I

1. Introduction To Biomedical Instrumentation: (6 Hrs)

Biometrics, Basic medical instrumentation system, Physiological systems of the body, Sources of biomedical signals, constrains in design of biomedical instrumentation systems.

2. Bioelectric signals, Electrodes & Transducers : (5 Hrs)

Origin of Bio-electric signals
Electrodes for ECG, EEG, EMG, Silver- Silver chloride Electrode, Electrical conductivity of Electrode Jellies & Creams, Microelectrodes
Transducer:- classification, characteristics, body pressure & temperature measurement, optical, photoelectric, Biosensors , Smart Sensors

3. Biomedical Recording Systems: (5 Hrs)

Basic Recording Systems, General consideration for Signal conditioners, Pre-amplifiers, Potentiometric recorder, Digital recorder.

4. Biomedical Recorder : (5 Hrs)

Electrocardiograph (ECG), Vector cardiograph (VCG), Phonocardiograph (PCG), Electroencephalograph (EEG), Electromyography (EMG)

SECTION –II

5. Biomedical Telemetry & Telemedicine: (5 Hrs)

Wireless telemetry, Single channel telemetry system, Multi-channel wireless telemetry systems, Multi-patient telemetry, Implantable telemetry systems, Transmission of analog physiological signals over telephone, Telemedicine

6. Biomedical imaging system:- (5 Hrs)

X-Ray machine , CT scanner, Ultrasonic, Thermal Imaging.

7. Patient Monitoring System (5 Hrs)

System Concepts, Cardiac Monitor, Bedside Monitors, Central Monitors, measurement of Heart rate, pulse rate, Blood pressure, temperature, respiration rate, catheterization laboratory instrumentation

8. Patient Safety:- (5 Hrs)

Electric Shock Hazards, Leakage currents, Safety codes for electromedical equipments, electrical safety analyser, testing of biomedical equipments

Term work:

The term work is based on the minimum 8 tutorials, based on the syllabus.

RECOMMENDED BOOKS:

1. Hand book of Biomedical Instrumentation by R S Khandpur (TMH), 2nd edition.
2. Biomedical Instrumentation & measurements by Leaslie Cromwell, 2nd edition (PHI).
3. Biomedical Electronics & Instrumentation by Onkar Pandey , Rakesh Kumar, Catson Pub.
4. Bioelectronic measurement by Dean A Dmane, David Michaels (PHI).
5. Introduction to Biomedical equipment design by Carr & Brown, John Wiley.
6. Biomedical Digital signal processing by Tompkins.

Solapur University, Solapur
B.E. (Electrical Engineering) Part-I (Elective-I)
5.3 MECHATRONICS

Teaching scheme:
Lecturers: 3Hrs/Weeks
Tutorial: 1Hrs/Weeks.

Examination Scheme:
Theory: 100 Marks.
TW: 25 Marks.

SECTION I

1. Introduction: (8 Hrs)
Definition, Trends, Control Systems, Microprocessor/Micro controller based controllers, PC based controllers, proportional/Integral/Differential controllers, PID Controllers, Digital Controllers, and Adaptive Controller.

2. Electromechanical Drives: (5 Hrs)
DC Servo motors, 4-quadrant servo drives, braking methods, bipolar drives, MOSFET Drivers, SCR Drives, variable frequency drives.

3. PLC Controllers: (4 Hrs)
Ladder diagram, FSD structured programming, Interfacing of Sensors and Actuators to PLC.

4. Programmable Motion Controllers: (3 Hrs)
Interpolation: point-to-point, Linear Circular, B-S plane, Home, Record position.

SECTION II

5. Precision Mechanical Actuation: (7 Hrs)
Pneumatic Actuators, Electro-pneumatic Actuators, hydraulic Actuators, Electro hydraulic
Actuators, Types of motions, Kinematics, Inverse Kinematics, Timing Belts, Ball Screw and Nut, Linear motion Guides, Linear Bearings, Harmonic Transmission, motor/Drive selection.

6. MEMS: (4 Hrs)
Overview of MEMS & Microsystems, Typical MEMS & Micro system, products and applications, Micro sensors and micro actuators: Phototransistors, pressure sensors, thermal sensors, micro grippers, micro motors, micro valves, Micro pumps, Micro Manufacturing: Bulk Manufacturing, Surface Manufacturing, LIGA Process.

7. Design of Mechatronic Systems: (6 Hrs)

The design process, traditional and Mechatronic designs. A few case studies like piece counting system pick and place manipulator, simple assembly involving a few parts, part loading. Unloading system, automatic tool and pallet changers etc.

8. Robot & its Peripherals: (5 Hrs)

End Effecters – Types, Mechanical Electromagnetic, Pneumatic Grippers, Tool as End effecter, Robot End effecter interface.

Sensors – Sensors in Robotics, Tactile Sensors, proximity and Range Sensors, Sensor based systems and uses, Robot programming.

Term-Work:

1. Interfacing and control of DC Servo motor with Microcontroller for position, speed and direction control.
2. PLC Programming in ladder, FBD, Structured.
3. Study of graphical PID tuning for X-Y position, Study of Rotary and Conveyor.
4. Pneumatic and Hydraulic actuators.
5. Robot programming.
6. CNC Programming.

Recommened Books:

1. Mechatronics 2nd Edition – W.Bolton Addison Wesley – 981-235-874-9
2. Mechatronics, Integrated Mechanical Electronic Systems- K.P. Ramachandran, G. K. Vijayaraghavan, M.S. Balsundaram (Wiley India Pvt Limited)
3. Mechatronics Principles, Concepts and Applications – N.P. Mahalik -TMH– 0-07-0483744.
4. Mechatronics – Dan Necsulescu -Pearson Education – 81-7808-676-X.
5. Computer Control of Manufacturing systems-Yoram Koren.-McGraw Hill 0-07-066379-3
6. MEMS and Microsystems Design and Manufacture – Tai – Ran Hsu – TMH 0-07-048709
7. Robot Technology (Fundamentals)- James G. Keramas (DELMAR CENGAGE learning)
8. Industrial Robotics: Technology, Programming and Applications –Grover, Weiss, Nagel, Ordey (McGraw Hill)
9. Robotics: Controls, Sensing, Vision and Intelligence – Fu, Gonzalez, Lee (McGraw Hill)
10. Robotics Technology and Flexible Automation – S.R.Deb (TMH)

Solapur University, Solapur
B.E. (Electrical Engineering) Part-I (Elective-I)
5.4 EXTRA HIGH VOLTAGE AC TRANSMISSION

Teaching Scheme:
Lectures: 3 Hour/ week
Tutorials/ week: 1Hrs

Examination Scheme:
Papers: 100 Marks
TW: 25 Marks

SECTION-I

1. Introduction and calculation of line and ground parameters:- (6 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 propogation resistance and inductance of ground return.

2. Voltage gradient of conductors and I2R and corona loss:- (5 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, I2R and corona loss, corona loss formula, charge voltage diagram with corona, attenuation of travelling waves due to corona loss, audiable noise, corona pulses, their generation and properties, limits for radio interference fields.

3. Theory of travelling waves and standing waves:- (5 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.

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.

SECTION-II

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:- (5 Hrs)

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

7. Insulation co-ordination:- (5 Hrs)

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

8. **Design of EHV-AC lines:- (5 Hrs)**
Introduction, design factors under steady state, design examples, steady state limits, line insulation design based upon transient over voltages.

Term-work

Six tutorials covering the topics mentioned in the above syllabus

Recommended Books:

1) “High voltage engineering” Tata McGraw Hill publishing company-1982 Naidu M S and Kamraju 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) “Electrical coronas” U of Calif press, 1965 Loeb L B.

6) “Current interruption in high voltage networks”, plenum press-1977. Ragaller K.

7) Transient performance of electric power system. McGraw Hill book co.-1950 Rudenberg R.

Solapur University, Solapur
B.E. (Electrical Engineering) Part-I (Elective-I)
5.5 HIGH VOLTAGE ENGINEERING

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

Examination Scheme:
Paper: 100 Marks
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, Townends growth equation, primary and secondary process, Townsends 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, break-downs 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 divertors, 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

Six tutorials covering the topics mentioned in the above syllabus

Term-work:-

Six assignments covering the topics mentioned in the above syllabus.

Recommended Books:-

1. High Voltage Engineering by M S Naidu, V Kamraju Tata McGraw Hill publications co. New Delhi
2. High voltage insulation engineering by Ravindra Arora, 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,
5. High Voltage Engineering Pergamon 1984 Kuffel E,
6. High Voltage Engineering fundamentals by E Kuffel, W S Zaengi, J Kuffel Newness publications
7. High Voltage Engineering by Prof. D V Razevig, Translated from Russian by Dr. M P Chourasia Khanna publishers, New Delhis

Solapur University, Solapur
B.E. (Electrical Engineering) Part-I
6: INDUSTRIAL TRAINING

Examination Scheme:
T.W.: 25 Marks

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

7: PROJECT SEMINAR - I

Teaching Scheme:
Practical : 4 Hours /Week

Examination Scheme:
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
B.E. (Electrical Engineering) Part-II
1: FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEM

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

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks
OE: 50 Marks

SECTION-I

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

2. Static Shunt Compensator (SVC AND STATCOM):- (14 Hours)
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 Hours)
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 Hours)**
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 Hours)
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 :- (8 Hours)
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
IPFC - Basic operating principles and characteristics, Control structure and applications
Generalized and Multifunctional FACTS Controller

7. **Harmonics:-** **(6 Hours)**
   Harmonics generated by FACTS and their mitigation, Different power quality problems that could be solved using flexible sub – systems

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, Jhon wiley & sons Newyork

Solapur University, Solapur
B.E. (Electrical Engineering) Part-II
2: SWITCHGEAR PROTECTION

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

Examination Scheme:
Paper: 100 Marks
TW: 25 Marks
OE: 50 Marks

SECTION-I

1. **Principles of circuit breaking:- (8 Hours)**
   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, acquaintance of ISI standards

2. **Low Tension Switchgear:- (6 Hours)**
   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, contact bounches

3. **Medium and high tension Switchgear:- (7 Hours)**
   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 Hours)**
   Types of Isolators, Voltage Capacity (manual and auto), Operations and Faults, Advantages, Purpose of earth Blades

SECTION-II

5. **Protective relaying:- (7 Hours)**
   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 Hours)**
   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 Hours)

Microprocessor based protective schemes (Block diagram and flow chart), Introduction to DSP based protection (only simple schemes, advantages etc), Static Relays (Block Diagram for Overcurrent, instantaneous, inverse, very inverse, IDMT relays), Electromagnetic, over current and directional relays

8. Over voltage Protection:- (4 Hours)

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 at least six practical and three assignments on the entire syllabus

Recommended Books:

1. Power system protection and switchgear, TMH publication, 1st Ed 1994 - Badri Ram and Vishwakarma D N
2. Switchgear and protection by J B Gupta, SK Kataria and Sons
3. Switchgear and protection, Wiley Eastern Ltd 1 Ed 1977 - Ravindranath and hander
4. Fundamentals of Power system Protection, PHI publication,EEE 2003 - Paithankar Y G and Bhide S R,
5. Switchgear and protection, Khanna publication, 4th Ed, 1997 - Rao sunil S,
6. Static Relays, TMH publication, 2nd Ed, 1994 - Rao Madhav,
7. GEC Relay Guide
8. “Computer Relaying for Power systems”, John Wiley & Sons Ed, 1990 - Phadke A G and Thorp J S

List of Experiments:

1. Simulation of merz-price protection of alternator/Generator
2. Simulation of distance protection of transmission line
   Simulation model for merz-price protection of 3-ph transformer with % differential relay
3. Simulation of distance protection of transmission line feeder protection
4. Phase angle & % ratio error measurement in current transformer
5. Phase angle & % ratio error measurement in potential transformer
6. Fault Simulation model for IM with induction motor
7. Study setup of air circuit breaker with earth leakage and over current protection
8. Simulation of Solid state universal relay kit including relay configuration for under voltage relay, over voltage relay, impedance relay, over current with instantaneous time characteristics, inverse time characteristics, very inverse time characteristics, definite time characteristics, IDMT characteristic

Solapur University, Solapur
B.E. (Electrical Engineering) Part-II
3: DIGITAL SIGNAL PROCESSING

Teaching Scheme:
Lectures: 4 hrs/week
Practical: 2 hrs/week

Examination Scheme:
Paper: 100 marks
Term work: 25 marks

SECTION – I

1. Introduction:- **(3 Hrs)**

DSP System concept, DT signals, co-relation of DT signals.

2. The Discrete Fourier transform and Fast Fourier Transform:- **(12 Hrs)**

DFT, Relation between DFT and Z Transform, Properties of DFT, Circular convolution, Fast convolution techniques (Overlap add and overlap save), Frequency analysis of signals using DFT, FFT Algorithms (DIT FFT and DIF FFT)

3. Realization of Digital Linear systems:- **(9 Hrs)**

Structures for realization of Discrete time systems, Structures for FIR Filters: Direct form, Cascade form & Lattice Structure. Structures for IIR filters: Direct form, Signal flow graph & transposed structure, cascade form and parallel form.

SECTION - II

4. IIR filters design:- **(7 Hrs)**

Impulse Invariant technique, Bilinear transformation, Frequency transformations, Analog filter approximation (Butterworth), Finite world length effects in IIR filters, Implementation of IIR filters.

5. FIR Filter design:- **(7 Hours)**

Characteristics of FIR Filters, Properties of FIR Filters, windowing method and frequency sampling method of filter design, finite word length effects in FIR filters, FIR Implementation techniques.

6. Introduction to programmable Digital Signal Processors:- **(6 Hrs)**

Basic Architectural features, multiply and accumulate (MAC) unit, Bus Architectures, VLIW Architecture, Special addressing modes, fixed point and Floating point Digital signal processors overview of TMS320C54XX DSP Architecture

7. Applications of DSP:- **(4 Hrs)**

Applications of DSP in power systems: measurement of electrical quantities, Power system Protection, state estimation etc., Applications of DSP for data compression, array processing and in Control System.

Term work: TW should consist of minimum 8 experiments based on above syllabus.

Reference Books:

1. Digital Signal Processing – Principles, Algorithms and Applications by John G Proakies Pearson Education
2. Digital Signal Processing – A Practical Approach by Ifeachor E.C. & Jervis B. W. -Pearson Education
3. Digital Signal Processing by S Salivahanan, A Vallavaraj & C Gnanapriya –TMH
4. Digital Signal Processing by Ramesh Babu -4th Edition Scientic Publication
5. Digital Signal Processors- Architecture, Programming and Applications by B Venkataramani & M. Bhaskar-TMH
6. Scientist and Engineers Guide on Digital Signal Processing
7. Discrete time signal Processing by A.V. Oppenheim & R.W. Schalfer.- John Wiley
8. Digital Signal Processing – A System Design approach by D.J. Defata- John Wiley
9. Digital Signal Processing Fundamentals Applications by Li Tan- Academic Press
10. Digital Signal Processing by M.H.Hyes.-(Schaums Outline) TMH
11. Fundamental of DSP using Matlab by Schilling-Cengage learning

Solapur University, Solapur
B.E. (Electrical Engineering) Part-II (Elective II)
4.1: Neural Network and Fuzzy Logic

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

Examination Scheme:
Paper: 100 Marks
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. Introduction:- **(5 Hrs)**
Fuzzy sets & membership, classical sets & fuzzy sets

5. Fuzzy System:- **(8 Hrs)**
Fuzzy relations, Fuzzification, & defuzzification, fuzzy logic & fuzzy system, fuzzy automata development of membership function

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

7. Fuzzy Control System:- **(5 Hrs)**
Simple fuzzy controls, fuzzy in process control, fuzzy statistical process control

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 Engineering) Part-II (Elective-II)
4.2: EMBEDDED & REAL TIME SYSTEMS

Teaching scheme:
Lecturers: 4 Hrs/weeks
Tutorial: 1 Hrs/weeks

Examination Scheme:
Theory: 100 Marks
TW: 25 Marks

.

SECTION-I

1. **Microcontrollers:-** Review **(3 Hrs)**

2. **8051 programming with C:- (5Hrs)**
   Data type & time delay, I/O programming, Logic operations, Programming Timer 0 & 1, Serial port, Interrupt programming, Accessing external data memory, programming for 8255.

3. **RISC processor for embedded system :- (8Hrs)**
   Introduction to ARM Controller, architecture, memory organization, pipeline & cache concepts, ARM (32 bit) & THUMB (16bit) operating modes, Introduction to instruction set & assembly language programming', ARM instruction set & THUMB instruction set, switching between ARM & THUMB instructions.

4. **Designing of embedded hardware & interfacing:- (8 Hrs)**
   Design-
   IrDA - Introduction to IrDA.
   USB - Introduction to USB, USB packets, physical interface, implementing a USB interface.
   Serial Ports - UART, Error detection, old Faithful- RS 232C, RS- 422, RS- 485
   I^2C - Overview of I^2C, adding a real time clock with I^2C, adding a small display with I^2C
   Interfacing - DS12887 RTC interfacing & programming.
   DS12887 RTC interfacing
   DS12887 RTC programming in C
   Alarm, SQW, & IRQ features of the DS12887 chip.

SECTION-II

5. **Introduction to real time concepts:- (6 Hrs)**
   Basic computer architecture & terminology, real time design issues, examples of real time system.

6. **Real time specifications & design techniques:- (6 Hrs)**
   Natural languages, mathematical specifications, flowcharts, structure charts, pseudo code & programming design languages, finite state automata, data flow diagrams, Petri Nets, Warnier- Orr Notation, State charts, Sanity in using Graphical techniques

7. **Hardware & Software integration:- (6 Hrs)**

Goals of real time system integration, tools, methodology, the software Heisenberg Uncertainty principle.

8. **Real time applications: (6 Hrs)**
   Real time systems as complex systems, the first real time application, real time data bases, real time image processing, real time UNIX, Building real time applications.

Term work: The term work is based on the minimum 8 tutorials, based on the syllabus.

Recommended Books:

1. A Embedded System Software by David E Simon, Pearson Education
2. Embedded Sysem Design- A Unified Hardware/Software Introdunction by Frank Vahid, Tony Givargis, Wiley Student Edition
3. Real time system design & analysis by Phillip A . Laplante, Wiley Student Editions
4. Embedded Systems-Architecture, Programming and Design by Raj Kamal, Tata Mcgraw Hill
5. Embedded C Programming and Microchip PIC by Barnett, O'cull, Cox, Cengage Learning
6. Embedded Microcontrollers by Todd D Morton, Pearson Eduction
7. 8051 Microcontroller & Embedded Systems by Mazidi M A, Pearson Education Asia LPE (2nd Edition)
8. 8051 Microcontroller by Kenneth Ayala, Penram International
9. Embedded hardware by John Catsoulis, O'REILLY Pub, 2nd Edition.
10. 8051 Microcontroller Databook
11. 8051 Microcontroller by Mazidi M A, Pearson Education Asia LPE (2nd Edition).
12. ARM Processor Databook
13. Atmel Micrcontroller Databook (AT89)
14. Phillip Microcontroller Databook
15. ARM architecture reference manual edited by David Seal

Solapur University, Solapur
B.E. (Electrical Engineering) Part-II (Elective II)
4.3: POWER SYSTEM DYNAMICS AND STABILITY

Teaching Scheme:
Lectures: 4 Hour/ week
Tutorial: 1 Hrs/weeks

Examination Scheme:
Papers: 100 Marks
TW: 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 of Synchronous Machine:- (8 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

3. Dynamics of Synchronous Generator Connected to Infinite Bus:- (8 Hrs)
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.

Solapur University, Solapur
B.E. (Electrical Engineering) Part-II (Elective II)
4.4: HIGH VOLTAGE DC TRANSMISSION

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

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

SECTION-I

1. **HVDC system Components and Configuration:- (7 HRS)**
   Constitution of EHVAC and DC Link, Classification of HVDC links, HVDC projects in India, Limitation and Advantage of HVDC over EHVAC transmission, Components of HVAC Transmission Systems, Planning for HVDC Transmission, Modern Trends in DC Transmission

2. **Converter Theory and Performance Equation:- (9 HRS)**
   Valve Characteristics, Converter Circuit, Converter Transformer Rating, multiple Bridge Converter, Detailed Analysis of converters

3. **Control of HVDC Systems:- (8 HRS)**
   Basic principle of control, control implementation, Converter firing control system, Valve blocking and bypassing, Starting and stopping, power flow reversal, Controls for enhancements of AC system performance, Higher Level Controllers, Telecommunication rquirements

SECTION-II

4. **Converter Faults and protection:- (6 HRS)**
   Converter Faults, Protection Against Over currents, Over Voltage in converter Stations, Protection Against over voltages

5. **Harmonics and Filters:- (6 HRS)**
   AC side and DC side Harmonics, Design of Filters

6. **Reactive Power Control:- (6 HRS)**
   Introduction, Reactive power requirements in Steady state, sources of reactive Power, Static VAR system, Reactive Power control during Transients

7. **Multiterminal DC System:- (6 HRS)**
   Introduction, Potential application of MTDC Systems, Types of MTDC Systems, Control and Protection of MTDC Systems, Study of MTDC Systems

Term work:-

Term work shall consist of at least six experiments / assignments carrying weightage of 15 Marks and a test covering the entire syllabus carrying weightage of 10 Marks

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

Solapur University, Solapur
B.E. (Electrical Engineering) Part-II (Elective II)
4.5: 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:- (9 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:- (9 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, Multimachine stability, Factors affecting transient stability

5 Power Quality:- (5 Hrs)

Introduction, Harmonics in power supply, Defining quality of power

Term work:-

The term work shall consist of minimum of four computer programs covering the syllabus carrying weightage of 15 marks and a test covering the entire syllabus carrying weightage of 10 marks

Recommended Books:-

1 Modern Power Systems Analysis, TMH publication, sec. Ed. 1989 - Nagrath I. J. & KOthari D. P.,
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 Shubha Pandit,.
6 Power System Analysis and Design, Thomson Asia Pvt. Ltd. 2003 - Glower D. J. and Sharma M. S.

Solapur University, Solapur
B.E. (Electrical Engineering) Part-II
5: PROJECT SEMINAR - II

Teaching Scheme:
Practical : 8 Hours /Week

Examination Scheme:
T.W.: 50 Marks
OE.: 100 Marks

A project group should complete the project and working model of Hardware/ Software (as applicable) should be submitted 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.