SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

TEACHING AND EXAMINATION SCHEME

Final Year Electrical Engineering

(For Academic Year 2014-15)

Part-I							
Sr. No	Name of Subject	Teaching Scheme (Hours/ Week)	Examination Scheme (Marks)				
			Paper	Test	TW	POE	Total
1	Indsutrial drives and control	4	80	20	-	-	100
2	Micro controller and Application	4	80	20	-	-	100
3	Restructuring and Deregulation	4	80	20	-	-	100
4	Power quality	4	80	20	-	-	100
5	Elective-I	4	80	20	-	-	100
6	Indsutrial drives and control lab	2	-	-	25	50	75
7	Micro controller and Application lab	2	-	-	25	25	50
8	Power Quality lab	2	-	-	25	-	25
9	Elective-I lab	2	-	-	25	-	25
10	Industrial training	-	-	-	25	-	25
11	Project Seminar-I	4	-	-	50	-	50
	Total Part-I	**32**	**400**	**100**	**175**	**75**	**750**
Part-II							
12	Switchgear Protection	4	80	20	-	-	100
13	FACTS	4	80	20	-	-	100
14	Digital Signal Processing	4	80	20	-	-	100
15	Elective-II	4	80	20	-	-	100
16	Switchgear Protection Lab	2	-	-	25	50	75
17	FACTS lab	2	-	-	25	50	75
18	Digital Signal Processing lab	2	-	-	25	-	25
19	Elective-II lab	2	-	-	25	-	25
20	Project Seminar-II	8	-	-	50	100	150
	Total Part-II	**32**	**320**	**80**	**150**	**200**	**750**

NOTE: Minimum two tests should be conducted for each theory subject and average of best two tests should be considered.

Elective Part-I

a) High Voltage Engineering
b) EHVAC Transmission
c) Mechatronics
d) Design & Estimation of Electrical System

Elective Part-II

a) HVDC Transmission
b) Power system Dynamics & Stability
c) Computer Aided Power system Design
d) Neural Network & Fuzzy Logic
e) Embedded & Real time systems

01. INDSUTRIAL DRIVES AND CONTROL

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: Introduction and dynamics of Electrical drives [8 hrs]

Block diagram of electrical drives, Advantage of Electrical drives, Parts of Electrical drives. Selection of motor rating and converter rating. Dynamics of motor – load combination, Determination of moment of inertia, Steady state stability of an Electric drives, Transient stability of Electric drives.

Unit 2: Characteristics of Motors [4 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

Unit 3: D.C. Motor Drives [8 hrs]

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 multi-quadrant operation chopper controlled dc series drives. Performance and stability of variable speed dc drives. Regenerative breaking of D.C. series motor

Unit 4: 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 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.

Slip Ring Induction Motor Drives: Slip power recovery using cascade converter, in rotor circuit. Kramer speed control and scheribus drive. Chopper controlled resistance rotor circuit.

Unit 5: Synchronous motor and Brushless D.C. Motor Drives [6 hrs]

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

Unit 6: Special Drives [4 hrs]

Stepper motor drives, switched reluctance motor drives, Torque equation, converter circuit for motor, operation of solar and battery operated drives.

REFERENCE 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

02. MICRO CONTROLLER AND APPLICATION

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: 8051 Architecture [08 hrs]

8051 internal resources, pin diagram, I/O pins, ports and their internal logic circuits, counters, serial port, interrupt structure, SFRs and their addresses, watch dog timer, internal code memory, data memory, stack pointer, flags, bit addressable memory. Comparative study of 8051 families by diff manufacturers (ATMEL, DALLAS, PHILIPS, INFINION, SST).

Unit 2: Assembly Language Programming [05 hrs]

Study of Instruction set of 8051- data move, logical, arithmetic, jump and call instructions, Interrupt handling, timer programming, serial port communication, use of assembler and C-8051 cross compiler, simulator.

Unit 3: Microcontroller based system design [10 hrs]

External memory and space decoding, reset and clock circuits, expanding I/O, memory mapped I/O, memory addresses decoding, system testing and troubleshooting.

Unit 4: Real World Interfacing I [06 hrs]

Interfacing various parallel devices to 8051 like 8255 PPI, Timer counter 8253, character LCD, 12 bit ADC such as AD574, DAC interfacing such as DAC0808, Single Key and matrix keyboards (4X4), seven segment LED modules

Unit 5: Real World Interfacing II [10 hrs]

Interfacing of various serial peripherals- 8051 data communication in 8 bit UART mode, multiprocessor mode, study of SPI, I2C communication protocols.

Unit 6: Microcontroller Applications (Block Schematic and flowchart) [04 hrs]

Microcontroller based automatic power factor control relay, solid state energy meter using ASIC, weighing balance, serial E2PROM interfacing, temperature indicator and controller, real time clock using DS1307.

TEXT BOOKS:

1The 8051 Microcontroller Architecture, Programming and Applications, Kenneth Ayala, 2nd Edition, Penram International.
2. The 8051 Microcontroller and embedded systems, Muhammad Ali Mazidi, Pearson

03. RESTRUCTURING AND DEREGULATION

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: Power Sector in India [6 hrs]

Evolution of integrated, monopoly, state electricity boards (SEBs). Introduction to various institutions in Indian Power Sector such as CEA, Planning commission, PFC, Ministry of Power, State and Central Governments, REC, financial institutions, Utilities & their roles. Challenges before Indian Power Sector.

Electricity Act 2003 and various national policies and guidelines under the Act.

Unit 2: Power Sector Economics [7 hrs]

Introduction to various concepts such as capital cost, Debt and Equity, depreciation, fixed and variable costs, working capital, profitability indices, Net Present Value, life cycle cost etc. Typical cost components of utilities such as Return in Equity, Depreciation, Interest and Finance Charges, O & M Expenses etc and their determinants. Introduction to Average, Marginal and Avoided costs. Tariff Setting principles and choice of the rate structure. Concepts of Subsidy and cross-subsidy.

Unit 3: Power Sector Regulation [7 hrs]

Role of regulation and evolution of regulatory commissions in India, Types and methods of regulation (Rate of Return Regulation, Performance Based Regulation, Incentive Regulation, Benchmarking or Yardstick regulation) The regulatory process in India (Composition of RCs, Selection, Authority, Regulatory decision making process) Non Price issues in Regulation such as Externalities (environment etc.), service quality, consumer service, social equity Transparency and public participation in regulatory process.

Unit 4: Introduction to Power Sector Restructuring and Market Reform [8 hrs]

Introduction, Models based on energy trading or structural models— Monopoly, Single buyer, wholesale competition, Retail competition etc. Ring Fencing or Accounting separations, Models based on contractual arrangements — Pool model, bilateral dispatch, Pool and bilateral trades, Multilateral trades. Ownership models (Public Sector — State owned and municipal utilities, Co-operatives, Private Sector, Public-Private Partnership) Rationale behind reforms, competition for the market vs. competition in the market, International experience with electricity reform — Latin America, The Nordic Pool, UK, USA, China and India (Orissa, AP and Maharashtra). The California Energy Crisis.

Unit 5: Competitive Electricity Markets [7 hrs]

Trading – electricity marketplaces, rules that govern the electricity markets, peculiarity of electricity as a commodity, various models of trading arrangements – integrated trading model, wheeling trading model, decentralized trading model. Retail Competition– retail access framework, competing retailers, metering and accounting issues, technological aspects of competition. Impact of market reform on Regulation and externalities (environment, social equity etc.)

Unit 6: Transmission Planning and Pricing [5 hrs]

Transmission planning in the era of market structure, transmission rights and pricing, different methods of transmission pricing, different transmission services (ancillary services etc.) congestion issues and management, grid codes, transmission ownership and control - Transco and ISO, transmission pricing and model in India – availability based tariff (ABT), role of load dispatch centers (LDCs), open access.

TEXT BOOKS:

1. "Deregulation in Power Industry", Proceedings of a course under Continuing Education Programme held by Department of Electrical Engineering, Indian Institute of Technology, Bombay.

2. "Know Your Power", A citizens Primer On the Electricity Sector, Prayas Energy Group, Pune

REFERENCE BOOKS:

1. Bhanu Bhushan, "ABC of ABT - A primer on Availability Tariff"
2. Central Electricity Regulatory Commission, Regulations and Orders - www.cercind.org
3. Electric Utility Planning and Regulation, Edward Kahn, American Council for Energy Efficient Economy
4. Electricity Act 2003 and National Policies – www.powermin.nic.in
5. Maharashtra Electricity Regulatory Commission Regulations and Orders - www.mercindia.com
6. Paper "The real challenges in Power sector Restructuring: Instilling Public Control Through TAP", Prayas Energy Group, Energy for Sustainable Development, September 2001, www.prayaspune.org
7. Privatization or Democratization The Key to the Crises in the Electricity Sector - The Case of Maharashtra 2002, www.prayaspune.org
8. Regulation in infrastructure Services: Progress and the way forward - TERI, 2001
9. Sally Hunt, "Making Competition Work in Electricity", 2002, John Wiley Inc
10. Various publications, reports and presentations by Prayas, Energy Group, Pune www.prayaspune.org

04. POWER QUALITY

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: Introduction [7 hrs]

Importance of power quality, terms and definitions of power quality as per IEEE Std. 1159, such as transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations. Symptoms of poor power quality. Definitions and terminology of grounding. Purpose of grounding. Good grounding practices and problems due to poor grounding.

Unit 2: Voltage Variation [6hrs]

RMS voltage variations in power system and voltage regulation, per unit system, complex power. Subdivision of voltage variations in power system. Long duration and short duration voltage variations, over voltage, under voltage, voltage sags, swells, imbalance, transient and flicker. Principle of regulating the voltage. Various devices used for voltage regulation and impact of reactive power management. Various causes of voltage flicker and their effects. Short term (Pst) and long term (Plt) flicker. Various means to reduce flicker.

Unit 3: Voltage Sag and Interruptions [7 hrs]

Definitions of voltage sag and interruptions. Voltage sags vs interruptions. Economic impact of voltage sag. Major causes and consequences of voltage sags. Voltage sag characteristics i.e. magnitude, duration, phase angle jump, point on wave initiation and point on wave recovery, missing voltage. Voltage sag assessment. Influence of fault location and fault level on voltage sag. Assessment of equipment sensitivity to voltage sags. Voltage sag requirements for computer equipment, CBEMA, ITIC, SEMI F 47 curves. Representation of the results of voltage sag analysis. Voltage sag indices. Mitigation measures for voltage sags, such as UPS, DVR, SMES, CVT etc. utility solutions and end user solutions.

Unit 4: Waveform Distortion [9 hrs]

Definition of harmonics, inter-harmonics, sub harmonics. Causes and effect of harmonics on all equipments. Voltage vs current distortion. Overview of Fourier analysis. Harmonic indices. A.C. quantities under non-sinusoidal conditions. Tripplen harmonics, characteristics and non characteristics harmonics. Harmonics series and parallel resonances. Consequences of harmonic resonance. K-rated transformer. Principles for controlling harmonics. Reducing harmonic currents in loads, Study of different types of tuned and de-tuned filters, Active filter topologies. Harmonic study procedure. Computer tools for harmonic analysis. Locating sources of harmonics. Harmonic filtering, passive and active filters. Modifying the system frequency response. IEEE 519-1992 harmonic standard.

Unit 5: Transient Over Voltages [6 hrs]

What are transients, their sources and effects? Impulsive transients due to lightning. Transient velocity, surge impedance and the effect of line terminations. Capacitor switching transients. Magnification of capacitor switching transient. Basic principles of over voltage protection. Various devices used for over voltage protection. Load switching related transient problems. Computer tools for transient analysis. Study of transient voltage surge suppressor and types based on their application for Electrical Distribution systems of sensitive Electronic Equipments, communication systems and LAN systems.

Unit 6: Power Quality Monitoring [5 hrs]

Need of power quality monitoring and approaches followed in power quality monitoring (Reactive and proactive approach). Power quality monitoring objectives and requirements. Initial site survey. Selection of monitoring equipments and use of various equipments required for power quality monitoring. Study of connection of power quality monitor, selection of monitoring location and period. Requirement of power

quality monitor to monitor various power quality parameters. System wide and discrete power quality monitoring. Setting thresholds on monitors, various techniques of data collection and analysis.

TEXT BOOKS:

1. J. Arrillaga, M. R. Watson, S. Chan, "Power System Quality Assessment", John Wiley and Sons

2. M. H. J. Bollen, "Understanding Power Quality Problems, Voltage Sag and Interruptions", New York: IEEE Press, 2000, Series on Power Engineering

3. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication

REFERENCE BOOKS:

1. Enriques Acha, Manuel Madrigal, "Power System Harmonics: Computer Modeling & Analysis", John Wiley and Sons Ltd.

2. Ewald F. Fuchs, Mohammad A. S. Masoum, "Power Quality in Power Systems and Electrical Machines"

3. G. J. Heydt, "Electric Power Quality", Stars in a Circule Publications 4. IEEE Std. 519-1992, IEEE recommended practices and requirements for harmonics control in electrical power system

05. ELECTIVE-I (a) HIGH VOLTAGE ENGINEERING

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: Electrostatic fields [4 hrs]

Electrostatic stresses, Gas/vacuum as insulators, liquid breakdown, solid breakdown, estimation and control of electric stresses, surge voltages, their distribution and control

Unit 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

Unit 3: Conduction and break-down in liquid and solid dielectric [10 hrs]

Liquids as insulators, conduction and break-down in pure liquids, conduction and breakdown in commercial liquids.

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

Unit 4: Generation and measurements of high voltages and currents [10 hrs]

Generation of HVDC/HVAC and impulse voltages, generation of impulse currents, tripping and control of impulse generators.

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

Unit 5: 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

Unit 6: 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

REFERENCE 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

05. ELECTIVE-I (b) EHVAC TRANSMISSION

Teaching Scheme: Examination Scheme:

Lectures: 2 Hours /Week Paper: 40 Marks

Class Test: 10 Marks

Unit 1: Introduction and calculation of line and ground parameters [5 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.

Unit 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, I2R 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, limits for radio interference fields.

Unit 3: Lighting and lighting protections [8 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.

Unit 4: Over voltage in EHV system covered by switching operations [5 hrs]

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

Unit 5: Power frequency voltage control and over voltages [7 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.

Unit 6: Insulation co-ordination and Design of EHV-AC lines [8 hrs]

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

Introduction, design factors under steady state, design examples, steady state limits, line insulation design based upon transient over voltages.

REFERENCE 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. “Electrical coronas” U of Calif press, 1965 Loeb L B.
5. “Current interruption in high voltage networks”, plenum press-1977. Ragaller K.
6. Transient performance of electric power system. McGraw Hill book co.-1950 Rudenberg R.

05. ELECTIVE-I (c) MECHATRONICS

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Theory Exam: 80 Marks
Class Test: 20 Marks

Unit 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.

Unit 2: Electromechanical Drives [5 hrs]

DC Servo motors, 4-quadrant servo drives, braking methods, bipolar drives, MOSFET Drivers, SCR Drives, variable frequency drives.

Unit 3: PLC and Programmable Motion Controllers [7 hrs]

Ladder diagram, FSD structured programming, Interfacing of Sensors and Actuators to PLC.
Interpolation: point-to-point, Linear Circular, B-S plane, Home, Record position.

Unit 4: 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.

Unit 5: Design of Mechatronics Systems [6 hrs]

The design process, traditional and Mechatronics 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.

Unit 6: Robot & its Peripherals [7 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.

REFERENCE 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. Robot Technology (Fundamentals)- James G. Keramas (DELMAR CENGAGE learning)

7. Industrial Robotics: Technology, Programming and Applications –Grover, Weiss, Nagel, Ordey (McGraw Hill)

8. Robotics: Controls, Sensing, Vision and Intelligence – Fu, Gonzalez, Lee (McGraw Hill)

9. Robotics Technology and Flexible Automation – S.R.Deb (TMH)

05. ELECTIVE-I (d) DESIGN & ESTIMATION OF ELECTRICAL SYSTEM

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: Introduction [6 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.

Unit 2: Project Management [6 hrs]

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

Unit 3: Estimation & Tendering [8 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

Unit 4: Special Electrical Installations [7 hrs]

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

Unit 5: Lighting System and Illumination [7 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).

Unit 6: Emergency Power Supply [6 hrs]

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

REFERENCE 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.

06. INDSUTRIAL DRIVES AND CONTROL LAB

Teaching Scheme	Examination Scheme
Practicals: 2 Hrs/week	TermWork: 25 Marks
	Practical: 25 Marks

Term-work shall consist of 8 experiments from list mentioned below.

LIST OF EXPERIMENTS:-

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.

07. MICRO CONTROLLER AND APPLICATION LAB

Teaching Scheme	Examination Scheme
Practicals: 2 Hrs/week	TermWork: 25 Marks
	Practical: 25 Marks

Term-work shall consist of 10 experiments from list mentioned below.

LIST OF EXPERIMENTS:-

1to 5. Programming of 8051 based on Instruction set.

6. Study of Interrupts of 8051 (Using Proteus)

7. Study of Interrupts of 8051 (Using hardware)

8. Study of Timer of 8051 (Using Proteus)

9. Study of Timer of 8051 (Using hardware)

10. Study of I/O operations (Using Proteus) of 8051

11. Study of I/O operations (Using a hardware) of 8051

12. Study of ADC Interfacing and Programming with 8051

13. Study of DAC Interfacing and Programming with 8051

14. Interfacing with LED display (single / 7 segment) / relay etc.

15&16. Applications of 8051

08. POWER QUALITY LAB.

Teaching Scheme | Examination Scheme

Practicals: 2 Hrs/week | TermWork: 25 Marks

TERM WORK:

Term work consists of 6 assignments (one from each Unit) & at list two experiments from the following

LIST OF EXPERIMENTS:

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

This simulation is to be carried out using software like PSCAD, ETAP, Simulink,

PowerWorld and SimPower etc.

09. ELECTIVE-I (a) HIGH VOLTAGE ENGINEERING LAB

Teaching Scheme | Examination Scheme

Practicals: 2 Hrs/week | TermWork: 25 Marks

Term-work

Term-work shall consist of six assignments covering the topics mentioned in the above syllabus.

09. ELECTIVE-I (b) EHVAC TRANSMISSION LAB

Teaching Scheme | Examination Scheme

Practicals: 2 Hrs/week | TermWork: 25 Marks

Term-work

Term-work shall consist of six tutorials covering the topics mentioned in the above syllabus

09. ELECTIVE-I (c) MECHATRONICS LAB

Teaching Scheme | Examination Scheme

Practicals: 2 Hrs/week | TermWork: 25 Marks

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.

09. ELECTIVE-I (d) DESIGN & ESTIMATION OF ELECTRICAL SYSTEM LAB

Teaching Scheme | Examination Scheme

Practicals: 2 Hrs/week | TermWork: 25 Marks

Term-work

The term work will consist of at least 6 assignments

10. INDUSTRIAL TRAINING

Examination Scheme

TermWork: 25 Marks

TERM-WORK

It consists of report on the industrial training and seminar giving details of the training.

11. PROJECT SEMINAR-I

Teaching Scheme | Examination Scheme

Practicals: 4 Hrs/week | TermWork: 50 Marks

1) Project group should consist of students not more than 4 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.

12. SWITCHGEAR AND PROTECTION

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: Switch-Gear [4 hrs]

Different types, study of L.T. fuse gear, Fuses & H.R.C. fuses, their characteristics and applications, A.C. medium and low voltage, Indoor & Outdoor switch-gear.

Unit 2: Circuit – Breakers [10 hrs]

Different theories of arc formation, AC and DC interruption and arc control devices. Transient recovery voltages, restriking voltage. Factors affecting TRV, Rate of Rise of TRV (RRRV). Resistance switching, damping of TRV, opening resistor, current chopping, switching OFF capacitor banks. Specifying the TRV waveforms. Rated characteristics of circuit breakers. Making and breaking capacities. Characteristics and working principle, applications and comparison of different types of circuit breakers. Air-break, Bulk oil, M.O.C.B., Air Blast, SF6 and vacuum circuit breakers. H.V.D.C. circuit breakers. Tests, study of relevant ISI specifications.

Unit 3: Protection Philosophy [10 hrs]

Introduction to protective faults, causes and effects. Importance of protective relaying, protective zones. Primary and Back-up protection. Desirable qualities of protective relaying. Selectivity, discrimination, speed, sensitivity, reliability, stability etc. Definitions of terms used in relaying. C.T. and P.T. for protection system.

Types of relays, principle of operation, working characteristics of balanced beam, induction type, thermal, distance or impedance (different type), Buccholz relay, negative phase sequence, harmonic restraint relays. Induction relays, setting, principles of over current, graded time-lag, directional, biased differential, reverse power, earth fault distance carrier current protection.

Unit 4: Static Relays [3 hrs]

Advantages and limitations, solid state devices employed in static relaying comparator, Time delay circuits, level detectors, characteristics and applications.

Unit 5: Apparatus Protection [10 hrs]

Transmission System Protection:-Using distance relays Introduction to distance relaying, zones of protection, setting and coordination of distance relays, pilot protection with distance relays, and realization of distance relays using numerical relaying algorithms.

Transformer protection:- Percentage differential protection, magnetic inrush current phenomenon, percentage differential relay with harmonic restraint, restricted earth fault protection, incipient faults, Buchholz relay, protection against over fluxing.

Protection of Transformer and Generator: - Stator phase and ground fault protection, protection against unbalanced loading, loss of excitation, loss of prime mover and over speeding.

Bus bar protection: –Different bus bar arrangements, differential protection of bus bar, high impedance differential relay.

Unit 6: Basics of Numerical relaying [5 hrs]

Numerical relaying fundamentals, sampling, sampling theorem, anti-aliasing filter, least square method for estimation of phasors, Fourier algorithms, Fourier analysis and discrete Fourier transform, estimation of phasors from discrete Fourier transform, Phasor Measurement Unit (PMU)

REFERENCE BOOKS:-

1. A Web Course (NPTEL) on ‘Digital protection of power system’, Prof. Dr. S.A.Soman, IIT Bombay.

2. Computer Relaying for Power Systems - A.G.Phadke, J.S.Thorp-Research studies press Ltd. England Jone Wiley & sons inc. New York.

3. Protection of Power Systems - Blackburn.

4. Fundamentals of Power System Protection-Y.G.Paithankar, S.R.Bhide. -Prentice hall, India.

5. The art and Science of Protective Relaying – Mason.

6. Protective Relaying – J. L. Blackburn.

7. Power System Protection and Switchgear – Badri Ram and D.N. Vishwakarma.

13. FLEXIBLE AC TRANSMISSION SYSTEM

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: FACTS Concept and general System Considerations [4 hrs]

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

Unit 2: FACTS controllers [8 hrs]

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

Unit 3: Static Shunt Compactors: SVC and STATCOM [4 hrs]

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

Unit 4: Static series Compensators: GCSC, TSSC, TCSC and SSSC [8 hrs]

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

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

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

Unit 6: Applications of FACTS [8 hrs]

Concepts of UPFC, IPFC, NGH-SSR damping scheme and thyristor controlled Braking Resistor and application of FACTS.

REFERENCE BOOKS:-

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

2. FACTS controllers in power transmission and distribution—K R Padiyar

14. DIGITAL SIGNAL PROCESSING

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: Sampling of Time Signals [8 hrs]

Sampling theorem, application, frequency domain representation of sampling, and reconstruction of band limited signal from its samples. Discrete time processing of continuous time signals, changing the sampling rate using discrete time processing.

Unit 2: Z-Transform [6 hrs]

Z-Transform: Definition, convergence. Properties of Z-Transform, Inverse Z-Transform. System Functions for Discrete-Time systems Characterized by Linear Constant-Coefficient Difference Equations. Recursive and Non-recursive Structures, Block Diagram and Signal Flow Graph.

Unit 3: Discrete Fourier Transform and Fast Fourier Transform [7 hrs]

Derivation of DFT from DTFT, Inverse DFT, Convolution using DFT. Computational complexity of the DFT, Decimation-in-time FFT Algorithm, Decimation-in-frequency FFT Algorithm, Comparison of DIT and DIF algorithms.

Unit 4: Realization [5 hrs]

Realization of FIR and IIR filters using direct form, cascade form, frequency sampling, parallel form, lattice and ladder structure.

Unit 5: Basics of Digital Filters [7 hrs]

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

Unit 6: Application of DSP [7 hrs]

Spectrum Analysis, power factor correction, Harmonic analysis and measurement, applications to machine control, DSP based vibration analysis system.

REFERENCE BOOKS:

1. 'Digital Signal Processing' by A.V. Oppenheim and R.W.Schafer, Prentice Hall.
2. John G. Proakis – Digital Signal Processing – PHI Publication
3. Simon Haykin- Signals and System

15. ELECTIVE-II (a) HVDC TRANSMISSION

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: HVDC system Components and Configuration [6 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.

Unit 2: Converter Theory and Performance Equation [7 hrs]

Valve Characteristics, Converter Circuit, Converter Transformer Rating, multiple Bridge Converter, and Detailed Analysis of converters.

Unit 3: Control of HVDC Systems [7 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 requirements.

Unit 4: Converter Faults and protection [5 hrs]

Converter Faults, Protection Against Overcurrents, Over Voltage in converter Stations, Protection Against over voltages.

Unit 5: Harmonics, Filters and Reactive Power Control [10 hrs]

AC side and DC side Harmonics, Design of Filters. Introduction, Reactive power requirements in Steady state, sources of reactive Power, Static VAR system, Reactive Power control during Transients.

Unit 6: Multi-terminal DC System [5 hrs]

Introduction, Potential application of MTDC Systems, Types of MTDC Systems, Control and Protection of MTDC Systems, Study of MTDC Systems.

REFERENCE 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

15. ELECTIVE-II (b) POWER SYSTEM DYNAMICS AND STABILITY

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: Introduction [6 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.

Unit 2: Modeling of Synchronous Machine [7 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.

Unit 3: Dynamics of Synchronous Generator Connected to Infinite Bus [7 hrs]

System Model, Synchronous Machine Model, System Simulation, Consideration of other Machine Models including SVC Model.

Unit 4: Small signal Stability [7 hrs]

Single and multi-machine system, Damping and Synchronizing torque Analysis, Power System Stabilizers.

Unit 5: Transient Stability [7 hrs]

Evaluation and Simulation, application of energy functions for direct stability evaluation, TS controllers.

Unit 6: Voltage Stability [6 hrs]

Introduction, affecting factors, analysis, comparison with angle stability

REFERENCE 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.

15. ELECTIVE-II (c) COMPUTER AIDED POWER SYSTEM DESIGN

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: Introduction [6 hrs]

Digital. computers in power system simulations, System view point, Hierarchy of transmission and distribution system, nature and scope of power system studies. Power system components, representation of transmission lines. Transformers - Two winding and auto-transformers, tap changing transformer and loads using ETAP Software. Generation of Impedance and admittance matrices of the system on digital computers using MATLAB Software.

Unit 2: Load flow studies [7 hrs]

Load flow studies, Power flow equations, Gauss-Seidel, Newton-Raphson, decoupled and fast decoupled methods of load flow analysis, Three phase load flow solution, Optimal load flow solution, Sensitivity analysis, Power System Software's for load Flow Analysis. Configuration of mixed AC-DC load Flow. Contingency Evaluation, Concept of Security, Security Monitoring and state Estimation, Data Acquisition systems and Man Machine Interface.

Unit 3: Fault Studies [7 hrs]

Fault Studies for symmetrical & unsymmetrical faults on three phase systems, Software for Fault Studies. Transient Stability Analysis including synchronous machines, system Network and loads, Euler, Modified Euler and Runge-Kutta method of Solution of transient stability. Transient Stability Analysis using ETAP, PSCAD/EMTDC Software.

Unit 4: Integrated Information Systems [7 hrs]

Schematic of Power System Integrated Information Systems, IT Architecture, Hardware Architecture, Software Architecture, Energy Management System (EMS),System Analysis using standard Power system software. Power Plant Control and Control Algorithms.

Unit 5: Supervision Control and Data Acquisition systems (SCADA) [7 hrs]

Introduction to SCADA,SCADA Systems-Data collection Equipment, Data Transmission Telemetric Equipment, Data monitoring Equipment, Remote Terminal Units, Communication between Control centre and SCADA system.

Unit 6: Power Systems and SCADA [6 hrs]

Central Operation and Control of Power Systems using SCADA, Functions of SCADA systems, Integration of Management control and protection functions by SCADA systems, SCADA configurations, Application of SCADA for power system operation and control.

REFERENCE BOOKS:-

1. Computer Aided Power System Operation and Analysis- R.N.Dhar, Tata MaGraw Hill

2. Computer Techniques in Power System Analysis- .A.Pai, Tata-McGraw Hill, New Delhi

3. Computer Methods in Power System Analysis — Stagg and El. Abiad, McGraw Hill (Japan Edn.)

4. Computer Aided Power System Analysis- George L. Kusic -(Prentice Hall India)

5. Computer Aided Power System Analysis and Control-A.K. Mahalanbis, D.P. Khothari, S.I. Ahson (Tata McGraw Hill)

6. Computer Modeling of Electrical Power Systems- J. Arrillaga, N.R. Watson 2nd Edition, WSE Willey Publications

7. Advanced Power Systems analysis and dynamics-L PSingh, New Age Intl. Publishers,

8. Modern Power system Analysis', I J Nagrath and D P Kothari, Tata McGraw Hill

9. SCADA: Supervisory Control And Data Acquisition-Stwart A Boyer, ISA Society, 2nd Edition.

10. Electrical Transients in Power Systems, Allan Greenwood, Wiley Interscience, New York.

15. ELECTIVE-II (d) NEURAL NETWORK & FUZZY LOGIC

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: Basics of Artificial Neural Network (ANN) [5 hrs]

Introductions, ANN, model of neural network, topologies, perceptions, basic learning rules-Supervised learning and unsupervised learning

Unit 2: Feed Forward and Feedback Networks [10 hrs]

Multi layer Networks, delta rule, back propagation training, Hop field network, gradient hop field network, (discrete & continuous) transient response, Boltzman machine.

Unit 3: Application of ANN [5 hrs]

Applications to various field such as image & signal Processing, Control Systems etc.

Unit 4: Fuzzy System [10 hrs]

Fuzzy sets & membership, classical sets & fuzzy sets. Fuzzy relations, Fuzzification, & defuzzification, fuzzy logic & fuzzy system, fuzzy automata development of membership function.

Unit 5: Fuzzy Arithmetic [5 hrs]

Extension principle, fuzzy arithmetic, approximate methods of extension.

Unit 6: Fuzzy Control System [5 hrs]

Simple fuzzy controls, fuzzy in process control, fuzzy statistical process control.

REFERENCE 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

15. ELECTIVE-II (e) EMBEDDED & REAL TIME SYSTEMS

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	Theory Exam: 80 Marks
	Class Test: 20 Marks

Unit 1: RISC processor for embedded system [7 hrs]

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.

Unit 2: 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

I2C - Overview of I2C, adding a real time clock with I2C, adding a small display with I2C

Interfacing - DS12887 RTC interfacing & programming in C Alarm, SQW, & IRQ features of the DS12887 chip..

Unit 3: Introduction to real time concepts [5 hrs]

Basic computer architecture & terminology, real time design issues, examples of real time system.

Unit 4: Real time specifications & design techniques [8 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.

Unit 5: Hardware & Software integration [6 hrs]

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

Unit 6: Real time application [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.

REFERENCE BOOKS:-

1. A Embedded System Software by David E Simon, Pearson Education

2. Embedded System Design- A Unified Hardware/Software Introduction 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 Education

7. Embedded hardware by John Catsoulis, O'REILLY Pub, 2nd Edition.

8. ARM Processor Data book

9. ARM architecture reference manual edited by David Seal

16. SWITCHGEAR PROTECTION LAB

Teaching Scheme	Examination Scheme
Practical: 2 hr/week	TermWork: 25 Marks
	Practical: 50 Marks

TERM WORK:

Term Work shall consist of a set of drawing as detailed below:

1. Sketch of one Circuit Breaker, Buchholz Relay and Induction Type of relay.

2. Different Types of protection provided to Stator and Rotor of Alternator.

3. Schemes for Transformer, Bus-bar, Feeder and Transmission Line Protection.

A set of 6 to 8 experiments on operation of different types of relays, protection of Transformer, Alternator, Feeder and Transmission Lines.

17. FLEXIBLE AC TRANSMISSION SYSTEM LAB

Teaching Scheme	Examination Scheme
Practical: 2 hr/week	TermWork: 25 Marks
	Practical: 50 Marks

TERM WORK:

The laboratory consists of Computer Simulation of various fact controllers. Approximately two numbers on each Unit from Unit No. 3 to Unit No. 6

18. DIGITAL SIGNAL PROCESSING LAB

Teaching Scheme	Examination Scheme
Practical: 2 hr/week	TermWork: 25 Marks

TERM WORK:

The term work shall consist of minimum SIX Experiments related with the syllabus as mentioned below

LIST OF EXPERIMENTS:-

1. To develop program for discrete correlation.
2. To understand sampling theorem.
3. Study of DSP starter kit and generation of Sine wave.
4. To design analog filter (low-pass, high pass, band-pass, band-stop
5. Demo of FIR Filter implementation using DSP kit.
6. To understand stability test.
7. Find a) Circular convolution,
    b) Using DFT IDFT method find Circular convolution,
    c) Find linear convolution using Circular convolution.
8. Plot frequency response of given system function (Magnitude & Phase)

19. ELECTIVE-II (a) HVDC TRANSMISSION LAB

Teaching Scheme	Examination Scheme
Practical: 2 hr/week	TermWork: 25 Marks

TERM WORK:

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

19. ELECTIVE-II (b) POWER SYSTEM DYNAMICS & STABILITY LAB

Teaching Scheme	Examination Scheme
Practical: 2 hr/week	TermWork: 25 Marks

TERM WORK:

Four assignments based on simulation of four machine system, IEEE 14 bus system and other systems in software like MATLAB, ATP, PSCAD, etc. and their contingency and stability analysis.

19. ELECTIVE-II (c) COMPUTER AIDED POWER SYSTEM DESIGN LAB

Teaching Scheme	Examination Scheme
Practical: 2 hr/week	TermWork: 25 Marks

TERM WORK:

The term work shall consist the record of minimum eight experiments based on the simulation of course outline above using ETAP / PSCAD / MATLAB Software:

LIST OF EXPERIMENTS:

1. Representation of Single line diagram of power system.
2. Generation of impedance and admittance matrices.
3. Load flow studies.
4. Short circuit analysis.
5. Fault studies.
6. Transient stability analysis.
7. Contingency analysis.
8. SCADA case study.

19. ELECTIVE-II (d) NEURAL NETWORK & FUZZY LOGIC LAB

Teaching Scheme	Examination Scheme
Practical: 2 hr/week	TermWork: 25 Marks

TERM WORK:

The term work shall consist of Assignment based on coding for fault studies and stability studies in MATLAB or C++ using ANN and Fuzzy logic.

19. ELECTIVE-II (e) EMBEDDED & REAL TIME SYSTEMS LAB

Teaching Scheme	Examination Scheme
Practical: 2 hr/week	TermWork: 25 Marks

TERM WORK:

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

20. PROJECT SEMINAR

Teaching Scheme	Examination Scheme
Practical: 8 hr/week	TermWork: 50 Marks
	Practical Exam: 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.