VII - SEM. ELECTRICAL ENGG.

SEM	SUB CODE	SUBJECT NAME	BOARD	L	T	P	HRS. PER WEEK	MAX. MARKS THEORY	PAPER	COLL. ASSES.	MAX. MARKS PRACT	PAPER	COLL. ASSES.	PAPER DURATION
7	7S-EE-01	CONTROL SYSTEM-II	EE	4	1	0	5	100	80	20				3 Hrs.
7	7S-EE-02	ELECTRICAL POWER – II	EE	4	1	0	5	100	80	20				3 Hrs.
7	7S-EE-03	ELECTIVE –I	EE	3	1	0	4	100	80	20				3 Hrs.
7	7S-EE-04	HIGH VOLTAGE ENGG.	EE	4	1	2	7	100	80	20	50	25	25	3 Hrs.
7	7S-EE-05	POWER ELECTRONICS	EE	4	1	2	7	100	80	20	50	25	25	3 Hrs.
7	7SEE-06	PROJECT SEMINAR		0	0	3	3				50		50	
		TOTAL CREDIT POINT = 19+2.5+3.5=25		19	5	7	31		500			150		TOTAL MARKS=650

VIII - SEM. ELECTRICAL ENGG.

SEM	SUB CODE	SUBJECT NAME	BOARD	L	T	P	HRS. PER WEEK	MAX. MARKS THEORY	PAPER	COLL. ASSES.	MAX. MARKS PRACT	PAPER	COLL. ASSES.	PAPER DURATION
8	8S-EE-01	POWER SEMICOND BASED	EE	4	1	0	5	100	80	20				3 Hrs.
8	8S-EE-02	ELECTIVE- 2	EE	3	1	0	4	100	80	20				3 Hrs.
8	8S-EE-03	SWITCHGEAR & PROTECTION	EE	4	1	2	7	100	80	20	50	25	25	3 Hrs.
8	8S-EE-04	COMP.APPL.IN ELECTRICAL ENGG.	EE	4	1	2	7	100	80	20	50	25	25	3 Hrs.
8	8S-EE-05	PROJECT		0	0	6	6				150	25	25	3 Hrs.
		TOTAL CREDIT POINT = 15+2+5=22		15	4	10	29		400		150	250		TOTAL MARKS=650

SEVENTH SEM B.E. ELECTRICAL

7S-EE-0I   ## CONTROL SYSTEMS -II

UNIT – 1   **COMPENSATION:** Review of performance Analysis of type 0, type 1 & type 2 systems. Need for compensation. Performance Analysis of Compensators in time & frequency domain, Bode Plots. Design of Compensators is not required.

UNIT-2   **DESIGN BY STATE VARIABLE FEEDBACK:** Review of state variable representations. Solution of state equation. Controllability & Observability. Design by State Variable Feedback.

UNIT-3   **OPTIMAL CONTROL SYSTEM:** Performance Index. Desirability of single P.I., Integral square error, parameter optimization with & without constraints. Optimal control problem with T.F. approach for continuous time system only.

UNIT–4   **NON LINEAR CONTROL SYSTEMS:** Types of non - linearities. Characteristics of NLCS. Inherent & intentional non- linearities. Describing function method for Analysis. Describing function of some common non- linearities. Stability analysis. Limit cycles & stability of limit cycles.

UNIT-5   **PHASE PLANE METHOD:** Singular points. Stability from nature of singular points. Construction of trajectory by Isoclines & Delta method, Computation of time.

UNIT-6   **SAMPLED DATA CONTROL SYSTEMS:** Representation SDCS, Sample & Hold circuit. Z-Transform. Inverse Z- Transform & solution of difference equations. 'Z' & 'S' domain relationship. Stability by Bi-linear transformation & Jury's test. Discritization of continuous time state equation. Solution of Discrete time state equations. Controllability &. Observability of Discrete time systems.

BOOKS :

1. Control System Analysis by Nagrath & Gopal (New Age International Pvt. Ltd.)
2. Linear System Analysis by D' Azzo & Houpis (McGraw Hill)
3. Modem Control Engineering by Ogata. (Prentice Hall)
4. Modem Control Theory by M Gopal. (Wiley Eastern)

7S- EE-02   ELECTRICAL POWER- II

UNIT 1: SYMMETRICAL COMPONENT TRANSFORMATION: Three phase power in unbalanced circuit in terms of symmetrical component. Sequence impedances of Generator. Transformer Transmission line & Passive loads. Phase shift in star I delta three-phase transformer (Y d1, Y d11 connection.).

UNIT 2: SYMMETRICAL FAULT ANALYSIS: Without & \with prefault load current. Selection of Circuit Breakers   ratings, current limiting reactors.

UNIT 3: UNSYMMETRICAL FAULT ANALYSIS: L-G, L-L-G, L-L, open conductors faults analysis using symmetrical components.

UNIT 4: STABILITY OF POWER SYSTEM- Steady state, Dynamic and Transient stability definition. Dynamics of synchronous machine, swing equation, swing equation for machines swinging coherently and Non-Coherently.' Power angle equation. Steady state stability studies.
TRANSIENT STABILITY STUDIES: -
Swing curve. Equal Area criterion for transient stability. Application of equal area criterion for different disturbances. Solution of swing equation by point-by-point method. Methods of improving transient stability.

UNIT 5: ECONOMIC OPERATION OF POWER SYSTEM: Introduction, Distribution of load between units within the plant Optimum generation scheduling considering transmission losses. Representation of transmission loss using loss formula coefficient. Derivation of loss formula co-efficient, simulation of   co-ordination equation on digital computer.

UNIT 6: i) GROUNDING OF NEUTRAL in power system.
ii) SHUNT & SERIES COMPENSATION-Generalized equation, shunt reactor compensation of very long line with intermediate switching station, series capacitor compensation at line center, shunt reactors at both ends and series capacitor in middle of line. Elementary idea of sub synchronous resonance problem and counter measures.

Books:

1. Elements of Power System Analysis by Stevenson (MGH)
2. Modem power System analysis by I.J. Nagrath & D.P.Kothari (MGH)
3. ElectricalPower System Analysis by Wadhwa C.L. (New Age International)
4. Extra High Voltage AC. Transmission Engineering by R D. Begamudre.

Note: - Unit 6 (ii) - Scope will be limited to the treatment given in recommended Book (4).

ELECTIVE-I NON-CONVENTIONAL ENERGY SOURCES

UNIT-1 **SOLAR RADIATION & IT" MEASUREMENT:** Solar Constant, Solar radiation at earth's surface, solar radiation geometry, solar radiation measurement estimation of average solar radiation, solar radiation on tilted surfaces.

UNIT-2 **SOLAR ENERGY COLLECTORS**: Physical Principles of the conversion of solar radiation into heat, flat plate collectors, transitivity of cover systems, energy balance equation and collector efficiency concentrating collectors, comparison concentrating and flat plate collectors, selective absorber coatings.
SOLAR ENERGY STORAGE: Solar Energy Storage system (Thermal, E1ectrial, Chemical, Mechanical), Solar ponds.

UNIT-3 **APPLICATION OF SOLAR ENERGY**: Solar water heating, space heating, space cooling, solar thermal heat conversion, photovoltaic solar energy conversion, solar pumping, solar cooking,

UNIT-4 **WIND ENERGY:** Basic principles of wind energy conversion, wind energy conversion, wind data & energy estimation, site selection consideration, basic components of wind energy conversion system (WECS), classification of WEC systems, generating system energy storage, application of wind energy.

UNIT-5 **ENERGY from OCEANS:** Ocean thermal electric conversation (OTEC), Claud & Anderson cycles, evaporators, Bio-fouling, Hybrid cycle
ENERGY FROM TIDES: Introduction basic principles of Tidal power, components of Tidal Power Plants, operation methods of utilization of Tidal Energy; Estimation of Energy & Power in simple single basin Tidal system, Advantages & limitations of Tidal Power Generations, energy & power from wares, wave energy conversions devices, small scale hydro electric power generation.

UNIT-6 **OTHER NON-CONVENTIONAI, ENERG Y SOURCE.** (Brief Introduction to operating principles only): Energy from Bio–Mass, Geothermal Energy, MHD power generation.

TEXT BOOK:

1. Non Conventional Energy Sources G.D. Rai, Khanna publishers.

UNIT-1   Real-time issues on signal transmission and control, Communication systems for industrial automation, Data acquisition and Supervisory control, Control of discrete manufacturing processes. Intelligent systems for Monitoring, supervision and control, Case studies of industrial control systems.

UNIT-2   Energy Auditing-Introduction, importance of Energy Audit basic terms of energy audit, Procedure for carrying energy audit, instruments used for energy audit such as power analyzer multipoint heat flow meter, lux meter portable infrared radiation thermometer, thermocouple based temperature indicator. Energy Conservation & Management, Need & importance of Energy Conservation & Management, payback period, return on investment (ROI),life cycle costs ,specific energy consumption. Calculation of Energy costs of specified products & simple systems. Analysis of selected energy intensive units like iron-steel, cement, petroleum refining etc.

UNIT-3   Principles of multi-objective Energy management with emphasis on conservation, User-friendly software development on Windows 9x. UNIX Platforms for Energy Conservation &. Management Studies.

UNIT-4   Serial data communication using RS232 and RS485 based system, distributed measurement system. IEEE488 protocol.

UNIT-5   Local area networks - Common topologies. Medium access control-round-robin, reservation and contention based strategies. ALOHA protocol and its variants. CSMA and CSMA/CD protocols. Token-ring protocol. IEEE 802 standards for local area networks High. Speed LANs - Fast and Gigabit Ethernet. FDDI Wireless LANs. Internet Working Repeaters, bridge *routers* and gateway. TCP protocol swite   computing. Name Service. Application protocols over TCP/IP. Network-Security.

UNIT-6   Design of microprocessor based Instrumentation systems, design. Interfacing circuits and data acquisition systems.

Books :

1. Microprocessor & Interfacing by D.V Hall.
2. LANE by Keiser, Mc. Graw Hill
3. Energy management by William T. Synder & Fredric W. Symonds, vol II
4. Energy management Handbook by W. C. Turker

7S-EE-O3 (3) ELECTIVE-I   **FUZZY LOGIC & NEURAL NETWORK**

UNIT–1: INTRODUCTION:
1. Fuzzy sets, Approximate reasoning, Representing set of rules.
2. Fuzzy knowledge based.(FKBC)parameters. Introduction rule and data base inference engine, choice of fuzzification and & defuzzification procedure

UNIT -2: **NONLINEAR FUZZY CONTROL**
Introduction, Control problem, FKBC as nonlinear transfer element, types of FKBC.

UNIT - 3: **ADAPTIVE FUZZY CONTROL**
Introduction, design, and performance evaluation, main approach to design.

UNIT-4: I. Fundamental concept of ANN.

2. Model of Artificial Neural Network (ANN), Learning & adaptation learning rules.
FEED FORWARD NETWORK:

Classification Model, feature & decision regions, minimum distance, Classification, perceptron, delta learning rules for multiperceptron layer, Generalized learning rules, back propagation Algorithm, back propagation training learning factors.

UNIT - 5: **RECURRENT NETWORKS**
Mathematical foundation of discrete time gradient type hope field networks, transient response & relaxation modeling.

UNIT-6: **ASSOCIATIVE MEMORIES & SELF ORGANIZING NETWORKS.**
Basic concept & performance analysis of recurrent associative memory, Bidirectional associative memory, Hamming net & MAXNET Unsupervised laming of clusters, counter propagation network, feature mapping self organizing feature maps, cluster discovery network (ART 1)

BOOKS:

1. Introduction of Artificial Neural Networks by Jacek Zurada (JPH).
2. Neural Network & Fuzzy system by Bart Kosko (PHI).
3. Neural Networks: Comprehensive Foundation by Simon Hayking (Maxwell) Macmillan, Canada Inc).
4. An Introduction to Fuzzy Control by D. Driankov (Narosa).
5. Fuzzy sets: Uncertainty & information by Klir & Folger (PHI)
6. Digital Image processing (AWFC) by Gonzalez.
7. Fuzzy Sets and Fuzzy Logic Theory and applications by Gearge D.Klir / Bo Yuan.

7S-EE-O3 (4) Elective I   FLEXIBLE AC TRANSMISSION SYSTEMS

Unit-I: **FACTS CONCEPT AND GENERAL SYSTEM CONSIDERATION**
Transmission Interconnection, Flow of Power in an AC System, factors affecting the Loading Capability, Power Flow and Dynamic Stability Consideration of Transmission interconnection, Importance of controllable. Parameters, FACTS Controller.

Unit-2:   **VOLTAGE-SOURCED AND CURRENT. SOURCED CONVERTERS**
Basic Concept of Voltage-Sourced Converters, Single-Phase Full-Wave Bridge Converter Operation, Single Phase Leg Operation, Square-Wave Voltage Harmonics for Single Phase Bridge, Three-Phase Full-Wave Bridge Converter. Sequence of Valve Conduction, Process in. Each Phase-Leg, Transformer connection for 12-PluseOperation, Three Level Voltage Sourced Convert, Pulse-Width Modulation Converter, Generalized Technique of Harmonic Elimination and Voltage Control, Basic Concepts of Current-Sourced Converters, Thyristor-Based Converters (with Gate Turn -On), Current Sourced Converter with Turn-Off Devices, Current Sourced Versus Voltage Sourced Converters.

Unit-3:   **STATIC SHUNT COMPENSATORS: SVC AND STATCOM**
Objectives of shunt Compensation, Methods of Controllable VAR Generation, Static Var Compensators SVC and STATCOM, Comparison Between STATCOM and SVC, Static Var System.

Unit-4:   **STATIC SERIES COMPENSATORS: GCS, TSSC, TCSC AND SSSC**
Objectives of series Compensation, Variable Impedance Type Series Compensators, Switching Converter Type Series Compensators, External (System) Control for Series *Reactive* Compensators.

Unit-5:   **STATIC VOLTAGE AND PHASE ANGLE REGULATORS; TCVR AND TCPAR**
Objectives of Voltage and Phase Angle regulators, Approaches to Thyristor Controlled Voltage and Phase Angle Regulators (TCVR and TCPARs), Switching Converter-Based Voltage and Phase Angle regulator, Hybrid Phase Angle Regulators.

Unit-6:   **COMBINE COMPENSATORS (UPFC, IPFC) AND SPECIAL PURPOSE FACTS CONTROLLERS '**
The Unified Power Flow Controller (UPFC}, Interline Power Flow Controllers Generalized and Multifunctional FACTS Controllers, Sub synchronous Resonance, NGH-SSR Damping Scheme, Thyristor-Controlled Braking Resistor (TCBR)

BOOKS :

1. Understanding FACTS by Narayan G. Hingorani and Laszlo Gyigyi (Standard Publishers)

Reference:

1. Flexible AC Transmission System (FACTS) Edited by Yang Hua Song and Johns (IEEE Publishers)

7S-EE-O3 (5) Elective I   ELECTRICAL INSTALLATION DESIGN

Unit 1:   Load forecasting, regression analysis numerical based on linear and exponential trends. Electrical installation for domestic commercial and industrial consumers, calculation of connected load, selection of transformers, switchgear cables and wires, single line diagram, special provision for high rise buildings (IER-50-A), earthing requirement, megger and earth tests, use of earth leakage circuit breakers. (Special reference to be given to IER2)

Unit 2:   Cables –PVC and XLPE cables their construction in brief, current ratings, specification, derating factors megger and continuity test. ver head distribution lines up to 33KV, line apparatus and basic construction in brief clearance selection of AAC and ACSR conductors , voltage drop calculation .Selection of Insulators, earthing requirement (special reference to be given to IER 77.79.80.81.87.89.90.91.92)

Unit 3:   Illumination design definitions, polar curves, simple calculations, working principles *of* fluorescent, sodium vapor and mercury vapors lamps. Capacitors and P.F. improvement – determination of rating and location of capacitors, calculation of payback period for additional capacitors.

Unit 4:   Substation Single line diagram plan, elevation, and clearances for 11 KV pole mounted, 11 KV plinth mounted (up to 1000 KVA and above 1000 KVA), 33 KV (up to *2500* KV A & above 2500 KV A) Substations. Single line diagram for substation with two transformer in parallel, Specifications of isolators, lightening arrestors, horn gap fuses, D.O. fuses, circuit breakers instrument transformers power transformer various bus bar systems, load transfer.(Special   reference   to   be   given   IER (31,33,35,43,44,45A4,50,51,54,55,58,64A,67,IS3043).

Unit 5:   Determination of fault level of various locations in substation, use of current limiting reactors. Philosophy of protective relaying, over current. earth fault, REF protection, earth leakage protection, OTI WTI, Buchholz relays. Fire lighting equipment, restoration of a person affected by electric shock. Earthing types. Measurement of earth resistance.

Unit 6:   Site testing of transformer (Visual, pre-commissioning tests like megger magnetic balance turns ratio) testing of oil, operational test for Buchholz OTI, WTI, alarm and trip functions.

BOOKS

1. Electric Power Distribution system by Pabla (TMH).
2. A Course in Electric Power by Soni, Gupta, Bhatnagar (Dhanpat Rai)
3. Electrical substation Engineering Practice by S. Rao (Khanna Publication)
4. Electrical Engineering Handbook by Wadhwa
5. Electrical Installation Design by Jain, Bajaj (IER, 1956,LatestEdition)

　　　　　　　　　　HIGH VOLTAGE ENGINEERING

Unit 1:　**BREAKDOWN MECHANISM IN DI-ELECTRIC:** Ionization process, Townsend's criterion for Break down, Break down in electro-negative gases, Time-lag for B.D., Streamer theory for B.D in gases, Paschen's law; B.D in non-uniform field. Corona discharges and introduction of corona, post B.D. phenomenon and applications, practical considerations in using gases for insulation purpose, vacuum insulation, Liquid as insulators, conduction and B.D. in pure and commercial liquids. Intrinsic, electromechanical & thermal B.D., B.D. of solid di-electrics in practice, B.D. in composite dielectrics

Unit 2:　**LIGHTING AND SWITCHING OVER VOLTAGES:** Mechanism of lightening, types of strokes, parameter and characteristics of lightening strokes, characteristics of switching surges, power frequency over voltages. Control of over voltage due to switching. Protection of lines by ground wires, protection by lightning Arrester, gap type and gapless L.A., selection of L.A. ratings; surge-absorbers.

Unit 3:　**TRAVELING WAVES AND INSULATION COORDINATION:** Traveling waves on transmission lines, Classification of lines, attenuation and distortion of traveling waves, reflection and transmission of waves, behavior of rectangular waves at transition points. Introduction to insulation coordination, associated terms, impulse wave form. Introduction to BIL reduced BIL and SIL.

Unit 4:　**GENERATION OF HIGH VOLTAGE AND CURRENTS:** Generation of High D.C voltages by rectifiers, voltage doubler and multiplier, circuits (Derivations of expression not required), electrostatic machines, Generation of high AC voltages by Cascade transformers, Resonant transformers, generation of high frequency AC high voltage. Generation of impulse voltages, Standard impulse wave shapes, analysis of model and commercial impulse generation circuits, wave shape control. Marx circuit, tripping and control of impulse generation, generation of switching surges generation of impulse current.

Unit 5:　**MEASUREMENT OF HIGH VOLTAGE AND CURRENT:** Measurement of high AC and DC voltage by micro ammeter, generating voltmeter resistance and capacitance potential divider, series impedance voltmeter, CVT, Magnetic type potential transformers, electrostatic voltmeter. Peak reading AC voltmeter. Sphere gap arrangement. Measurement of impulse voltage by potential dividers and peak reading voltmeters. Measurement of High AC DC current; measurement of nigh frequency and impulse current by resistive shunt (Bifilar strip shunt only,)

Unit 6:　**NON DESTRUCTIVE AND HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS:** Non destructive testing Measurement of DC Resistivity, measurement of Dielectric constant and loop-factor (low and power frequency only), Schering bridge for high charging circuits, for high dissipation factor, for three terminal measurement, transformer ratio arm bridges, partial discharge measurements by straight detectors & by balance detectors, calibration of detectors, discharge detection in power cables. High voltage testing. Testing of insulators, bushings, isolators, circuit breakers, cables, transformers, lightning arresters and power capacitors.

Books:

1. High Voltage Engineering by M.S. Naidu and V. Kamaraju (TMG).
2. High Voltage Engineering by C.L.Wadhwa. (New Age International).

POWER ELECTRONICS

Unit 1: **SCR AND ITS CHARACTERISTICS:** Gate characteristics, SCR turn off, ratings, series and parallel connections of SCRs. Triac and its applications, Unijuction transistors, Triggering circuits and opto couplers.

Unit 2: **LINE COMMUTATED CONVERTERS:** Working of single pulse converter, two pulse mid point converter. Three pulse midpoint converter and 3 phase six pulse bridge converters, effect of source inductance in converters, effect of free wheeling diode.

Unit 3: **SINGLE PHASE AND THREE PHASE HALF CONTROLLED CONVERTERS:** Speed control of d.c. Motors using line commutated converters. Cycloconverters (single phase).

Unit 4: **STATIC CONTROLLABLE SWITCHES:** Characteristic and working of MOSFET Gate turn off thyristor and insulated gate bipolar transistor, protection of SCR gate circuit protection, over voltage and over current protection, snubber circuit design, converter circuit faults and their protection.

Unit 5: **D.C. CHOPPERS:** Principles of step down chopper, step up chopper classification, impulse commutated and resonant pulse choppers. Multi phase choppers. Application of choppers, Inverters: Basic series resonant. Inverter, half bridge and full bridge series resonant inverters.

Unit 6: Single phase and three phase bridge invertors, commutation and trigger-circuits for forced commutated thyristor inverters. Output voltage control, Harmonics in output voltage waveform, Harmonic attenuation by filters. Harmonic reduction by pulse width modulation techniques. Analysis for single pulse width, modulation. Working of current source inverters few applications of inverters.

BOOKS:

1. Power Electronics circuits Devices and Applications by M. H. Rashid. (Prentice Hall)
2. Power Electronics by C.W. Lander. (TMH)
2. Thyristor and their Applications by Dr. M.Ramamoorty (Affiliated East West Press)
4. Thyristor and their Applications by Dr. G.K.Dubey and Doralda and Joshi. (Wiley Eastern)

EIGHTH SEM B. E. ELECTRICAL

8S-EE-O1

POWER SEMICONDUCTOR BASED DRIVES

Unit 1: Dynamics of electric drives and control of electric drives, energy conservations in electric drives.

Unit 2: **D.C. MOTOR DRIVES:** Controlled rectifier fed D.C. Drives, single phase and three phase rectifier control of D.C. Separately excited motor. Dual converter control of D.C separately excited motor. Power factor, supply harmonics and ripple in motor current. Chopper controlled dc drives of separately excited dc motor, chopper control of series motor, source current harmonics.

Unit 3: **INDUCTION MOTOR DRIVES:** Stator voltage control, variable frequency control using voltage source invertors, current sourced invertors and cycloconverter.

Unit 4: **SYNCHRONOUS MOTOR DRIVE:** Starting Braking of synchronous motor, variable frequency control self controlled synchronous motor drive employing load com mutated thyristor inverter of cycloconverter, starting of large synchronous motors.

Unit 5: Brushless dc motor, stepper motor, switched reluctance motor drives and eddy current drives. Introduction to solar and battery powered drives.

Unit 6: **TRACTION DRIVES:** Conventional dc and ac traction drives, semiconductors converter controlled Drives, 25KV AC traction using semiconductor converter controlled dc motor. DC traction using semiconductor, chopper controlled dc motors, poly phase AC motors for traction drives.

BOOKS:

1. Fundamentals of Electric drives by G. K. Dubey. (Narosa Publications)
2. Modem Electric Traction by H. Pratap
3. Electric drives concepts and applications by V.Subramanian.(TMH)

8S-EE-O2 (1) ELECTIVE-II   EHV AC & HVDC TRANSMISSION

Unit 1: (i) Power Handling capacities of EHV AC transmission lines. (ii) Voltage, gradients, Electric field of point charge, sphere gap, line-charge, single and three phase lines and bundled conductors. Maxwell's potential coefficients, Mangoledt formula.

Unit 2: (i) Electrostatic and electromagnetic fields of EHV line, electric shock and Threshold current, capacitance of long object; calculation of electrostatic field of AC. Lines (3-phase single and double circuit lines only). Effect of high electrostatic field, measurement *of* electrostatic field, induced voltages in insulated ground wires, electromagnetic interference (ii) Corona, types, critical disruptive voltages, factors affecting corona, methods for reducing corona power loss, corona current wave form, charge voltage diagram, audible noise and radio interference.

Unit 3: (i) Comparison of EHVAC and HVDC systems. (ii) Conversion from AC to DC. Rectifiers, converters, conversion from DC to AC, Invertors. (iii) Kinds of DC link. (iv) Earth electrode and earth returns: Introduction, objectives, location and configuration, resistance of electrodes, means of reducing earth electrode resistance, trouble caused by earth current and remedies. (v) Multi terminal HVDC system: Introduction, 2-pole transmission, MTDC system with series and parallel-connected converters, advantages, applications, configurations and types.

Unit 4: (1) Power flow control in HVDC system: Constant current, constant voltage, constant ignition and extinction angle control, control characteristics. (ii) Parallel operation of AC and DC links (Synchronous and Asynchronous links)

Unit 5: (i) Harmonic Filters: Introduction, Filters, surge capacitors and damping circuits, shunt filters, series filters, AC filters, design of AC. filters and tuned filters, double frequency and damped filters, cost consideration. Rating, harmonics on D.C. side of converter, D.C. Harmonic filters. (ii) Reactive power compensation: Reactive power requirements of HVDC converters, substations, effect of delay angle and extinction angle on reactive power.

Unit 6: (1) HVDC circuit breakers Introduction, construction, principle, switching energy interruption of DC current, application of MRTB. Types of HVDC C.B. capability and characteristics of HVDC circuit breakers (ii) HVDC substation protection against short circuit introduction, fault Clearing, protective zones, protection symbols, HVDC line pole protections (fault clearing and re-energizing), (iii) HVDC sub-station protection against over voltage, difference between Insulation coordination of AC and DC systems, fundamentals of switching over voltages, O.V. on A.C sides, and on D.C side, surge- Arresters protection scheme. Insulation coordination and protection margin.

BOOKS: -

1. EHV AC and HVDC Transmission Engineering and practice by S.Rao.
2. Electrical Power Systems (2nd Edition) by C.L. Wadhwa (New Age International Pvt. Ltd.).
3. EHV *AC* Transmission If by Begamudre

8S-EE-02(2)   Elective II   ENTREPRENEURSHIP DEVELOPMENT

UNIT 1   Need analysis, market survey, and characteristics of market, sample survey, demand forecasting, secondary data, accuracy, and confidence level uncertainty.

UNIT 2   Technical feasibility: Process selection, level of automation, plant capacity, acquiring technology, appropriate technology plant location, Equipment selection & procurement Govt. policies.

UNIT 3   Economic feasibility: Cost of project, working capital analysis, fixed cost, means of finance, estimation of sales and production price analysis, break even point, projected cash flow statements, projected balance sheet, projected profit and loss statement projected cash projected cash flow, rate of return, discounted payback period, cost benefit analysis, return after taxes.

UNIT 4   Project Planning & Control: CPM, PERT. Optimum project duration, resource allocation, updating.

UNIT 5   Project report: Preparation of project report, risk analysis, sensitivity analysis, and methods of raising capital.

UNIT 6   Project review: Initial review, performance analysis, ratio analysis, sickness, project revival, environmental & social aspects.

RECOMMENDED BOOKS:

1. Projects by Prasanna Chandra (Tata Mc Graw Hill publishing company Ltd.)
2. CPM & PERT by Shrinath (East West publisher).
3. Projects by P.K Joy (Mc. Millan).
4. Engineering Economy by H.G. Thuesen, W.J. Fabricky, G.J. Thuersen, (Prentice hall of India Pvt. Ltd.)

8S-EE-02(3) ELECTIVE-II ADVANCED MICROPROCESSORS AND PERIPHERALS

Unit 1: Introduction to 16 bit microprocessors. 8086/8088 CPU architecture, memory organization and interfacing. Addressing modes, instruction Set, examples Pseudo opcodes with ASM-86.

Unit 2: Interfacing of peripherals 8255 and 8253 with 8086. Architecture, operation and interfacing of 8251, 8257 with 8085 and 8086/8088.

Unit 3: Architecture, operation and interfacing of 8259,with 8279, with 8085 and 8086/8088.

Unit 4: Multiprocessor system bus, 8087 coprocessor with architecture and instruction set, organization of PCXT / AT motherboard.

Unit 5: Introduction to 80286, 386, 486 architecture. Concepts of Cache, associated/virtual memory. DOS structure.

Unit 6: Architecture of 8051 microcontroller, its important features, interface with parallel and serial I/O (Instruction set not included.)

BOOKS:

1. Programming and interfacing of 8086/8088 by D. V.Hall (McGraw Hill).
2. Programming and Interfacing 8086 by Leu and Gibson (PHT).

REFERENCE:

1. Intel Reference Manuals for j) Microprocessor and ii) microcontrollers.
2. 80286/80386 Assembly Language by Murary (Tata McGraw Hill).
3. 80386 Assembly Language by Fernandez: (T.M.H.)

8S-EE-02(4)   ELECTIVE-II   BIOMEDICAL ENGINEERING

UNIT 1:   Introduction: Human body physiology and subsystems, Biochemistry, Measurement of Electrical activities of human body.

UNIT 2:   Electrocardiography, Electro -encephalography, electromyography, Electro ethnography, Principles specifications and interpretation of records.

UNIT 3:   Measurement of no electrical quantity in human body, Measurement of blood flow respiration rate and depth heart rate.

UNIT 4:   ESR blood pressure, temperature PH impedance of various parts GSR mobility of internal organs.

UNIT 5:   Control of body functioning: Stimulator for muscle and nervous system cardiac pacemaker.

UNIT 6:   Blood pump respiration controller myo electric control of paralyzed muscles.

BOOKS:

1. Biomedical Instrumentation & Measurements by L.Cronwel (McGraw Hill)
2. Biomedical Engineering System by L. Cronwel (McGraw Hill).
3. Bioelectric Phenomena by Robert Blensev (McGraw Hill).

8S-EE-02(5) ELECTIVE-II   DIGITAL SIGNAL PROCESSING

UNIT 1: Discrete time signals & systems, Discrete time signals, Discrete time systems, Linearity, causality, stability, static dynamic, Time Invariance Time variance, classification of discrete time systems, linear convolution, circular convolution, cross correlation, Autocorrelation. Linear constant coefficient difference equations, sampling theorem & sampling process, Reconstruction of sampling data, convolution.

UNIT 2 Frequency domain representation of discrete time signals and systems, Fourier transformer of discrete time signals, properties of discrete time Fourier transformer,

UNIT 3 The Z - transform: Definition. Properties of the region of convergence for the Z- transform, Z - transform properties, Inverse Z - transform using contour integration, complex convolution theorem, Parseval's theorem, unilateral Z - transform, stability interpretation using Jury's array.

UNIT 4 Transform analysis of LTI system & structures for discrete - time system: Frequency response of LTI system, relationship between magnitude & phase, all pass system, minimum phase system, linear system with generalized linear phase.
Block diagram representation & signal flow graph representation of linear constant Coefficient difference equations, basic structures for IIR systems, transposed forms, basic network structures for FIR systems, lattice structures..

UNIT 5 Filter design techniques: Design of discrete time IIR filters from continuous time filters. Frequency transformations of low pass IIR filters, Design of FIR filters by windowing, FIR filter design by Kaiser Window method. Frequency sampling method.

UNIT 6 Discrete Fourier Transform: Discrete Fourier series, properties of discrete Fourier series discrete Fourier transform, properties of DFT, circular convolution using discrete Fourier transform. Decimation in time FFT algorithm, decimation in frequency FFT, FFT of long sequences using overlap add & overlap save method.

BOOKS:

1. Discrete time signal processing 2nd Edition by Alan V. Oppenheim, Ronald W. Schafer & Buch Pearson.
2. Digital Signal Processing - A Computer based approach by Sanjit K. Mitra.

REFERENCE:

1. Digital signal processing Theory & application by. Prows and Manolakis, 3rd edition PHI Ltd.

8S EE 02 (6) Elective III   **OPTIMIZATION TECHNIQUES**

UNIT-I: Introduction: Concept of optimization, statement of optimization problem. Classification of optimization problems, optimization techniques.

UNIT-2:   Classical Optimization Techniques: Single variable optimizations, multivariable optimization with no equality and in equality constraints, solution using lagrangian multipliers, Kunh - Tucker Conditions.

UNIT-3:   Linear Programming (Simplex method): Application of linear programming, standard form & geometry of linear programming problems, definitions & theorems, solution of system of linear simultaneous equations, pivotal reduction of a general system of equations, simplex algorithm.

UNIT-4:   **Nonlinear Programming- I dimensional minimization methods:**
Introductions, unimodal functions, elimination methods, direct root methods.

UNIT-5:   **Nonlinear programming-II: Unconstrained optimizations techniques-**
Introductions, Direct search methods, Random & Grid search methods, Powell's method. Indirect search method, Canchy's method, Fletchor Reaves method, Newton's method.

UNIT-6:   **Nonlinear Programming Ill: Constrained Optimization techniques:**
Introduction, characteristics of constrained problem, sequential linear programming, Zoutendijk's method of feasible directions, Rosen's gradient projection method.

TEXT BOOKS:
   1.   Engineering Optimization: Theory & practical (Third Edition), by S.S. Rao, New Age International.

8SEE-03　　　　　　　**SWITCH GEAR AND PROTECTION**

Unit 1　General philosophy of Protective Relaying: Protective zones, primary protection, back up protection Remote and Local Back up selectivity.

Unit 2:　Medium voltage Line Protection: Over current relaying, directional- over current relay.

Unit 3:　High Voltage Line Protection: Distance relays, carrier distance Schemes. Unit carrier schemes.

Unit 4:　Equipment Protection: Principles of differential relaying, protection of generator, transformers and bus Bars by differential relaying and other relays. Protection Induction Motors against overloads, short circuits. Thermal relays, miniature circuit.

Unit 5:　Introduction static relays: Comparison of static and electro mechanical relays, two input amplitude and phase comparator and their duality. Generation of various distance relay characteristics using above comparators.

Unit 6:　Switchgear: Circuit breakers. Arc interruption theory, recovery and Restricting voltages, RRRV, breaking of inductive and capacitive currents, C.B, ratings, different media of arc interruption, overview of oil circuit breakers, construction and operation of Air blast, SF6 and vacuum breakers.

Books:

1. Art and science of Protective Relaying by Mason.
2. Protective Relaying, Vol. I & II by Warrington.
3. Switchgear and Protection by Sunil S.Rao.
4. Switchgear and Protection by Ravindranath and Chander. (Khanna Publications)
5. Power System Protection and Switchgear by B.Ram (TMG).

COMPUTER APPLICATIONS IN ELECTRICAL ENGINEERING

E-04

Unit 1: Incidence & Network Matrices: Graph incidence Matrices, Primitive network, and formation of network matrices by Singular transformations.

Unit 2: Algorithm *for* formation of Bus Impedance and Bus Admittance matrix for system without mutual coupling.

Unit 3: Three phase Networks: Three phase balance network elements with balanced and unbalanced excitation, incidence and network matrices for three-phase element. Algorithm for formation of three-phase bus impedance matrix without mutual coupling. .

Unit 4: Load Flow Studies: Power system load flow equations, solution Technique, Gauss Seidel, Newton Raphson and fast decoupled technique with and without voltage control buses. Representation of tap changing and phase shifting transformers, Elementary load flow programs.

Unit 5: Short circuit studies: Three phase network short circuit calculations using bus impendence matrix for balance and unbalanced faults. Computer programme for short circuit studies on simple system.

Unit 6: Transient Stability studies: Modeling of synchronous machine. power system network for transient stability studies, Numerical solution of swing equation by modified Euler and Runge Kutta 4th order method. Elementary computer programme for the transient stability study.

BOOKS:

1. Computer method in power system analysis by Stagg and Ele Abiad (McGraw Hill)
2. Electric Energy System Theory and introduction by Oile J.Elgard. (TMH)
3. Elements of power system analysis by William D. Stevenson.(TMH)
4. Computer Analysis of Power system by R.N.Dhar.