Academic Scheme

For

B. Tech Electrical Engineering

Four Years Programme

Syllabus of Electives

(For Batches 2015 onwards)

Vetted in BOS 2017

Department of Electrical Engineering
Islamic University of Science and Technology
Awantipora, Jammu and Kashmir – 192122

Departmental List of Electives

*Electives not to be offered to Electrical Engineering students.

COURSE CODE	COURSE TITLE	L - P	PREFERRED SEMESTER	PREREQUISTE COURSES
ELE-G01T	Technology: What, Why and Why not?	2-0	III/IV/V	-
*ELE-G02T	Introduction To Electrical Technology	3 – 0	I/II/III	-
*ELE-E01T	Network Analysis	4 - 0	III/IV	-
ELE-E02T	Linear Algebra	4 – 0	IV/V	-
ELE-E03T	Signals and Systems	3 – 0	III/IV	-
*ELE-E04T	Renewable Energy Sources	4 – 0	V	-
ELE-E05T	Special Electrical Machines	4 - 0	VI/VII	Electrical Machines
ELE-E06T	Electronic Measurements and Instrumentation	4 – 0	V/VI	-
*ELE-E07T	Advanced Control System	3 – 0	VII/VIII	Control System
ELE-E08T	Optimal Control	3 – 0	VII/VIII	Advanced Control Systems & Linear Algebra
ELE-E09T	Advanced Power Electronics	4 - 0	VII/VIII	Power Electronics
ELE-E10T	Flexible AC Transmission System (FACTS)	4 - 0	VIII	Power Electronics
ELE-E11T	Power System Operation & Control	4 - 0	VIII	Power Systems
ELE-E12T	Optimization Techniques	4 - 0	VII/VIII	Control Systems
ELE-E13T	Electrical Drives	4 - 0	VII/VIII	Power Electronics
ELE-E14T	Power System Planning and Load Forecast	4 - 0	VII/VIII	Power Systems
ELE-E15T	Power Station Practice	4 - 0	VIII	Power Systems
ELE-E16T	Nonlinear Systems	3 – 0	VII/VIII	Control Systems
ELE-E17T	EHV AC & DC Transmission	4 - 0	VII/VIII	Power Electronics
ELE-E18T	Advanced Control Systems Lab	0-2	V/VI/VII	Advanced Control Systems
ELE-E19T	High Voltage Engineering (HVE)	4 - 0	VII/VIII	Power System

ELE-G01T – Technology: What, why and why not?

L – P

2– 0

Brief history of technology; Introduction to Philosophy of technology and philosophy of science, the relationship between technology and science; Technological artifacts; Technological knowledge; Technological processes; Technology and the nature of humans; Ethics and aesthetics of technology; Design and technology; Ethical and Social Aspects of Technology

Books

1) Teaching about Technology, Marc J. De Vries
2) Philosophy of Technology, Val Dusek
3) A Companion to the Philosophy of Technology Edited by Jan Kyrre Berg Olsen, Stig Andur Pedersen and Vincent F. Hendricks

ELE - G02T – Introduction to Electrical Technology

L – P

3– 0

Unit I

Introduction to DC circuits, Active and passive two terminal elements, Ohms law, Voltage-Current relations for resistor, inductor & capacitor, Kirchhoff's laws, Mesh analysis, Nodal analysis, Sinusoids, Generation of AC, Average and RMS values, Introduction to three phase systems types of connections, relationship between line and phase values

Unit II

Generation, Transmission and Distribution of Electrical Energy, Introduction to Power System, Single line diagram, impedance and reactance diagram of a power system, Single Phase and Three Phase Transmission, Overhead and Underground transmission System

Unit III

Working principle, construction and applications of DC machines and AC machines (1-phase transformers, single phase induction motors), introduction to alternators: Principle of operation and working

Unit IV

Symbols and sign conventions as mentioned in electricity rules, Safety measures in electrical system, Types of wiring: wiring accessories, staircase, fluorescent lamps & corridor wiring, Basic principles of earthing: Types of earthing, Wire jointing, Casing and capping, Wiring: Wiring of main distribution boards.

Unit V

Concept of measurement and measuring instruments, Types of electrical measuring instruments: Ammeters, Voltmeters, Extension of range of meters, Wattmeters, Energy Meters, Power Factor meter.

Books Recommended

- Electrical Engineering fundamentals by Deltoro, Prentice Hall India (PHI).
- Basic Electrical Engineering by D.P. Kothari. and I. J. Nagrath Tata McGraw - Hill.
- Basic Electrical and Electronics Engineering by S.K. Bhattacharya Pearson Education.

ELE – E01T - Network Analysis

L – P

4 – 0

Unit I

First order differential equation: Differential equations as applied in solving networks, Application of initial conditions, Evaluating initial conditions in networks, Laplace Transformation properties, Solution of Network problems with Laplace transformation, Wave form analysis and synthesis: The unit step, ramp and impulse functions and their Laplace transforms, Initial and final value of f (t) from f (S), Convolution integral, convolution as summation

Unit II

Network theorems and impedance functions: Complex frequency, transform impedance and transform circuits, series and parallel combinations of elements, Network Functions-poles and zeros: Network functions for one port and two port networks (ladder and general networks), Poles and zeros of network functions, Restriction on pole and zero locations for driving point and transfer functions, Time domain behaviour from pole zero plot

Unit III

Two port parameters: Relationship of two port parameters, Admittance, impedance, transmission and hybrid parameters, Relationship between parameter sets, Parallel connection of two port Networks, characteristics impedance of two port networks

Unit IV

Network synthesis- Synthesis problem formulation, properties of positive real functions, Hurwitz polynomials, properties of RC, LC and RL driving point functions, Foster and Cauer synthesis of LC and RC circuits

Unit V

Filter fundamentals – pass and stop band, filter classification, constant K & m derived filters, behaviour of characteristic impedance over pass & stop bands, design of filters

Books Recommended

1. Network Analysis by Van Valkenberg.
2. Network Analysis & Synthesis by F. Kuo.
3. Ryder JD, Networks, Fields & Lines.
4. Circuit Theory (Analysis & Synthesis) by A. Chakrabarti, Dhanpat Rai & Co.

ELE – E02T – Linear Algebra

L – P

4 – 0

UNIT I

Fields Vector spaces, Subspaces, Linear combinations and subspaces, Linear dependence and independence, Spanning Set and Basis, Finite dimensional spaces, Dimension.

UNIT II

Gaussian elimination, Solving Ax = b for square systems by elimination, pivots, multipliers, back substitution, invertibility of a, Mull Space and Range, Rank and nullity, Consistency conditions in terms of rank , General Solution of a linear system, Elementary Row and column operations, Row Reduced Form, LU Factorization, important Subspaces associsted with a matrix.

UNIT III

Inner product, Norms, Orthogonality, Orthonormalization by Grem-Schmidt (QR factorization), orthonormal basis, properties of determinants, cofactor formula, applications to finding inv (A).

UNIT IV

Eigenevalues and Eignevectors, characteristic equation, Cayley-Hamilton theorem, computing powers A^k and matrix exponentials to solve difference and differential equations.

UNIT V

Symmetric matrices, positive definite matrices, real eigenvalues and orthogonal eigenvectors, Linear transformations and change of basis, Singular Value Decomposition, orthonormal bases for diagonalisation.

Books Recommended:

1. Introduction to Linear Algebra by Gilbert Strang.
2. Linear Algebra: Step by Step: Kuldeep Singh

ELE – E03T – Signals and Systems

L – P

3 – 0

UNIT I

Classification of signals and systems: Introduction to signals and systems classification, basic operation on signals, elementary signals.

Systems: Definition, classification, systems viewed as interconnection of operations. Sampling theorem graphical and analytalical proof for band limited signal, sampling CT signals and aliasing.

UNIT II

Time domain representation of LTI systems: Differential and block diagram representation of LTI, impuse response and properties of LTI systems, Convolution integral, properties of convolution, laplace transform, properties ,ROC, Inversion of Laplace, Unilateral Laplace transform and its application to solve differential equations, relation between Laplace and fourier **.**

UNIT III

Analysis of continues time signal: Continuous time FT, applititude spectra of CT signals, properties of CTFT, convolution and multiplication property, system characterised by linear constant coefficient differential equation, limitation FT and need of ZT and LT.

UNIT IV

Analysis of discrete time signals and systems: DTFT and properties, Z transform , ROC ,properties of Z transform, inverse Z transform, poles and zeroes, relation between Z transform and Laplace transform, unilateral Z transform and its application to difference equation with non- zero initial condition**.**

Books

1) Signals and systems, Book by Alan V. Oppenheim

ELE- E04T - Renewable Energy Sources

L	P
4	0

UNIT I

Conventional & Non-conventional Energy resources, Energy problem, Energy & Environment, Need for renewable energy, Relevant energy conversion systems & Technologies, Electricity generation, Rural Energy.

UNIT II

Wind Energy: Principles of Power Generation from wind, site selection, wind speed & power duration curves, wind power system components, Wind-Diesel Hybrid systems & recent developments.

UNIT III

Solar Energy: Solar cell, principle and operation. Solar module & array, solar radiation, solar collectors – flat plate & concentrating collectors, solar water heaters & solar thermal power plants. solar wind Diesel system – operation & design. Miscellaneous Applications

UNIT IV

Electric Power Generation from Tidal, OTEC & Geothermal energy. Simple power plant based on Tidal / OTEC / Geothermal.
Direct Energy Conversion techniques, MHD & Thermo-Electric power generation.

UNIT V

Energy conservation, Energy conservation in Transport sector, rural energy, urban energy, Industrial energy, power generation & distribution, Energy efficient buildings, Energy audit, Typical case studies.

Books Recommended

1. Non-Conventional Energy Resources, R.K Singal, Dhanpat Rai Publications.
2. Energy Technology, S. Rao, B.B Parlekar, Khanna Publications.
3. Wind & Solar Power System, CRC Press.
4. Principle of Energy Conversion, Culp, McGraw Hill Publications.

ELE – E05T – Special Electrical Machines

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4	0

Unit I

SYNCHRONOUS RELUCTANCE MOTORS: Constructional features, Types, Axial and radial air gap motors – Operating principle, Reluctance, Phasor diagram, Characteristics, Vernier motor

Unit II

STEPPING MOTORS: Constructional features, Principle of operation, Variable reluctance motor, Hybrid motor, Single and multi stack configurations, Theory of torque predictions, Linear and non-linear analysis, Characteristics, Drive circuits

Unit III

SWITCHED RELUCTANCE MOTORS: Constructional features, Principle of operation, Torque prediction, Power controllers, Non-linear analysis, Microprocessor based control, Characteristics, Computer control

Unit IV

PERMANENT MAGNET BRUSHLESS D.C. MOTORS: Principle of operation, Types, Magnetic circuit analysis, EMF and torque equations, Power controllers, Motor characteristics and control

Unit V

PERMANENT MAGNET SYNCHRONOUS MOTORS: Principle of operation, EMF and torque equations,
Reactance, Phasor diagram, Power controllers, Converter , Volt-ampere requirements, Torque speed characteristics,
Microprocessor based control.

Books Recommended:

1. T. Kenjo, Stepping Motors and Their Microprocessor Controls", Clarendon Press London, 1984
2. T. Kenjo and S. Nagamori, Permanent Magnet and Brushless DC Motors", Clarendon Press, London, 1988.
3. T.J.E. Miller, Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989
4. P.P. Aearnley, Stepping Motors – A Guide to Motor Theory and Practice", Peter Perengrinus, London, 1982.

ELE - E06T Electronic Measurements and Instrumentation

L P
4 0

Unit I

Transducers: Theory, construction and use of various transducers (resistance, inductance, capacitance, electromagnetic, piezo electric type)

Unit II

Measurement of Displacement and Strain: Displacement Measuring Devices: wire wound potentiometer, LVDT, strain gauges and their different types such as inductance type, resistive type, wire and foil type etc. Gauge factor, gauge materials, and their selections, sources of errors and its compensations. Strain gauge bridges and amplifiers.

Unit III

Force and Torque Measurement: Different types of force measuring devices and their principles, load measurements by using elastic Transducers and electrical strain gauges. Load cells, proving rings. Measurements of torque by brake, dynamometer, electrical strain gauges.

Unit IV

Electronic Measurements: Digital Voltmeters and Multimeters, phase, time and frequency measurement, Oscilloscope.

Unit V

Data Acquisition Systems: Comments of Data Acquisitions system, sample and Hold circuits, different recorders: single channel and multi channel data acquisition system, Using DAC, ADC, Multiplexing.

Books Recommended

- A Course in Electrical and Electronic Instruments and Measurements, by A.K Sawhney, Dhanpat Rai & Sons, Delhi.
- Electronic Measruments and Instrumentation, Cooper

ELE – E07T – Advanced Control System

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4	0

UNIT I

Fields and Vector spaces; Linear independance and dependance; Basis and Dimension; Subspace; Representation using state variable methods; Similarity Transformation; Eigen values and Eigen vectors; Canonical forms; Conversion of State variable models to transfer functions and vice-versa;

UNIT II

Solution of state equations; Properties of state transition matrix- computation of state transition matrix by Laplace transformation and Cayley-Hamilton theorem; Concepts of Controllability and Observability.

UNIT III

Control System design using State variable methods Introduction, State variable feedback structure; Pole-placement design using state feedback; Limitations of State Feedback; State feedback with Integral control, Observer-based state feedback control;

UNIT IV

Introduction to Discrete-time control systems; Basic Discrete-time signals; State space representation of Discrete-time systems; Difference equation models; The z transform; The Pulse transfer function; s-Plane to z-Plane mapping, Stability on the z-plane and the Jury Stability criteria; Mathematical modelling of Impulse sampling and data hold.

UNIT V

Nonlinear Control Systems Non-linear Systems: Types of non-linearities, phenomena related to non-linear systems.
Analysis of non-linear systems: linearization, phase portraits, describing function method and feedback linearisation.
Stability: Lyapunov's stability theorems for continuous time systems.

Books Recommended:

- M.Gopal, Digital Control and State variable Methods.
- Stefani R., Savant C., Shahian B., Hostetter G., Design of Feedback Control Systems
- Discrete-time systems, K. Ogata.
- Optimal Control Systems, D.S. Naidu.
- Applied nonlinear control, Jean-Jacques Slotine, Weiping Li.

ELE – E08T – Optimal Control

L	P
4	0

UNIT I

Introduction: formulation of optimal control problems; parameter optimization versus path optimization; local and global optima; general conditions on existence and uniqueness; finite-dimensional optimization.

UNIT II

Calculus of variations: Euler-Lagrange equation; path optimization subject to equality and inequality constraints; differences between weak and strong extrema; second-order conditions for extrema.

UNIT III

The maximum principle : Pontryagin's maximum principle; optimal control with state and control constraints; time-optimal control; singular solutions; numerical methods.

UNIT IV

Hamilton-Jacobi-Bellman equation: Hamilton-Jacobi-Bellman equation, relationship with dynamic programming; sufficient conditions for optimality; synthesis of optimum state regulator systems; numerical methods.

UNIT V

Linear quadratic problems: basic finite-time and infinite-time state regulator ; spectral factorization, robustness, frequency weightings; tracking and disturbance rejection; the Kalman filter and duality.

Books Recommended:

1) D.S. Naidu, Optimal control systems.
2) D. Liberzon, Calculus of Variations and Optimal Control Theory: A Concise Introduction.
3) Donald Kirk, Optimal Control Theory: An Introduction.

ELE – E09T – Advanced Power Electronics

L	P
4	0

Unit-1

Switched -Mode Power Supplies (SMPS), Advantages of Switching Power Supplies over Linear Power Supplies.

Unit-2

Non-Isolated DC-DC Converters: DC-DC Buck Converter, DC-DC Boost Converter, DC-DC Buck Boost Converter, DC-DC Cuk Converter.

Unit-3

Isolated DC-DC Converters; DC-DC Flyback Converter, DC-DC Forward Converter, DC-DC Push-Pull Converter, DC-DC Half Bridge Converter, DC-DC Full Bridge Converter.

Unit-4

Design aspects of Magnetics for DC-DC Converters, PWM Techniques for DC-DC Converter.

Unit-5

Uninterruptible Power Supply (UPS): Off Line UPS, On- Line UPS, Rating of Battery Bank, Calculation of Back-up-time. Introduction to AC-DC Improved Power Quality Converters.

Books Recommended:

1. Power Electronics Converters, Applications, and Design by Mohan, Undeland, Robbins Wiley Indian Edition.
2. Power Electronics by M. H. Rashid
3. Power Electronics and Motor Drives: Advances and Trends by Bimal K. Bose Academic Press
4. FACTS Controllers by Hingorani
5. IEEE Transactions on Power Electronics & Industrial Electronics

ELE - E10T - Flexible AC Transmission Systems (FACTS)

L	P
4	0

UNIT I

Introduction to FACTS, Need of FACTS Controllers and its Objectives, Need of transmission interconnections, power flow in AC systems power flow and dynamic stability considerations, Relative importance of controllable parameters, Basic types of FACTS controllers Brief description & definitions ,Benefits from FACTS technology

UNIT II

Introduction to shunt compensation Objectives of Shunt compensation Voltage control by SVC, V-I characteristics, Influence of SVC on system voltage, SVC applications, Prevention of voltage instability, STATCOM , Comparison of SVC & STATCOM

UNIT III

Introduction to series compensation, Objectives of series compensation, Operation of TCSC: Different modes of operation, Modelling of TCSC: variable reactance model, Transient stability model, TCSC Applications, Improvement of system stability limit, voltage collapse prevention, TSSC, GCSC.

UNIT IV

Basic concept of voltage source converters and current source converter SSSC, principle of operation, Applications, UPFC: Modes of operation , Applications, Introduction to IPFC.

UNIT V

Introduction to TCPAR, TCVR, TCBR & their applications, Industrial applications of FACTS devices.

Books Recommended

1. Narain G. Hingorani and Laszl Gyugyi, "Understanding FACTS – Concept &technology of flexible AC transmission systems", Standard publishers distributors, IEEE press.
2. Padiyar. K.R," FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008.

ELE – E11T – Power System Operation and Control

L	P
4	0

Unit-1: INTRODUCTION
Basic Review of Physical Structure of power system, Operation and Control Functions and Hierarchies Design and Operating Criteria.

Unit-2: OPTIMAL SYSTEM OPERATION
Optimal System Operation and Unit Commitment. Economic load dispatch studies, Development of loss formula for optimum load dispatch, Optimum power dispatches in hydrothermal power systems: short and long range scheduling.

Unit-3: CONTROL OF VOLTAGE AND REACTIVE POWER
Mechanism of real and reactive power control. Control of voltage, frequency and tie-line power flows, Q-V and P-f control loops, FACTS and HVDC. Single and multi-area AGC. Net interchange tie-line bias control.

Unit-4: POWER SYSTEM SECURITY
Introduction, factors affecting power system security, Security analysis, Contingency Selection, Techniques for contingency evaluation-D.C. load flow and fast decoupled load flow. Emergency control, preventive control and Restorative Control.

Unit-5: ENERGY CONTROL CENTERS AND LOAD DISPATCH CENTRE FUNCTIONS
Energy Control Centers, load dispatch centers. Online computer control, SCADA, Data acquisition systems.

Books:

1. R.N. Dhar: Computer Aided P.S Operation and Analysis.
2. D. P. Kothari, I. J. Nagrath: Modern Power System Analysis, TMH
3. Haadi Sadat: Power system Analysis, TMH, India.
4. K. R. Padiyar: HVDC Power Transmission System Technology and System Interaction; Wiley Eastern.
5. K. R. Padiyar: FACTS Controllers in Power Transmission and Distribution. New Age International, 2009.

ELE - E12T - Optimization Techniques

L	P
4	0

Unit I

Introduction, Optimization problem formulation, optimization algorithms, applications and examples, different optimization methods available.

Unit II

Single Variable optimization-Optimization criteria, bracketing methods – Exhaustive search method, bound phase method; Region Elimination methods – Fibonacci search method, Golden search method; Gradient based methods – Newton Raphson method, Bisection method; Root finding using optimization technique.

Unit III

G Multi objective optimization- Optimization criteria, Different search methods, Unidirectional search, Direct search method,Evolutionary optimization method, Powell"s conjugate direction method; Gradient based methods, Newton"s method and Variable metric method.

Unit IV

Specialized Methods- Integer programming, Geometric programming, simulated annealing, Global optimization using - steep descent method, simulated annealing.

Unit V

Genetic algorithms and evolutionary approaches-Differences and similarities between genetic algorithms and traditional techniques, operators of GA"s, Computer program for simulated annealing, Newton Raphson method, Evolutionary optimization method.

Books Recommended

1. Kalyanmoy Deb, "Optimization for Engineering design", Prentice Hall, India.
2. Kalyanmoy Deb, "Multi objective optimization using Evolutionary algorithms", John Wiley.
3. Taha, Operations Research, TMH.
4. S. Rao , Optimization Techniques

ELE – E13T – Electrical Drives

L	P
4	0

UNIT I

Definition of Electric Drive, Structure and Elements of an Electric Drive, classification of Electric Drives Advantages of Electrical Drives, Types of Loads, Quadrant Diagrams, Four quadrant operation, Power requirement of different loads, Drive specifications.

UNIT II

Multi-Quadrant operation of separately-excited D.C Motor with regenerative braking, Transfer functions of separately excited D.C Motor, Single-phase converter-fed separately excited D.C Motor Drives, Mathematical Analysis and Torque/speed characteristics, performance evaluation (in Continuous Conduction Mode and Discontinuous Conduction Mode), Methods of improving the performance of DC Motor Drives, Three-phase converter fed DC Motor Drives (in Continuous Conduction Mode and Discontinuous Conduction Mode),

UNIT III

Motoring and regeneration operation of chopper-fed separately-excited DC Motor Drive, Chopper-fed series motor drive, Dynamic braking, Composite braking, Two quadrant and Four quadrant operation of chopper-fed DC Motor Drives

UNIT IV

3-phase AC voltage controller-fed Induction Motor drive, voltage source inverter (VSI) and current source inverter (CSI) variable frequency drives, comparison of VSI and CSI drives, Cyclo-converter fed Induction Motor drive, static rotor resistance control of 3-phase slip ring Induction Motor.

UNIT V

Control of synchronous Motor: Self-controlled synchronous motor, vector controlled synchronous motor, Permanent Magnet Synchronous Motor Drive, Brushless DC Motor Drive, Switched Reluctance Motor (SRM) Drive.

Books Recommended:

1. An Introduction to Electrical Drives by G.K. Dubey.
2. Power Semi-conductor controlled Drives by G.K. Dubey
3. Power Electronic Control of A.C Motors by Murphy & Turnbull
4. Power Electronics and A.C Drives by B.K. Bose

ELE – E14T- Power System Planning and Load Forecasting

L – P

4 – 0

UNIT I: Load Forecasting

Load Forecasting Categories-Long term, Medium term, short term, very short term Applications of Load Forecasting, Factors Affecting Load Patterns Medium and long term load forecasting methods- end use models, econometric models, statistical model based learning. Short Term Load Forecasting (STLF): Applications of Load Forecasting

UNIT II: Power System Reliability

Basic Notions of Power System Reliability- sub systems, reliability indices, outage classification, value of reliability tools, Concepts and methodologies, power system structure, Reliability based planning in power systems, Effect of failures on power system, Planning criteria

UNIT III: Basic Tools and Techniques

Random processes methods & Markov models, Computation of power system reliability measures by using Markov reward models, Evaluation of reliability indices, Universal Generating Function (UGF) Method, Monte Carlo simulation.

UNIT IV: Reliability of Generation Systems

Capacity outage calculations, reliability indices using the loss of load probability method, unit commitment and operating constraints, optimal reserve management, single and multi-stage expansion.

UNIT IV: Reliability Assessment for Elements of Transmission and Transformation Systems

Reliability indices of substations based on the overload capability of the transformers, evaluation and analysis of substation configurations, Reliability analysis of protection systems for high voltage transmission lines

Books Recommended:

1. Markey operations in electric power systems Forecasting, Scheduling, and Risk Management, Shahidehpour M Yamin, H Li z, John Wiley & sons

2. Reliability evaluation of power systems, Billinton R, Allan R (1996) Plenum Press New York 3. Computational Methods in Power system Reliability, D. Elmakias, Springer-Verlag

ELE – E15T – Power Station Practice

L	P
4	0

Unit I

Overview of different types of power stations and their auxiliaries: Thermal power plants, hydroelectric stations, nuclear power stations, diesel power stations, gas turbine plants. Power generation terms: Connected load, Maximum Demand, Demand Factor, Load factor, Diversity factor, Load duration curve, Number and size of generator units, base load and peak load plants.

Unit II

Economics of generation, factors affecting the cost of generation, reduction of costs by interconnection of stations, curves useful in system operation, choice of size and number of generating units. Power factor, disadvantages of low power factor, methods of improving power factor, location of power factor improvement apparatus

Unit III

Tariffs in Electrical energy, factors influencing the rate of tariff, designing tariff, different types of tariff, flat rate tariff, block rate tariff, two part tariff, maximum demand tariff, power factor tariff.

Unit IV

Neutral grounding, solid grounding, resistance grounding, reactance grounding, arc suppression coil grounding, earthing transformers, choice of methods of neutral grounding equipment, grounding for safety. Maintenance schedule of various electrical equipments: Alternators, Transformers, Circuit Breakers.

Unit V

Introduction, classification of substations, equipments for substations, selection and location of site for substation, Key diagram of typical substations, substation auxiliary supply, substation earthing.

Books Recommended:

1. Electric power stations by Car.
2. Electric power system control by H.P. Young.
3. Elements of Power Station design by M.V. Deshpande
4. Generation of Electrical Energy by B.R.Gupta

ELE – E16T – Nonlinear Systems

L	P
3	0

Introduction to nonlinear systems: Examples of phenomena, models and derivation of system equations. Fundamental properties: Existence and uniqueness, Dependence on initial conditions and parameters. Phase plane analysis. Limit cycles and oscillations. Describing function method and applications. Circle criterion. Lyapunov stability of autonomous systems. Perturbation theory and Averaging. Singular perturbation model and stability analysis. Basic results on Lie algebra. Controllability and Observability of nonlinear systems. Bifurcations. Chaos. Synchronization.

Books

• H. K. Khalil, Nonlinear systems, 3rd edition, Prentice Hall, 2001.
• J. J. E. Slotine and W. Li, Applied nonlinear systems, Prentice Hall, 1991.
• A. Nijemjer and A. van der schaft, Nonlinear dynamical control systems, Springer, 1989.
• M. Vidyasagar, Nonlinear Systems Analysis, Society for Industrial and Applied Mathematics, 2002.
• S. Strogatz, Nonlinear Dynamics and Chaos, Westview Press, 2001.

ELE - E17T - EHV AC and DC Transmission

L	P
4	0

UNIT I

Introduction-Necessity for EHV Transmission-Problems involved in EHV Transmission-Operational Aspects of EHV power transmission-Compensation of EHV systems, Environmental and biological aspects

UNIT II

Standard Voltage levels for Transmission lines, -Average values of line parameters -Cost of Transmission line and Equipments-Mechanical consideration inline performance-Comparison of Overhead and Underground lines

UNIT III

Power Transferability of Ac line – Line losses- Transient stability of Ac line – control of power flow through line Right – of- way(R.O.W)-Corona-Towers(support)-Insulation Coordination and surge arrester protection-Clearance and Creepage distances

UNIT IV

Choice of HVDC Transmission, Comparison of AC and DC Transmission –Economics of DC power Transmission, Description of HVDC Converter station- Types of HVDC Links- Merits and Limitations of HVDC System, Applications

UNIT V

Pulse number – Choice of Converter Configuration – Simplified analysis of Graetz circuit(6-pulse and 12 -pulse converter) – Principles of HVDC link Control, Protection Systems in HVDC Substation.

Books Recommended

1. Rakosh Das Begamudre, "Extra High Voltage AC Transimission Engineering",Third Edition , New Age International.
2. Direct Current Transmission, Kimbark.
3. Padiyar. K.R "HVDC Power Transmission Systems", New Age International.
4. Chakrabarti.AM.L.Soni, P.V.Gupta, U.S.Bhatnagar, "Power SystemEngineering", DhanpatRa i& Co.
5. Sunil S.Rao, "Switchgear Protection and Power Systems", Khanna Publishers

ELE – E18P – Advanced Control System Lab

L	P
0	2

Experimental demonstration of various concepts of control system design (controllers and observers) using state space methods, Digital Control system analysis and design, Microprocessor based control, Demonstration of nonlinear control on standard problems like inverted pendulum, Experiments on system identification, Control system analysis and design using MATLAB / SIMULINK.

ELE – E19T – High Voltage Engineering

L	P
4	0

UNIT I

Causes of over voltages and their effects on power system – Lightning, switching and temporary over voltages – protection against over voltages – Insulation coordination

UNIT II

Gaseous breakdown in uniform and non-uniform fields – corona discharges –Vacuum breakdown – conduction and breakdown in pure and commercial liquids– breakdown mechanisms in solid and composite dielectrics.

UNIT III

Generation of high DC voltages - multiplier circuits –Van de Graff generator – high alternating voltage generation using cascade transformers-production of high frequency AC high voltages-standard impulse wave shapes-Marx circuit generation of switching surges - impulse current generation-tripping and control of impulse generators.

UNIT IV

HVDC measurement techniques – measurement of power frequency A.C voltages sphere gap measurement technique-potential divider for impulse voltage measurements – measurement of high D.C, A.C and impulse currents

UNIT V

Tests on insulators-testing of bushings-testing of isolators and circuit breakers cable testing- testing of transformers-surge diverter testing -radio interference measurement-use of I.S for testing.

Books Recommended

1 .Naidu.M.S, and Kamaraju, "High Voltage Engineering", Tata McGraw Hill,2009.
2. Wadhwa.C.L, "High Voltage Engineering", Wiley Eastern Limited, 2007.
3. Kuffel.E and Abdullah. M, "High Voltage Engineering", Pergamon Press,2000.
4. Dieter Kind, "An Introduction to High Voltage Experimental Technique", Wiley Eastern Limited, 1978.
5. RavindraArora, Wolfgang Mosh, "High Voltage and Electrical Insulation Engineering", Wiley-VCH Publishers, 2011.