DR. A P J ABDUL KALAM UNIVERSITY, INDORE

SYLLABUS

of

BACHELOR OF ENGINEERING

(Electrical & Electronics Engineering)

(Second Year, Grading System)

(Session July- December 2017)

College of Engineering

Dr. A P J Abdul Kalam University, Indore

DR. A P J ABDUL KALAM UNIVERSITY, INDORE

Syllabus for Bachelor of Engineering

(Electrical & Electronics Engineering)

List of Subject (Second Year, Grading System)

Sub Code: MA-220 **Sub Name:** Mathematics-III **4 Credits**

Unit-1 Fourier Series

Fourier Series for Continuous & Discontinuous Functions, Expansion of odd and even periodic functions, Half range Fourier series, Complex form of Fourier Series.

Unit-2 Fourier Transform

Complex Fourier Transform, Fourier Sine and Cosine Transforms, Applications of Fourier Transform in Solving the Ordinary Differential Equation.

Unit-3 Laplace Transform

Introduction of Laplace Transform, Laplace Transform of elementary Functions, Properties of Laplace Transform, Change of Scale Property, First and Second Shifting Properties, Laplace Transform of Derivatives and Integrals. Inverse Laplace Transform & its Properties, Convolution theorem, Applications of Laplace Transform in solving the Ordinary Differential Equations.

Unit-4 Functions of Complex Variables

Analytic functions, Harmonic Conjugate, Cauchy-Riemann Equations, Line Integral, Cauchy's Theorem, Cauchy's Integral Formula, Singular Points, Poles & Residues, Residue Theorem , Application of Residues theorem for Evaluation of Real Integrals.

Unit-5 Vector Calculus

Differentiation of Vectors, Scalar and Vector Point functions, Gradient, Directional derivative, Divergence and Curl. Line Integral, Surface Integral and Volume Integral, Stoke's Theorem and Gauss divergence theorem. COURSE OUTCOMES- The curriculum of the Department is designed to satisfy the diverse needs of students. Coursework is designed to provide students the opportunity to learn key concepts of Fourier Series, Different Transforms, Complex Analysis & Vector Calculus.

References:

[1] Erwin Kreyszig: Advanced Engineering Mathematics, Wiley India.
[2] H C Taneja: Advanced Engineering Mathematics, I.K. International Publishing House Pvt. Ltd.
[3] C B Gupta & S R Singh : Engineering Mathematics , Mc Graw Hill Education.
[4] S S Sastri: Engineering Mathematics, PHI
[5] Ramana: Advance Engg. Mathematics, TMH New Delhi.
[6] Engineering Mathematics By Samnta Pal and Bhutia, Oxford Publication

Sub Code: EX-221 **Sub Name:** Electrical Measurements and Instrumentation **4 Credits**

Unit 1: Introduction

Fundamentals of Measurement system, Static and Dynamic Characteristics of measurement systems: Systematic Characteristics, Generalized model, Transfer function, Techniques for dynamic compensation, Accuracy of measurement systems in steady state: Measurement error, Error probability function, Error reduction techniques, Reliability, Choice and Economics of measurement systems. Loading effects due to shunt connected and series connected instruments, calibration curve, Testing & calibration of instruments.

Unit 2: Instruments

Galvanometers - Theory, principle of operation and construction of ballistic galvanometer, D'arsonal galvanometer, Definition of analog & digital instruments, Classification of analog instruments, their operating principle, Operating force.

Different types of Ammeter & Voltmeter – PMMC, MI, Electrodynamometer, Induction, Expression for control & deflection torque, their advantages, disadvantages & error, Extension of range of instruments using shunt & multiplier. Digital Voltmeter, Ammeter, Multimeter and Wattmeter.

Instrument transformers: Potential and current transformers, ratio and phase angle errors, testing of instrument transformers, Difference between CT and PT, errors and reduction of errors.

Unit 3: Measurements-I

Measurement of power- Power in AC and DC Circuit, Electrodynamometer type of wattmeter, Construction, theory, operation & error, Low power factor & UPF wattmeter, Double element and three element dynamometer wattmeter, Measurement of power in three phase circuit, one, two & three wattmeter method, Measurement of reactive power by single wattmeter, Measurement of power using CTs & PTs.

Measurement of Energy: Single phase and three phase digital / Electronic energy meter – construction & operation – Energy flow and power calculations, errors – Testing by phantom loading, Tri-vector meter, Maximum demand meter, Ampere hour meter.

Unit 4: Measurements-II

Resistance Measurement – Classification of low, medium & high resistance – Voltmeter Ammeter method, Wheatstone Bridge, Kelvin's double bridge & loss of charge methods for resistance measurement, Earth resistance measurement.

Magnetic Measurement – B-H Curve, Hysteresis Loop determination, Power loss in sheet metal – Lloyd Fischer square for measurement of power loss.

Unit 5: Power factor meter

Single phase and three phase Electro-dynamometer type & moving iron type. Frequency meter – Vibrating reed, Resonance type & Weston type, Synchronoscope, Ohmmeter –series & stunt type, Megger & Ratio meter.

Text book:-

1.A.K. Sawhney; 'A course in Electrical & Electronic Measurements & Instrumentation'; Dhanpat Rai & co(p) Ltd ,New Delhi.

References:

[1] G. K. Banerjee,' Electrical and Electronic Measurements'. PHI Learning Pvt.Ltd.

[2] R. B. Northrop,' Introduction to Instrumentation and Measurement'; CRC press Taylor & Francis

[3] Vijay Singh;' Fundamentals of Electrical & Electronic Measurements', New Age International Publishers. http://www.rgpvonline.com D

Topics for the laboratory (Expandable):

[1] Measurement of low resistance using Kelvin's Double bridge

[2] Measurement of medium resistance using Wheatstone's bridge

[3] Measurement of high resistance by loss of charge method

[4] Measurement of Insulation resistance using Megger

[5] Measurement of earth resistance by fall of potential method and verification by using earth tester

[6] Measurement of power in a single phase ac circuit by 3 voltmeter/ 3 Ammeter method

[7] Calibration of a dynamometer type of wattmeter with respect to a standard/Sub Standard wattmeter 8. Calibration of single phase digital/ Electronic type energy meter.

[9] Calibration of a dynamometer type of wattmeter by Phantom Loading method.

[10] Measurements using Instrument Transformers.

[11] Study of various types of Indicating Instruments.

[12] Measurement of Power in three phase circuit by one, two & three wattmeters.

Sub Code: EX-222 **Sub Name:** Network Analysis **4 Credits**

Unit 1: Introduction

Introduction to circuit elements R,L,C and their characteristics in terms of linearity & time dependant nature, voltage & current sources controlled & uncontrolled sources KCL and KVL analysis, Nodal & mesh analysis, analysis of magnetically coupled circuits, Transient analysis :- Transients in RL, RC&RLC Circuits, initial conditions, time constants. Steady state analysis- Concept of phasor & vector, impedance & admittance, Network topology, concept of Network graph, Tree, Tree branch & link, Incidence matrix, cut set and tie set matrices, dual networks, Dot convention, coupling coefficient, tuned circuits, Series & parallel resonance.

Unit 2 : Network Theorems for AC & DC circuits

Thevenins & Norton's, Superpositions, Reciprocity, Compensation, Substitution, Maximum power transfer, and Millman's theorem, Tellegen's theorem, problems with dependent & independent sources.

Unit 3: Frequency domain analysis

Laplace transform solution of Integro-differential equations, transform of waveform synthesized with step ramp, Gate and sinusoidal functions, Initial & final value theorem, Network Theorems in transform domain

Unit 4: Concept of signal spectra

Fourier series co-efficient of a periodic waveform, symmetries as related to Fourier coefficients, Trigonometric & Exponential form of Fourier series.

Unit 5: Network function & Two port networks

Concept of complex frequency, Network & Transfer functions for one port & two ports, poles and zeros, Necessary condition for driving point & transfer function. Two port parameters – Z,Y, ABCD, Hybrid parameters, their inverse & image parameters, relationship between parameters, Interconnection of two ports networks, Terminated two port network.

References:

[1] M.E. Van Valkenburg, Network Analysis, (PHI)
[2] F.F.Kuo, Network Analysis.
[3] Mittal GK; Network Analysis; Khanna Publisher
[4] Mesereau and Jackson; Circuit Analysis- A system Approach; Pearson.
[5] Sudhakar & Pillai; Circuit & Networks- Analysis and Synthesis; TMH
[6] Hayt W.H. & J.E. Kemmerly; Engineering Circuit Analysis; TMH
[7] Decarlo lin; Linear circuit Analysis; Oxford
[8] William D Stanley : Network Analysis with Applications, Pearson Education
[9] Roy Choudhary D; Network and systems; New Age Pub
[10] Charles K. Alexander & Matthew N.O. Sadiku: Electrical Circuits :TMH
[11] Chakraborti :Circuit theory: Dhanpat Rai.

Topics for the laboratory (Expandable):

[1] To Verify Thevenin Theorem.

[2] To Verify Superposition Theorem.

[3] To Verify Reciprocity Theorem.

[4] To Verify Maximum Power Transfer Theorem.

[5] To Verify Millman's Theorem.

[6] To Determine Open Circuit parameters of a Two Port Network and to Determine Short Circuit parameters of a Two Port Network.

[7] To Determine A,B, C, D parameters of a Two Port Network

[8] To Determine h parameters of a Two Port Network

[9] To Find Frequency Response of RLC Series Circuit.

[10] To Find Frequency Response of RLC parallel Circuit.

Sub Code: EX-223T **Sub Name:** Analog Electronics **4 Credits**

Unit 1: Semiconductor Diodes:

Theory of P-N junction, temperature dependence and break down characteristics, junction capacitances, Zener diode, Varactor diode, Tunnel diode, PIN diode, LED, Photo diode, Schottky diode, Diode applications: series –parallel configurations, full wave and half wave rectification, voltage multiplier circuits, diode testing.

Unit 2: Transistors:

BJT, types& configuration, working principal, characteristics, and region of operation, load line, biasing methods, Small signal analysis of transistor (low frequency) using h-parameters, thermal runaway and thermal stability. FET, MOSFET, Transistor as an amplifier, gain, bandwidth, frequency response.

Unit 3: Feedback amplifier and Oscillators:

Feedback amplifier, negative feedback, voltage-series, voltage shunt, current series and current shunt feedback, Sinusoidal oscillators, L-C (Hartley Colpitts) oscillators, RC phase shift, Wien Bridge, and Crystal oscillators. Power amplifiers, class A, class B, class A B, C amplifiers, their efficiency and power Dissipation, Push-pull and complimentary symmetry push-pull amplifier.

Unit 4: Wave shaping circuits:

Switching characteristics of diode and transistor turn ON, OFF time, reverse recovery time, transistor as switch, Multivibrators, Bistable, Monostable, Astable multivibrators. Clipper and clamper circuit, Differential amplifier, calculation of differential, common mode gain and CMRR using h- parameters, Darlington pair, Boot strapping technique. Cascade and cascade amplifier.

Unit 5: Operational Amplifier:

Operational amplifier basics, practical Op-amp circuits & characteristics, slew rate , bandwidth, offset voltage ,basic current, application, inverting, non- inverting amplifier, summer, average, differentiator, integrator, differential amplifier, instrumentation amplifier, log and antilog amplifier, voltage to current and current to voltage converters, comparators Schmitt trigger , active filters, 555 timer and its application.

References:

[1] Robert L Boylestad, Louis Nashelsky; Electronic Devices and Circuits; Pearson
[2] Jacob Millman, Cristos C Halkias, Satyabrata Jit; Electronic Devices and Circuits; McGraw- Hill
[3] Anil K Maini, Electronic Devices and Circuits, Wiley
[4] S Salivahanan, N Suresh Kumar; Electronic Devices and Circuits; McGraw- Hill

Topics for the laboratory (Expandable):

[1] Design & measure the frequency response of an RC coupled amplifier using discrete components.

[2] Design a two stage RC coupled amplifier and determine the effect of cascading on gain and bandwidth.

[3] Study the effect of voltage series, current series, voltage shunt and current shunt feedback on amplifier using discrete components.

[4] Design & realize inverting, non-inverting and buffer amplifier using 741 op-amps.

[5] Verify the operation of a differentiator circuit using op amp IC 741 and show that it acts as a high pass filter.

[6] Verify the operation of a integrator circuit using op amp 741 and show that it acts as a low pass filter. 7. Design & Verify the operation of adder and subtractor circuit using op amp 741.

[8] Plot frequency response of AC coupled amplifier using op amp 741 and study the effect of negative feedback on the bandwidth and gain of the amplifier.

[9] Study of IC 555 as astable and monostable multivibrator.

[10] Design & realize using op amp 741, wein-bridge oscillator

Sub Code: EX-224 **Sub Name:** Signals and Systems **4 Credits**

Unit 1: Classification of signals and systems:
Continuous time signals (CT signals), Discrete time signals (DT signals) - Step, ramp, pulse, impulse, sinusoidal and exponential signals, basic operations on signals, classifications of CT and DT signals- Periodic and a periodic signals, energy and power signals, random signals, CT systems and DT systems, basic properties of systems, basic properties of systems, linear time invariant systems and properties.

Unit 2: Analysis of continuous time signals:
Time and frequency domain analysis, Fourier series analysis, spectrum of CT signals, Fourier transform and Laplace transform, region of convergence, wavelet transform.

Unit 3: Linear time invariant continuous time systems:
Differential equations representation, block diagram representation, state variable representation and matrix representation of systems, impulse response, step response, frequency response, reliability of systems, analog filters.

Unit 4: Analysis of discrete time signals:
Convolution sum and properties, sampling of CT signals and aliasing, DTFT and properties, Z transform and properties, inverse Z transform.

Unit 5: Linear time invariant discrete time systems:
Differential equations. Block diagram representation, impulse response, analysis of DT LTI systems using DTFT and Z transform, state variable equations and matrix representation of systems, Digital filters.

References:

[1] Alan V. Oppenheim, Alan S. Willsky, S Hamid Nawab, 'Signals and Systems', 2nd edition 2015 Pearson New International Edition
[2] A. Anand Kumar, Signals and Systems, PHI, III edition, 2015
[3] Mahmood Nahvi, Signals and Systems, McGraw Hill
[4] Simon Haykins and Barry Van Veen, Signals and Systems, Wiley India
[5] A. Nagoor Kani; 'Signals and Systems' McGraw Hill
[6] Robert A. Gabel and Richard A.Roberts, Signals & Linear Systems, Wiley.
[7] Rodger E. Ziemer, William H. Tranter, D. Ronald Fannin. Signals & systems, Pearson Education.

Sub Code: HU-220 **Sub Name:** Communication Skills **2 Credits**

Introduction: Communication, definition and role of communication, Process of communication, Importance of professional communication, Levels of communication, Types of communication, Challenges in communication. Non-verbal communication – Body language, personal appearance, posture, gesture and hand movement, eye contact, facial expressions, paralinguistic features - proxemics, haptics, chromatics. Oral presentations. Case studies.

References:

[1] Business Communication, Mc Graw Hill Education, Matthukutty M. Monippally.
[2] Effective Business Communication , Mc Graw Hill Education, Neera Jain, Shoma Mukherji.
[3] Technical Communication , Cengage , P. Subba Rao, B. Anita Kumar, C. Hima Bindu.
[4] Business Correspondence & Report Writing , Mc graw Hills. , R.C. Sharma & Krishna Mohan .
[5] Technical Communication – Principles & Practice , Oxford , Meenakshi Raman.
[6] Business Communication- Mc graw Hills , Peter Cordom.
[7] Communication Skills , Oxford , Sanjay Kumar & Pushpa TMH.
[8] Effective Technical Communication , M. Ashraf Rizvi ,Mc Graw Hill Education.

Language Lab II

Module 1 : Reading comprehension
Module 2 : Role plays
Module 3 : Debate
Module 4 : Group discussion
Module 5 : Resume writing
Module 6 : Interview skills
Module 7 : Body language
Module 8 : Oral presentations

Sub Code: EX-225 **Sub Name:** Electrical Machine-I **4 Credits**

Unit 1Transformer-I:

Working principle, e.mf. Equation, construction, phasor diagrams, equivalent circuit, voltage regulation, losses, separation of hysteresis and eddy current losses, efficiency, tests: open circuit and short circuit, load, Sumpner's test, Condition for maximum efficiency and regulation, Power and distribution transformer, all day efficiency, Excitation phenomenon. Autotransformer: working, advantages, its equivalent circuit and phasor diagram.

Unit 2 Transformer-II:

Three phase transformer: its construction, groups and connections, their working and applications; Scott connection; Parallel operation of Transformers: application, advantages, requirement and load sharing; Tap changers, cooling, conservator and breather. Pulse and high frequency transformers.

Unit 3 Three phase Induction Motor- I:

Working principle, construction, comparison of slip ring and squirrel cage motors, steady state analysis, phasor diagram and equivalent circuit, power flow diagram, torque-speed and power-speed characteristics, Losses and efficiency, No load and block rotor test, circle diagram

Unit 4 Three phase Induction Motor-II:

Starting of squirrel cage and slip ring motors, power factor control, Cogging & Crawling, Double cage &Deep bar Indication Motor, impact of unbalanced supply and harmonics on performance, speed control, braking, Induction Generator. Applications

Unit 5 Single Phase Motors:

Single Phase Induction motor; double revolving field theory, equivalent circuit and its determination, performance calculation, starting methods and types of single phase Induction motors: their working principle and applications, comparison with three phases Induction Motor. Single phase A.C. series motor, Servo motors, Linear Induction Motor

Text Books

[1] Electrical Machines by Nagrath and Kothari, McGraw-Hill.

[2] P.S.Bimbhra, Electrical Machines, Khanna Publishers.

References:

[1] V.Del Toro, "Electrical Machines & Power Systems", 1985, Prentice-Hall, Inc., EnglewoodCliffs
[2] S K Bhattacharya, Electrical Machines, McGraw-Hill

[3] Ashfaq Hussain, Electrical Machines, Dhanpat Rai & Co
[4] Langsdorf, A.C. Machines, McGraw-Hill
[5] Samarajit Ghosh, Electrical Machines, Pearson

List of Experiments (expandable):

[1] Perform turn ratio and polarity test on 1-phasetransformer.

[2] Perform load test on a 1-phase transformer and plot its load characteristics.

[3] Perform OC and SC tests on a 1-phase transformer and determine its equivalent circuit. Also find its efficiency and regulation at different load and power factor.

[4] Perform OC and SC tests on a 3-phase transformer and determine its equivalent circuit. Also find its efficiency and regulation at different load and power factor.

[5] Perform Sumpner's test on two 1-phase transformer and determine its efficiency at various load.

[6]Perform No-load and block rotor test on a 3- phase IM and determine its equivalent circuit.

[7] Perform load test on a 3- phase IM and plot its performance characteristics.

[8] Study various types of starters used for 3- IMs.

[9] Perform No-load and block rotor test on a 1- phase IM and determine its equivalent circuit.

Unit 1Number Systems and Codes:

Digital number systems, base conversion, Binary, Decimal, octal, Hexadecimal, number system with radix r, Gray codes. Alphanumeric codes – ASCII code and BCD codes, concept of parity, complementr's& (r-1)'s, subtraction with complements, signed Binary numbers, Error Detecting & Correcting codes. Basic Theorems & Properties of Boolean algebra: AND, OR, NOT operators, laws of Boolean algebra, Demorgon's theorem, Boolean expression & logic diagram. Negative logic, Alternate logic gate representation (concept of bubbled gates) canonical and standard Forms (Minterms&Maxterms), sum of minterms& product of maxterms, conversion between canonical forms. Truth table & maps, 2,3,4,5 and 6 variable maps, solving digital problems using Maps, Don't care conditions, Tabular minimization. Sum of product & product of sum reduction, Exclusive OR & Exclusive NOR circuits, Parity generator &checkers.

Unit 2 Combinational Circuits:

Design procedure, Adders (half and Full), subtractor (half and full) code convertors, Analysis of design, Universal building blocks, Implementation of any logic circuit with only NAND gates or with only NOR gates, Binary serial adder, parallel adder, serial/parallel adder, look ahead carry generator, BCD adder, Binary multiplier, Magnitude comparator, Decoder, Demultiplexer, Encoders, priority encoder, Multiplexers & implementation of combinational logic diagram.

Unit 3 Sequential Logic Circuit :

Latches, SR latch with NAND & NOR gates, D latch, edge triggered flip flop, J-K flip flop, T flip flop, Master slave flip flop, Analysis of clocked sequential circuit, state table, state diagram, state reduction state equations, state assignments, flip flop excitation table & characteristic equations, Design procedure for sequential circuits, Design with state reduction, Applications of flipflop.

Unit 4 Registers and Counters :

Asynchronous and Synchronous counter, counters with MOD numbers, Down counter, UP/DOWN counter, propagation delay in ripple counter, programmable counter, Pre-settable counter, BCD counter, cascading, counter applications, Decoding in counter, Decoding glitches, Ring Counter, Johnson counter, Rotate left & Rotate right counter, Registers – Buffer, Shift left, shift right, shift left/Right registers, parallel in parallel out, serial in serial out, parallel in serial out, serial in parallel out registers. Random Access Memory, Timing waveform, Memory Decoding, Internal Construction, Coincident decoding, Address multiplexing, Read only memory – Combinational circuit implementation, Type of ROMs, combinational PLDs, Programmable Logic Array (PLA), Programmable Array Logic (PAL), sequential programmable device. Analog todigital conversion – Ramp type, dual slope, integration, successive approximation, parallel conversion, parallel/ serial conversion, convertor specifications, Digital to Analog convertors – Binary weighted & R/2R D to A convertors.

References:

1. A. Anand Kumar, Fundamentals of digital circuits, PHI
2. A K Maini, Digital Electronics, Wiley India
3. Thomas Blakeslee; Digital Design with standard MSI and LSI; Wiley Interscience
4. Jain RP; Modern digital electronics; TMH
5. M Mano; Digital Logic & Computer design; PHI
6. Tocci ; Digital Systems Principle & applications; Pearson EducationAsia
7. Gothmann; Digital Electronics;PHI
8. Malvino, Leech; Digital Principles and applications–(TMH)
9. Floyad; Digital Fundamentals(UBS)
10. Nripendra N. Biswas; Logic Design Theory(PHI)
11. D.C. Green; Digital Electronics (Pearson EducationAsia)
12. SubrataGhoshal; Digital Electronics, Cengage

List of Experiments (Expandable):

1. Verification of all the logic gates.
2. Design of BCD to Excess-3 code converter.
3. Implementation of NAND & NOR as Universal gate.
4. Design of RS, JK, T& D Flip flop.
5. Multiplexer /De multipexer based boolean function
6. Design of combinational circuit forthe (i) Halfadder (ii) Fulladder (iii) Half subtractor (iv) Full subtractor
7. Design various A-D & D-Aconvertors.
8. Verify the truth table of SR flip flop
9. Verify BCD to seven segment decoder.

Sub Code: EX-227 **Sub Name:** Power System -I **3 Credits**

Unit-I Introduction:

An overview of Electrical Energy Generation General background, structure and components of power network. Power generation – Introduction to conventional, non-conventional & distributed generation, Effect of transmission voltage on power system economy. Selection of size of feeder. Comparison of isolated versus interconnected power system. Problems associated with modern large interconnected power system. Power Plant Economics - Load curves, base load, peak load, load factor, demand factor, diversity factor, capacity factor, utilization factor, cost of electricity, capital cost, fuel and operation cost.

Unit-2 Transmission Line Components & Under Ground Cabling:

Inductance resistance and capacitance of transmission line, Calculation of inductance for 1-Φ and 3- Φ, Single and double circuit line, Concept of GMR and GMD, Symmetrical & asymmetrical conduction configuration, Calculation of capacitance for 2 wire and 3 wire systems, Effect of ground or capacitance, Capacitance calculation for symmetrical and asymmetrical 1-phase and three phase, Single and double circuit line, Charging current, Transposition of line, Composite conductor, Skin and proximity effect, bundle conductor. Underground Cable Comparison of cables and overhead transmission lines, Classification of cables, requirement of cable construction, capacitance of single and multi-core cable, economic core diameter, dielectric stress in cable, Grading of cables, ionization of Heating of cables, Phenomena of dielectric losses and sheath loss in cables, Thermal resistance of cables.

Unit-3 Transmission systems & performance of transmission line:

Various systems of transmission, effect of system voltage, comparison of conductor materials required for various overhead systems. Short, Medium & long transmission line and their representation, Nominal T, Nominal JI, Equivalent T and equivalent JI, network models, ABCD constants for symmetrical &asymmetrical network, Mathematical solution to estimate regulation & efficiency of all types of lines. Surge Impedance, loading, Interpretation of long line equation and its equivalent equation. Tuned power lines. Power flow through transmission line, Circle diagram, Method of voltage control, Static & rotating VAR generator, transformer control.

Unit-4

Insulator & Mechanical design, types of conductors used in overhead transmission line, Types of line supports and towers, Distribution of conductors over transmission towers, Spacing between conductors, Length of span and sag tension calculation for transmission line, Wind & ice loading, support of line at two different levels, string chart, Sag template, Stringing of conductor, Vibration and Vibration dampers. Insulator Materials used for transmission line insulations, Types of insulator for overhead transmission line failure of insulator, Voltage distribution of suspension insulator, String efficiency, Shielding and grading.

Unit-5 Voltage control & Distribution system:

AC single phase, 3 phase, 3wire & 4 wire distribution, Kelvin's law for most economical size of conductor Substation layout showing substation equipment, bus bar single bus bar and sectionalized bus bar, main and transfer for bus bar system, sectionalized double bus bar system, ring mains.

References:

1. William Stevenson, Elements of Power System Analysis, McGraw Hill.
2. C.L. Wadhwa, Electrical Power System Analysis, New Age International.
3. D.P. Kothari, I.J. Nagrath, Modern Power System Analysis TMH, III Ed. Reprint 2008.
4. D.P. Kothari, I.J. Nagrath, Power System Engineering TMH II Ed. Reprint 2009.
5. John Grainger and William Stevenson, Power system Analysis, McGraw Hill.
6. Ashfaq Husain, Electrical Power Systems, Vikas Publishing House.

Sub Code: EX-228 **Sub Name:** Control Systems **4 Credits**

Unit-1

Modeling of dynamic systems: Electrical, Mechanical and hydraulic systems, Concept of transfer function, Simulation of differential equations in analog computer, State space description of dynamic systems: Open and closed loop systems, Signal flow graph, Mason's formula, Components of control systems: Error detectors (Synchros & Potentiometer), Servomotors (AC & DC), techo generators, power amplifier, steeper motors

Unit-2

Time – domain analysis of closed loop systems: Test signals, time response of first and second order systems, Time domain performance specifications, Steady state error & error constants Feedback control actions: Proportional, derivative and integral control.
Solution of state equation: Eigen values & eigenvectors digitalization state transitive matrix, stability Routh-Hurwit stability analysis.

Unit-3

Characteristics equation of closed loop system root loci, construction of loci, Effect of adding, poles and Zeros on the loci, Stability by root loci.

Unit-4

Frequency, Domain analysis, Bode plots, Effect of adding, poles and Zeros, Polar plot, Nyquist stability analysis, Relative stability: Gain and phase margins.

Unit-5

Design of control systems with PD/PI/PID Control in time domain and Frequency domain, lead lag, Lag-lead compensation, Design of compensating networks

References:

1. B.C. Kuo and Farid Golnaraghi, 'Automatic Control Systems', Wiley India.
2. M. Gopal, 'Control system engineering', McGraw Hill
3. K. Ogata, 'Modern Control Engineering', Pearson
4. D. Roy, Chaudhary,'Modern Control Systems', PHI.
5. S. Salivahanan, R. Rengaraj, G.R. Venkatakrishnan, 'Control System Engineering', Pearson.
6. Stefani Shahian Savant,Hostetter, 'Design of feedback control systems' Oxford
7. B.S. Manke, Control system Engineering, Khanna Publishers

List of experiments (Expandable)

1. Time response of second order system.
2. Characteristics of Synchros.
3. Effect of feedback on servomotors.
4. Determination of transfer function of A-C servomotor.
5. Determination of transfer function of D-C motor.
6. Formulation of PI & PD controller and study of closed loop responses of 1st and 2nd order dynamic systems.
7. State space model for classical transfer function using MATLAB.
8. Simulation of transfer function using operational amplifier.
9. Design problem: Compensating Networks of lead and lag.
10. Temperature controller using PID.
11. Transfer function of a DC generator.
12. Characteristics of AC servomotor.
13. Use of MATLAB for root loci and Bode plots of type-1, type-2 systems.
14. Study of analog computer and simulation of 1st orderand 2nd order dynamic equations.
15. Formulation of proportional control on 1st order and 2nd order dynamic systems.
16. Feedback control of 3rd order dynamic Systems
17. Study of lead and lag compensating networks.
18. Effect of adding poles & zeros on root loci and bode plots of type-1, type-2 systems through MATLAB.

Sub Code: EX-220 **Sub Name:** Material Science **4 Credits**

Unit 1 Introduction to material science and engineering:
Atomic structure and bonding in materials. Types of material, Recent advances and future trends: (Smart & Nano materials) Crystal structure of materials, crystal systems, unit cells and space lattices, crystalline solids and their role in influencing various properties.
Metals & Alloys:Mechanical behavior of metals and alloys, Tensile & compressive stress-strain relations, fracture toughness,fatigue, creep, wear and abrasion. Microstrcture, properties and applications of ferrous and non-ferrous alloys, low alloy steels, aluminum alloys, copper alloys, stainless steels, cast irons, superalloys.

Unit 2 Introduction to SF6:
Physical properties, Electrical properties, SF6as a dielectric and insulating material, Specification of SF6 gas for GIS application, Handling of SF6 gas before use, Equipment for handling the SF6 Gas, Advantages and Applications of SF6.

Unit 3 Ceramics, Polymers, Composites:
Structure, defects and properties of Ceramics materials, processing and applications of traditional and advanced ceramics. Thermal, electrical, magnetic, optical and mechanical behavior of ceramics.

Classification of Polymers, Polymerization, Structure and Properties, additives for polymer products, Homo polymers and co-polymers, Elastomers and Thermoplastic elastomers, Polymer Blends and Alloys, Liquid crystal polymers, Polymer foams, Properties and applications of polymers. Properties and applications of various composites, metal matrix and ceramic matrix composite, Bone-a natural composite materials.

Classification of composite materials, Laws of mixtures, Factors affecting composite properties, Interfacial bonding, Mechanical Behavior of Composites: Young's Modulus and strength considerations for continuous FRCs and short FRCs.

Unit 4 Electrical Properties:
Electrical conduction in metals, Concept of energy band diagram for materials - conductors, semiconductors and insulators, electrical conductivity, effect of temperature on conductility, intrinsic and extrinsic semiconductors, dielectric properties. Compound semiconductors, Electrical properties of ceramics, Nano-electronics.

Unit 5 Magnetic and optical properties:
Origin of magnetism in metallic and ceramic materials, Paramagnetism, diamagnetism, anti-ferro magnetism, ferromagnetism, ferrimagnetism, magnetic hysteresis, effect of temperature, soft and hard magnetic materials and their properties. Reflection, refraction, absorption and transmission of electromagnetic radiation in solids.

Unit 6 Advanced Materials and Tools:
Smart materials, exhibiting ferroelectric, piezoelectric, optoelectric, semiconducting behavior, lasers and optical fibers, photoconductivity and superconductivity, nanomaterials, synthesis, properties and applications, biomaterials, photoconductivity and superconductivity, nanomaterials, Ultra-light Materials and Metallic Foams: Definition and processing, characterization of cellular metals, properties.

Text Book:
1. William D. Callister, David G. Rethwisch 'Callister's Material Science and Engineering', Willey.
2. William F Smith, Javad Hashemi, Ravi Prakash 'Material science and engineering', McGraw Hill.

References:

1. L. Solymar, D. Walsh & R. R.A. Syms 'Electrical Properties of Materials', Oxford university press.
2. James F. Shackelford, Madanapalli K. Muralidhara 'Introduction to Materials Science for Engineers', Pearson
3. V. Rajendran ' Materials Science' McGraw Hill education Pvt. Limited.
4. Ian P. Jones ' Materials Science for Electrical and Electronics Engineers' Oxford university press.
5. Asleland, Fulay, Wright, Balani 'The Science and Engineering of Materials', Cengage learning.
6. K. M. Gupta and Nishu Gupta 'Advanced Electrical and Electronics Materials' Willey.
7. M. S. Naidu, "Gas Insulated Substations", IK International Publishing House.

Sub Code: EX-221 **Sub Name:** System Engineering **4 Credits**

Unit 1

What is System Engineering, Origin, Examples of Systems requiring systems engineering, Systems Engineer Career Development Model, Perspectives of Systems Engineering, Systems Domains, Systems Engineering Fields, System Engineering Approaches.

Unit 2

Structure of Complex Systems, System Building Blocks and Interfaces, Hierarchy of Complex Systems, System Building Blocks, The System Environment, Interfaces and Interactions, Complexity in Modern Systems.

Unit 3

Concept Development and Exploration, Originating a New System, Operations Analysis, Functional Analysis, Feasibility, System Operational Requirements, Implementation of Concept Exploration.

Unit 4

Engineering Development, Reducing Program Risks, Requirements Analysis, Functional Analysis and Design, Prototype Development as a Risk Mitigation Technique, Development Testing, Risk Reduction. Integration and Evaluation,

Unit 5

Integrating, Testing, And Evaluating The Total System, Test Planning And Preparation, System Integration, Developmental System Testing, Operational Test And Evaluation, Engineering For Production, Transition From Development To Production, Production Operations.

References:

1. Alexander Kossiakoff, William N Sweet, "System Engineering Principles and Practice, Wiley India
2. Blanchard Fabrycky, Systems engineering and analysis, Pearson
3. Dennis M. Buede, William D.Miller, "The Engineering Design of Systems: Models & Methods" Wiley India
4. JeffreyL Whitten, Lonnie D Bentley, "System Analysis and Design Methods"
5. Richard Stevens, Peter Brook," System Engineering – Coping with complexity, Prentice Hall

Sub Code: EX-229 **Sub Name:** Residential Load Simulation Lab **2 Credits**

Graphical interfaces to model and study smart: Thermostats, Air conditioners, Furnaces, Water heaters, Refrigerator, Stoves, Dish washers, Cloth washers, Dryers, Lights, Pool pumps. Wind, solar, and battery sources of power generation in residential houses; Impact of different variables such as ambient temperature, solar radiation, and household activity levels that considerably contribute to energy consumption.

References:

1. Hemant Joshi, Residential Commercial and Industrial Electric Systems; McGraw Hill