

Energy Audit and Management

303150 : Energy Audit and Management

Unit 01: Energy Scenario (6 Hrs.)

Classification of Energy resources, Commercial and noncommercial sources, primary and secondary sources, commercial energy production, final energy consumption. Energy needs of growing economy, short terms and long terms policies, energy sector reforms, energy security, importance of energy conservation, energy and environmental impacts, emission check standard, salient features of Energy Conservation Act 2001 and Electricity Act 2003. Indian and Global energy scenario. Introduction to IE Rules. Study of Energy Conservation Building Code (ECBC).

Unit 02: Energy Management (6 Hrs.)

Definition and Objective of Energy Management, Principles of Energy management, Energy Management Strategy, Energy Manager Skills, key elements in energy management, force field analysis, energy policy, format and statement of energy policy, Organization setup and energy management. Responsibilities and duties of energy manager under act 2001. Energy Efficiency Programs. Energy monitoring systems.

Unit 03: Demand Management (6 Hrs.)

Supply side management (SSM), Generation system up gradation, constraints on SSM.

Demand side management (DSM), advantages and barriers, implementation of DSM. Use of

demand side management in agricultural, domestic and commercial consumers. Demand

management through tariffs (TOD). Power factor penalties and incentives in tariff for demand

control. Apparent energy tariffs. Role of renewable energy sources in energy management,

direct use (solar thermal, solar air conditioning, biomass) and indirect use (solar, wind etc.)

Introduction to Net Metering.

Unit 04: Energy Audit (6 Hrs.)

Definition, need of energy audits, types of audit, procedures to follow, data and information

analysis, energy audit instrumentation, energy consumption –

production relationship, pie

charts. Sankey diagram, Cusum technique, least square method and numerical based on it.

Outcome of energy audit and energy saving potential, action plans for implementation of

energy conservation options. Bench- marking energy performance of an industry. Report

formats

Unit 05: Energy Conservation in Applications (6 Hrs.)

a) Motive power (motor and drive system). b) Illumination c) Heating systems (boiler and

steam systems) d) Ventilation(Fan, Blower and Compressors) and Air Conditioning systems

e) Pumping System f) Cogeneration and waste heat recovery systems g) Utility industries (T

and D Sector)

Unit 06: Financial analysis (6 Hrs.)

Financial appraisals; criteria, simple payback period, return on investment, net present value

method, time value of money, break even analysis, sensitivity analysis and numerical based

on it, cost optimization, cost of energy, cost of generation.

Text Books:

[T1] Guide books for National Certification Examination for Energy Managers/Energy

Auditors Book , 1-General Aspects (available on line)

[T2] Guide books for National Certification Examination for Energy

Managers/Energy

Auditors Book 2 – Thermal Utilities (available on line)

[T3] Guide books for National Certification Examination for Energy Managers/Energy

Auditors Book 3- Electrical Utilities (available on line)

[T4] Guide books for National Certification Examination for Energy Managers/Energy

Auditors Book 4 (available on line)

Reference Books:

[R1] Success stories of Energy Conservation by BEE (www. Beeindia.org)

[R2] Utilization of electrical energy by S.C. Tripathi, Tata McGraw Hill.

[R3] Energy Management by W.R. Murphy and Mackay, B.S. Publication.

[R4] Generation and utilization of Electrical Energy by B.R. Gupta, S. Chand Publication.

[R5] Energy Auditing made simple by Balasubramanian, Bala Consultancy Services.

Websites:

[W1] www.energymanagertraining.com

[W2] www.em-ea.org

[W3] www.bee-india.org

Power System II

303146 : Power System II

Unit 01: Performance of Transmission Lines (08 Hrs.)

Evaluation of ABCD constants and equivalent circuit parameters of Long transmission line. Concept of complex power, power flow using generalized constants, receiving end power circle diagram for transmission line (assuming ABCD constants are already given), surge impedance loading, Line efficiency, Regulation and compensation, basic concepts. Numerical based on: ABCD constants of Long transmission line, Power flow, circle diagram.

Unit 02: EHV-AC transmission: (08 Hrs.)

Role of EHV-AC transmission, standard transmission voltages, average values of line parameters, power handling capacity and line losses, phenomenon of corona, disruptive critical voltages, visual critical voltages, corona loss, factors and conditions affecting corona loss, radio and television interference, reduction of interference, Numerical Based on Corona, Corona loss and power handling capacity.

Unit 03: Per unit system and Load Flow Analysis (08 Hrs.)

Per unit system: Single line diagram, Impedance and reactance diagrams and their uses, per unit quantities, relationships, selection of base, change of base, reduction to common base, advantages and application of per unit system. Numerical based on network reduction by using per unit system.

Load Flow Analysis: Network topology, driving point and transfer admittance, concept of Z-bus and formulation of Y-bus matrix using Direct method, singular transformation method, Introduction to load flow analysis, power- flow equations generalization to n bus systems, classification of buses, Newton- Raphson method (using polar coordinates - Descriptive treatment only) Numerical based on Y bus Matrix.

Unit 04: Symmetrical Fault Analysis (08 Hrs.)

3-phase short-circuit analysis of unloaded alternator, sub-transient, transient and steady state current and impedances, D.C. Offset, and effect of the instant of short-circuit on the waveforms, estimation of fault current without pre-fault current for simple power systems, selection of circuit- breakers and current limiting reactors and their location in power system (Descriptive treatment Only) Numerical Based on symmetrical fault analysis

Unit 05: Unsymmetrical Fault Analysis: (08 Hrs.)

Symmetrical components, transformation matrices, sequence components, power in terms of symmetrical components, sequence impedances of transmission line and zero sequence networks of transformer, solution of unbalances by symmetrical components, L-L, L-G, and L-L-G fault analysis of unloaded alternator and simple power systems with and without fault impedance.

Numerical based on symmetrical components and unsymmetrical fault calculation.

Unit 06: HVDC Transmission (Descriptive treatment only) (08 Hrs.)

Classification and components of HVDC system, advantages and limitations of HVDC transmission, comparison with HVAC system, introduction to HVDC control methods - constant current, constant ignition angle and constant extinction angle control, HVDC systems in India, recent trends in HVDC system.

Text Books:

[T1] I.J. Nagrath and D.P. Kothari – Modern Power System Analysis – Tata McGraw Hill, New Delhi.

[T2] B R Gupta , "Power System Analysis and Design", S.Chand.

[T3] Ashfaq Hussain, "Electrical Power Systems", CBS Publication 5th Edition.

[T4] J.B.Gupta. "A course in power systems" S.K. Kataria Publications. [T5] P.S.R. Murthy, "Power System Analysis", B.S. Publications

Reference Books :

[R1] H. Hadi Sadat: Power System Analysis, Tata McGraw-Hill New Delhi.

[R2] G. W. Stagg and El- Abiad – Computer Methods in Power System Analysis – Tata McGraw Hill, New Delhi.

[R3] M.E.El-Hawary, Electric Power Systems: Design and Analysis, IEEE Press, New York.

[R4] Rakash Das Begamudre, "Extra High voltage A.C. Transmission Engineering", New age publication.

[R5] M.A.Pai, Computer Techniques in Power System Analysis, Tata McGraw Hill Publication.

[R6] Stevenson W.D. Elements of Power System Analysis (4th Ed.) Tata McGraw Hill, New Delhi.

[R7] K.R.Padiyar: HVDC Transmission Systems, New Age International Publishers Ltd, New Delhi.

[R8] Olle I. Elgard – Electric Energy Systems Theory – Tata McGraw Hill, New Delhi.

[R9] V. K. Chandra, Power Systems, Cyber tech Publications.

[R10] NPTEL Web course and video course on power system analysis.

Utilization of Electrical Energy

303148 : Utilization of Electrical Energy

Credit 03

Unit 01: Electric Heating (06 Hrs.)

Modes of heat transfer, mathematical expressions Electric heating: Introduction to electric heating, Advantages of electrical heating

Heating methods: - Resistance heating – Direct resistance heating, indirect resistance heating, electric ovens, different types of heating element materials, temperature control of resistance furnaces, and design of heating element (Numerical).

Applications of resistance heating

Induction heating : Principle, core type and coreless induction furnaces, Ajax Wyatt furnace, Numerical on melting furnaces Applications of induction heating Electric arc heating – Direct and indirect arc heating, types of arc furnaces, equivalent circuit of arc furnace, condition for maximum output, power factor at maximum output (Numerical), Heat control in arc furnace, Applications of arc heating Dielectric heating –Principle, choice of voltage and frequency for dielectric heating (Numerical), Applications of dielectric heating Electric Welding -Welding m e t h o d s –Electric arc welding and resistance welding, Equivalent circuit of arc furnace (Numerical) Modern welding techniques like ultrasonic welding and laser welding

Unit 02: Electrochemical Process (04 Hrs.)

Need of electro-deposition. Applications of Faraday's laws in electrodeposition. Factors governing electro-deposition. Objectives of electroplating. Equipments and accessories for electroplating plant, Electroplating on non-conducting materials, Principle of anodizing and its applications Electrical Circuits Used in Refrigeration, Air Conditioning

Brief description of vapour compression refrigeration cycle. Description of electrical circuits used in Refrigerator, Air Conditioner

Unit 03: Illumination (04 Hrs.)

Definitions of luminous flux, solid angle, luminous intensity, illumination, luminous efficacy, depreciation factor, coefficient of utilization, space to height ratio, reflection factor; Laws of illumination.

Design of illumination schemes-Factors to be considered for design of illumination scheme, Calculation of illumination at different points, considerations involved in simple design problems for indoor installation, illumination schemes, standard illumination level. Natural day light illumination (brief information)

Different sources of light: Incandescent lamp, fluorescent lamp, comparison between them.

Incandescent and discharge lamps – their construction and characteristics; mercury vapour lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, neon lamps Electroluminescent lamp-LEDs, types, LASERs Comparison of all above luminaries.

Unit 04: Electric Traction (06 Hrs.)

History of Indian railways.

Traction systems - Steam engine drive, electric drive, diesel electric

drive, types of diesel locomotives, Advantages of electric traction, Brief treatment to - Indian railway engine coding terminology, WDM,WDP,WDG series and their capacity . Introduction to metro system, mono rail system.

Systems of track electrification: D.C. system, single phase low frequency A.C. system, 3 phase low frequency A.C. systems, composite systems – kando systems, single phase A.C. to D.C. system Different accessories for track electrification -overhead wires, conductor rail system, current collector-pentograph, catenary Electric locomotive- Block diagram with description of various equipment and accessories.

Supply system constituents-Layout and description of -Traction substation, feeding post(25kV), feeding and sectioning arrangement, sectioning and paralleling post, neutral section. Details of major equipment in traction substation-transformer, circuit breaker, interrupter

Unit 05: Traction Mechanics (08 Hrs.)

Types of services- Urban, Sub-urban, Main line Speed time curves, trapezoidal and quadrilateral speed-time curves, average and schedule speed (Numerical), Tractive effort. Specific energy consumption. Factors affecting specific energy consumption (Numerical), Mechanics of train movement, coefficient of adhesion (Numerical).

Unit 06: Traction Motors, Control of Traction Motors, Train Lighting (08 Hrs.)

Desirable characteristic of traction motors. Suitability of D.C. series motor, A.C. series motor, 3 phase induction motor and linear induction motor for traction. Control of traction motors -Seriesparallel control, Shunt and bridge transition (Numerical), Electrical breaking, Regenerative breaking in traction, Suitability of different motors for braking. Train lighting system.

Railway signalling: - History, necessity, block system route relay interlock and necessity. Metro signalling, Electromechanical system for route relay interlock. Introduction to train tracking system, types. Anti-collision system-brief treatment only.

Text Books:

[T1] E. O. Taylor 'Utilization of Electrical Energy' – Revised in S.I. Units by V.V.L. Rao, Orient Longman

[T2] J.B. Gupta, 'Utilization of Electric Power and Electric Traction', S.K. Kataria and sons, Delhi

[T3] C. L. Wadhwa, 'Generation, Distribution and Utilization of

Electrical Energy', Eastern Wiley Ltd.

[T4] A. Chakraborti, M. L. Soni, P. V. Gupta, U.S. Bhatnagar, 'A text book on Power System Engineering', Dhanpat Rai and Co.(P) Ltd – Delhi

[T5] Clifford F. Bonntt 'Practical Railway Engineering', (Imperial college press)

Reference Books:

[R1] 'Art and science of Utilization of Electrical Energy' by H. Partab, Dhanpat Rai and Co.(P) Ltd –Delhi

[R2] 'Modern Electric Traction' by H. Partb, Dhanpat Rai and Co. (P) Ltd – Delhi

[R3] 'Lamps and lighting' by M. A. Cayless, J.R. Coaton and A. M. Marsden

[R4] 'BIS, IEC standards for Lamps, Lighting Fixtures and Lighting' By Manak Bhavan, New Delhi

[R5] 'Illumination Engineering from Edison's Lamp to the Laser' Joseph B. Murdoch

[R6] 'Two centuries of Railway signalling' by Geoffrey, Kichenside and Alan Willims (Oxford Publishing Co-op)

[R7] 'Generation and Utilization of Electrical Energy' S. Sivanagaraju, M. Balsubba Reddy, D. Srilatha (Pearson)

[R8] 'Electrical Powers' S. L. Uppal, Khanna Publication

Design of electrical machines

303149: Design of Electrical Machines

Credit:04

Unit 01: Transformer

Modes of heat dissipation. Heating and cooling curves. Calculations of heating and cooling time constants. Types and constructional features of core and windings used in transformer.

Transformer auxiliaries such as tap changer, pressure release valve, breather and conservator.

Specifications of three phase transformers as per IS 2026(Part I).

Unit 02: Transformer Design

Output equation with usual notations, optimum design of transformer for minimum cost and loss. Design of main dimensions, core, yoke and windings of transformer. Methods of cooling and tank design. Estimation of resistance and leakage reactance of transformer.

Unit 03: Performance parameters of Transformer

Estimation of no-load current, losses, efficiency and regulation of transformer. Calculation of mechanical forces developed under short circuit conditions, measures to overcome this effect. Introduction to Computer aided design of transformer, generalized flow chart for design of transformer.

Unit 04: Three phase Induction Motor Design : Part I

Specification and Constructional features. Design of ac windings. Output equation with usual notations, specific electrical and magnetic loadings, ranges of specific loadings, turns per phase, number of stator slots.

Unit 05: Three phase Induction Motor Design : Part II

Suitable combinations of stator and rotor slots .Calculations for main dimensions and stator design parameters. Selection of length of air gap, factors affecting length of air gap, unbalanced magnetic pull. Design of rotor slots, size of bars, end rings for cage rotor and rotor slots, turns and area of cross section of conductor for wound rotor.

Unit 06: Performance parameters of Three Phase Induction motor

Leakage flux and leakage reactance: Slot leakage, tooth top leakage, zig-zag leakage, overhang leakage, leakage reactance calculation for three phase machines. MMF Calculation for air gap, stator teeth, stator core, rotor teeth and rotor core, effect of saturation, effects of ducts on calculations of magnetizing current, calculations of no-load current. Calculations of losses and efficiency. Calculation of short time and continuous rating of electrical machine.

Text Books:

[T1] M.G. Say – Theory and Performance and Design of A.C. Machines, 3rd Edition, ELBS London.

[T2] A.K.Sawhney – A Course in Electrical Machine Design, 10th Edition, - Dhanpat Rai and sons New Delhi.

[T3] K. G. Upadhyay- Design of Electrical Machines, New age publication

[T4] R. K. Agarwal – Principles of Electrical Machine Design, S. K.Katariya and sons.

[T5] Indrajit Dasgupta – Design of Transformers – TMH

Reference Books:

[R1] K.L. Narang , A Text Book of Electrical Engineering Drawings, Reprint Edition : 1993 / 94 – Satya Prakashan, New Delhi. [R2] A Shanmugasundaram, G. Gangadharan, R. Palani, - Electrical Machine Design Data Book, 3rd Edition, 3rd Reprint 1988 - Wiely Eastern Ltd., - New Delhi

[R3] Vishnu Murti, "Computer Aided Design for Electrical Machines", B.S. Publications.

[R4] Bharat Heavy Electricals Limited, Transformers - TMH.

Industrial And Technology Management

311121: Industrial And Technology Management

Credit 03

Unit 01: Introduction to managerial and economical demand Managerial Economics: Definition of economics, Demand and Supply concept, Law of demand and supply, Elasticity of demand and supply, Demand forecasting: Meaning and methods.

Management: Meaning, scope, function, and importance of management. Difference between administration and management. Types of business ownership: Sole proprietorship, Partnership (Act 1934), LLP (Limited Liability Partnership), (Act2008). Business Organizations: Line organization, Line and Staff organization and Functional Organization. Joint Stock Company: Public Limited and Private Limited, Public Sector Undertaking (PSU)

Unit 2: Technology and Industrial Management

Introduction to industrial management: Concept, development, application and its scope.

Introduction of Technology Management : Definition of technology, Management and its relation with society, classification of technology, Management of technology at various levels- its importance on National Economy, Ethics in technology management, Critical Factors in technology management.

Unit 3: Quality Management

Definition of Quality Management: Definition of quality, continuous improvement, Types of quality. Quality of design, Assistance Tools: Ishikawa diagram – Pareto Analysis. Pokka Yoke (Mistake Proofing) quality circles, Kaizen. TQM, 5S (Case study of Toyota, descriptive treatment). Six-Sigma, Quality Management Standards (Introductory aspects only) The ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004. Environmental Management System Standard.

Unit 4: Marketing and Financial Management

Marketing Management: Market, meaning, characteristics and its types: Perfect Competition, Monopoly, Monopolistic completion and Oligopoly. Marketing and selling, marketing planning. Market survey and market research, online Marketing.

Financial Management: Definition of financial management, cost. Types of costs, and methods of costing, price, capital. Debit, credit, books of accounts and final accounts.

Unit 5: Human Resource Management

Motivation: Introduction to Motivation, theories of work motivation: Maslow Hierarchy of need's theory, Theory X, Theory Y and F. Herzberg's two factor theory. Group dynamics: Types and interactions of groups, stages of group dynamics: Norming, Storming, Forming, Performing and Adjourning. Leadership- Laissez-faire, importance, qualities of good leadership. Human Resource Management- Introduction, importance, scope. HR planning. Recruitment, selection, training and development, Performance management.

Unit 6: Entrepreneurship

Entrepreneurship- Definition, concept, traits, qualities of entrepreneur. Importance and limitations of rational decision making, Decision making under certainty, uncertainty and risk. Incentives for small business development, Government policies and incentives, Case study on Small scale industries in India. Introduction to Intellectual Property Rights (IPR), Meaning of IPR, Different forms of IPR, Patents, Criteria for securing Patents. Patent format and structure, Copy and trademark (Descriptive treatment only).

Text Books:

[T1] O.P. Khanna, industrial engineering and management, Dhanpat Rai and sons, New Delhi.

[T2] E. H. McGrah, S. J. Basic managerial skill for all.

[T3] Tarek Khalil, Management of Technology Tata Mc Graw Hill Publication Pvt. Ltd.

[T4] Prabuddha Ganguli Intellectual Property rights TATA McGraw-Hill Publishing Company

[T5] Management Accounting and financial management by "M. Y. Khan and P. K. Jain", Mcgraw Hill-Tata-ISBN.

Reference Books:

[R1] C. B. Mamoria and V.S.P.Rao- Personnel Management, Himalaya Publishing House, 30th Edition 2014 [R2] Harold Koonlz and O D'onnel – Management.McGrawHill Publication 1980

[R3] Philip Kotler- Marketing Management. Pearson Edition 2008

[R4] Robert Heller, Managing Teams, Dorling Kindersley, London.

[R5] Kelly John M, Total Quality Management, InfoTech Standard, Delhi.

[R6] Joseph M. Juran Juran's Quality Handbook TATA McGraw-Hill.[R7] Dale H. Besterfield and CarolBesterfield Total Quality Management Prentice Hall of India Pvt. Ltd.

[R8] Shiv Sahai Singh[Editor] The Law of Intellectual Property rights.[R9] N. R. Subbaram, What Everyone Should Know About Patents, Pharma Book Syndicate, Hyderabad.

[R10] Principles and Practices of Management –Dr. P.C. Shejwalkar, Dr. Anjali Ghanekar, Prof. Deepak Bhivpathki.

[R11] Financial Management by "I M Pandey", Vikas Publishing House Pvt. Ltd., Delhi Philip Kotler- Marketing Management

Advance Microcontroller and its Applications

303141: Advance Microcontroller and its Applications

Credit 05

Unit 01 : PIC Architecture

Comparison of CISC and RISC, RAM and Program memory organization, Program counters, Stack pointer, Bank Select Register, Status register, Data transfer instructions, Arithmetic and logical instructions. Assembly language programs.

Unit 02 : Assembly language programming

Addressing Modes for PIC 18 microcontroller, Branch instruction, CALL, RETURN, Bit addressable instruction. Assembly language programs I/O ports, SFR related to PORTs, I/O port programming.

Unit 03 : Programming of PIC microcontroller in C

Embedded C concepts, Header and source files and pre-processor directives, Data types, data structures, Control loops, functions, bit operations. I/O port programming in C, Delay programming.PIC 18 Timer 0 Programing in C

Unit 04 : Special Hardware features and Programming

Timers required for CCP Applications, CCP module in PIC 18 microcontroller, Applications of CCP mode Generation of waveform using Compare mode of CCP module. Period measurement of a unknown signal using Capture mode in CCP module, Speed control of DC motor using PWM mode of CCP module

Unit 05 : Interrupt programming :

Interrupt Programming, Programming of Timer interrupts, Programming of External interrupts, Serial port programming. Interfacing of PIC18F458 8 bit model LCD(16x2)

Unit 06 : Interfacing of PIC Microcontroller

PIC ADC, Programming of ADC using interrupts, Measurement of temperature and voltage Using PIC microcontroller. Interfacing DAC with PIC18F458, Interfacing of Electromechanical Relays and Opto-isolators.

Text Books:

[T1] PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18 by Muhammad Ali Mazidi, Rolind D. McKinley, Danny Causey, Pearson Education.

[T2] Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC by Ramesh Gaonkar, Thomson and Delmar learning, First Edition.

[T3] Programming And Customizing the PIC Microcontroller by MykePredko, TATA McGraw-Hill.

[T4] PIC microcontroller: An introduction to software and Hardware interfacing by Han- Way-Huang Thomson Delmar Learning.

[T5] Microcontroller Theory and Applications with PIC18F, M.Rafiquzzaman, John Wiley and Sons

Reference Books:

[R1] PIC18F458 datasheet

[R2] MPLAB IDE user guides

[R3] MICROCHIP Technical Reference Manual of 18F4520 Embedded Design with PIC 18F452 Microcontroller by John B. Peatman, Prentice Hall

Electrical Installation, Maintenance and Testing

303144: Electrical Installation, Maintenance and Testing

Credits 04

Unit 01: Distribution Systems: Classification of supply systems (State Only) (i)DC, 2-wire system, (ii) Single phase two wire ac system, (iii) Three phase three wire ca supply system, iv) Three phase four wire ac supply system. Comparison between overhead and underground systems (For above mentioned systems) on the basis of volume requirement for conductor. AC Distribution System: Types of primary and secondary distribution systems, calculation of voltage drops in ac distributors (Uniform and Non Uniform Loading) (Numerical) Economics of power transmission: Economic choice of conductor (Kelvin's law) (Derivation and Numerical) Distribution Feeders: Design considerations of distribution feeders; radial and ring types of primary feeder's voltage levels, energy losses in feeders.

Unit 02: Substation and Earthing:

Substation: Classification of substations, Various equipments used in substation with their specifications, Bus bar arrangements in the substation: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.

Earthing: Necessity of Earthing, Types of earthing system (Equipment and Neutral), and Maintenance Free Earthing system. Methods of testing earth resistance, Different electrode configurations (Plate and Pipe electrode), Tolerable step and touch voltages, Steps involved in design of substation earthing grid as per IEEE standard 80 – 2000.

Unit 03: Maintenance and Condition Monitoring:

Importance and necessity of maintenance, different maintenance strategies like breakdown maintenance, planned/preventive maintenance and condition based maintenance. Planned and preventive maintenance of transformer, Induction motor and Alternators. Insulation stressing factors, Insulation deterioration, polarization index, dielectric absorption ratio. Concept of condition monitoring of electrical equipments. Advance tools and techniques of condition monitoring, Thermography.

Unit 04: Condition Monitoring and Testing of Electrical Equipment:

Failure modes of transformer, Condition monitoring of oil as per the IS/IEC standards, Filtration/reconditioning of insulating oil, Condition monitoring of transformer bushings, On load tap changer, dissolved gas analysis, degree of polymerization. Induction motor fault diagnostic methods – Vibration Signature Analysis, Motor Current Signature Analysis. Testing of Power cables – Causes of cable failure, fault location methods and Remedial actions. Testing of Transformer - Type tests and Routine tests.

Unit 05: Estimation and Costing:

Introduction, HT, LT overhead lines and underground cables, cable sizing, price catalogue, labour rates, schedule of rates and estimating data (only theory), Estimation and conductor size calculations of internal wiring for Residential and Commercial (Numericals) installations and estimate for underground LT service lines.

Unit 06: Electrical Safety:

Causes of Accidents, Prevention of Accidents & precautions to be taken. Dangers arising as a result of faulty equipments and tools, chemicals, water, poor joints and insulation strains and moving machines. Contents of first aid box, treatment for cuts, burns and electrical shock. Procedures for first aid (e.g. removing casualty from contact with live wire and administering artificial respiration). Various statutory regulations (Electricity supply regulations, factory acts and Indian electricity rules of Central Electricity Authority (CEA), Classification of hazardous area.

Text Books:

[T1] B. R. Gupta- Power System Analysis and Design, 3rd edition, Wheelers publication.

[T2] S. Rao, Testing Commissioning Operation and Maintenance of Electrical Equipment, Khanna publishers.

[T3] S. L. Uppal - Electrical Power - Khanna Publishers Delhi.

[T4] Hand book of condition monitoring by B. K. N. Rao, Elsevier Advance Tech., Oxford (UK).

[T5] S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House.

[T6] B. V. S. Rao – Operation and Maintenance of Electrical Equipment – Asia Publication.

[T7] Hand book on Electrical Safety.

Reference Books:

[R1] P.S. Pabla –Electric Power Distribution, 5th edition, Tata McGraw Hill.

[R2] S. L. Uppal, Electrical Wiring and Costing Estimation, Khanna Publishers, New Delhi.

[R3] Surjit Singh, Electrical wiring, Estimation and Costing, Dhanpat Rai and company, New Delhi.

[R4] Raina K.B. and Bhattacharya S.K., Electrical Design, Estimating and Costing, Tata McGraw Hill, New Delhi

[R5] B.D. Arora-Electrical Wiring, Estimation and Costing,- New Heights, New Delhi.

[R6] M.V. Deshpande, Elements of Power Station design and practice, Wheelers Publication.

[R7] S. Sivanagaraju and S. Satyanarayana, Electric Power Transmission and Distribution, Pearson Publication

Power Systems-I

Power Systems-I

Credits - 03

Module 1: Basic Concepts

EvolutionofPowerSystemsandPresent-

DayScenario.Structureofapowersystem: Bulk Power Grids and Microgrids. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power. Skin effect and Ferranti effect

Module 2: Power System Components

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines:

Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Transformers: Three-phase connections and Phase-shifts. Threewinding transformers, auto-

transformers, Neutral Grounding transformers. Tap-Changing in transformers. Transformer Parameters. Single-phase equivalent of three-phase transformers.

Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and subtransient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and perunit calculations.

Module 3: Over-voltages and Insulation Requirements

Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

Module 4: Introduction to DC Transmission & Renewable Energy Systems

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid.

Text/References:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.

2.O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.

3.A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.

4.D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.

5.B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley,2012.

Control Systems

Control Systems

Credits - 03

Module 1: Introduction to control problem

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function

models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra. Signal flow graph

Module 2: Time Response Analysis

Standard test signals. Time response of first and second-order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Module 3: Frequency-response analysis

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Module 4: Introduction to Controller Design

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Module 5: State variable Analysis

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Text/References:

- M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
- B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
- K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
- I. J. Nagrath and M. Gopal, "Control Systems Engineering", New

Age International, 2009

Power Electronics

Power Electronics

Credits - 03

Module 1: Power switching devices

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module 2: Thyristor rectifiers

Single-phase half-wave and full-wave rectifiers, Single-phase fullbridge thyristor rectifier with R- load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Module 3: DC-DC converter

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage. Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module 4: Single-phase and 3-phase voltage source inverter

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation. Current Source Inverter

Text/References:

- M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
- N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.

- R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science& Business Media, 2007.
- L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

Microprocessors and Microcontrollers (PE1)

EC110 Microprocessors and Microcontrollers

3 Credits

1 Introduction to Microprocessor Systems: Architecture and Pin diagram of 8085, Timing Diagram, Memory organization, Addressing modes, Interrupts. Assembly Language Programming, 8085 interrupts, Additional I/O concepts and processes.

2 Interfacing of 8085 with 8255, 8254/ 8253, 8251, 8259: Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and- Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253/8254), USART (8251), PIC (8259), DAC, ADC, LCD, Stepper Motor.

3 Introduction to 8086, 80286, 80386 and 80486 Microprocessor: 8086 Architecture, Generation of physical address, Pin diagram of 8086, Minimum Mode and Maximum mode, Bus cycle, Memory Organization, Memory Interfacing, Addressing Modes, Assembler Directives, Instruction set of 8086, Assembly Language Programming, Hardware and Software Interrupts. Introduction of 80286, 80386, and 80486 microprocessor

4 Overview of Microcontroller 8051: Introduction to 8051 Microcontroller, Architecture, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming 8051 resources, interrupts, Programmer's model of 8051, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions, Timer and Counter Programming, Interrupt Programming.

Name of Authors / Books /Publishers

1 "Microprocessors and Microcontrollers", Muhammad Ali Mazidi, Pearson, 2006

2 "Microprocessors and Interfacing, Programming and Hardware",

Douglas V Hall, Tata McGraw Hill, 2006

3 "MicroProcessor Architecture, Programming and Applications with the 8085", Ramesh Gaonkar, PHI

4 "The 8051 Microcontroller and Embedded Systems", Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. MCKinlay, 2nd Edition, Pearson Education, 2008

5 "The 8086 Microprocessor: Programming and Interfacing The PC", Kenneth J. Ayala, Delmar Publishers, 2007

6 "Advanced Microprocessors and Peripherals", A K Ray, K M Bhurchandi, Tata McGraw Hill, 2007

Probability Theory and Stochastic Processes

EC113 Probability Theory and Stochastic Processes

3 Credits

1. Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models.

2. Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions;

3. Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

4. Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

5. Random process. Stationary processes. Mean and covariance functions. Er-godicity. Transmission of random process through LTI. Power spectral density, Markov chain and Markov processes.

Sl. No. Name of Authors / Books /Publishers

 "Probability and Random Processes with Applications to Signal Processing," H. Stark and J. Woods, Third Edition, Pearson Education
"Probability, Random Variables and Stochastic Processes", A.Papoulis and S. Unnikrishnan Pillai, Fourth Edition, McGraw Hill. 3 "Introduction to Probability Theory with Stochastic Processes", K.

L. Chung, Springer International

Microprocessors and Microcontrollers

EC110 Microprocessors and Microcontrollers

3 Credits

1 Introduction to Microprocessor Systems: Architecture and Pin diagram of 8085, Timing Diagram, Memory organization, Addressing modes, Interrupts. Assembly Language Programming, 8085 interrupts, Additional I/O concepts and processes.

2 Interfacing of 8085 with 8255, 8254/ 8253, 8251, 8259: Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and- Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253/8254), USART (8251), PIC (8259), DAC, ADC, LCD, Stepper Motor.

3 Introduction to 8086, 80286, 80386 and 80486 Microprocessor: 8086 Architecture, Generation of physical address, Pin diagram of 8086, Minimum Mode and Maximum mode, Bus cycle, Memory Organization, Memory Interfacing, Addressing Modes, Assembler Directives, Instruction set of 8086, Assembly Language Programming, Hardware and Software Interrupts. Introduction of 80286, 80386, and 80486 microprocessor

4 Overview of Microcontroller 8051: Introduction to 8051 Microcontroller, Architecture, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming 8051 resources, interrupts, Programmer's model of 8051, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions, Timer and Counter Programming, Interrupt Programming.

Name of Authors / Books /Publishers

1 "Microprocessors and Microcontrollers", Muhammad Ali Mazidi, Pearson, 2006

2 "Microprocessors and Interfacing, Programming and Hardware", Douglas V Hall, Tata McGraw Hill, 2006

3 "MicroProcessor Architecture, Programming and Applications with

the 8085", Ramesh Gaonkar, PHI 4 "The 8051 Microcontroller and Embedded Systems", Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. MCKinlay, 2nd Edition, Pearson Education, 2008 5 "The 8086 Microprocessor: Programming and Interfacing The PC", Kenneth J. Ayala, Delmar Publishers, 2007 6 "Advanced Microprocessors and Peripherals", A K Ray, K M Bhurchandi, Tata McGraw Hill, 2007

Computer Networks and Security

EC114 Computer Networks and Security

3 Credits

1 Data communication Components : Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum

2 Data Link Layer and Medium Access Sub Layer : Error Detection and Error Correction Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back - N ARQ, Se- lective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

3 Network Layer : Switching, Logical addressing – IPv4, IPv6; Address mapping –ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols. Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

4 Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

5 Network Security: Passive and Active Attacks, Symmetric Encryption, Encryption Algorithms, Key Distribution, Traffic Padding, Message Authen- tication, Hash function, Secure Hash function, Public-key Encryption, Digital Signature, RSA Public Key Encryption algorithm, Key Management, Secure Socket Layer and Transport layer Security, SSL Architecture, SSL Record Pro- tocol, Change Cipher Spec Protocol, Alert Protocol, handshake Protocol, IP level security IPSEC, Application layer security PGP, Firewall, Virtual Private Networks.

Name of Authors / Books /Publishers

1 "Data Communication and Networking", 4th Edition, Behrouz A. Forouzan, McGraw-Hill

2 "Data and Computer Communication", 8th Edition, William Stallings, Pearson Prentice Hall India

3 "Computer Networks", 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.

4 "Internetworking with TCP/IP", Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.

5 "TCP/IP Illustrated", Volume 1, W. Richard Stevens, Addison-Wesley, United States of America

6 "Network Security Bible", by Cole, Krutz and Conley, Wiley dreamtech

Power Electronics

Power Electronics

Credits - 03

Module 1: Power switching devices

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module 2: Thyristor rectifiers

Single-phase half-wave and full-wave rectifiers, Single-phase fullbridge thyristor rectifier with R- load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Module 3: DC-DC buck converter

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter,

analysis and waveforms at steady state, duty ratio control of output voltage.

Module 4: DC-DC boost converter

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module 5: Single-phase voltage source inverter

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Module 6: Three-phase voltage source inverter

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Module 7: A.C. to A.C. Converter

Classification, principle of operation of step up and step down cycloconverter, single phase to single phase cyclo-converter with resistive and inductive load, three phase to single phase cyclo-converter, half wave and full wave, cosine wave crossing technique. three phase to three phase cyclo-converter. output voltage equation of cycloconverter.

Text/References:

 M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

Microwave Engineering

MICROWAVE ENGINEERING

Rectangular & circular waveguides:Introduction to microwave communication and EM spectrum, Rectangular wave guide: Field Components, TE, TM Modes, Dominant TE10 mode, Field Distribution,

Power, Attenuation. Circular waveguides: TE, TM modes. Wave velocities,

Microstrip transmission line (TL), Coupled TL, Strip TL, Coupled strip line,

Coplanar TL, Microwave cavities

Passive microwave devices: Scattering matrix, Passive microwave devices:

Microwave hybrid circuits, Terminations, Attenuators, Phase Shifters, Directional couplers: Two-hole directional couplers, S- Matrix of a directional coupler, Hybrid couplers, Microwave propagation in ferrites,

Faraday rotation, Isolators, Circulators, S-parameter analysis of all components.

Microwave tubes :Microwave tubes: Limitations of conventional active

devices at microwave frequency, Two cavity Klystron, Reflex Klystron, Magnetron, Traveling wave tube, Backward wave oscillators, Gyro Devices: Their schematic, Principle of operation, Performance characteristic

and their applications.

Solid state amplifiers and oscillators: Transferred electron

devices: Gunneffect diodes & modes of operation. Avalanche transit – time devices:

IMPATT diode, TRAPPAT diode, BARITT diode.

Microwave Measurements: VSWR meter, Frequency meter,

Spectrum

analyser, Network analyser, Tunable detector, Slotted line carriage, Power

meter, Microwave power measurement, Insertion loss and attenuation

measurement, VSWR measurement, Return loss measurement by a reflectometer, Frequency measurement, measurement of cavity Q, Dielectric constant measurement of a solid, EM radiation & measurement.

Cyber Security

Cyber Security

Introduction - Introduction to Information Systems, Types of Information Systems, Development of Information Systems, Introduction to Information Security, Need for Information Security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.

Application Security- (Database, E-mail and Internet), Data

Security

Considerations-Backups, Archival Storage and Disposal of Data, Security

Technology-Firewall and VPNs, Intrusion Detection, Access Control. Security

Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, Email

Viruses, Macro Viruses, Malicious Software, Network and Denial of Services

Attack, Security Threats to E-Commerce- Electronic Payment System, e- Cash,

Credit/Debit Cards. Digital Signature, Public Key Cryptography

Developing Secure Information Systems- Application

Development

Security, Information Security Governance & Risk Management, Security

Architecture & Design Security Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control, CCTV

and Intrusion Detection Systems, Backup Security Measures.

Security Policies- Development of Policies, WWW Policies, Email Security

Policies, Policy Review Process-Corporate Policies-Sample Security Policies,

Publishing and Notification Requirement of the Policies. Evolving Technology Security – Mobile, Cloud, Outsourcing, SCM.

Information Security Standards-ISO, IT Act, Copyright Act, Patent Law,

IPR. Cyber Laws in India; IT Act 2000 Provisions, Intellectual Property Law:

Copy Right Law, Software License, Semiconductor Law and Patent Law.

Case Study - Corporate Security

Micro-controller for Embedded Systems

REC602 MICROCONTROLLER FOR EMBEDDED SYSTEMS

I Introduction , Microcontrollers and Embedded systems, Overview of the 8051,

Inside the 8051, Addressing modes, assembly programming, 8051 data types and

directives, Interfacing with 8051, Programming the 8051 timers

II MSP430x5x series block diagram, address space, on-chip peripherals (analog and

digital), and Register sets. Instruction set, instruction formats, and various

addressing modes of 16-bit microcontroller; Sample embedded system on MSP430

microcontroller. Memory Mapped Peripherals, programming System registers, I/O

pin multiplexing, pull up/down registers, GPIO control. Interrupts and interrupt

programming.

III Watch dog timer, system clocks, Timer & Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and data acquisition ADC and Comparator in MSP430, data transfer using DMA.

IV Serial communication basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C). UART protocol, I2C protocol, SPI protocol. Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.

 ${\bf V}$ Internet of Things (IoT) overview and architecture, Overview of wireless sensor

networks and design examples. Various wireless connectivity: NFC, ZigBee,

Bluetooth, Bluetooth Low Energy, Wi-Fi. Adding Wi-Fi capability to the

Microcontroller, Embedded Wi-Fi, User APIs for Wireless and Networking

applications, Building IoT applications using CC3100 user API for connecting

sensors.

Text Book:

 Mazidi Ali Muhammad, MazidiGillispie Janice, and McKinlayRolin D "The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Publication.
John H Davies, "MSP430 Microcontroller Basics" Newnes Publication.

Reference Book:

1. TI MSP430x5xx and MSP430x6xx Family User's Guide.

Digital Communication

EC115 Digital Communication

3 Credits

1 Introduction: Block Diagram of Digital Communication System, Advantages of Digital communication system over Analog communication systems, Sampling theorem, Signal reconstruction in time domain, Practical and Flat Top Sampling, Sampling of Band-pass Signal, Aliasing Problem, Uniform and Non-uniform quantization. Signal to Quantization ratio of Quantized Signal.

2 Baseband Transmission: Line Coding and its properties, Various types of PCM waveforms. Attributes of PCM waveforms, Mary Pulse Modulation waveforms, Differential Pulse Code Modulation, Multiplexing of PCM signals, Delta modulation, Idling noise and slope overload, Adaptive Delta Modulation, Adaptive DPCM, Comparison of PCM and DM

3 Baseband Detection: Error performance degradation in communication systems, Eb/NO parameter, Matched filter and its derivation, Inter-Symbol Interference (ISI), Nyquist criterion for zero ISI and raised cosine spectrum, Correlation detector : Decision threshold and Error probability for Binary, Unipolar (on-off) signalling

4 Band-pass Modulation and Demodulation: Types of digital modulation, Waveforms for Amplitude, Frequency and Phase Shift Keying, Method of generation and detection of coherent and non-coherent binary ASK, FSK and PSK, Differential phase shift keying, Quadrature modulation techniques, M- ary FSK, Minimum Shift Keying (MSK), Probability of error and comparison of various digital modulation techniques

5 Error: A base band signal receiver, Probability of error, The Optimum filter, Matched Filter, Probability of error in Matched filter, Coherent reception, Coherent reception of ASK, PSK and FSK, Non-Coherent reception of ASK, FSK, PSK and QPSK, Calculation of bit error probability of BPSK and BFSK, Error probability for QPSK

6 Multiple Access Techniques: Time division multiplexing, Frequency division multiplexing, Code division multiplexing, Introduction to upcoming techniques of transmission

Sl. No. Name of Authors / Books /Publishers

1. "Communication Systems", Simon Haykin, Wiley publication, 4th Edition, 2004

2. "Digital Communication Fundamentals and Applications", Bernard Sklar, Pearson Education India, 2nd Edition, 2009

3. "Modern Electronic Communication", Miller Gary M, Prentice-Hall, 6th Edition, 1999

4. "Digital Communications", John Proakis, Tata Mc Graw Hill, 5th Edition, 2007

5. "Electronic Communication Systems, Fundamentals Through Advanced", Wayne Tomsi, Pearson Education, 4th Edition, 2001