ANNEXURE - I

SYLLABUS

PART – I

ENGINEERING MATHEMATICS (Common to all Candidates)

i) Determinants and Matrices: Solving system of equations – Rank of the Matrix – Eigenvalues and eigenvectors – Reduction of quadratic form to canonical form.

ii) Calculus and Differential Equations: Partial derivatives – Jacobians – Taylor's expansion – Maxima and Minima. Linear ordinary differential equations with constant coefficients – Simultaneous first order linear equations with constant coefficients. Formation of partial differential equation (PDE) – Solution of first order PDE – Solution of linear higher order PDE with constant coefficients.

iii) Vector Calculus: Double and triple integrations and their applications – Gradient, Divergence, Curl and Laplacian – Green's, Gauss divergence and Stroke's theorem.

iv) Functions of Complex Variables and Complex Integration : Analytic functions – Conformal Mapping – Bilinear transformation – Cauchy's integral theorem and integral formula – Taylor and Laurent Series – Singularities – Residues – Residue theorem and its applications.

v) Transforms: Laplace Transform – Inverse transforms – Application to solution of linear ordinary differential equations with constant coefficients. Fourier integral theorem – Fourier transform pair – Sine and Cosine transforms. -transform – Inverse Z– transform – Solution of difference equations using Z– transform.

vi) Numerical Methods: Solution of linear system by direct and iterative methods – Interpolation and approximation – Numerical Differentiation and Integration – Solving Ordinary Differential Equations.

vii) Applied Probability: Probability and Random variables – Standard Discrete and Continuous distribution – Moments – Moment generating function and their properties. Two-Dimensional Random Variables – Covariance – Correlation and Regression.

PART – II

BASIC ENGINEERING & SCIENCES (Common to all Candidates)

i) Applied Mechanics : Law of Mechanics – Lame's theorem – Forces, Moments and Couples – Displacement, velocity and Acceleration – Friction – Moment of Inertia.

ii) Mechanical Engineering : Laws of thermodynamics – Open and closed systems – Equation of state – Heat and Work.

iii) Physics : Sound – Latices – Ultrasonic flaw detector – X-ray radiography – Interference Fringes – Planck's quantum theory – Laser and Fibre Optics.

iv) Material Science : Fracture – Magnetic and Dielectric materials – Conductor and Semi conductor materials – Ceramic and Super conductor materials.

v) Civil Engineering : Fluid Statics and Dynamics – Boundary Layer – Pumps and Turbines – Environmental Pollution. **vi) Electrical Engineering :** Ohm's law – Kirchoff's law – A.C. circuits – D.C. machines – Transformers – Synchronous machines – Instrumentation. **vii) Computers :** Computer organisation – Architecture – Arrays – Pointers – User defined function – C program. **viii) Chemistry :** Adsorption – Chromatography – Chemical kinetics – Electrochemistry – Spectroscopy – Fuels and Combustion.

PART – III

1. CIVIL ENGINEERING

i) Structural Engineering :

Mechanics: Stress-Strain Relationships – Principal stresses and Principal strain in two dimension and three dimension. Composite Bars – Composite Beams – Elastic Constants. Beams and Bending – Shear Force and Bending Moment Diagrams – Flexural and Shear Stresses. Slope and Deflection of Beams. Thin and Thick Cylinders. Torsion. Theories of Failure – Unsymmetrical Bending – Curved Beams – Theories of Columns. Combined Direct and Bending Stresses.

Structural Analysis: Static and Kinematic Indeterminancy – Energy Principles – Deflection of pin jointed plane frames – rigid frames. Classical Method of Analysis of indeterminate structures (Slope deflection and Moment Distribution) – Matrix Method. Arches and Suspension Bridges – Influence Line for Determinate and Indeterminate Structures. Plastic Analysis of Structures.

Building Materials: Cement - Concrete – properties of ingredients- Mix Design- Quality Control- Special Concrete – Concreting Methods- Brick – Brick Masonry – Stone – Timber – Steel.

Concrete Structures: Design Methods – Limit State Design for beams, slabs, columns and footings – retaining walls – Water Tanks. Prestressed Concrete – Principles – Methods – Losses – Deflection – Design.

Steel Structures: Steel Sections – Connections – Design of Tension and Compression Members – Beams, Column Bases – Plate Girders and Trusses.

ii) Soil Mechanics and Foundation Engineering : Soil Mechanics: Nature of soil – phase relationships – Soil classification; Soil water – static pressure – effective stress principle; permeability – seepage; Stress distribution in soil – Consolidation (Terzaghi's one dimension consolidation theory); Compaction shear strength of soil – Mohr – Coulomb theory – determination of shear strength by different methods; Slope stability analysis – protection measures.

Foundation Engineering: Site investigation – scope and objectives – drilling techniques – depth and spacing of boreholes – sampling Techniques – penetration tests (SPT and SCPT) – plate load test – selection of foundation; Foundation types – shallow foundation – bearing capacity (Terzaghis Theory and BIS formula) – allowable bearing pressure – bearing capacity from field tests – settlement of foundation – allowable settlement – Codal provisions; Design of foundations – Isolated, combined and raft foundation; Pile foundations – static and dynamic pile driving formulae (Engineering News and Hiley method) – Pile groups – capacity and settlement – Codal provisions – pile load test – negative friction on piles; Earth pressure theories – Earth pressure on retaining walls – stability analysis of retaining wall.

iii) Transportation Engineering : Highway Planning: Road Classification, Geometric Design of Highways, Construction of Earth, WBM, Bituminous and concrete roads, Design of flexible and rigid pavements. Drainage of roads, maintenance of roads. Railways, Airways, Docks and Harbour Planning: Railway alignment, components of permanent way, geometric design Airport planning, components of airport, site

selection, planning for terminal building, runways. Harbour planning, components of harbour, inland water transport.

Traffic Engineering: Traffic characteristics, Traffic surveys, Traffic Signals, Road markings and signs.

iv) Water Resources Engineering : Fluid Mechanics and Hydraulics: Properties of fluids. Fluid statics and relative equilibrium. Basic concepts of fluid flow - kinematics and dynamics. Concept of system and control volume application to continuity, momentum and energy equations. Dimensional analysis and model studies. Laminar and turbulent flow through pipes. Boundary layers. Steady uniform and gradually varied flow in open channels. Rapidly varied flows. Turbines and pumps and positive displacement pumps.

Hydrology and Ground Water: Hydrometeorology. Hydrologic cycle. Precipitation and its measurements. Abstractions. Runoff estimation. Hydrograph analysis. Unit Hydrograph. Hydrologic extremes floods and droughts. Rainwater harvesting. Properties of aquifer. Groundwater development. GEC norms. Well hydraulics. Steady and unsteady flows. Ground water quality.

Irrigation Engineering: Irrigation system. National water policy. Components of irrigation network. Design of lined and unlined channels. Waterways, head works, gravity dams and spillways. Design of weirs on permeable foundation. Soil water relations. Crop water requirements. Irrigation scheduling and methods. Duty, delta and base period. Irrigation water quality. Irrigation water management. Participatory approach.

v) Environmental Engineering : Water and Waste water Engineering: Water requirements; water demand, quality standards; Development of water supply source, conveyance system; basic unit processes and operations for water treatment; water distribution; sewage characteristics; sewage treatment, primary and secondary treatment of sewage, sludge disposal, sewage disposal.

Air Pollution and Control: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

Noise Pollution and Control: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

vi) Surveying: Surveying: Chain survey-traversing-plotting: compasses-bearings - plane table-leveling-bench marks-temporary and permanent adjustments-reduction: contouring and volumes-theodolites - Gale's table-lay out - setting out works-curve ranging-mine surveying-techeometric survey triangulation- base line-correctionstrigonometric leveling - errors and sources-classification of errors-

equationlevel netsastronomical survey-practical astronomy-photogrammetry-EDM-hydrographic surveyriver.

Electronic survey- infrared EDM-microwave system-modern positioning systems - trilateration.

2. MECHANICAL ENGINEERING

i) Mechanics : Statics of Particles, Equilibrium of Rigid Bodies, Properties of Surfaces and Solids, Dynamics of Particles, Friction and Elements of Rigid Body Dynamics – Basics of Mechanisms, Kinematics of Linkage Mechanisms, Kinematics of Cam Mechanisms, Gears and Gear Trains, Friction, Force Analysis, Balancing and Vibration.

ii) Strength of Materials and Design : Stress, Strain and Deformation of Solids, Transverse Loading on Beams and Stresses in Beams, Deflection of Beams, Energy Principles, Thin cylinders and spherical resells Torsion - Fundamentals of Design for Strength and Stiffness of Machine Members, Design of Shafts and Couplings, Design of Fasteners and Welded Joints, Design of Springs and Engine Parts, Design of Engine parts, Bearings and Flywheels, Design of Transmission Systems for Flexible Elements, Spur Gears and Parallel Axis Helical Gears, Bevel, Worm Gears and Crossed Helical Gears, Design of Gear Boxes, Design of Cam, Clutches and Brakes.

iii) Material Science and Metallurgy : Constitution of Alloys and Phase Diagrams, Heat Treatment, Ferrous and Non ferrous Metals, Non-Metallic Materials, Mechanical Properties and Testing, Crystal Defects and Strengthening of Materials Conducting and 6 Semiconducting Materials, Magnetic and Dielectric Materials, Nuclear Physics, Superconducting and New Engineering Materials.

iv) Thermodynamics: Basic Concepts and First Law, Second Law, Entropy and Availability, Properties of Steam, Psychrometry, Ideal and Real Gases and Thermodynamic Relations, Fuels and Combustion, - Gas Power Cycles, Stream Turbines, Internal Combustion Engines, Internal Combustion Engines Testing and Performance, Gas Turbines, - Steam Nozzle, Air Compressor, Refrigeration and Air-Conditioning, Boilers, Cogeneration and Waste Heat Recovery.

v) Heat Transfer: Conduction, Phase Change Heat Transfer and Heat Exchangers, Radiation, Mass Transfer- Refrigeration Cycle, Refrigerants, System Components and Balancing, Psychrometry, Air Conditioning Systems, Unconventional Refrigeration Cycles.

vi) Production Technology : Foundry Technology, Hot & Cold Working, Forging, Advances in Forming Process, Principles and Applications of Joining Processes, Theory of Metal Cutting, Centre Lathe and special Purpose Lathes, Reciprocating Machines, Milling Machines and Gear Cutting, Abrasive Process, Broaching, CNC Machine Tools and Part Programming.

vii) Automotive Engines : Engine Construction and Operation, SI Engine Fuel System, Cooling and Lubrication System, Combustion and Combustion Chambers, Two Stroke Engines, Diesel Engine Basic Theory, Fuel Injection System, Air Motion, Combustion and Combustion Chambers, Supercharging and Turbocharging, Diesel Engine Testing and Performance.

3. ELECTRICAL & ELECTRONICS ENGINEERING

i) Electrical Circuits and Fields : KCL, KVL, Nodal & Mesh analysis, transient response of D.C and A.C networks; sinusoidal steady-state analysis; resonance in electrical circuits; concepts of ideal voltage and current sources, network theorems, driving point admittance and transfer functions of two port network, three phase circuits; Fourier series and its application; Gauss theorem, electric field intensity and potential due to point, line, plane and spherical charge distribution, dielectric, capacitance 7 calculations for simple configurations; Ampere's and Biot-Savart's law, inductance calculations for simple configurations.

ii) Electrical machines : Single phase transformer-equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformer-connections; auto transformer; principles of energy conversion, windings of rotating machines: D.C generators and motors-characteristics, starting and speed control, armature reaction and commutation; three phase induction motors-performance characteristics, starting and speed control; single-phase induction motors; synchronous generators- performance, regulation; synchronous motors-starting characteristics, applications, synchronous condensers; fractional horse power motors; permanent magnet and stepper motors.

iii) Power Systems : Electric power generation – thermal, hydro, nuclear; transmission line parameters; steady-state performance of overhead transmission lines and cables and surge propagation; distribution system, insulators, bundle conductors, corona and radio interferences effects; per-unit quantities; bus admittance and impedence matrices; load flow; voltage control and power factor correction; economic operation; symmetrical components, analysis of symmetrical and unsymmetrical faults; principle of over current, differential and distance protections; concepts and solid state relays and digital

protection; circuit breakers; principles of system stability-swing curves and equal area criterion

iv) Control systems : Principles of feedback; transfer function; block diagram; steadystate errors; stability- Routh and Nyquist criteria; Bode plots; compensation; root loci; elementary state variable formulation; state transition matrix and response for Linear time Invariant systems.

v) Power Electronics and Drives : Semiconductor power devices-diodes, transistors, thyristors, triacs, GTO, MOSFETs and IGBTs-static characteristic and principles of operation; triggering circuits; phase control rectifiers; bridge converters-fully controlled and half controlled; principles of choppers and inverters, basic concepts of adjustable speed dc and ac drives.

vi) Digital Electronics : Digital Logic Theory: Number systems-Combinational logic circuits-Minimisation of Boolean functions-IC families-Arithmetic circuits, Multiplexer & decoders-Sequential circuits-Flip flops, counters, shift registers, Schmitt trigger, timers and multivibrators.

Microprocessor : General 8 bit microprocessor Architcture-8085, 8086 processor – Architecture, Memory, I/O interfacing, Instruction set, Addressing modes, Timing diagram & delays, Machine cycles, Interrupts, counters, Assembly language programming.

Microcontrollers: 8 bit microcontroller – 8051 architecture, bus configuration, Instruction sets, programming & applications.

vii) Digital Signal Processing : Analog signals-sampling & Aliasing-Discrete time signals & systems- LTI systems- Convolution sum-Difference equation representation-Z Transform & its Inverse-Discrete Fourier series & Fourier transform-Radix 2 FFT – Decimation in me and frequency- Inverse DFT using FFT-Analog Butterworth & Chebyshev filter design-IIR & FIR filter design and Realisation.

viii) Computer Control of Processes, Networks : State models and state equationscontrollability & observability-pole assignment-discrete data system – state space representation-stability-data hold, Z & modified Z transform – Pulse transfer functionprogrammable logic controllers. Data networks-switching OSI, Data link control, Media access protocol-BISYNC, SDLC, HDLC, CSMA/CD, TCP/IPBridges, routers, gateways, Ethernet and Arcnet configuration.

ix) Communication Engineering : Modulation and demodulation systems – Types of transmission lines – losses – standing waves – Ground wave and space wave propagation – Digital communication concepts – Data Communication codes, serial and parallel interface – Network protocol – Types of satellites – Advantages of optical fibre communication.

4. ELECTRONICS AND COMMUNICATION ENGINEERING

i). Circuit Analysis: DC Circuit analysis, Thevenin's and Norton's equivalent circuits, Sinusoidal steady state analysis, Transient and resonance in RLC circuits.

Electronic Devices: Diodes, Bipolar Junction Transistors, FET, MOSFET, UJT, Thyristor.

Electronic Circuits: Small signal amplifiers using BJT and FET devices, Large signal amplifiers, Power supplies, Feed back amplifiers, Oscillators, Pulse shaping circuits.

Digital Electronics: Logic gates, Combinational circuits, Sequential circuits.

Linear Integrated Circuits: Operational amplifiers and its applications, PLL, Voltage regulators, A/D and D/A converters.

Measurements and Instrumentation: Transducers, Digital Instruments, Display and Recording systems. **Microprocessor and its applications:** Microprocessors-8085 and 8086 architectures and interfaces, Micro-controller and applications.

ii). Electromagnetic Fields: Static Electric and Magnetic fields, Time varying Electric and Magnetic fields, Maxwell equations. **Transmission Lines and Networks:** Transmission line equations, impedance matching, Filters.

EM waves and waveguides: Guided waves, Rectangular and cylindrical waveguides.

Antennas and Propagation: Aperture antennas, arrays, Propagation of radio waves.

Microwave Engineering: Microwave tubes, semiconductor devices, Passive components, Microwave measurements.

iii). Communication Theory and Systems: AM, FM and PM, Sampling and Quantisation, PCM, DM, ADM, Multiplexing.

Digital Communication: Base band signaling, Band pass signaling, Error control coding, Spread spectrum techniques.

Computer Communication Networks: Definition of layers, data link protocols, Network interconnection. Message routing technologies, End-End protocols.

Optical Communication: Optical Fibers, optical transmitters and receivers.

iv). Signals and Systems: Continuous time signals and systems-Fourier Transform, Laplace transform, Discrete time signals and systems-DTFT, DFT, Z-Transform.

Digital Signal Processing: IIR and FIR filters, Realisation and implementation, Quantisation effects.

Control Systems: Transfer function, Time and frequency response analysis, Stability analysis, state variable analysis

5. PRODUCTION and MANUFACTURING

i) Basic Mechanisms and Elements of Design : Mechanisms, Friction, Gearing and Cams, Balancing, Vibration, Fundamentals of Design, Design of Basic Machine Elements, Design of Mechanical drives, Design of Automotive components, Recent Advances.

ii) Casting, metal forming and metal joining processes : Casting Processes, Welding Processes, Special Casting Processes, Testing of Castings & Weldments - Fundamentals of Metal Forming, Forging and Rolling, Extrusion and Drawing Processes, Sheet Metal Forming Processes, Recent Advances, Mechanisms, Friction, Gearing and Cams, Balancing, Vibration, Fundamentals of Design, Design of Basic Machine Elements, Design of Mechanical drives, Design of Automotive components, Recent Advances.

iii) Tool Engineering, Machine tool operation, Metrology and Inspection : Mechanics of Metal Cutting, Tool Material, Tool Wear and Tool Life, Gear Manufacture, Concept & Programming of CNC machines, Advanced CNC programming & Tooling - General Concepts of measurements, Linear and Angular measurements, Measurement of Surface Finish Measuring Machines, Metrology of Screw Thread & Gears, Computer Aided Inspection and Laser Metrology - Strength and rigidity of machine tool structures, Slideways, Spindles and spindle supports, Machine Tool Dynamics.

iv) Engineering Materials, and Computer Aided Manufacturing : Introduction and Constitution of Alloys and Phase Diagrams, Heat Treatment, Ferrous and Non Ferrous Metals, Mechanical Properties and Testing, Welding and Foundry Metallurgy, Manufacturing Processes for Plastic, Mechanical, Chemical and Electro-chemical energy based processes, Electrical Energy based Waste Processes, Thermal Energy Process, Rapid Prototyping and Rapid Tooling – polymer Matrix Composites, Metal Matrix Composites, Ceramics Matrix Composites, Advances in Polymers & Composites.

v) Product and Process Design, Design of Jigs and Fixtures and Press Tools : Computer Aided Design, Computer Graphics Geometric Modelling, Product Design Concepts, Recent Advances, Process Planning, Estimating, Costing and Elements of Cost, Analysis of Overhead Expenses, Estimation of Costs for Forging, Casting and Welding, Estimation of Machining Time, Purpose Types and Functions Of Jigs and Fixtures, Jigs, Fixtures, Press working Terminologies and Elements of dies and Strip Layout, Design and Development of Dies.

vi) Operations Research: Linear Programming, LP Extensions, Networks, Inventory Models, Dynamic Programming, Decision Analysis, Game Theory, Waiting Line Models, Markov Processes.

vii) Operations Management : Forecasting, Aggregate Planning, Capacity Management, Production Activity Control, Estimation and Costing, Product Cost Estimation, Software Cost Estimation, Costing Methods, Cost Analysis for Planning and Control.

viii) Quality Control Reliability and Maintenance : Quality Concepts, Statistical Process Control, Process Capability Analysis, Advanced Control Charts, Acceptance Sampling, Reliability Concepts, Failure Data Modeling, Reliability Prediction and Modeling, Reliability Management, Risk Assessment, Maintenance Concept, Maintenance Models, Maintenance Logistics, Total Production Maintenance, Fault Diagnosis.

6. INDUSTRIAL ENGINEERING

i) Probability, Statistics, Engineering Economy and Costing: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions. Introduction to Managerial Economics, Production and Cost Analysis, Pricing, Estimation of Material and Labour Costs, Estimation of Operational Cost.

ii) Work System Design and Ergonomics: Productivity – concepts and measurements; method study, micro-motion study, principles of motion economy; work

measurement – time study, work sampling, standard data, PMTS; job evaluation, merit rating, incentive schemes, Ergonomics- Factors influencing performance, Metabolism - Physiological factors involved in muscular activity, Work posture – Work space layout and Work station design, Safety Management practices – Effect of Environment – heat, cold and noise.

iii) Operation Research: Linear programming – problem formulation, simplex method, duality and sensitivity analysis; transportation and assignment models; network flow models; Project management – PERT and CPM, Dynamic Programming, Decision Analysis, Game Theory, Waiting Line Models, Markov Processes, Inventory – functions, costs, classifications, deterministic inventory models, quantity discount; perpetual and periodic inventory control systems, Introduction to simulation and applications

iv) Operations and Supply Chain Management: Layout- Classification- Layout Design- Manual Method (SLP) and Computerized Methods (ALDEP, CORELAP and CRAFT), Line Balancing. Product Design and Process Planning Forecasting, Aggregate Planning, Master Production Schedule, MRP-I, Capacity Management, Production Activity Control, Push and pull production systems, concept of JIT manufacturing system, Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Supply Chain Drivers and Performance measures, IT in supply Chain.

v) Quality Engineering and Management: Quality Concepts, TQM -Basic concepts– TQM Framework - Contributions of Quality Gurus - Tools and Techniques, Control charts for variables and attributes, Statistical Process Control, Process Capability Analysis, Acceptance Sampling, Quality Systems**,** Reliability Concepts, Reliability Prediction and Modeling, Reliability Management, Maintenance Concept, Maintenance Models, Total Productive Maintenance(TPM), Fault Diagnosis, Design of Experiments- Terminologies, Single and multi-factor experiments- Fractional factorial experiments, Introduction to Taguchi Design of experiments

7. COMPUTER SCIENCE & ENGINEERING AND INFORMATION TECHNOLOGY

i) Applied Probability And Operations Research : Random Processes, Probability Distributions, Queuing Models and Simulation, Testing of Hypothesis, Design of Experiments.

ii) Discrete Mathematical Structures : Formal Language and Automata - Graph Theory.

iii) Compiler Design : Optimisation – Code Generation – Implementation – Principles of Programming Languages – Programming Paradigms.

iv) Operating Systems And System Software : Process Management, Storage Management, I/O Systems, Design and Implementation of LINUX OS, assemblers, Loaders, Linkers, Macro Processors.

v) Distributed Systems : Communication and Distributed Environment, Distributed Operating Systems, Distributed Shared Memory, Protocols, Fault Tolerance and Distributed File Systems, Distributed Object Based Systems.

vi) Programming And Data Structures : Problem Solving Techniques, Trees, Hashing and Priority Queues, Sorting, Graph, Heap Search.

vii) Algorithm Analysis And Design Techniques : Dynamic Programming, Greedy Algorithms, Advanced Algorithms, NP Completeness and Approximation Algorithms.

viii) Microprocessors And Microcontrollers - **Computer Architecture And Organisation :** Digital Fundamentals, Combinational Circuits, Synchronous and Asynchronous Sequential Circuits, Instruction Set Architecture(RISC,CISC,ALU Design), Instruction Level Parallelism, Processing Unit and Pipelining, Memory Organisation.

ix) Digital Signal Processing : FFT, Filter Design.

x) Computer Networks : Data Communication Systems, Applications.

xi) Database Management Systems : Relational Model, Database Design, Implementation Techniques, Distributed Databases, Object Oriented Databases, Object Relational Databases, Data Mining and Data Warehousing.

xii) Software Engineering Methodologies : Software Product and Processes - Software Requirements Management - Requirement Engineering, Elicitation, Analysis, Requirements Development and Validation, Requirements Testing - Object Oriented Analysis And Design – Modular Design, Architectural Design, User Interface Design, Real Time Software Design, System Design, Data acquisition System - Software Testing And Quality Assurance - SQA Fundamentals, Quality Standards, Quality Metrics, Software Testing Principles, Defects, Test Case Design Strategies, Software Quality and reusability, Software Project Management, Software Cost Estimation, Function Point Models, Software Configuration Management, Software Maintenance.

xiii) Artificial Intelligence : Intelligent Agents, Search Strategies, Knowledge Representation, Learning, Applications.

xiv) Mobile Computing : Wireless Communication Fundamentals, Telecommunication Systems, Wireless Networks.

xv) Security In Computing : Program Security, Security in Operating Systems, Database and Network Security, Scientific Computing, Information Coding Techniques, Cryptography, Network Security.

8. INSTRUMENTATION ENGINEERING

i) Measurements: Units & Standards, Calibration methods, Systematic and random errors in measurement, propagation of errors, static & dynamic characteristics of Transducers. PMMC, MI and dynamometer type instruments. Bridges for measurement of R, L and C. Measurement of voltage, current and power in single and three phase circuits, time, phase and frequency measurements, digital voltmeter, digital multi-meter. Oscilloscope, shielding and grounding.

ii) Analog Electronics: Characteristics and applications of diode, Zener diode, BJT and MOSFET. Small signal analysis of transistor circuits, feedback amplifiers, Characteristics of operational amplifiers and applications of opamps:- difference amplifier, adder, subtractor, integrator, differentiator, instrumentation amplifier, precision rectifier and active filters. Oscillators, signal generators, voltage controlled oscillators and phase locked loop.

iii)Digital Electronics : Combinational logic circuits, minimization of Boolean functions. IC families:- TTL and CMOS. Arithmetic circuits, comparators, Schmitt trigger, multivibrators, sequential circuits, flip-flops, shift registers, timers and counters, sample-andhold circuit, multiplexer, analog-to-digital (successive approximation, integrating, flash and sigma-delta) and digital-to-analog converters (weighted R and R-2R ladder), Characteristics of ADC and DAC (resolution, quantization, significant bits, conversion/settling time). Basics of number systems, 8-bit microprocessor and microcontroller:- applications, memory and input-output interfacing, basics of data acquisition systems.

iv) Industrial Instrumentation & Analytical Instrumentation : Transducers for industrial instrumentation:- displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (differential pressure, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor); liquid level and viscosity measurement. Smart Transmitters (HART/Foundation Fieldbus enabled Transmitters). pH and conductivity meters, Chromatography, NMR & X-ray Spectroscopy.

v) Control Systems and Industrial Data Communication: Laplace, Fourier and z-transforms, DFT and FFT, Basics of IIR and FIR filters. Feedback principles, signal flow graphs, transient response, steady-state-errors, Bode plot, Routh and Nyquist criteria, root loci and state-space representation of systems. Design of lead, lag and lead-lag compensators, on-off, P, P-I, P-I-D, cascade, feed-forward, and ratio controllers. Distributed Control System, PLC & SCADA. Basics of Industrial data Communication and Internet of Things.