SYLLABUS
PART-A (PAPER-I)

PHASE 1: PRELIMINARY EXAMINATION (WRITTEN-1) – 100 MARKS

Duration: 60 minutes
Total Marks: 100

Medium: English
Number of Questions: 100

The examination would comprise 100 Multiple Choice Type Questions carrying 100 marks for 1 hour duration. With 1 Mark for Correct Answer and 0.30% Negative marking for wrong answer or attempting more than one option or left blank.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Type of Test / Topics Covered</th>
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<tbody>
<tr>
<td>1.</td>
<td>English Grammar</td>
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<td>2.</td>
<td>General Science and Environment</td>
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<td>3.</td>
<td>Computer / I.C.T. Aptitude and Data Analysis &amp; Interpretation</td>
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<td>4.</td>
<td>Indian Economy / Geography / Natural Resources / Population</td>
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<td>5. a)</td>
<td>The Constitution of India:</td>
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<td></td>
<td>i. Preamble</td>
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<td>ii. Fundamental Rights and Duties</td>
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<td>iii. Directive Principles of State Policy</td>
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<td>iv. Powers of the President</td>
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<td>v. Powers of the Governor</td>
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<td>vi. Judiciary System</td>
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<td>vii. Election Commission</td>
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<td>viii. Comptroller and Auditor General</td>
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<td>b)</td>
<td>Right to Information Act, 2005 (RTI Act)</td>
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<td>6.</td>
<td>Current Affairs:</td>
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<td>Important Events- Regional / National / International</td>
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<td>7.</td>
<td>Professional/Technical Education:</td>
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<td>Education System in Gujarat-State Policy, Knowledge Consortium of Gujarat (KCG), Higher Education Institutions (IIT, NITs, IIMs, IISc, IISER, IIITMs, NITTTRs, UGC, AICTE, PCI, DEC, BCI, NCTE, INC, COA, MCI, DCI, VCI), Higher Education System (Diploma, Degree, Masters, Doctorate, Vocational Education and Training (VET)), Rashtriya Uchchattar Shiksha Abhiyan (RUSA), Higher Education Funding Agency (HEFA), Higher Education Ranking Agency (NBA, NAAC), University Administration Systems, Propagation of Professional and Technical Education, Regulatory and Sanctioning Institutions.</td>
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SYLLABUS
PART-B (PAPER-II)

CENTER: MOBILE COMPUTING AND WIRELESS TECHNOLOGY

Advt No. 2: Assistant Professor: Mobile Computing and Wireless Technology

1. Research Methodology
   • General introduction to Research
     *History of Science & Technology*: Importance of research, role of research, aims & objectives, research process, phases of research.
   • Research problem Formulation
     *Review of Research Literature*: Purpose and use of literature review, locating relevant information, use of library & electronic databases, preparation & presentation of literature review, research article reviews, theoretical models and framework. Identification of gaps in research, formulation of research problem, definition of research objectives.
   • Research Design
     *Qualitative Methods*: Types of hypothesis and characterization.
     *Quantitative Methods*: Statistical methods for testing and evaluation.
     *Characterization of experiments*: Accuracy, reliability, reproducibility, sensitivity. Documentation of ongoing research.
   • Research Publication & Presentation
     *Quality indices of research publication*: impact factor, immediacy factor, H-index and other citation indices.
   • Research Ethics and Morals
     Issues related to plagiarism, collaborative models and ethics, acknowledgements.
     Trademarks.

2. Engineering Mathematics
   • Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.
   • Calculus: Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration.
• Probability: Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.

3. Computer Networks
• Concept of layering. LAN technologies (Ethernet).
• Flow and error control techniques, switching.
• IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control.
• Application layer protocols (DNS, SMTP, POP, FTP, HTTP).
• Basics of Wi-Fi.
• Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

4. Programming and Data Structures
• Programming in C.
• Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

5. Databases
• ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms.
• File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

6. Communication
• Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems;
• Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications;
• Information theory: entropy, mutual information and channel capacity theorem;
• Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation;
• Fundamentals of error correction, Hamming codes;
• Timing and frequency synchronization, inter-symbol interference and its mitigation;
• Basics of TDMA, FDMA and CDMA.

7. Advanced Object Oriented Programming:
• Data Types, Operators and Language, Constructs, Classes and Objects
• Inner Classes and Inheritance, Interface and Package
• TCP and Datagram sockets, Servlets, Java Server Pages, Remote Method Invocation, JDBC, JavaBeans
• Enterprise Java Beans, Introduction to Struts Framework
• Introduction to hibernate, HQL, J2EE (struts) and hibernate, Introduction to Spring Framework

8. **OS Programming:**
   • Introduction to OS & Overview of architecture
   • Processes Management, CPU Scheduling
   • POSIX Threads, Inter Process Communication - Data Exchange and Synchronization with shared memory
   • Message queues, semaphores, Memory management, Virtual Memory and Paging, Virtual File System
   • Pipes & FIFOs, System programming in linux, Linux Architecture, Programming in Linux Shell Programming

9. **Wireless Communication and Mobile Computing**
   • MAC and Routing Protocols for IEEE 802.11 Wireless Mesh Networks, Throughput Analysis of the IEEE 802.11e Enhanced Distributed Channel Access, Piconet and Scatternet management in Bluetooth Networks
   • TCP performance in Bluetooth piconets, Scheduling in Bluetooth Networks, Scatternet Formation and Self- Routing in Bluetooth Networks, High Capacity Bluetooth Access Point Design for Interface Elimination
   • Wireless Communication: Cellular Architecture, Large scale and Small scale fading channel models, diversity receivers, DS-CDMA transmitter and receiver design, Multi-user Detection, multi–carrier CDMS and OFD< performance analysis.

10. **Wireless Programming and Applications Development**
    • J2ME Architecture, the CLDC and the KVM
    • Tools and Development Process Classification of CLDC Target Devices, CLDC Collections API
    • CLDC Streams Model MIDlets, MIDlet Lifecycle, MIDP Programming, MIDP Event Architecture High-Level Event Handling
    • Low- Level Event Handling, the CLDC Streams Model The CLDC Networking Package, the MIDP Implementation, Introduction to WAP
    • WML Script and XHTML Introduction to Multimedia Messaging Services (MMS)

11. **System Development Methodology**
    • Software Engineering, Brief concept of Software Life Cycle Models
    • Agile Techniques for software development, Software Development Tools & Techniques
    • Software Quality Assurance, Introduction to Coding Standards
    • Software Testing, Different Testing Tools, Test Driven Development (TDD) Project Management
• Risk Analysis and Management, Introduction to MS Project, Case Study

12. Mobile Adhoc Networks
• Introductory concepts: Different models of operation. Various applications of MANET, Destination Sequenced Distance Vector protocol: Overview, route advertisement, extending base station coverage
• Properties of DSDV protocol, Dynamic Source Routing protocol: Overview and properties, DSR route discovery, route maintenance.
• Support for heterogeneous networks and mobile IP. Multicast routing with DSR Ad Hoc On-Demand Distance-Vector protocol: Properties, unicast route establishment, multicast route establishment.
• Broadcast. Optimizations and Enhancements Link Reversal Routing: GafniBertsekas algorithm, lightweight mobile routing algorithm.
• Temporally ordered routing algorithm Preserving battery life of mobile nodes: Associatively based routing, effects of beaconing on battery life

• Overview: Security - Threats, Vulnerabilities, Attacks, Integrity, Confidentiality, Policy and relevant definitions Authentication – Different techniques
• Cryptography – Symmetric Key Cryptography, Asymmetric key Cryptography, Key management, Digital signatures, Certificate
• Distributed Systems Security – Cipher techniques, Protection systems, Example protocols
• Wireless and Mobile system security – Strategies, Routing security, Different schemes for MANET
• Hardware Perspectives for End to End Security (E2E) in wireless application Optimizing wireless security with FPGAs and AS
1. **Research Methodology**
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   - **Research Design**
   - **Research Publication & Presentation**
   - **Research Ethics and Morals**

2. **Engineering Mathematics**
   - **Linear Algebra**: Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.
   - **Calculus**: Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration.
   - **Probability**: Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.

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• Programming in C.
• Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

5. Databases
• ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms.
• File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

6. Operating System

7. Host Security

8. Cryptography
• Need for Security, Cryptography Techniques, Symmetric key cryptography algorithms, Asymmetric key cryptography algorithms, Public Key Infrastructure, User Authentication Mechanism, Cryptography in Java.

9. Internetworking & Security
• Internetworking – introduction, protocol independence
• Sockets –TCP, UDP, various socket functions, TCP client server model
• I/O multiplexing: select and poll functions, I/O models, socket states, generic socket options, IPv4 socket options, ICMPv6 socket option, TCP socket option, SCTP socket option.
• Daemon processes, Unix domain protocols introduction, unix socket address structure, socket functions, unix domain stream client/server and datagram client/server, receiving sender credential.
• Nonblocking i/o introduction, nonblocking reads and writes, connect and accept
• Introduction to advanced UDP and SCTP sockets.

10. Ethical Hacking

11. Wireless LAN & Security

12. Mobile Security

Advt No. 5: Assistant Professor: Industrial Design

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• Research Design
  Qualitative Methods: Types of hypothesis and characterization. Quantitative Methods: Statistical methods for testing and evaluation. Characterization of
experiments: Accuracy, reliability, reproducibility, sensitivity, Documentation of ongoing research.

- **Research Publication & Presentation**

- **Research Ethics and Morals**

2. **Engineering Mathematics**

- **Linear Algebra:** Matrix algebra; Systems of linear equations; Eigen values and Eigen vectors.
- **Calculus:** Functions of single variable; Limit, continuity and differentiability; Mean value theorems, local maxima and minima, Taylor and Maclaurin series; Evaluation of definite and indefinite integrals, application of definite integral to obtain area and volume; Partial derivatives; Total derivative; Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.
- **Ordinary Differential Equation (ODE):** First order (linear and non-linear) equations; higher order linear equations with constant coefficients; Euler-Cauchy equations; Laplace transform and its application in solving linear ODEs; initial and boundary value problems.
- **Partial Differential Equation (PDE):** Fourier series; separation of variables; solutions of one-dimensional diffusion equation; first and second order one-dimensional wave equation and two-dimensional Laplace equation.
- **Complex variables:** Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.
- **Probability and Statistics:** Definitions of probability and sampling theorems; Conditional probability; Discrete Random variables: Poisson and Binomial distributions; Continuous random variables: normal and exponential distributions; Descriptive statistics - Mean, median, mode and standard deviation; Hypothesis testing.
- **Numerical Methods:** Accuracy and precision; error analysis. Numerical solutions of linear and non-linear algebraic equations; Least square approximation, Newton’s and Lagrange polynomials, numerical differentiation, Integration by trapezoidal and Simpson’s rule, single and multi-step methods for first order differential equations.

3. **Applied Mechanics and Design**

- **Engineering Mechanics:** Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collisions.
• **Mechanics of Materials**: Stress and strain, elastic constants, Poisson's ratio; Mohr’s circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler’s theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

• **Theory of Machines**: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

• **Vibrations**: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.

• **Machine Design**: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.

4. **Fluid Mechanics and Thermal Sciences**

• **Fluid Mechanics**: Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli’s equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings.

• **Heat-Transfer**: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, StefanBoltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis.

• **Thermodynamics**: Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.

5. **Materials, Manufacturing and Industrial Engineering**


- **Casting, Forming and Joining Processes**: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.

- **Machining and Machine Tool Operations**: Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, design of jigs and fixtures.

- **Metrology and Inspection**: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

- **Computer Integrated Manufacturing**: Basic concepts of CAD/CAM and their integration tools.

- **Production Planning and Control**: Forecasting models, aggregate production planning, scheduling, materials requirement planning.

- **Inventory Control**: Deterministic models; safety stock inventory control systems.

- **Operations Research**: Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.
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- Research Design

- Research Publication & Presentation

- Research Ethics and Morals

2. Engineering Mathematics

- Linear Algebra: Matrix algebra; Systems of linear equations; Eigen values and Eigen vectors.

- Calculus: Functions of single variable; Limit, continuity and differentiability; Mean value theorems, local maxima and minima, Taylor and Maclaurin series; Evaluation of definite and indefinite integrals, application of definite integral to obtain area and volume; Partial derivatives; Total derivative; Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

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order one-dimensional wave equation and two-dimensional Laplace equation.

- **Complex variables:** Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.
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- **Numerical Methods:** Accuracy and precision; error analysis. Numerical solutions of linear and non-linear algebraic equations; Least square approximation, Newton’s and Lagrange polynomials, numerical differentiation, Integration by trapezoidal and Simpson’s rule, single and multi-step methods for first order differential equations.

3. **Process Calculations and Thermodynamics**
   - Steady and unsteady state mass and energy balances including multiphase, multicomponent, reacting and non-reacting systems. Use of tie components; recycle, bypass and purge calculations; Gibb’s phase rule and degree of freedom analysis.
   - First and Second laws of thermodynamics. Applications of first law to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

4. **Fluid Mechanics and Mechanical Operations**
   - Fluid statics, Newtonian and non-Newtonian fluids, shell-balances including differential form of Bernoulli equation and energy balance, Macroscopic friction factors, dimensional analysis and similitude, flow through pipeline systems, flow meters, pumps and compressors, elementary boundary layer theory, flow past immersed bodies including packed and fluidized beds, Turbulent flow: fluctuating velocity, universal velocity profile and pressure drop.
   - Particle size and shape, particle size distribution, size reduction and classification of solid particles; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, agitation and mixing; conveying of solids.

5. **Heat Transfer**
   - Steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations. Design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators.
6. **Mass Transfer**
   - Fick’s laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage-wise and continuous contacting and stage efficiencies; HTU & NTU concepts; design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption.

7. **Chemical Reaction Engineering**
   - Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.

8. **Instrumentation and Process Control**
   - Measurement of process variables; sensors, transducers and their dynamics, process modeling and linearization, transfer functions and dynamic responses of various systems, systems with inverse response, process reaction curve, controller modes (P, PI, and PID); control valves; analysis of closed loop systems including stability, frequency response, controller tuning, cascade and feed forward control.

9. **Plant Design and Economics**
   - Principles of process economics and cost estimation including depreciation and total annualized cost, cost indices, rate of return, payback period, discounted cash flow, optimization in process design and sizing of chemical engineering equipments such as compressors, heat exchangers, multistage contactors.

10. **Chemical Technology**
    - Inorganic chemical industries (sulfuric acid, phosphoric acid, chlor-alkali industry), fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries (polyethylene, polypropylene, PVC and polyester synthetic fibers).
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• Probability and Statistics: Definitions of probability and sampling theorems; Conditional probability; Discrete Random variables: Poisson and Binomial distributions; Continuous random variables: normal and exponential distributions; Descriptive statistics - Mean, median, mode and standard deviation; Hypothesis testing.


3. Structural Engineering

• Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Friction and its applications; Kinematics of point mass and rigid body; Centre of mass; Euler’s equations of motion; Impulse-momentum; Energy methods; Principles of virtual work.

• Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Theories of failures; Simple bending theory, flexural and shear stresses, shear centre; Uniform torsion, buckling of column, combined and direct bending stresses.

• Structural Analysis: Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis.

• Concrete Structures: Working stress, Limit state and Ultimate load design concepts; Design of beams, slabs, columns; Bond and development length; Prestressed concrete; Analysis of beam sections at transfer and service loads.

• Steel Structures: Working stress and Limit state design concepts; Design of tension and compression members, beams and beam- columns, column bases; Connections - simple and eccentric, beam-column connections, plate girders and trusses; Plastic analysis of beams and frames.

4. Geotechnical Engineering

• Soil Mechanics: Origin of soils, soil structure and fabric; Three-phase system and phase relationships, index properties; Atterberg’s limits and their significance; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Darcy’s law; Seepage through soils - two-dimensional flow, flow nets, uplift pressure, piping; Principle of effective stress, capillarity, seepage force and quicksand condition; Compaction in laboratory and field conditions; One-dimensional consolidation, time rate of consolidation; Mohr’s circle, stress paths,
effective and total shear strength parameters, characteristics of clays and sand.

- **Foundation Engineering**: Sub-surface investigations - scope, drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes - finite and infinite slopes, method of slices and Bishop’s method; Stress distribution in soils - Boussinesq’s and Westergaard’s theories, pressure bulbs; Shallow foundations - Terzaghi’s and Meyerhoff’s bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations - types of piles, dynamic and static formulae, load capacity of piles in sands and clays, pile load test, negative skin friction.

5. **Water Resources Engineering**

- **Fluid Mechanics**: Properties of fluids, fluid statics; Continuity, momentum, energy and corresponding equations; Potential flow, applications of momentum and energy equations; Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth.
- **Hydraulics**: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Kinematics of flow, velocity triangles; Basics of hydraulic machines, specific speed of pumps and turbines; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, slope profile, hydraulic jump, uniform flow and gradually varied flow.
- **Hydrology**: Hydrologic cycle, precipitation, evaporation, evapotranspiration, watersheds, infiltration, unit hydrographs, hydrograph analysis, flood estimation and routing, reservoir capacity, reservoir and channel routing, surface run-off models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy’s law.
- **Irrigation**: Duty, delta, estimation of evapo-transpiration; Crop water requirements; Design of lined and unlined canals, head works, gravity dams and spillways; Design of weirs on permeable foundation; Types of irrigation systems, irrigation methods; Water logging and drainage; Canal regulatory works, cross-drainage structures, outlets and escapes.

6. **Environmental Engineering**

- **Water and Waste Water**: Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment. Unit operations and unit processes of domestic wastewater, sludge disposal.
- **Air Pollution**: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.
7. **Transportation Engineering**

- **Transportation Infrastructure**: Highway alignment and engineering surveys; Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments; Geometric design of railway track, defects in rails, points and crossings; Bridges and tunnels-alignment, types, construction; Airport runway length, taxiway and exit taxiway design; Ports, Harbours and Docks-elements, layouts and planning.

- **Highway Pavements**: Highway materials - desirable properties and quality control tests; CBR test method; Tri-axial test method; Design of bituminous paving mixes; Marshall stability test method; Design factors for flexible and rigid pavements; Design of flexible pavement using IRC: 37-2012; Design of rigid pavements using IRC: 58-2011; Distresses in concrete pavements; Highway drainage.

- **Traffic Engineering**: Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Control devices, signal design by Webster’s method; Types of intersections and channelization; Highway capacity and level of service of rural highways and urban roads; Road safety aspects.

8. **Geomatics Engineering**

- Principles of surveying: Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement – Plane Table surveying, Levelling and trigonometric leveling, Traversing, Tacheometry and triangulation survey; Total station; Measurement of area and volume; Horizontal and vertical curves.

- Photogrammetry - scale, flying height; Remote sensing - basics, platform and sensors, visual image interpretation; Basics of Geographical information system (GIS) and Global Positioning system (GPS).

9. **Construction, Materials and Management**

- Construction Materials: Structural steel - composition, material properties and behaviour; Cement - composition, types, properties and testing, Concrete - constituents, mix design, short-term and long-term properties; Bricks and mortar; Timber; Glass; Bitumen; Paints; Plastic polymeric materials; Damp proof, thermal proof, fire proof, sound proof and acoustical materials; anti-termite treatment. Cofferdams; Caissons; Underground water control- well points, grouting and other techniques.

- Construction Management: Types of construction projects; Tendering and construction contracts; Rate analysis and standard specifications; Cost estimation; Project planning and network analysis - PERT and CPM.
1. **Research Methodology**
   - **General introduction to Research**
     *History of Science & Technology*: Importance of research, role of research, aims & objectives, research process, phases of research.
   - **Research problem Formulation**
     *Review of Research Literature*: Purpose and use of literature review, locating relevant information, use of library & electronic databases, preparation & presentation of literature review, research article reviews, theoretical models and framework. Identification of gaps in research, formulation of research problem, definition of research objectives.
   - **Research Design**
     *Qualitative Methods*: Types of hypothesis and characterization.
     *Quantitative Methods*: Statistical methods for testing and evaluation.
     *Characterization of experiments*: Accuracy, reliability, reproducibility, sensitivity. Documentation of ongoing research.
   - **Research Publication & Presentation**
     *Quality indices of research publication*: impact factor, immediacy factor, H-index and other citation indices.
   - **Research Ethics and Morals**
     Issues related to plagiarism, collaborative models and ethics, acknowledgements.

2. **Engineering Mathematics**
   - **Linear Algebra**: Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.
   - **Calculus**: Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration.
   - **Probability**: Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.
3. **Computer Networks**
   - Concept of layering, LAN technologies (Ethernet).
   - Flow and error control techniques, switching.
   - IPv4/IPv6, routers and routing algorithms (distance vector, link state).
   - TCP/UDP and sockets, congestion control.
   - Application layer protocols (DNS, SMTP, POP, FTP, HTTP).
   - Basics of Wi-Fi.
   - Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

4. **Communication**
   - Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems;
   - Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications;
   - Information theory: entropy, mutual information and channel capacity theorem;
   - Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation;
   - Fundamentals of error correction, Hamming codes;
   - Timing and frequency synchronization, inter-symbol interference and its mitigation;
   - Basics of TDMA, FDMA and CDMA.

5. **Programming**
   - Programming in C.

6. **LSI**
   - Design flow, Design hierarchy, Concept of regularity, Modularity, and Locality, FPGA and CPLD, Fabrication of MOSFET, Metal Oxide Semiconductor (MOS) structure, MOS System under external bias, Structure and Operation of MOS transistor, MOSFET Current-Voltage characteristics, MOSFET scaling and small-geometry effects, MOSFET capacitances, MOS Inverters, Combinational and Sequential CMOS Logic Circuits, Dynamic CMOS Logic Circuits, Fault types and models, Controllability and observability, Ad Hoc Testable design techniques, Scan –based techniques, built-in Self Test (BIST) techniques.

7. **Real Time Operating System**
   - Operating system service, Process management, Timer function, Event function, Memory management, File and I/O subsystem management, Interrupt routine in RTOS environment and handling of interrupt Sources calls, Real Time Operating Systems, Basic Design Using an RTOS,
RTOS Task Scheduling Models, Interrupt Latency and Response of the Tasks as Performance Metrics.

8. **MSP430 RISC CPU architecture:**
   - Instruction set, Clock system, Memory subsystem, interrupt programming, On-chip peripherals - Watchdog Timer, Basic Timer, Real Time Clock (RTC), ADC, Universal Serial Communication Interface (USCI), Interfacing LED, LCD, Seven segment LED modules interfacing, Direct Memory Access.

   **Advt No. 12: Assistant Professor: Mechatronics**

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2. **Engineering Mathematics**
   - **Linear Algebra:** Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.
• Calculus: Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration.
• Probability: Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.

3. Mechatronics Engineering
• Basic Mechanical Engineering: Motion and power transmission mechanisms, Design of mechanisms, Basics of hydraulic and pneumatic systems, Properties of gas and steam, Heat engines, Steam engines, I.C. engines, Pumps, compressors, Refrigeration and air conditioning.
• Basic Electrical and Electronics Engineering: Fundamentals of electrical and electronics engineering, Programmable Logic Controllers (PLCs), Microprocessors, Microcontrollers and embedded systems, Electric Circuits and fields, Control systems, Electrical and electronic measurement, Analog and digital electronics, Power electronics and drives
• Manufacturing Technology: Metal cutting principles and Conventional machining processes, Computer Aided Manufacturing (CAM), Basic part programming, Measuring and gauging standards, Non-traditional manufacturing methods, Location theory and Jig-fixtures design.
• Metal Forming Processes: Hot and Cold working, Metal forming processes like Extrusion, Drawing, Rolling, Forging, Casting, Welding, etc.
• Robotics: Robot fundamentals, Basic configurations, Robot kinematics, Trajectory planning, types of end effectors, drive systems, Robot sensors, applications in manufacturing
Computer aided Design: Fundamentals of computer graphics, Geometrical modeling, Finite element analysis
• Machine Vision and Image Processing: Digital image fundamentals, image enhancement, image compression, image restoration
• Operations Research: Linear programming, Transportation model assignment model, Network analysis, sequencing problem, decision theory, replacement, queuing model, inventory control
• Material Science and Metallurgy: Iron-Iron Carbon diagram, Heat treatment processes, Ferrous and non-ferrous metals, Non destructive testing
• Machine Design: Stress-strain relationship and elastic constants, bending stress, crushing stress, bearing pressure, shear stresses, torsion of circular shafts, principal stresses, Euler’s theory of columns, strain energy methods, Design of keys, power screw, curved beam, lever, design under fluctuate loading, bearing selection.
• Theory of Machines: Basics of mechanisms, velocity and acceleration of linkages, Cams, Belts, Gears, Gear trains, Gyroscope, Balancing, Fundamental of vibrations (SDOF)
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2. Natural Products
3. **Pharmacology**

4. **Medicinal Chemistry**

5. **Pharmaceutics**

6. **Pharmaceutical Jurisprudence**
   - Drugs and cosmetics Act and rules with respect to manufacture, sales and storage. Pharmacy Act. Pharmaceutical ethics.

7. **Pharmaceutical Analysis**

8. **Biochemistry**

9. **Microbiology**
   - Principles and methods of microbiological assays of the Pharmacopoeia. Methods of preparation of official sera and vaccines. Serological and diagnostics tests. Applications of microorganisms in Bio Conversions and in Pharmaceutical industry.

10. **Clinical Pharmacy**
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   • Research Design
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   • Research Ethics and Morals

2. General Management
   • The Concept of Management-Functions of Management-Theories and concept of Management- Line authority staff authority
   • The concept of Corporate Strategy; Components of Strategy Formulation-Competitor Analysis- Strategic Dimensions and Group Mapping-Industry Analysis- Strategies in Industry Evolution-Ethics and Management System-Ethical issues and Analysis in Management-Value based organizations-Personal framework for ethical choices.
3. **Production and Operation Research**
   - Role and Scope of Production Management - Facility Location; Layout Planning and Analysis; Production Planning and Control – Production Process Analysis; Demand Forecasting for Operations - Production Scheduling; Work measurement - Time and Motion Study - Statistical Quality Control. Role and Scope of Operations Research; Linear Programming - Sensitivity Analysis - Transportation Model - Inventory Control - Queuing Theory - Decision Theory - Markov Analysis - PERT / CPM.

4. **Research Methodology**

5. **Marketing Management**
   - Marketing – Concept; Nature and Scope; Marketing myopia; Marketing mix; Different environments and their influences on marketing; Understanding the customer and the competition.
   - Role and Relevance of Segmentation and Positioning - Static and Dynamic understanding of BCG Matrix and Product Life Cycle - Brands - 4Ps and NPD - Test Marketing Concepts.
   - Promotion mix – Advertising - Public Relations - Distribution channel - Wholesaling and Retailing. - Marketing Research - Consumer Behavior theories and models - Sales Function - Export Marketing – Indian and global context.

6. **Financial Management**
   - Mergers and Acquisitions - International Financial Management.

7. **Human Resource Management**
   - Significance; Objectives; Functions; A diagnostic model; External and Internal environment; Forces and Influences; Organizing HRM function.
ARCHITECTURE

1. Architecture and Design
   - Principles of Art and Architecture
   - Space, Volume and Mass, Organization of space, Form – Function Relationship.
   - Basics of Anthropometrics
   - Planning and design considerations for different building types
   - Functional integration of interior and exterior spaces
   - Context, Site planning
   - Barrier free design
   - Space Standards, Building Codes, National Building Code

2. History of Architecture
   - Elements, construction, architectural styles and examples of different periods of Indian and Western History of Architecture
   - Planning, construction systems and materials used in Vedic Civilization, elements of Buddhist Architecture, Temple Architecture
   - Oriental, Vernacular and Traditional Architecture
   - Architectural developments since Industrial Revolution
   - Influence of modern art on architecture
   - Architectural styles-Art nouveau, International styles, Post Modernism, Deconstruction in architecture
   - Recent trends in Contemporary Architecture
   - Works of renowned national and international architects

3. Building Materials, Construction and Management
   - Behavioral characteristics and applications of different building materials viz. mud, timber, bamboo, brick, concrete, steel, RCC, glass, FRP, AAC, different polymers
   - Composites Building construction techniques, methods and details
   - Basics of structural systems and types
   - Design of structural elements in wood, steel and RCC
   - Building systems and prefabrication of building elements
• Estimation, specification, valuation and Professional practice – current updates- acts, rules, regulations
• Construction planning and equipments, Project management techniques e.g. PERT, CPM etc.

4. **Environmental Planning and Design**
   • Ecosystem- natural and man-made ecosystem
   • Environmental considerations in planning and design
   • Thermal comfort, ventilation and air movement, Principles of lighting and illumination, Climate responsive design
   • Building Performance Simulation and Evaluation
   • Environmental Concepts of Environmental Impact Analysis

**PLANNING (URBAN AND REGIONAL)**

5. **Planning Theory**
   • Scientific Rationalism and Planning
   • Participation and Planning
   • Advocacy Planning, Pluralism and Equity Planning
   • Political Economy Theories and the City
   • Collaborative and Communicative Planning
   • Planning, Implementation and Evaluation

6. **Urban Design**
   • Concepts and theories of urban design, principles, tools and techniques
   • Public spaces: character, spatial qualities and Sense of Place; Elements of urban built environment – urban form, spaces, structure, pattern, fabric, texture, grain etc.
   • Public Perception, Public Realm
   • Urban design interventions for sustainable development and Transportation.
   • Historical and modern examples of urban design
   • Urban renewal and conservation
   • Basics of Landscape design
7. **Urban Planning**
   - Planning process
   - Types of plans - Master Plan, City Development Plan, Structure Plan, Zonal Plan, Action Area Plan, Town Planning Scheme, Regional Plan
   - Principles of urban planning, zoning
   - Sustainable urban development
   - Emerging concepts of cities - Eco-City, Smart City, Transit Oriented Development (TOD), SEZ- Special Economic Zone, SIR-Special Investment Region, etc.

8. **Housing**
   - Concepts, principles and examples of neighborhood
   - Housing typologies, Slums, Affordable Housing, LIG, HIG, Housing for special areas and needs
   - Residential densities
   - Standards for housing and community facilities
   - National Housing Policies and other Programs, Schemes, Regulations, Acts

9. **Planning Techniques and Management**
   - Tools and techniques of Surveys – Physical, Topographical, Landuse and Socioeconomic Surveys
   - Methods of non-spatial and spatial data analysis
   - Graphic presentation of spatial data
   - Application of G.I.S and Remote Sensing techniques in urban and regional planning;
   - Decision support system and Land Information System
   - Basics of Urban Economics
   - Law of demand and supply of land and its use in planning
   - Social, Economical and environmental cost benefit analysis
   - Techniques of financial appraisal
   - Management of Infrastructure Projects
   - Development guidelines such as URDPFI, CGDCR
   - Central and State planning organization, Local self-governance.
   - Planning Legislation and implementation- RFCTLARR ACT, 2013, GTPUD Act, 1976, etc.

10. **Services and Infrastructure**
    - Building Services: Water supply; Sewerage and drainage systems
    - Principles of water supply and sanitation systems, water treatment, Water supply and distribution system, Water harvesting systems
    - Principles, Planning and Design of storm water drainage system
• Sewage disposal methods, Methods of solid waste management - collection, transportation and disposal, Recycling and Reuse of solid waste.
• Power Supply and Communication Systems, network, design and guidelines.
• Sanitary fittings and fixtures, Plumbing systems, Principles of internal and external drainage system.
• Intelligent Buildings
• Elevators, Air-Conditioning systems; Firefighting Systems
• Building Safety and Security systems.

11. **Transportation**

• Process and Principles of Transportation Planning and Traffic Engineering
• Road capacity, Traffic survey methods, Traffic flow characteristics
• Traffic analyses and design considerations
• Travel demand forecasting
• Land-use – transportation – urban form inter-relationships
• Hierarchy of roads and level of service, Design of roads, intersections, grade separators and parking areas
• Traffic and transport management and control in urban areas
• CMP-Comprehensive Mobility Plan for cities and urban area
• Mass transportation planning
• Para-transits and other modes of transportation, Pedestrian and slow moving traffic planning
• Intelligent Transportation Systems