Lingaya's Vidyapeeth

Faridabad

Ph.D Admission: Entrance Test and Interview

1 Introduction: The Lingaya's Vidyapeeth operates its Ph.D Programme on the lines of applicable UGC guidelines. Please refer to the document "Ph.D guidelines" for information on eligibility, duration of Ph.D, disciplines/ area of research, course work, Ph.D execution process etc.

2. Entrance test and Admission: The Admission to Ph.D at Lingaya's Vidyapeeth shall be done on the basis of a written test followed by an interview for the candidates.

- **Written Test**: The Written Test shall be a qualifying test with the qualifying marks set by the Vidyapeeth. The written test shall consist of two parts – 1) Research Methodology/ Aptitude and 2) the Specific Core Subject.

- **Syllabus for Written test**: The syllabus for the written test for Research Methodology/ Aptitude (common to all candidates) and for the specific core subjects (based on discipline of the candidate) are given in this document. Lingaya's Vidyapeeth reserves the right to revise the syllabus from time to time as deemed necessary. The prospective candidates may check the web site for the updates on the syllabus from time to time.

- **Exemption from Entrance test**: Candidates who have qualified in UGC/ CSIR (JRF) Examination/ SLET/ GATE /M.Phil (As a Regular Candidate from UGC Recognized University for admission to non-engineering disciplines) etc., are not required to appear for the Written Test. However, their participation in the interview is mandatory for the admission.

- **Personal Interview:** The candidates qualified in the written test shall be required to attend before an Expert Committee for a personal Interview. The candidates shall be selected in the Interview based on their aptitude for Research, their suitability and ability to pursue the PhD work, research area of interest, vacancies, and facilities available in the area of candidate's interest.

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Syllabus for Written test for Ph.D entrance Examination

Research Methodology (Common to all candidates)

1. **Introduction**
   Scope and Meaning of Research, purpose and importance of Research, Research Process, Qualities of a good researcher, Principal elements of research, Characteristic features of research, Ethics in Research, Research establishments in various areas with Indian scenario, Research funding agencies and National and International Research awards.

2. **Types of Research**
   Classifications of research, types of research: Fundamental/pure research, Application oriented research, applied research, product development - concepts, examples and case studies.
   Problem solving approach and societal oriented research - concepts, examples and case studies
   Concepts of invention, innovation, entrepreneurship.

3. **Research Problem : A brain teaser**
   Introduction to research problem, Components of Research problem, Sources of selecting a suitable Research Problem, Concepts of project definition, planning, scope, Project progress and Project status, Project management Theoretical study and modelling, experimentation, field study, comparison of theoretical and experimental/ field study & validation of results, error identification & reduction/ elimination.

4. **Sampling & Measurement Scaling**
   Introduction to Sampling, Definitions, Reasons for sampling, Considerations in choosing a Sample, Types of Sample - Probability sample and Non-probability

sample, What Size Sample is needed? Rules of Measurement, Criteria of good measurement (Reliability and Validity); Basic Scales – Nominal, Ordinal, Interval and Ratio Scale, Plagiarism: concepts, importance and tools, importance of Impact factor, H index, citation, Fundamentals of Intellectual property rights, patents, copy rights, trademarks.

5. Data collection & Analysis

Primary and Secondary data, Sources, Advantages and Disadvantages of Secondary data, Importance of publications, Reputed Research journals of international and national level, Literature review: concepts, importance, sources of literature survey , Theoretical modeling and comparison of theory and experiments, Survey methods; Interview Method, Observation Method, Distinction between questionnaire and Schedule , Descriptive analysis; Tabulation, Cross-tabulation, parametric and non-parametric tests.

6. Basic Knowledge of computers and software:

Basics of computers.. History of development of computers, Mainframe, Mini, Micro's and Super Computer Systems. General awareness of computer Hardware i..e. CPU and other peripheral devices (input / output and auxiliary storage devices). Basic knowledge of software and programming languages. General awareness of popular commercial software packages and other Scientific application packages.

6. Publications, plagiarism, Intellectual property rights

Quality of research work and papers –indexing, impact factor, H Index, citation index Meaning and principles ofplagiarism, methods of plagiarism check, plagiarism checking software. Principles of intellectual property rights, patents, copyrights, trademarks and their importance.

7. Writing PhD research proposal

Literature review, objectives, work plan, generation of results, analysis of results, output and importance of the results. *Students shall write a sample proposal on the given topic.*

Aptitude Questions (Common to all candidates)

The Aptitude questions will test your ability to perform tasks and react to the situations. These will include numerical reasoning, verbal reasoning, logical reasoning, situational judgement.

SCHOOL OF ELECTRONICS AND ELECTRICAL ENGINEERING

PH.D DISCIPLINES: ELECTRICAL ENGIEERING, ELECTRONICS ENGIEERING AND COMMUNICATIONS ENGIEERING

1. **BASIC ELECTRONICS:** PN Junction diode, Energy bands in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers, PN junction diode, Zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, PIN and avalanche photo diode, Basics of LASERs. Small Signal Equivalentcircuits of diodes, BJTs, MOSFETs and analog CMOS. Simple diode circuits, clipping, clamping, rectifier. Biasing and bias stability of transistor; FET amplifiers.

2. **DIGITAL ELECTRONICS:** Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR; Boolean algebra, Error detection and correction codes, Karnaugh map, Multiplexers and Demultiplexers, BCD arithmetic circuits, Encoders and Decoders, Flip Flops: S -R, J-K, T, D, master-slave, edge triggered; Switching mode operation of p-n junction, D/A and A/D converters.

3. **MICROPROCESSOR:** Introduction to microprocessor, 8085/8086 microprocessor: Architecture & Block Diagram; Instruction Set of 8085/8086 microprocessor: data transfer instructions, arithmetic instructions, branch instructions, looping instructions; The 8255 PPI Chip Architecture; The 8259 Programmable Interrupt Controller, The 8237 DMA controller.

4. **DIGITAL SIGNAL PROCESSING:** Discrete-Time Signals, Discrete-Time Systems, Sampling of Time Signals, Digital Filters, Multirate Digital Signal Processing, ADSP 2100, DSP processors, Applications of DSP in: Communications, speech processing, image processing, Biomedical and Radars

5. **INDUSTRIAL DRIVES:** Components of electrical drives; choice of electrical drive; dynamics of electrical drives; calculation of time and energy; loss in transient operations; steady state stability and load equalization. closed loop control phase-locked-loop (PLLI) control; Thermal model of motor heating and cooling; classes of motor duty and motor rating. D.C. motors and induction motors etc. starting; braking and speed control of motors; quadrant drives; types of loads; torque and associated controls used in process industries; choice of motors and relays. Brushless DC motor, Stepper Motor, Switched Reluctance Motor

6. **POWER SYSTEM:** General layout & main components of thermal power station (in brief). Available hydropower; selection of site for hydroelectric power stations; their classifications; layout and main components (in brief). Nuclear power plants – fission energy; general layout and main components (in brief); waste disposal; types of nuclear reactors (in brief); general lay out and main components (in brief); types of nuclear radiations & their effect.

7. **TRANSMISSION SYSTEM**: Calculations of resistance, inductance, capacitance of a single conductor, multi conductor, single phase and three phase transmission lines; transposition; double circuit lines; skin and proximity effect; Generalized ABCD constants; representation & steady state analysis of short and medium lines; regulation and efficiency; nominal–T and pi circuits; Long line: current – voltage relationship, hyperbolic solution; surge impedance; Surge impedance loading; lumped circuit equivalent representation; Ferranti effect; power flow through a transmission line; reactive power generation / absorption of a line; power transfer capability; shunt and series compensation (in brief). Improvement of power factor of the system using synchronous condensers.

SCHOOL OF COMPUTER SCIENCE & ENGINEERING

PHD DISCIPLINES: COMPUTER SCIENCE, INFORMATION TECHNOLOGY AND COMPUTER ENGINEERING

1. **COMPUTER ARCHITECTURE & ORGANIZATION: -** Combinational Circuit: adder, subtractor, decoder, MUX etc. Sequential Circuit: Flip-flops, Registers, Counters, Machine Instructions and Addressing Modes, ALU & Data path, Memory interface, I/O Interface, Instruction pipeline, Cache, Main and secondary storage.

2. **COMPUTER NETWORKS: -** ISO/OSI stack, LAN technologies, Flow and error control techniques,
IPV4,IPV6, TCP/UDP, Routing algorithms , Congestion control, Application layer protocols, Basic concepts of Switches, Bridges, Gateway & Routers, Basic concepts of Network security : Public and private key cryptography, Firewall, Digital signature etc.

3. **Operating System:-** Process, Thread, Interprocess Communication, CPU Scheduling , Concurrency control, synchronization, Deadlock, Memory management and Virtual Memory, File system, I/O System Protection and Security.

4. **Data Structures:-** Overview of Programming in C/C++, Recursion, Parameter Passing, Scope, Binding, Array , Stacks, Queues, Link list, Searching & Sorting Techniques ,Lists and their Applications, Trees: Binary Tree, Properties & Representation, ADT Binary Tree, Binary search Trees, AVL Trees & Applications, Graphs: Representations & Properties, Directed and Undirected graphs, Graph search methods, Path finding Algorithms, Asymptotic notations ,Greedy, Dynamic Approach, Branch and Bound techniques.

5. **Theory of Computation and Compiler Design:-** Regular Language and Finite Automata, Context free Grammar, Context sensitive Grammar, Push down automata, Turing Machine, Undecidabilty, Lexical Analyzer, Parsing Syntax, Direct translation, Run time environment, Immediate and Target code generation, Code optimization.

6. **Database Management system:-** Basic concept, ER model , Relationship Model, Relational algebra, Tuple Calculus, Data Base design, Integrity constraint, Normal Forms, Query languages (SQL), File structure, Concurrency Control and Transactions.

7. **Software Engineering and Web development:-** Information gathering , requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project, design, coding testing, implementation, maintenance. HTML, XML, Scripting and Basic Concept of Client and server side programming.

8. **Probability Theory and Discrete Mathematics:-** Conditional Probability , Mean , Median, Mode and Standard Deviation, Exponential, Sets, Relations, Functions, Group, Partial Order, Boolean algebra, Propositional and Predicate Logic.

9. **Advance Computing:-** Artificial intelligence, Heuristic and blind search, Knowledge base system, Fuzzy logic, fuzzy membership function, Neural network, ANN, Learning rules. Single layer and multilayer neural network, Back Propagation network, Genetic algorithm, Fundamentals, basic concepts, working principle, encoding and fitness function.

SCHOOL OF MECHANICAL ENGINEERING

PH.D DISCIPLINES: MECHANICAL ENGINEERING, AUTOMOBILE ENGINEERING

(A) APPLIED MECHANICS AND DESIGN:

(i) **ENGINEERING MECHANICS:** Free body diagrams and equilibrium; kinematics and dynamics of particles and of rigid bodies in plane motion; impact.

(ii) **MECHANICS OF SOLIDS:** Stress and strain, force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; springs; thin walled sections; Euler's theory of columns; strain energy methods; thermal stresses; mechanical properties; material testing.

(iii) **THEORY OF MACHINES:** Kinematics and dynamics of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels; bearings; governors; static & dynamic balancing of rotors.

(iv) **VIBRATIONS:** Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance; critical speeds of shafts.

(v) **DESIGN:** Design for static and dynamic loading; failure theories; principles of the design of machine elements such as shafts, spur gears, rolling and sliding contact bearings, brakes, clutches and various joints.

(B) PRODUCTION AND INDUSTRIAL ENGINEERING:

(i) **PRODUCTION ENGINEERING:** Unconventional Machining Processes, Computer controlled machines, CAD/CAM, CNC, Mechanics of Metal Cutting, Tool wear and Machinability, Economics of Metal cutting, Metal Forming, Casting Processes, Powder Metallurgy, Joining Processes, Finishing operations and super finishing processes, Measurement.

(ii) **INDUSTRIAL ENGINEERING:** Production systems, Systems approach, Productivity, Product design and development, Production Planning and Control, Statistical Quality Control, Operations Scheduling, Linear Optimization Models, Assignment and Transportation Models, Waiting Line models, Capacity Planning, Plant and Facility layout, Plant Location, Production and Assembly Line Balancing, Time and motion study, Work sampling, Predetermined Time Systems, Principles of Motion economy, Industrial safety, Cost concepts and Break Even analysis, Interest and Money time relationship, Demand and Supply Relationship, Market types and competition, Principle s of Management, Motivation, Organization, Forecasting.

(C) THERMAL ENGINEERING:

(i) **THERMODYNAMICS:** Basic Laws of Thermodynamics, Availability, Irreversibility, Concept of Exergy, Thermodynamic cycles related to energy conversion.

(ii) **HEAT TRANSFER:** Basic modes of Heat Transfer, Heat Exchangers.

(iii) **I.C.ENGINES:** Air Standard cycles, Normal and Abnormal Combustion in S.I. engines and C.I.engines., Engine performance, Alternative Fuels for I.C. Engines.

(iv) **FLUID MECHANICS AND MACHINES:** Fluid properties, Bernoulli's equation, Flow through pipes, Hydraulic machines.

(v) **TURBOMACHINES:** Euler's equation, Fans, Compressors and Pumps, Turbines.

(vi) **REFRIGERATION AND AIR CONDITIONING:** Refrigeration systems, Vapor Compression cycles, Vapor Absorption system, Refrigerants, Expansion devices, Condenser and evaporator, Psychometric process.

(vii) **GAS DYNAMICS:** Basic equations for fluid flow, Wave propagation, Rayleigh line, Fanno line, Shock waves.

(viii) **ENERGY CONVERSION SYSTEMS:** Energy sources, Basic cycles related to energy conversion system, Environmental evaluation.

SCHOOL OF CIVIL ENGINEERING

PH.D DISCIPLINES: CIVIL ENGINEERING

1. **ENGINEERING MECHANICS:** System of Coplanar Forces, Centroids and Moment of Inertia, Friction, Kinematics of a particle, Kinematics of rigid bodies, Kinetics of particles and kinetics of rigid bodies, Momentum and Energy principles, Belt Friction.

2. **STRENGTH OF MATERIALS:** Shear force and bending moment, Simple Stresses and strains, Shear stresses in beams, Principal stresses and strains, Direct and bending stresses, Columns and struts, Thin cylinders.

3. **FLUID MECHANICS:** Fluid statics, pressure measurement, buoyancy & floatation, fluid kinametics, fluid dynamics, flow measurement, orifices, mouth pieces, notches, weirs, flow through pipes, dimensional analysis and models, laminar flow, turbulent flow in pipes, boundary layer theory, flow through channels, rapidly varied flow.

4. **SURVEYING:** Measurement of Horizontal distances, Chain surveying, Measurement of angles, Measurement of elevations, Theodolite Surveying, Tacheometric Surveying, Curves, Hydrographic surveying,

5. **THEORY OF STRUCTURES:** Fixed Beams, Continuous Beams, Moving Load, influence lines, Strain

6. **CONCRETE TECHNOLOGY:** Cement, Aggregates, Water, Admixtures, Fresh Concrete, Properties of Hardened Concrete, Concrete Mix Design.

7. **GEOTECNICAL ENGINEERING:** Structure of soil, The Three Phase System, Index Properties of soils, Classification of Soils, Soil Water and Effective stress principal, Permeability of soils, Compressibility, Compaction, Shear strength, Exploration and in situ soil measurements.

8. **WATER RESOURCES ENGINEERING:** Hydrology, Precipitation, Infiltration, Evaporation and evapotranspiration, Run-off, Hydrographs, Floods, Ground water hydrology, Irrigation.

9. **ENVIORMENTAL ENGINEERING:**
   (i) **WATER SUPPLY ENGINEERING:** Introduction to Water Supply, Quality of Water, Sources of Water, Raw Water Conveyance, Treatment of Water, Distribution of Water.,

(ii) **SANITORY ENGINEERING:** Sewage and Sewerage, Sewer Design, Sewer Appurtenances, Sewer Pumping, Waste Water Characteristics, Sewage Treatment, Effluent Disposal.

SCHOOL OF BASIC SCIENCES

PH.D DISCIPLINE: PHYSICS

1. General information on science with special reference to Physics and its interface with society to test the candidate's awareness of science, aptitude of scientific and quantitative reasoning.

2 **BASIC MATHEMATICAL METHODS:** Calculus, Vector algebra and vector calculus, Linear algebra, matrices, Linear differential equations, Fourier - series, Elementary complex analysis.

3 **CLASSICAL DYNAMICS:** Basic principles of classical dyna mics. Lagrangian and Hamiltonian formalisms. Symmetries and conservation laws. Motion in the central field of force. Collisions and scattering. Mechanics of a system of particles. Small oscillations and normal modes. Wave motion - wave equation, phase velocity, group velocity, dispersion. Special theory of relativity - Lorentz transformations, addition of velocities, mass - energy equivalence.

4 **ELECTROMAGNETICS:** Electrostatics - Laplace and Poisson equations, boundary value problems. Magnetostatics - Ampere's theorem, Biot - Savart Law, electromagnetic induction. Maxwell's equations in free space and in linear isotropic media. Boundary conditions on the fields at interfaces. Scalar and vector potentials. Gauge invariance. Electromagnetic waves - reflection and refraction, dispersion, interference, coherence, diffraction, polarization. Electrodynamics of a charged particle in electric and magnetic fields. Radiation from moving charges, radiation from a dipole. Retarded potential.

5 **QUANTUM PHYSICS AND APPLICATIONS:** Wave - particle duality. Heisenberg's uncertainty Principle. The Schrodinger equation Particle in a box, Harmonic Oscillator, Tunnelling through a barrier. Motion in a central potential, Orbital angular momentum. Angular momentum algebra, spin. Addition of angular momenta. Time - independent perturbation theory. Fermi's Golden Rule. Elementary theory of scattering in a central potential. Phase shifts, partial wave analysis, Born approximation, identical particles, spin - statistics connection.

6 **THERMODYNAMIC AND STATISTICAL PHYSICS:** Laws of thermodynamics and their consequences, Thermodynamic potentials and Maxwell's relations. Chemical potential, phase equilibria. Phase space, microstates and macrostates. Partition function. Free Energy and connection with thermodynamic quantities. Classical and quantum statistics, Degenerate electron gas. Blackbody radiation and Planck's

distribution law, Bose-Einstein condensation. Einstein and Debye models for lattice specific heat.

7 EXPERIMENTAL DESIGN: Measurement of fundamental constants: e, h, c, Measurement of High & Law Resistances, L and; Detection of X - rays, Gamma rays, charged particles, neutrons etc: Ionization chamber, proportional counter, GM counter, Scintillation detectors, Solid State detectors. Emission and Absorption Spectroscopy. Measurement of Magnetic field, Hall effect, magnetoresistance. X -ray and neutron Diffraction. Vacuum Techniques: basic idea of conductance, pumping speed etc. Pumps; Mechanical Pump, Diffusion pump; Gauges; Thermocouple, Panning, Pirani, Hot Cathode. Low Temperature: Cooling a sample over a range up to 4 K and measurement of temperature; Measurement of Energy and Time using electronic signals from the detectors and associated instrumentation: Signal processing, A/D conversion, multichannel analyzers, Time-of-flight technique; Coincidence Measurement; true to chance ratio, correlation studies.

8 ELECTRONICS: Physics of p n junction. Diode as a circuit element; clipping, clamping; Rectification, Zener regulated power supply; Transistor as a circuit element: CC, CB and CE configuration. Transistor as a switch, OR, AND, NOT gates. Feedback in Amplifiers. Operational amplifier and its applications: inverting, non inverting amplifier, adder, integrator, differentiator, wave form generator, comparator & Schmidt trigger. Digital integrated circuits NAND & NOR gates as building blocks, X OR Gate, simple Combinational circuits, Half & Full adder, Flip-flop, shift register, counters. Basic principles of A/D & D/A converters; Simple applications of A/D & D/A converters.

8. **ATOMIC & MOLECULAR PHYSICS:** Quantum states of an electron in an atom. Hydrogen atom spectrum. Electron spin. Stern-Geriach experiment. Spin-orbit coupling, fine structure, relativistic correction, spectroscopic terms and selection rules, hyperline structure. Exchange symmetry of wave functions. Paulâs exclusion principle, periodic lable alkali type spectra, LS & JJ coupling, Zeeman, Paschen Back and Stain effects. X-Rays and Auger transitions, Compton effect. Principles of ESR, NMR. Convalent, ionic and Van der Waals interaction. Rotation Vibration spectra. Raman Spectra, selection rules, nuclear spin and intensity alternation, isotope effects, electronic states of diatomic molecule s, Frank Condon principle. Lasers spontaneous and stimulated emission, optical pumping, population inversion, coherence (temporal and spatial) simple description of Ammonia maser, CO_2 and He-Ne Lasers.

9. **CONDENSED MATTER PHYSICS:** Crystal classes and systems, 2d & 3d lattices, Bonding of common crystal structures, reciprocal lattice, diffraction and structure lector, elementary ideas about point defects and dislocations. Lattice vibrations, Phonons, specific heat of solids, free electron theory Fermi statistics; heat capacity. Electron motion in periodic potential, energy bands in metals, insulators and semi-conductors; fight binding approximation; impurity levels in depend semi -conductors.

Electronic transport from classical kinetic theory, electrical and thermal conductivity, Hall effect and thermoelectric power transport in semiconductors. Dielectric Polarization mechanisms, Clauslus equation, Plezo, Pyto and ferroelectricity. Dia and Para magnetism; exchange interactions, magnetic order, ferro, anti ferro and ferrimagnetism. Super conductivity basic phenomenology; Meissner effect, Type 1 and Type 2 Super conductions, 8CS, Paining mechanism.

SCHOOL OF BASIC SCIENCES

Ph.D DISCIPLINE: MATHEMATICS

1. **LINEAR ALGEBRA:** Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cay ley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms.

2. **COMPLEX ANALYSIS:** Algebra of complex numbers, the complex plane, polynomials, Power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

3. **ORDINARY DIFFERENTIAL EQUATIONS (ODES):** Existence and Uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

4. **PARTIAL DIFFERENTIAL EQUATIONS (PDES):** Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

5. **NUMERICAL ANALYSIS:** Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

6. **LINEAR PROGRAMMING PROBLEM:** Simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

7. **CALCULUS OF VARIATIONS:** Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

8. **LINEAR INTEGRAL EQUATIONS:** Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

9. **CLASSICAL MECHANICS:** Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two -dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

SCHOOL OF BASIC SCIENCES

Ph. D DISCIPLINE: CHEMISTRY

INORGANIC CHEMISTRY:

1. **CO-ORDINATION COMPOUNDS OF METALS:** Step wise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH metry and spectrophotometry.

2. **BORON COMPOUNDS:** Higher boranes, carboranes and metalloboranes, compounds with, metalmetal multiple bonds, metal carbonyls and halide clusters.

MATERIALS CHEMISTRY:

1. **MULTIPHASE MATERIALS:** Two component phase equlibria, eutectic phase formation (Pb-Sn), Solid solution, Cu-Ni, peritectic phase formation: Fe -Ni, Fe-C phase diagram, phase transformation in Fe -C alloys, Solid solutions and intermetallic compound.

2. **HIGH TC MATERIALS:** Defect pervoskites, high Tc superconductivity in cupra tes, preparation and characterization of 1, 2, 3, and 2, 1, 4, materials, normal state properties, anisotropy, temperature dependence of electrical resistance, optical photon modes, superconductivity state, heat capacity, coherence length, elastic constants, position life times, microwave absorption pairing and multigap structure in high Tc materials, applications of high Tc materials.

3. **CORROSION:** Definition, Classification, Units and rate of corrosion, Electrochemical corrosion reaction, Rusting, Polarization, Activation Polarization, Concentration Polarization, Passivity, Inhibitors, Electrochemical series of metals, Galvanic series of metals and Alloys, Galvanic corrosion, Ceramic corrosion, Pitting corrosion, Intergranular corrosion, Stress corrosion.

4. **POLYMER CHEMISTRY:** General characteristics of chain growth polymerization, alkene polymerization by free radical, anionic and cationic initiators, ring opening polymerization of ethers, lactones and lactams. General characteristics of step growth poly merization, synthesis of polymers by step polymerization, polyesters, polycarbonates, polyamides, polyphenylene oxide, polysulphones, polysiloxanes Zeigler-Natta co-ordination polymerization Copolymerisation, general characteristics, copolymer equation and its application, monomer reactivity ratio and copolymer structure, block copolymer and graft copolymer.

ORGANIC CHEMISTRY:

1. **NAME REACTIONS AND THEIR MECHANISMS:** Formations and stabilities of carbonium ions, carbanions, carbenes, nitrenes, radicals and arynes, Reactive intermediates, Nucleophilic, Electrophilic, Radical substitution, Addition and Elimination reactions. Barton, Baeyer -villigier, Birch, Chichi babi n, Clemmensen Diels-alder, Friedel crafts, Hoffmann, Hofmann -Loffler-Freytag, Hydroboration, Lossen, Mannich, Michael addition, Meerwei n - Ponndorf-Verley, Perki n, Grignard, Reimer -Tiemann, Reformatsky, Stork enamine, Wittig, Wolff -Kishner. Oppenaur oxidations, Robinson annulations, Routine functional group transformations and inter -conversions of simple functionalities, Aldol, Clasien, Stobbe and Dieckmann, Schmidt, Condensations, Beckmann and Fries, Favorski, Curtius Rearrangements.

2. **STEREOCHEMISTRY AND CONFORMATIONAL ANALYSIS:** Concept of chirality, Asymmetric synthesis (including enzymatic and catalytic nexus) enantio and diastereo -selective synthesis, racemization, resolution, Walden inversion. Effects of conformation on reactivity in acyclic compounds and cyclohexanes, Conformational analysis of cyclohexane.

PHYSICAL CHEMISTRY:
1. **SPECTROSCOPY:** Theoretical treatment of rotational, vibrational and lectronic spectroscopy. Principles of NMR, EPR, Mössbauer and photoelectron spectroscopy.

2. **CHEMICAL EQUILIBRIUM:** Free energy and entropy of mixing, partial molar quantities, Gibbs -Duhem equation. Equilibrium constant, temperature -dependence of equilibrium constant, phase diagram of one-and two-component systems, phase rule.

SCHOOL OF COMMERCE & MANAGEMENT

Ph.D DISCIPLINE: COMMERCE & MANAGEMENT

MANAGERIAL ECONOMICS: Nature and scope of Managerial Economics. Importance of Managerial decision—making; Marginal analysis; Objective of a firm, Demand function, Elasticity of demand and its significance in Managerial decision-making; Consumer equilibrium-utility and indifference curve approach; Price, income and substitution effects; Fundamentals of demand estimation and forecasting; Short-run and long-run production functions; Cost curves and economics of scale; Price and output determination under perfect competition, monopoly, monopolistic, competition, and oligopoly; Pricing strategies and tactics; National Income— alternative concepts aid measurement of National income; Inflation—types, measurement and control; Balance of Payments; Monetary and Fiscal Policies.

ORGANIZATIONAL BEHAVIOR AND ETHICS : The concept and significance of organizational behavior- Skills and roles in an organization- classical, Neo-classical and modern theories of organizational structure-Organizational design-Understanding and Managing individual behavior personality-Perception-Values-Attitudes-Learning-Motivation, Understanding and managing group behavior, process-Inter-personal and group dynamics-communication- leadership-managing change-managing conflicts, Organizational development.
Ethics and management system; ethical issues and analysis in management; Value based organizations; Personal framework for ethical choices; Ethical pressure on individual in organizations; Gender issues; Ecological consciousness; Environmental ethics; Social responsibilities of business; Corporate governance and ethics.

BUSINESS STATISTICS Univariate Analysis: An overview of central tendency, dispersion, skewness. probability Theory; Classical, relative and subjective probability, - Addition and multiplication probability models; Conditional probability and Baye's Theorem. Probability Distributions: Binomial, Poisson, and normal distributions; Sampling and sampling methods; Sampling and non-s Sampling; Law of Large Number and Central Limit Theorem; Sampling distributions and their characteristics. Statistical Estimation and Testing; Point and interval estimation of population mean, proportion, and variance; Statistical testing of hypothesis and errors; Large and small sampling tests- Z, t and F tests. Non-Parametric Tests: Chi-square tests; Sign tests; Wilcoxon Signed— Rank tests; Kruskal-Wallis test. Correlation and Regression Analysis: Two variables case.
Index Numbers: Meaning and types; Weighted aggregative indices- Laspeyre's and Paasch's indices; Laspeyre's and Paasth's indices compared, indices of weighted

average of (price and quantity) relatives; Tests of adequacy Special problems-shifting the base; splicing, overlapping index series; Uses and problems of Index number; Time Series Analysis; Trend Analysis.

Statistical Quality Control: Causes of variations in quality characteristics, Quality control charts, - purpose and. logic; Constructing a control chart computing the control limits (X and R charts); Process under control and out of control, Warning limits; Control charts for attributes -fraction defectives and number of defects Acceptance sampling.

HUMAN RESOURCE MANAGEMENT: Concepts and perspectives in HRM; HRM in changing environment, Human resource planning- Objectives, process and techniques, Job analysis- job description, Selecting human resources, Induction, training and development, Exit policy and implications, Performance appraisal and evaluation, Potential assessment, Job evaluation, Wage determination, Industrial relations and Trade unions, Dispute resolution and grievance management, Labour welfare and social security measures.

FINANCIAL MANAGEMENT: Financial management- nature and scope, Valuation concepts and valuation of securities, Capital budgeting decisions- risk analysis, Capital structure and cost of capital, Dividend policy-determinant, Long-term and short-term financing instruments, Mergers and Acquisitions.

MARKETING MANAGEMENT: Marketing Environment and Environment scanning; Marketing information systems and marketing research; understanding consumer and industrial markets; demand measurement and forecasting; market segmentation - targeting and positioning; product decisions, product mix, product life cycle; new product development; branding and packaging; pricing methods and strategies. Promotion mix; advertising; Personal selling; channel management; vertical marketing systems; Evaluation and control of marketing effort; Marketing of services; Customer relation management, Uses of internet as a marketing medium-other related issues like branding, market development, advertising and retailing on the net.

PRODUCTION MANAGEMENT: Role and scope of production management; Factory location; Layout planning and analysis; Production Planning and control - production process analysis; Demand forecasting for operations; Determinations of product mix; Production scheduling; Work measurement ; Time and motion study; Statistical Quality Control; Role and scope of operations research; linear programming; sensitivity analysis; duality; transportation model; inventory control; Queueing Theory; decision theory; Markov Analysis; PERT/CPM.

ENTREPRENEURSHIP: Concepts- types, characteristics; motivation; competencies and development; innovation and entrepreneurship; small business - concepts government policy for promotion of small and tiny enterprises; process of business opportunity identification; detailed business plan preparation; managing small enterprises; planning for growth; sickness in small enterprises; rehabilitation of sick enterprises; Entrepreneurship (organizational entrepreneurship).

SCHOOL OF EDUCATION

Ph. D DISCIPLINE: EDUCATION

1. **PHILOSOPHY OF EDUCATION:** Meaning of philosophy, scope of Philosophical inquiry, meaning of education with reference to individual growth and development, origin and purpose of human existence as the common denominator between Philosophy and Education, need for philosophy of education.

2. **SOCIOLOGY OF EDUCATION:** Development and scope, difference with Educational Sociology, sociological approach, researches in the area of Sociology of Education.

3. **LEARNING:** Concept, Levels of learning, Gagne's types of learning. Theories of Learning- Thorndike's Connectionism, Pavlov's Classical Conditioning, Skinner's Operant Conditioning, Learning by Insight, Hull's Needs Reduction Theory, Tolman's Sign-Gestalt Theory, Kurt-Lewin's Field Theory and their Educational implications. Factor influencing Leaning.

4. **PERSONALITY:** Concept, development, structure and dynamics of personality. Theories of Personality: Allport, Eysenck; Psychoanalytic approach of Freud, Erickson; Behavioural approach – Miller and Dollard and Bandura and Walter; Humanistic approach – Roger, Maslow; Indian Theories: Vedic, Rabindra Nath Tagore, Mahatma Gandhi, and Sri Aurobindo.

5. **METHODS OF EDUCATIONAL RESEARCH:** Experimental; Normative Survey; Historical; Case Study;
Developmental; Fundamental, Applied , Evaluative and Action Research; Qualitative Research: Phenomenological, Ethnomethodical and Naturalistic Enquiry.

6. **DATA ANALYSIS:** Measures of control tendency, measures of variability, correlations, properties and uses of normal distribution, standard uses, difference between Means, Hypothesis testing, ANOVA.

7. **COMPARATIVE EDUCATION:** Scope and major concepts of Comparative Education, Methods in Comparative Education, Role of UNO in improving educational opportunities a mong the member countries, various organs of the UNO

and their educational activities, Primary Education: U.S.A, U.K., Japan and India, Secondary Education: U.S.A., U.K. Japan and India, Erosion of Moral values and Ethics.

8. **DEVELOPING A RESEARCH PROPOSAL:** Problem and its sources; Selection and definition of problem;

   Objectives – Primary, secondary and concomitant; Hypothesis: Nature, definition, types, sources; Characteristics of a good hypothesis; Directional and non - directional hypothesis.

SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

Ph.D DISCIPLINE : ENGLISH

1. **English Literature from 14th century to 16th century:** Characteristic features of the literary works of this period; Basic information about the prominent works and their authors

2. **17th century English Literature:** Characteristics of the Restoration period; Prominent writers and their contributions; Major features of the literary works; Significance of this period

3. **Romantic Period in English Literature:** Characteristics of the period; Prominent writers and their works; dominating features of the literary works of this period

4. **Victorian Age:** Characteristics of the period; Literature as a mirror to the social life; Prominent works and their significance

5. **Modern & Post-modern Literature:** Characteristic features of the period; Prominent works and authors of the age; Salient features of the literary works of this period

6. **Literary tools:** Literary terms; Figures of speech; Literary forms & genres

7. **Usage of English Grammar:** Remedial English; Summarization; Comprehension; Editing the passage

SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

Ph. D DISCIPLINE: MASS COMMUNICATION

Principal of Mass Communication- Media systems and theories: authoritarian, libertarian, socialistic, social-responsibility, development, participatory. Mass media: public opinion and democracy. Media culture and its production. Media organizations, media content, market-driven media content- effects, skyvasion, cultural integration and cultural pollution.
Issue of media monopoly- cross-media ownership

History of Media- Early communication systems in India- development of printing- early efforts to publish newspapers in different parts of India. Newspapers and magazines in the nineteenth century- first war of Indian Independence and the press- issue of freedom, both political freedom and press freedom. Birth of the Indian language press- contribution of Raja Ram Mohan Roy; birth of the Indian news agencies. The Indian press and freedom movement-Mahatma Gandhi and his journalism; social, political and economic issues before independence and the Indian press; historical development of important newspapers and magazines in English; important personalities of Indian journalism. The press of India after Independence; social, political and economic issues and the role of the Indian press problems and prospects.

Print Media and Electronic Media- Investing reporting- purposes, sources, styles, techniques.
Columns- development, criticism, reviews, feature writing, news analysis, backgrounding. -
Political reporting -Legislative reporting -Diplomatic reporting.

Evolution and growth of electronic media: radio, television and internet. Characteristics or radio, television and Internet as medium of communication- spoken, visual and multiple versions of information through links. Principles and techniques of audio-visual communication thinking audio and pictures, grammar of sound, visuals and web production.

Public Relation and Corporate Communication- Evolution and history of public relations-definitions of PR, PR and allied disciplines (publicity, propaganda, public affairs, lobbying, etc.). Interface of PR with various management disciplines (human resource development, finance, marketing, law, etc.)- publics in PR, PR tools (interpersonal, mass media and selective media)-PR in industry (public sector, private sector and multinational)- PR in central and state governments and the functioning of various media units of the State and Union governments.

Communication Research- Definition- elements of research- scientific approach- research and communication theories- role- function- scope and importance of communication research-basic and applied research. Research design components- experimental, quasi-experimental, benchmark, longitudinal studies- simulation- panel studies- content analysis. Methods of communication research- census method, survey

method, observation method- clinical studies-case studies- content analysis. Tools of data collection: sources, media source books, questionnaire and schedules, people's meter, diary method, field studies, logistic groups, focus groups, telephone, surveys, online polls. Random sampling methods and representativeness of the samples, sampling errors and distributions in the findings.

Media Law and Ethics Media Law: Constitution of India: fundamental rights- freedom of speech and expression and their limits- provisions of declaring emergency and their effects on media- provisions for amending the constitution; provisions for legislature reporting; parliamentary privileges and media; theory of basic structure; union and states; and election commission and its machinery. Specified press laws in India-Contempt of Courts Act 1971- civil and criminal law of demotion- relevant provisions of Indian Penal Code with reference of sedition, crime against women and children; laws dealing with obscenity; Official Secrets Act, 1923, vis-à-vis right to information-Cinematograph Act, 1953; Prasar Bharati Act; WTO agreement and intellectual property right legislations, including Copyright Act, Cable Television Act. Media's ethical problems including privacy, right to reply, communal writing and sensational and yellow journalism; freebies, bias, coloured reports; ethical issues related with ownership of media- role of press and/or media councils and press ombudsmen in the world-Press Council of India and its broad guidelines for the press- codes suggested for the press by Press Council and Press Commissions and other national and international organizations- and codes for radio, television, advertising and public relations.

International Communication- Impact of new communication technology on news flow-satellite communication- its historical background- status- progress- effects-information super highways- international telecommunication and regulatory organizations- UNESCO's efforts in removal imbalance in news flow- debate on new international Information and Economic Order- MacBride Commission's report- non-aligned news agencies news pool- its working, success, failure. Issues in international communication- democratization of information flow and media systems- professional standards; communication research- telecommunication tariffs; information- prompted cultural imperialism- criticisms; violence against media persons;-effects of globalization on media systems and their functions; transnational media ownership and issues of sovereignty and security; international intellectual property rights; international media institutions and professional organizations; code of conduct.

Inter-Cultural Communication- Culture- definition- process- culture as a social institution- value systems- primary- secondary- eastern and western perspectives. Inter-cultural communication-definition- process- philosophical and functional dimensions-cultural symbols in verbal and non-verbal communication. Perception of the world-Western and Greek (Christian)- varied eastern concepts (Hindu, Islamic, Buddhist, others)- retention of information- comparison between eastern and western concept. Communication as a concept in western and eastern cultures (Dwaitha- Adwaitha-Vishishtadwaitha- Chinese (DaoTsu and Confucius- Shinto Buddhism) and also Sufism. Culture, communication and folk media- character, content and functions- dance and music as instruments of inter-cultural communication; UNESCO's efforts in the promotion of inter-cultural communication- other organizations- code of ethics.

SCHOOL OF PHARMACY

Ph. D DISCIPLINE CLINICAL RESEARCH

1) **Clinical Pharmacology**: Principles of Basic Pharmacology, Pharmacokinetics (ADME), Pharmacodynamics (mechanism of Action), Toxicity Studies, Dose Response relationship, Therapeutic index, Neurological disorders, malignant diseases, Infectious diseases,

   Reference Book: Essentials of Medical Pharmacology- K.D Tripathi, Basic Principles of Internal Medicine by Harrison, Mc Graw Hills publishers

2) **Fundamentals of Clinical Research**: Drug Discovery and Development, History of Clinical Research, Indian Regulation (Schedule Y), Drug and Cosmetic Act, ICMR Guidelines, Worldwide Regulations (ICH-GCP, US FDA), Introduction to Clinical Data Management, Process of Data management, Data Validation, Medical Coding

   Reference Book: Basic Principles of Clinical research and Methodology by S.K Gupta
   ICMR, FDA and CDSCO websites.

3) **Biostatistics**: Basic Definition and Application, Types of Data (Nominal Data, Ordinal data, Ranked Data, Discrete Data, Continuous Data), Measures of Central Tendency (Mean, Median, Mode), Measures of Dispersion (Variance , standard Deviation, Coefficient Of variance), Parametric and Non-Parametric Tests, Hypothesis Testing, Probability, Frequency Distribution

   Reference Book: Principles of Biostatistics by Marcello Pagano

4) **Pharmacogenomics**: Importance of Study in Pharmacogenomics, Pharmacogenetic Phenotypes, Gene Therapy, Classification of Enzymes, Basic aspects of Enzyme Kinetics, Recombinant DNA Technology, Cellular organization, DNA Replication, Immunity, Analytical Techniques

   Reference Books: Pharmacogenomics introduction and Clinical perspective by Joseph.S.Bertino
   Concepts in Pharmacogenomics by Zdanowicz

5) **Clinical Research Methodology**: Epidemiological Studies, Clinical Trial Design, Phases of Clinical Research, Aim of different Phases, Intellectual Property Rights (TRIPS and GATT), Indian Patent Law, Endpoints in Clinical Trials, Quality of Life Studies, Pharmacoeconomic studies

   Reference Books: Guide to Clinical Trials by Bert Spilker, Lippincott Williams and Wilkins
   Basic Principles of Clinical research and Methodology by S.K Gupta

6) **Bioethics**: Background of ethics in Clinical Research, Ethical Principles, Ethics Committees- Roles and Responsibilities, Privacy and Confidentiality, Importance of Informed Consent Form in Clinical Research, use of placebo

   Reference Books: Protecting Study Volunteers in research by C.M Dunn, Thomson Centre watch, Boston

7) **Clinical Trial Management**: Basics of Project Management, Steps involved in Project Development, Managing the project Team, Tracking Management of Project, Clinical Research Outsourcing, Offshoring, Monitoring of Clinical Trials, Audits and Inspection

   Reference Books: Project Management by Gray, Larson, Desai
   The CRA's guide to Monitoring Clinical Research by Karen E. Woodin and John C. Schneider
   Basic Principles of Clinical research and Methodology by S.K Gupta

SCHOOL OF PHARMACY

Ph.D DISCIPLINE: PHARMACY

Pharmaceutics: Development, manufacturing standards Q.C. limits, labeling, as per the pharmacopoeal requirements. Storage of different dosage forms and new drug delivery
systems. Biopharmaceutics and Pharmacokinetics and their importance in formulation. Formulation and preparation of cosmetics. Pharmaceutical calculations. Therapeutic Drug Monitoring Dosage regimen in Pregnancy and Lactation, Paediatrics and Geriatrics. Renal and hepatic impairment. Drug - Drug interactions and Drug - food interactions, Adverse Drug reactions. Medication and Patient counselling.

Pharmacology: General Pharmacology & Toxicology principles. Drug interaction. Pharmacology of drugs acting on Central nervous system, Cardiovascular system, Autonomic nervous system, Gastro intestinal system and Respiratory system. Pharmacology of Autocoids, Hormones, Hormone antagonists, chemotherapeutic agents including anticancer drugs. Bioassays, Immuno Pharmacology. Drugs acting on the blood & blood forming organs. Drugs acting on the renal system.

Pharmaceutical Analysis: Principles, instrumentation and applications of the following: Absorption spectroscopy (UV, visible & IR). Fluorimetry, Flame photometry, Potentiometry. Conductometry and Polarography. Pharmacopoeial assays. Principles of NMR, Mass spectroscopy. X-ray diffraction analysis. Basic Principle instrumentation, Methodological Techniques and Quantitative Analysis of drugs and their Metabolites using Column, Paper chromatography, TLC, Ion-exchange chromatography, GC, HPLC and HPTLC.

Pharmaceutical Chemistry: Structure, nomenclature, classification, synthesis, SAR and metabolism of the category of drugs, which are official in Indian Pharmacopoeia and British Pharmacopoeia. Introduction to drug design. Stereochemistry of drug molecules. Hypnotics and Sedatives, Analgesics, NSAIDS, Neuroleptics, Antidepressants, Anxiolytics, Anticonvulsants, Antihistaminics, Local Anesthetics, Cardio Vascular drugs - Antianginal agents Vasodilators, Adrenergic & Cholinergic drugs, Cardiotonic agents, Diuretics, Antiypertensive drugs, Hypoglycemic agents, Antilipidemic agents, Coagulants, Anticoagulants, Antiplatelet agents. Chemotherapeutic agents - Antibiotics, Antibacterials, Sulphadrugs. Antiprotozoal drugs, Antiviral, Antitubercular, Antimalarial, Anticancer, Antiamoebic drugs. Diagnostic agents.

Pharmacognosy & Phytochemistry: Chemistry, tests, isolation, characterization and estimation of phytopharmaceuticals belonging to the group of Alkaloids, Glycosides, Terpenoids, Steroids, Bioflavanoids, Purines, Guggul lipids. Pharmacognosy of crude drugs that contain the above constituents. Standardization of raw materials and herbal products. WHO guidelines. Quantitative microscopy including modern techniques used for evaluation. Biotechnological principles and techniques tissue culture.

Biochemistry: Biochemical role of hormones, Vitamins, Enzymes, Nucleic acids, Bioenergetics. General principles of immunology, Metabolism of carbohydrate, lipids, proteins. Methods to determine, kidney & liver function. Lipid profiles.

Pharmaceutical Jurisprudence: Drugs and Cosmetics Act and rules there under with respect to manufacture, sales and storage. Pharmaceutical ethics. Pharmacy Act and any other acts and rules pertaining to the field of Pharmacy applicable in India.