UTTARANCHAL UNIVERSITY

(Established vide Uttaranchal University Act, 2012, Uttarakhand Act No. 11 of 2013)
Premnagar-248007, Dehradun, Uttarakhand, INDIA

SYLLABUS FOR PH.D. ENTRANCE EXAM

SYLLABUS FOR ENTRANCE EXAMINATION FOR Ph.D.

Research Aptitude/ Research Methodology
(Common to all)

General aptitude:

1. General Science: General understanding of science including matters of everyday observation and experience.

2. Current events: Knowledge of significant national and international events.

3. General mental ability and reasoning: Reasoning and analytical abilities.

4. Environmental awareness: Pollution and its impacts, climate change, sustainable development

5. Basic Computer Skills: Basic computer awareness and its uses. Role and use of computers in research.

6. Interactive English: Grammar, vocabulary, sentence completion, usage, synonyms, antonyms, one word substitute, idioms/phrases, error detection and comprehension.

7. Information and Communication Technology (ICT): Terminology and abbreviations used in ICT, applications of ICT in academics and research.

Research aptitude:
1. Meaning, nature, significance and types of research.synopsis, hypothesis, data collection, literature survey, sampling, interviewing, questionnaire, data processing, interpretation, report writing, bibliography, Article, research paper, seminar, conference, symposium, workshop etc.

2. Role of governing bodies/research organizations like UGC, CSIR, ICAR, ICSSR, ICPR, ISRO, DRDO etc. in research and development.

3. Basic Statistics for Research- Basic of Stats with Mean, Median, Mode, Standard Deviation & Variance. Their applications in research.

Basic concept of Permutation, Combination & Probability.

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Discipline/ Subject course syllabus

BIOTECHNOLOGY

Biomolecules (Carbonydrates, proteins, lipids, enzymes), metabolic pathways, Enzyme kinetics and inhibition, immobilized enzymes. Cellular & Molecular Biology- Membrane structure and function; Cell theory; Structural organization and function of intracellular organelles; Cell division and Cell cycle and cancer biology; Structure and types of DNA, RNA; DNA replication, repair, transcription, translation, gene regulation. Immunology: Innate and accuired, Structure & function of antibody, MHC, antigen-antibody interactions. Autoimmunity; vaccines, hypersensitivity. Genetic engineering, gene cloning, transgenic organisms, molecular markers, vectors, methods of gene transfer, molecular farming, Gene therapy. Concepts of genetics. Bacteria, Fungi, viruses, laboratory identification of microbes, sterilization techniques, culture media and types, transformation, conjugation, transduction Host–Pathogen interactions, antibiotics. Fermentation Technology - Basic fermentor (types), downstream processing; Isolation; screening and maintenance of industrially important microbe, scaling up of cell culture, industrial biotechnology products. Electrophoresis, centrifugation, microscopy, biosensors, chromatography, Mass spectrophotometry, PCR, DNA fingerprinting. Bioinformatics- Databases, sequence alignment, search engines, BLAST, FASTA, Phylogenetic analysis. Cell and tissue culture (plant and animal) - Media, different types / methods of culture, applications, cell lines, secondary metabolites, Concept of Intellectutal property rights. Environmental biotechnology, Bioremediation, Bioleaching, biopesticides. waste management.

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SYLLABUS FOR PH.D. ENTRANCE EXAM- CHEMISTRY

Chemical periodicity, Structure and bonding including shapes of molecules (VSEPR Theory). Main group elements and their compounds: Allotropy, industrial importance of the compounds. Transition elements and coordination compounds: spectral and magnetic properties. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications. Organometallic compounds & applications, bonding and structure, and reactivity. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, nitrogen fixation, metal complexes in medicine. Electron spectroscopy and microscopic techniques.

Basic principles of quantum mechanics: Chemical applications of group theory rules. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; Chemical thermodynamics: Kinetics and their applications; elementary; phase equilibria solutions. Nernst equation, redox systems, electrochemical cells; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions. Colloids and surfaces.

IUPAC nomenclature of organic molecules including Regio- and stereoisomers. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Common named reactions and rearrangements – applications in organic synthesis. Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Principles and applications of photochemical reactions in organic chemistry. Structure determination of organic compounds by IR, UV-Vis, 1H & 13C NMR and Mass spectroscopic techniques. Principles of qualitative and quantitative analysis; acid-base, oxidation reduction and precipitation reactions; use of indicators; nuclear reactions & applications of isotopes.

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SYLLABUS FOR PH.D. ENTRANCE EXAM-COMPUTER SCIENCE & ENGINEERING

C Programming and Data structure: Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs

Operating Systems: Process and memory management, Concurrent processing, Scheduling, Multiprocessor Operating Systems and related Thread Handlings

Software Engineering: Models, Process and Project Metrics, Analysis Concepts and Principles, Measures, Metric Indicators, Software Quality Assurance, Software Prototyping.

DBMS: DBMS design, Distributed Databases, Client/Server Architecture, ODBMS and RDBMS, Data Warehousing and Data Mining

Network and Information Security; Concept of layering, Flow and error control techniques, Switching, IPv4/IPv6, Routing and routing algorithms, Basics of network and information security, Introduction to intelligent networking, Performance analysis of networks

Theory of Computation: Models of computation, Automata Languages accepted by models, Grammars, Languages, Non-computability and Examples of non-computable problems, Turing machine, Compiler design

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SYLLABUS FOR PH.D. ENTRANCE EXAM- CIVIL ENGINEERING

Section 1: 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.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle energy recovery, treatment and disposal).

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

Section 2: 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; Airport runway length, taxiway and exit taxiway design.

Highway Pavements: Highway materials - desirable properties and quality control tests; Design of bituminous paving mixes; 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.

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.

Section 3: Geomatics Engineering

Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves.

Remote sensing and GIS: Principles and fundamentals of Image Processing; Geographical Information Systems-Fundamentals and Advances, Surveying-Advances and GNSS, Photogrammetry -principles and applications Geographical Positioning system (GPS)

Section 4: Structural Engineering

Structural Mechanics : Analysis of Flexure, Torsion, Shear, Compression and Tension - Analysis of Structures-Force and Stiffness methods - Concrete making materials and Technology- Design of Concrete , Steel Structures- Plastic analysis and design-Prestressed Concrete- simple and continuous beams- Structural Dynamics- Analysis of Free and Forced vibrations-Damping-Seismic design- Modal analysis-Finite Element method - Theory of Elasticity-Analysis of Stress and Strain.
Construction Materials and Management: Construction Materials: Structural steel - composition, material properties and behaviour ; Concrete - constituents, mix design, short-term and long-term properties; Bricks and mortar; Timber; Bitumen.

Section 5: Geotechnical Engineering
Soil Mechanics: Origin of soils, soil structure and fabric; Three-phase system and phase relationships, index properties; 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.

Section 6: 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, evapo-transpiration, watershed, 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.

Section 7: Construction Technology and Management

Project Planning & Management-Network Scheduling-PERT, CPM Construction Techniques-RC & PSC, Modular construction practice-Construction Economics & Finance-Depreciation, Project appraisal Quantitative Methods in Construction Management-Linear and Dynamic programming Construction Methods& Equipment- Equipment for Earth moving, Material transport, Pile driving, dewatering-Contract Management & Arbitration- types of contracts, disputes-Construction Materials-Concrete, polymers, Sealants.

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SYLLABUS FOR PH.D. ENTRANCE EXAM- ENGLISH

- Drama
- Poetry
- Fiction, Short Story
- Non-Fictional Prose
- Language: Basic concepts, English in use.
- Indian Writing in English
- Literary Criticism
- Literary Theory
- Research Methods and Materials in English

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SYLLABUS FOR PH.D. ENTRANCE EXAM- FOOD SCIENCE & NUTRITION

ADVANCE FOOD SCIENCE NUTRITION

Food groups – balanced diet, food pyramid, RDA, BMI,BMR,macro and micro nutrition, Meal Planning, nutraceuticals, Functional foods, Prebiotics, Probiotic. Food microbes ,Food toxicology.Major food constituents, their physicochemical properties.Principle of Food Science, Role of water in food. Carbohydrates, proteins and lipids: classification, physical, chemical, nutritional, and functional properties Structural correlations; auto-oxidation of lipids and rancidityIntroduction Food science and nutrition,

Diet therapy, fevers, Allergy, Obesity, underweight, lung diseases, GI tract diseases.Nutritional intervention-national nutrition policies and programmes.Food and nutrition security.Quality evaluation of foods- objectives and subjective, Quality attributes; Classification of quality attributes.Food guidelines and safety measurement.

Food processing and preservation Basic concept and technology, Food Adulteration, Health hazards of food adulterants, Food additives, Food Laws and standards.

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SYLLABUS FOR PH.D. ENTRANCE EXAM- FOOD TECHNOLOGY

Chemistry of Carbohydrates, Proteins, Lipids, Pigments, Food flavours, Enzymatic and non-enzymatic browning; amino acids and fatty acids classifications, Water soluble and fat soluble vitamins, Role of minerals in nutrition, Antinutrients in food, General Characteristics of microorganisms, Microbial growth in food: Intrinsic and extrinsic factors, Microbial Food spoilage, Food borne illness, food fermentation. Food Products Technology: Processing principles: Canning, chilling, freezing, dehydration, control of water activity, CA and MA storage, fermentation, hurdle technology, addition of preservatives and food additives, Food packaging, food laws; Grain products processing: Milling of rice, wheat, and maize, parboiling of paddy, cereal based products bread, biscuits, extruded products and breakfast cereals, Solvent extraction, refining and hydrogenation of oil; ripening of fruits, Fruits, vegetables and plantation products processing: jam, jelly, marmalade, squash, candies, and pickles, tea, coffee, chocolate and essential oils from spices; Milk and milk products processing: Pasteurized and sterilized milk, cream, butter, ghee, ice-cream, cheese and milk powder; Animal products processing: Drying and canning of fish, post mortem changes, tenderization and freezing of meat, egg powder. Basic food engineering - Heat transfer: Heat transfer by conduction, convection, radiation, boiling and condensation, sterilization, evaporation of liquid foods, drying methods, spray and freeze-drying, freezing and crystallization; Mass transfer operations. Novel Thermal

Techniques, dielectric heating, Microwave processing, Infrared heating, ohmic heating, pulse electric field, Properties and functions of various nutraceuticals – functional food ingredients – probiotic, prebiotic and symbiotic and their functional role. Antioxidants, nutraceuticals and functional foods. Analytical Instruments: Ultra violet spectroscopy; infrared absorption spectroscopy; near-infrared absorption spectroscopy; mass spectroscopy; nuclear magnetic resonance spectroscopy. , Biotechnology and food safety.

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SYLLABUS FOR PH.D. ENTRANCE EXAM (LAW)

I. Jurisprudence

1. Nature and Sources of Law
2. Schools of Jurisprudence
3. Concept of Rights and Duties
4. Legal Personality
5. Concept of Property, Ownership and Possession

II. Constitutional Law

1. Preamble
2. Fundamental Rights and Duties
3. Directive Principles of State Policy
4. Judiciary

III. Administrative Law

1. Nature , Scope and Importance of Administrative Law
2. Principle of Natural Justice
3. Judicial Review of Administrative Actions

IV. Law of Crimes

1. General Principles of Criminal Liability – Actus reus and mens rea, individual and group liability and constructive liability
2. General Exceptions
3. Theories and Kinds of punishments
4. Compensation to the victims of crime

V. Law of Torts

1. Nature and Definition of Torts
2. General Principles of Tortious liability
3. General defenses

4, Strict and absolute liability

VI. Public International Law

1. Definition, Nature and Basis of International Law
2. Sources of International Law

VII. Family Law-I

1. Sources and schools
2. Marriage and Dissolution of Marriage

VIII. Environment and Human Rights Law

1. Meaning and Concept of Environment and Environmental Pollution
2. Concept and Development of Human Rights

IX. Intellectual Property Rights

1. Concept and Meaning of Intellectual Property
2. Theories of Intellectual Property

X. Comparative Public Law and System of Governance

1. Comparative Law – Relevance, Methodology, Problems and Concerns
2. Rule of Law – Formal and Substantive versions

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SYLLABUS FOR PH.D. ENTRANCE EXAM – MECHANICAL ENGINEERING

Engineering Mathematics

Linear Algebra: Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.

Calculus: Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.

Differential equations: First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.

Complex variables: Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series.

Probability and Statistics: Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations.

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.

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, Stefan-Boltzmann 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.

Applications: *Power Engineering*: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. *I.C. Engines*: Air-standard Otto, Diesel and dual cycles. *Refrigeration and air-conditioning*: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes. *Turbomachinery*: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines.

Materials, Manufacturing and Industrial Engineering

Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials.

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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SYLLABUS FOR PH.D. ENTRANCE EXAM- MATHEMATICS

Real numbers system, sequence and series of functions, convergence and uniform convergence. Gauss theorem ,Green's theorem, Stoke's theorem. Analytic functions, Cauchy-Riemann equations, Cauchy's theorems, singularities. Groups, Cayley's theorem, Sylow's theorem, Rings, Euclidean domains, unique factorization domains. Algebra of matrices, rank of a matrix, Eigen value and vectors. Vector spaces, basis and dimension, linear transformations, dual space, annihilators and inner product spaces. First order ODE and PDE, Existence and uniqueness of solution $\frac{dy}{dx} = f(x, y)$. Classification of second order PDE, wave , heat and Laplace equation. Linear integral equation of Fredholm and Volterra type, Variation of calculus , Euler-Lagrange equation. Numerical solutions of algebraic equations, numerical solution of systems of linear algebraic equations, finite differences, interpolation, numerical differentiation and integration, numerical solutions of ODEs . LPP, simplex method dual of LPP, assignment Problem, transportation problem, queuing theory.

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SYLLABUS FOR PH.D. ENTRANCE EXAM - COMPUTER APPLICATIONS/COMPUTER SCIENCE

1) Fundamental of Computer Science
2) Data Science
3) Theory of Computation
4) Cloud Computing
5) Recent Trends in Computer Science

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SYLLABUS FOR PH.D. ENTRANCE EXAM – MANAGEMENT

1) General Management
2) Marketing
3) Human Resource Management
4) Finance
5) International Business

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SYLLABUS FOR Ph.D. ENTRANCE EXAMINATION- PHYSICS

1. Mathematical Methods of Physics: Vector calculus. Matrices and their properties, linear ordinary differential equations of first & second order, Special functions. Fourier series, Fourier and Laplace transforms. Complex analysis, Elementary probability theory, binomial, Poisson and normal distributions.

2. Classical Mechanics: Dynamical systems, Phase space dynamics, stability analysis. Central force motions, Variational principle, Lagrangian and Hamiltonian formalism Small oscillations, Poisson brackets and canonical transformations. Special theory of relativity.

3. Electromagnetic Theory: Electrostatics, Laplace and Poisson equations, Magnetostatics: Biot-Savart law, Electromagnetic induction. Maxwell's equations in free space. Electromagnetic waves in free space. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction.

4. Quantum Mechanics: One dimensional Schrödinger equation. Commutators and Heisenberg uncertainty principle. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momentum; Hydrogen atom. Time-dependent and independent perturbation theory and applications. Variational method, identical particles.

5. Thermodynamic and Statistical Physics: Laws of thermodynamics. Maxwell relations, Phase space, micro- and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Classical and quantum statistics, Ideal Bose and Fermi gases. Blackbody radiation and Planck's distribution law.

6. Atomic & Molecular Physics: Quantum states of an electron in an atom. Electron spin, Spectrum of helium and alkali atom. LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electronic rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers.

7. Condensed Matter Physics: Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Free electron theory and electronic specific heat. Band theory of solids Superconductivity:

8. Nuclear and Particle Physics: Basic nuclear properties, Binding energy, semi-empirical mass formula, liquid drop model. Classification of fundamental forces. Elementary particles and their quantum numbers. Quark model, baryons and mesons.

9. Electronics and Experimental Methods: Semiconductor, device structure, device characteristics, frequency dependence and applications. Opto-electronic devices Operational amplifiers and their applications. Digital techniques and applications.

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SYLLABUS FOR Ph.D. ENTRANCE EXAMINATION- MASS COMMUNICATION

UNIT-I INTRODUCTION TO COMMUNICATION

Communication process of communication Fundamentals of Communication – Definition, Nature, Scope, Types and Functions. Communication Models and Theories. Fundamentals of Journalism – Definition, Nature, Scope and Functions

UNIT II- PRINT MEDIA AND MEDIA LAWS ETHICS

Qualifications, Duties and Responsibilities of Journalists. Principles and Practices of Editing and Designing. Basics of News – Concept, Elements, News Sources, Structure of News, Principles of News Writing Feature Writing. Specialized Reporting. Salient Features of Indian Constitution – Preamble, Directive Principles of State Policy, Fundamental Rights and Duties. Freedom of Speech and Expression in India. Major Media Laws of India .Press Council of India and Press Commissions. Media Ethics and Code of Conduct for Media Professionals. Press and Book Registration Act, Right to Information Act, Official secret Act, Working journalist act, Journalistic Ethics

UNIT III- ADVERTISING AND PUBLIC RELATIONS

Fundamentals of Advertising Types, Functions and Significance. Fundamentals of Public Relations – Concept, Nature, Scope, Types, Functions and Significance. Advertising Agency – Structure, Advertising and gender issue, laws related to indecent portrayal of women, Resources, Functions and Significance. Public Relations Management – Types of Publics and Art of Management of Different Public Relations (Investor Relations, Employee Relations, Supplier Relations, Distributor Relations, Customer Relations, Media Relations, Government Relations, Community Relations etc. Corporate Communication – Role of Communication in Corporate Houses, Corporate Communication Principles and Practices, DAGMAR and AIDA, PR tools and techniques, PR campaign and design

UNIT IV- COMMUNICATION RESEARCH

Fundamentals of Communication Research. Defining Research Problem, Review of Literature, Research Design, Primary Data Collection, content analysis, Statistical Analysis, Results and Discussion, Testing of Hypothesis, Sampling etc. Types of Media Research –Quantitative and Qualitative. Data Collection and Analysis Procedures, Principles and Techniques of Writing Research paper

UNIT V- ELECTRONIC MEDIA AND NEW MEDIA PRODUCTION

History of Radio and Television, Writing for Electronic Media – Principles and Techniques. Production for Radio and Television. Production of Multi-Media Contents. Types of New Media – Computer, Internet, E-mail, Mobile Phone, Video Streaming, Video Conferencing etc..Web Designing – Concept, Nature, Scope, Web Language, Presentation, Multi-Media Production d) Cyber Laws and Ethics

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SYLLABUS FOR Ph.D. ENTRANCE EXAMINATION- ECONOMICS

Microeconomic Analysis: Introduction to Microeconomics, Cardinal and Ordinal Utility Analysis, Theoryof Production and Costs; Pricing and output under different forms of market structure; Theory of Rent, Interest and Wages

Macroeconomic Analysis: Concepts of GDP and National Income, Classical Theory of Income and employment, Consumption, Investment, Multiplier

Money and Banking: Concepts of Money in a Modern Economy, Monetary Aggregates, Quantity Theory of Money, Money Supply and Credit Creation

Statistical Analysis: Frequency Distribution, Graphical Representation of Data, Techniques of Data Collection, Sampling Techniques, Correlation, Regression

Indian Economy: Indian Economy: Basic features, Agriculture: Land Reforms and Green Revolution; New agricultural policy; New industrial policy; Balance of Payment

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SYLLABUS FOR Ph.D. ENTRANCE EXAMINATION- AGRICULTURE

Discipline:

1. **Ph.D. Agronomy**
2. **Ph.D. Plant Pathology**
3. **Ph.D. Entomology**
4. **Ph.D. Horticulture**
5. **Ph.D. Genetics and Plant Breeding**
6. **Ph.D. Plant Physiology**
7. **Ph.D. Silviculture and Agroforestry**
8. **Ph. D. Soil Science and Agriculture Chemistry**

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Entrance test Syllabus of Ph.D. Agronomy

Unit 1: Crop Ecology and Geography

Principles of crop ecology; Ecosystem-concept and determinants of crop productivity; Physiological limits of crop yield and variability in relation to ecological optima; Crop adaptation; Climate shift and its ecological implication; Greenhouse effect; Agro-ecological and agro climatic regions of India; Geographical distribution of cereals, legumes, oilseeds, vegetables, fodders and forages, commercial crops, condiments and spices, medicinal and aromatic plants; Adverse climatic factors and crop productivity.

Unit 2: Weed Management

Scope and principles of weed management; Weed classification, biology, ecology and allelopathy; Weed seed dormancy, Crop weed competition, weed threshold; Herbicides classification, formulations, mode of action, selectivity and resistance; Persistence of herbicides in soils and plants; Application methods and equipment; Cultural, physical, chemical and biological weed control, bio-herbicides: Integrated weed management; Special weeds, parasitic and aquatic weeds and their management in cropped and non-cropped lands;

Unit 3: Soil Fertility and Fertilizer Use

History of soil fertility and fertilizer use; Concept of essentiality of plant nutrients, their critical concentrations in plants, nutrient interactions, diagnostic techniques with special emphasis on emerging deficiencies of secondary and micro-nutrients; Soil fertility and productivity and their indicators; Fertilizer materials including liquid fertilizers, their composition, mineralization, availability and reaction in soils; Water solubility of phosphate fertilizers; Slow release fertilizers, nitrification inhibitors and their use for crop production; Principles and methods of fertilizer application including fertigation; Integrated nutrient management and bio-fertilizers;

Unit 4: Dryland Agronomy

Concept of dryland farming; dryland farming Vs rainfed farming; History, development, significance and constraints of dryland agriculture in India; Climatic classification and delineation of dryland tracts; Characterization of agro-climatic environments of drylands; Rainfall analysis and length of growing season; Types of drought, effect on plant growth, drought resistance, drought avoidance, drought management; Crop Planning including contingency, crop diversification, varieties, cropping systems and mid-season corrections for aberrant weather conditions.

Unit 5: Crop Production

Crop production techniques for cereals, millets, pulses /grain legumes, oilseeds, fiber crops, sugarcane, tobacco, fodder and pasture crops including origin, history, distribution, adaptation, climate, soil, season, modern varieties, seed rate, fertilizer requirements, crop geometry, intercultural operations, water requirement, weed control, harvest, quality components, industrial use, economics and post-harvest technology.

Unit 6 : Sustainable Land Use Systems

Tillage - Concept, types, tilth, tools and implements; Modern concepts of tillage and conservation agriculture; Land capability classification, Alternate land use and Agro forestry systems; Types, extent and causes of wasteland; Shifting cultivation; Concept of sustainability.

Unit 7: Soil-Plant-Water Relationship

Importance of water in agriculture; Hydrological cycle; runoff and infiltration, factors affecting infiltration; Soil water relations, water retention by soil, soil moisture characteristics, field capacity, permanent wilting point, plant available water and extractable water; Soil irrigability classifications, Determination of soil water content, computation of soil water depletion, soil water potential and its components; Movement of soil water-saturated and unsaturated water flow; Evapotranspiration (ET), PET, AET and its measurements.

Unit 9: Irrigation Water Management

History of irrigation in India; Major irrigation projects in India; Water resource development; Crop water requirements; Concepts of irrigation scheduling, Different approaches of irrigation scheduling; Concept of critical stages of crop growth in relation to water supplies; Methods ofIrrigation.

Unit 10: Management of Problematic Soils and Crop Production

Problem soils and their distribution in India, acidic, saline, waterlogged and mined- soils; Response of crop to acidity, salinity, excess water and nutrient imbalances; Reclamation of problem soils, role of amendments and drainage; Crop production techniques in problem soils – crops, varieties, cropping system and agronomic practices; Degraded lands and their rehabilitation. Management strategies for flood prone areas.

Unit 11: Cropping and Farming Systems and Organic Farming

Cropping system – Definition, principles, classification; Cropping system for different ecosystem; Interaction and indices; Non-monetary inputs and low cost technologies.LEIA, HEIA and LEISA

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Entrance test Syllabus of Ph.D. Plant Pathology

Unit 1: History and Principles of Plant Pathology

Milestones in phytopathology with particular reference to India. Historical developments of chemicals, legislative, cultural and biological protection. Classification of plant diseases, Physiologic specialization, Koch's postulates.Growth, reproduction, survival and dispersal of plant pathogens. Enzymes and toxins in relation to plant disease. Altered metabolism of plants under biotic and abiotic stresses.Structuraland Biochemical defense mechanisms.R-Genes, Phytoalexins and PR proteins.

Unit 2: Laboratory and Analytical Techniques

Preparation and sterilization of common media. Methods of isolation of pathogens and theiridentification. Preservation of microorganisms in pure culture. Methods of inoculation.Measurement of plant disease.Detection and Diagnosis of pathogens in seeds and other planting materials: Laboratory equipmentand their use: autoclave, hot air oven, laminar flow, spectrophotometer, light andelectron microscopy and incubator.

Unit 3: Mycology

Importance and basic concept of mycology. General characters and classification of fungi (According to the Classification – Ainsworth, 1973). Life cycles ofimportant phytopathogenic fungi. Economic mycology and edible fungi.

Unit 4: Plant Bacteriology

Identification and classification of bacteria. morphology, ultrastructure and chemical compositionof prokaryotic cell in relation to function. Growth curve, nutrition and auxotrophic mutants.Resting cells in elementary bacterial genetics and variability: transformation, conjugation,transduction.Bacteriophages: lytic and lysogenic cycles. Economic uses of prokaryotes.

Unit 5: Plant Virology

Nature, composition and architecture of viruses and viroids. Properties of viruses. Nomenclatureand classification of viruses. Mycoviruses and baculoviruses. Assay of plant viruses including biological, physical, chemical,serological and molecular methods. Transmissionof viruses: virus - vector relationships.

Unit 6: Phanerogamic Parasites and Non-parasitic Diseases

Diseases caused by Phanerogamic parasites and their management. Diseases due tounfavourablesoil environment, drought and flooding stress etc. Nutritional deficiencies. Primary /secondary airpollutants and acid rain.

Unit 7: Diseases of Crop Plants

Fungal and bacterial diseases of cereals, millets, oilseeds, pulses, fruits, vegetables, plantation, fiber, spices,medicinal and ornamental crops with special reference to etiology, disease cycle, perpetuation,epidemiology and management.

Unit 8: Management of Plant diseases

General principles of plant quarantine. Chemical nature andclassification of fungicides and antibiotics. Spraying and dustingequipments, their care and maintenances. Important cultural practices and their role in diseasemanagement, solarization, integrated disease management.Plant growth promoting Rhizobacteria. Biotechnology for crop disease management.

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NAAC GRADE

Entrance Test Syllabus of Ph.D. Entomology

Unit 1: Systematics& Morphology

History and development of Entomology, Evolution of insects, position of insects inthe animal world, characteristics of phylum Arthropoda, structural features ofimportant arthropod groups such as Trilobita, Chelicerata and Mandibulata,structural features of important classes of phylum Arthropoda viz. Arachnida,Crustacea, Chilopoda, Diplopoda and Hexapoda. Classification of insects up to orderlevel, habits, habitats and distinguishing features of different Order and important Families. Body wall, its structure, outgrowths, endoskeleton, Body regions, segmentation,sclerites and sutures. Head and head appendages, types of mouth parts, antennae,their structure and types. Thorax structure, thoracic appendages and theirmodification. Wings, their modification and venation, Abdomen; structure, abdominalappendages both in Pterygota and Apterygota. External genitalia, general structureand modification in important insect orders.

Unit 2: Embryology, Internal Anatomy and Physiology

Embryonic and post embryonic development, types of metamorphosis, physiology of ecdysis. General features and types of larvae and pupae. Structure, function andphysiology of Digestive, Circulatory, Respiratory, Reproductive, Nervous andExcretory systems, Sense Organs; structure and types. Insect food and nutrition;minerals, carbohydrates, proteins and amino acids, lipids, vitamins and their role ingrowth and development, artificial diets.

Unit 3: Biological Control

Importance and scope of biological control, history of biological control: Biocontrolagents-parasites, predators and insect pathogens. Important entomophagous insectOrders and Families. Ecological, biological, taxonomic, legal and economic aspects ofbiological control, phenomena of multiple parasitism, hyperparasitism,superparasitism and their applied importance. Mass multiplication techniques and economics.Biocontrol organizations in world and India.

Unit 4: Chemical Control and Toxicology

History, scope and principles of chemical control. Insecticides and their classification.Formulations of insecticides. Susceptibility of insects to the entry of insecticides.Physical, chemical and toxicological properties of different groups of insecticides:chlorinated hydrocarbons, organophosphates, carbamates, synthetic pyrethroids,chlordimeform, chitin synthesis inhibitors, avermectins, nitroguandines,phenylpyrrozzoles, botanicals (natural pyrethroids, rotenone, neem products,nicotine, pongamia spp. etc). Combination insecticides. Problems of pesticide hazardsand environmental pollution. Safe use of pesticides, precautions and first aidtreatments. Insecticides Act 1968, registration and quality control of insecticides.Evaluation of toxicity, methods of toxicity testing, determination of LD 50, LT 50, RL 50etc. Pesticides residues in the environment and their dynamics of movements,methods of residue. Pharmacology of insect

poisons. Mode of action of differentgroups of insecticides. Insecticide resistance; mechanism, genetics and management ofinsecticide resistance.

Unit 5: Innovative Approaches in Pest Control

Behavioral control: pheromones-types and uses, advantages and limitations.Hormonal control: types and function of insect hormones, insect hormone mimics,advantages and limitations. chemosterilants, antifeedants, attractants, repellents;their types, method of applications, advantages and limitations. Genetic control:concepts and methods, case histories, advantages and limitations. Potentialities ofIPM.

Unit 6: Integrated Pest Management:

History, concept and principles of IPM. Components of IPM: Host plant resistance,agronomic manipulations, mechanical and physical methods, chemical methods,biocontrol agents utilization, genetic and behavioral control strategy etc. IPMstrategies for field and horticultural crops. IPM case histories. Concept of damagelevels- Economic threshold levels (ETL), Economic injury levels (EIL) and theirdetermination. System approach, Agro ecosystem and cropping system vs. IPM.Constraints and Strategies of IPM implementation.

Unit 7: Pesticide Application Equipments:

Types of appliances: sprayers, dusters, fog generators, smoke generators, soilinjecting guns, seed treating drums, flame throwers, etc. Power operated sprayersand dusters. Types of nozzles and their uses. Maintenance of appliances. Aerialapplication of pesticides, principles of aerial application, factors affecting theeffectiveness of aerial application. Equipments for aerial applications. Advantages anddisadvantages of aerial application.

Unit 8: Pests of Crops and their Management

Distribution, host range, biology and bionomics, nature of damage and managementof arthropod pests of cereals, Oilseed, pulses and fibre crops, sugarcane and tobacco.Polyphagous pests: locusts, termites, hairy catepillars, cut worms and white grubs. Pests of Horticultural Crops and their ManagementDistribution, host range, biology and bionomics, nature of damage and managementof arthropod pests of vegetables, fruits and plantation crops, spices, condiments andornamentals.Fundamentals of storage of grains and grain products. Storage losses, sources ofinfestation/infection, factors influencing losses, insect and non-insect pests, their nature of damage and control. Non-insect pests (rodents, birds, mites) of storedproducts and their control. Integrated management of storage pests.

Unit 9:Beneficial Insects:

Honey bees and their economic importance. Bee species, their behaviour, habit andhabitats. Bee Keeping: bee pasturage, hives and equipments, seasonal management.Bee enemies including diseases and their control.Sericulture, Silkworm species, their systematic position and salient features. Rearing techniquesof mulberry-muga-eri and tassar silkworms. Nutritional requirements of silkworms.Sericulture: rearing house and appliances, silkworm breeds, principles of voltinism,

seed production and its economics. Enemies and diseases of silkwormsand their management. Sericulture organization in India.Lac InsectLac insect, its biology, habit and habitats. Host Trees: pruning, inoculation, laccropping techniques, and harvesting. Enemies of lac insect and their control.Pollinators, biocontrol agents of weeds, soil fertility improving agents, scavengers. Useof insects and insect products in medicines. Usefulness of insects in scientificinvestigations, insects as food.

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Entrance Test Syllabus of Ph.D. Horticulture

Unit 1:

Soil and climatic requirements for fruits, vegetables and floriculture crops, improved varieties, Criteria for site selection, layout and planting methods, nursery raising, commercial varieties/hybrids, sowing and planting times and methods, seed rate and seed treatment for vegetable crops; macro and micro propagation methods, plant growing structures, pruning and training, crop coefficients, water requirements and critical stages, fertilizer application, fertigation, irrigation methods, harvesting, grading and packaging, post harvest practices, Garden tools, management of orchard, Extraction and storage of vegetables seeds.

Unit 2:

Importance and scope of fruit cultivation; Classification of fruit crops; Climatic requirement; Selection of site; Fencing and wind break; Lay out and planting systems; Sexual and asexual methods of plant propagation; Production technology of important tropical, sub tropical and temperate fruit crops. Importance of vegetable cultivation for nutritional security; Production technology of important vegetable crops: potato, brinjal, tomato, chilli, onion, okra, cabbage, cauliflower, musk melon, water melon, cucumber and leafy vegetables. Status and scope of floriculture in India and abroad; Production technology of commercial flower crops: Rose, chrysanthemum, gladiolus, marigold, gerbera, carnation, lilium, jasmine, anthurium and orchids.

Unit 3:

Importance of postharvest technology in horticultural crops. Maturity indices, harvesting, handling, grading of fruits, vegetables, cut flowers, plantation crops, spices, medicinal and aromatic plants. Pre-harvest factors affecting quality, factors responsible for deterioration of horticultural produce, physiological and bio-chemical changes, hardening and delaying ripening process. Postharvest treatments of horticultural crops. Quality parameters and specifications. Structure of fruits, vegetables and cut flowers related to physiological changes after harvest. Methods of storage for local market and export. Pre-harvest treatment and pre-cooling, prestorage treatments. Different systems of storage, packaging methods and types of packages, recent advances in packaging. Types of containers and cushioning materials, vacuum packaging, cold storage, poly shrink packaging, grape guard packing treatments. Modes of transport.

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Entrance Test Syllabus of Ph.D. Genetics & Plant Breeding

Unit 1: General Genetics and Plant Breeding

Mendelian inheritance. Cell structure and division, Linkage, its detection and estimation. Epistasis. Gene concept, allelism and fine structure of gene. Extra chromosomal inheritance. DNA – structure, function, replication and repair. Genetic code. Gene-enzyme relationship. Replication, Transcription and Translation. Gene regulation in prokaryotes and eukaryotes. Nuclear and cytoplasmic genome organization. Spontaneous and induced mutations and their molecular mechanisms. Crop domestication, evolution of crops and centres of diversity. Emergence of scientific plant breeding. Objectives and accomplishments in plant breeding and the role of National and International institutes. Gametogenesis and fertilization. Modes of sexual and asexual reproduction and its relation to plant breeding methodology. Apomixes, incompatibility and male sterility systems and their use in plant breeding. Epigenetics.

Unit 2: Economics Botany and Plant Breeding Methods

Origin, distribution, classification, description and botany of cereals (wheat, rice, maize, sorghum, pearl millet, small millets); pulses (pigeonpea, chickpea, black gram, green gram, cowpea, soybean, pea, lentil, horse gram, lab-lab, rice bean, lathyrus, lima bean; oilseeds (groundnut, sesamum, castor, rapeseed mustard, sunflower, safflower, niger, linseed); fibre and sugar crops, fodder and green manures; Breeding methods for self-pollinated, cross-pollinated and asexually propagated crops. Combination, recombination and transgressive breeding. Single seed descent. Populations, their improvement methods and maintenance, Hybrid breeding and genetic basis of heterosis. Ideotype breeding. Mutation breeding, Concept of tree breeding. Speed breeding methods, Pre-breeding, Reverse Breeding.

Unit 3: Genome Organization and Cytogenetics of Crop Plants

Chromosome number, structure, function and replication. Sex determination & sex linkage. Recombination and crossing over. Molecular and cytological mechanism of crossing over.

Karyotype analysis.Chromosomal theory of inheritance. Cell cycle and its regulation. Banding techniques. *In situ* hybridization. GISH and FISH Special types of chromosomes. Chromosomal interchanges, inversions, duplications and deletions. Polyploids, haploids, aneuploids, their utility and their meiotic behaviour. Wide hybridization and chromosomal manipulations for alien gene transfer. Pre-and post- fertilization barriers in wide hybridization. Genome organization and Cytogenetics of important crop species- wheat, maize, rice, sorghum, *Brassica*, groundnut, cotton, *Vigna*, potato and sugarcane. Cytogenetic techniques for gene location and gene transfer, Construction and use of molecular marker based chromosome maps.

Unit 4: Quantitative and Biometrical Genetics

Quantitative characters. Multiple factors inheritance. Genetic control of polygenic characters. Genetic advance and types of selection their effects on population mean and variance. Metric characters under natural selection. Repeatability and asymmetry of response. Breeding value. Dominance and interaction deviations. Hardy Weinberg law and changes in gene frequency due to migration, mutation and selection. Linkage disequilibrium. Genetic load. Polymorphism. Breeding value, heritability. Response to selection, correlated response. Estimates of variance components and covariance among relatives. Mating designs with random and inbred parents. Estimation of gene effects and combining ability. Effects of linkage and epistasis on estimation of genetic parameters. Maternal effects. Genotype-environment interactions, stability of performance and stability analysis. Heterosis and its basis (Genetic, biochemical and physiological). Mating system and mating design- diallel, line X tester, NC-I NC-II and NC-III designs, approaches to estimate and exploit components of self and cross pollinated crops. GGE biplot analysis, Principal component analysis, AMMI and GGI analysis.

Unit 5: Genetic Engineering and Biotechnological Tools in Plant Breeding

Somatic hybridization, micropropagation, somaclonal variation, in vitro mutagenesis. Anther culture. Cryopreservation. Genetic and molecular markers, generation of molecular markers and their application in genetic analyses and breeding. Molecular markers in genetic diversity analysis and breeding for complex characters. Gene tagging, QTL mapping, MAS, MARS and

MABB. Vectors. DNA libraries, DNA fingerprinting, DNA sequencing. Nucleic acid hybridization and immunochemical detection. Chromosome walking, Recombinant DNA technology, Gene cloning strategies. Gene transfer methods. Artificial synthesis of gene. Genetic transformation, transgenics and cisgenics. Antisense RNA, RNAi and micro RNA techniques in crop improvement. Genome editing using CRISPER/cas, Genomic selection, RNA Seq analysis,

Unit 6: Plant Breeding for Stress Resistance and Nutritional Quality

Genetic and molecular basis and breeding for resistance to diseases and insect-pests. Breeding for vertical and horizontal resistance to diseases. Genetic and physiological basis of abiotic stress tolerance. Breeding for resistance to heat, frost, flood, drought and soil stresses. Important quality parameters in various crops, their genetic basis and breeding for these traits. Role of molecular markers in stress resistance breeding using biotechnological tools (MAS, MARS and MABB and transgenics). Biofortification.

Unit 7: Plant Genetic Resources and their Regulatory System; Varietal Release and Seed Production

Plant exploration, germplasm introduction, exchange, conservation, evaluation and utilization of plant genetic resources. Types of genetic resources. Centres of diversity of cultivated plants. Genetic erosion and genetic vulnerability. Convention on Biological Diversity and International Treaty on Plant Genetic Resources for Food and Agriculture. Intellectual Property Rights and its different forms for protection of plant genetic resources. Biodiversity Act. Protection of Plant Varieties and Farmers' Rights Act and its features. System of variety release and notification. Types of seeds and seed chain. Maintenance breeding- nucleus and breeder seed production. Seed production and certification.

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Entrance Test Syllabus of Ph.D. Plant Physiology

Unit 1: Cell Organelles and Water Relations

Cell organelles and their physiological functions Structure and physiological functions of cell wall, cell inclusions. Cell membrane structure and functions. Water and its role in plants, properties and functions of water in the cell, water relations, water potential of plant cells. Mechanism of water uptake by roots transport in roots, movement of water in plants, water loss from plants, energy balance, solar energy, input energy dissipation at crop canopy level. Evapotranspiration, plant factors influencing transpiration rate. Stomata, structure function - Mechanism of stomatal movement, antitranspirants. Physiology of water high temperature and salinity stress in plants. Influence of water stresses at cell, organ, plant and canopy levels. Indices for assessment of drought resistance.

Unit 2: Metabolic Processes and Growth Regulation

Energy and work, free energy and chemical potential, redox reactions and electrochemical potential. Enzyme classification and mechanism of action, factors affecting enzyme action. Gene expression and protein turnover. Photosynthesis, translocation and respiration as key processes regulating carbon metabolism and plant growth. Photosynthesis and bioproductivity. Photochemical process-Chloroplast, its structure, CAM plants and their significance. Rubisco structure and regulations, Photorespiration and its significance, CO_2 fixation as a diffusive process, effect of environmental factors on photosynthetic rates. Synthesis of sucrose, starch, oligo and polysaccharides. Translocations of photosynthates and its importance in sink growth. Mitochondrial respiration, growth and maintenance respiration, cyanide resistant respiration and its significance. Nitrogen metabolism. Inorganic nitrogen species (N_2, $N0_3$, NH_3) and their reduction, protein synthesis, nucleic acids. Sulphate uptake and reduction. Lipid metabolism-storage, protective and structural lipids. Secondary metabolites and their significance in plant defence mechanism. Growth and differentiation, hormonal concept of growth and differentiation, plant growth hormones (auxins, gibberellins, cytokinins, ABA, ethylene, etc.), biosynthesis of

growth hormones and their metabolism, synthetic growth regulators, growth retardant, apical dominance, senescence, fruit growth, abscission, photo-morphogenesis, photo-receptors, phytochrome, physiology of flowering, photoperiodism and vernalisation.

Unit 3: Crop Productivity and Modelling

Role of crop physiology in agriculture, crop growth and productivity, crop growth models describing yield (Duncan/Passioura), phenology-crop productivity, growth factors related to biomass - concept of growth ratescanopy photosynthesis (leaf area and net assimilation rates as determining factors). Light interception as a major function of leaf area-index, LAD canopy architecture- Light extinction coefficient relative growth rate. Net assimilation rate. Biomass and yield relations. Assimilate partitioning, yield and yield structure analysis. Concept of source and sink, factors influencing source and sink size and productivity. Environmental factors determining

Unit 4: Abiotic Stress Responses in Plants

Abiotic stresses affecting plant productivity. Basic principles of a crop improvement programme under stress, interactions between biotic and abiotic stresses. Drought 21 characteristic features, water potential in the soilplant-air continuum. Development of water deficits, energy balance concept, transpiration and it's regulation – stomatal functions/VPD. Physiological process affected by drought. Drought resistance mechanisms: Escape, dehydration postponement (Drought avoidance), Dehydration tolerance, and characteristics of resurrection plants. Osmotic adjustment Osmoprotectants, stress proteins. Water use efficiency as a drought resistance trait. Molecular responses to water deficit stress perception, expression of regulatory and function genes and significance of gene products. Stress and hormones-ABA as a signaling molecule – Cytokinin as negative signal. Oxidative stress: reactive oxygen species (ROS) – role of scavenging systems (SOD, catalase etc.). High temperature stress: tolerance mechanisms- role of membrane lipids in high temperance tolerance. Functions of HSPs chilling stress; effects on physiological processes. Crucial role of membrane lipids. Salinity: species variation in salt tolerance. Salinity effects at cellular and whole plant level, tolerance mechanisms. Breeding for

salt resistance. Heavy metal stress: aluminum and cadmium toxicity in acid soils. Role of phytochelatins (heavy, metal binding proteins).

Unit 5: Plant Growth Regulators and Plant Development

Plant growth regulators – Hormones, endogenous growth substances and synthetic chemicals. Endogenous growth regulating substances other than hormones. Brassinosteriods, triacontanol, phenols polyamines, jasmonates, concept of death hormone. Classification, site of synthesis, biosynthetic pathways and metabolism and influence on plant growth and development by auxins, gibberellins, cytokinins, abscisic acid and ethylene. Concept of hormone action - hormone receptors and signal transduction Hormone mutants. Hormonal regulation of gene expressions at various developmental stages of plant-flowering, seed maturity, seed dormancy. Action of hormones on cellular functions: Auxins- cell elongation, retardation of abscission of plant parts, gibberellins – stem elongation, germination of dormant seeds, cytokinins-cell division, retardation of senescence. Abscisic acidstomatal closure and induction of drought resistance, ethylene- fruit ripening, acceleration of senescence of leaves. Interaction of hormones in regulation of plant growth and development processes. Synthetic growth regulators, growth retardants, apical dominance, senescence, fruit growth, abscission. Growth and differentiation, hormonal concept of growth and differentiations. Rooting of cuttings- flowering- physiological and molecular aspects of control of reproductive growth. Apical dominance, senescence and abscission. Fruit growth and development, physiological and molecular aspects of ripening processes and improving post-harvest life of fruits. Induction and breaking dormancy in seeds and buds. Synthetic growth regulators. Practical utility in agriculture and horticulture. Herbicides, classification and their mode of action.

Unit 6: Mineral Nutrition

Importance of mineral nutrition in plant growth. Classification and essentiality criteria. General mechanisms - concept of apparent free space and nature of bio-membranes. Dual mechanism and

other concepts of ion uptake. Short distance transport-pathway from external solution (Apoplasm) to sieve across the root cortical cells-factors contributing to xylem loading. Long distance transport in xylem and phloem, xylem unloading in leaf cells. Uptake and release of mineral nutrients by foliage. Rhizosphere and root biology, root growth, influence of microorganism in nutrient acquisition, release and uptake by plant roots. Yield and mineral nutrition-concept of nutrient use efficiency, Mineral nutrition under adverse soil situations-drought, salinity, acidity etc. Heavy metal toxicity and concept of phytoremediation. Interaction of phytohormones and nutrients. Molecular aspects- uptake and transport, role of transporter genes, genetics of nutrient uptake, identification and transfer of genes for tolerance to nutrient deficiencies, etc. Soil less culture – Hydroponics - Role of Macro, Micro and beneficial nutrients- Identification of nutrient deficiencies and toxicities.

Unit 7: Morphogenesis, Tissue Culture and Plant Transformation

Morphogenesis; the cellular basis of growth and morphogenesis; polarity in tip growing cells and

diffusive growing cells. Control of cell division and differentiation, phyto-chromes, different forms, physiological effects and gene regulation, and cellular totipotency, physiology and biochemistry of differentiation, in organ cell, tissue and cultures, micropropagation strategies, application of tissue culture in agriculture, horticulture, forestry and industry: plant transformation; transformation vectors, concept of selectable and scorable markers. Agrobacterium mediated transformation, binary vectors, biolistics. Electroporation, selection of putative transgenic plants, genetic analysis. PCR, Southern analysis evaluation of transgenic plants.

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Entrance Test Syllabus of Ph.D. Silviculture and Agroforestry

Unit I: Silviculture

Definition, object and scope of silviculture; Site factors - climatic, edaphic, physiographic, biotic and their influence on forest vegetation; Forest regeneration: natural and artificial; Silvicultural systems - high forest and coppice systems; Seed collection, processing, storage, viability and pretreatment; Seed dormancy and methods for breaking dormancy; Seed testing and germination tests; Seed certification and ISTA Rules; Forest nursery - need, selection and preparation of site, layout and design of nursery beds; Types of containers; Root trainers; Growing media and sowing methods; Management of nursery-shading, watering, manuring, fertilizer application, weed control, insect pest and diseases control; Planting techniques: site selection, evaluation and protection; Soil working techniques for various edaphic and climatic conditions;

Unit II: Planting patterns

Plant spacing, manure and fertilizer application, irrigation/moisture conservation techniques; Choice of species. Afforestation on difficult sites: saline-alkaline soils, coastal sands, lateritic soils, wetlands, ravines and sand dunes, dry and rocky areas, cold desert; Tending operations - weeding, cleaning, climber cutting, thinning - mechanical, ordinary, crown and selection thinning, improvement felling, pruning and girdling;Silviculture of important tree species- Populus, Eucalyptus, Dalbergia, Acacia, Tectona, Shorea, Prosopis, Casuarina, Pinus, Gmelina, Azadirachta, Diospyros, Pterocarpus, Anogeissus, Santalum, Quercus and Albizia, bamboos, Melia dubia, Ailanthus excelsa , Simarouba and Karanja. Plantation forestry – industrialand energy plantations

Unit III: Social forestry and Agroforestry

-Social forestry, community forestry and farm forestry; Concept and definition of agroforestry, Benefits and constraints of agroforestry; Historical development of agroforestry and overview of global agroforestry systems. Classification of agroforestry systems: structural, functional, socioeconomic and ecological; Diagnosis and design of agroforestry system; Land capability classification and land use; Criteria of an ideal agroforestry design, productivity, sustainability and adoptability; multipurpose tree species and their characteristics suitable for agroforestry.

Unit IV: Agroforestry management Plant management practices in agroforestry

Tree-crop interactions: ecological and economic; Concept of complementarity, supplementarily and competition; Productivity, nutrient cycling and light, water and nutrient competition in agroforestry; Concept of allelopathy and its impact on agroforestry; Agroforestry practices and systems in different agro - ecological zones of India.

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Entrance Test Syllabus of Ph.D. Soil Science & Agriculture Chemistry

Unit 1: Pedology

Concept of land, soil and soil science. Composition of earth crust and its relationship with soils; Rocks, minerals and other soil forming materials; Weathering of rocks and minerals; Factors of soil formation; Pedogenic processes and their relationships with soil properties; Soil development; Pedon, polypedon, soil profile, horizons and their nomenclature. Soil Taxonomy - epipedons, diagnostic subsurface horizons and other diagnostic characteristics, soil moisture and temperature regimes, Interpretation of soil survey data for land capability and crop suitability classifications, Fertility Capability Classification- Nutrient indexing. Macro-morphological study of soils. Application and use of global positioning system for soil survey. Soil survey- types andtechniques. Soil series characterization and procedure for establishing soil series, benchmark soils and soil correlations. Study of base maps: cadastral maps, toposheets, aerial photographs and satellite imageries. Use of geographical information system for preparing thematic maps. Application of Remote Sensing in soil survey and mapping. Soils of India

Unit 2: Soil Physics

Significance of soil physical properties. Soil texture – Stoke's Law- textural classes. Soil structure – classification, soil aggregation and significance, soil consistency, bulk density and particle density of soils and porosity, their significance and manipulation. Soil water- retention and potentials. Soil moisture constants. Movement of soil water- saturated and unsaturated flow- Darcy's law - hydraulic conductivity - infiltration, percolation, permeability, drainage and methods of determination of soil moisture. Thermal properties of soils, soil temperature. Soil air- composition, gaseous exchange, influence of soil temperature and air on plant growth. Soil physical constraints affecting crop production and their management strategies.Methods of soil analysis - particle size distribution, bulk and particle density, moisture constants. Soil erosion - types, effects,. Rain erosivity and soil erodibility. Runoff - methods of measurement, factors and management. Soil conservation measures. Characterization and evaluation of soil and land

quality indicators; Causes of land degradation; Management of soil physical properties for prevention/restoration of land degradation; management of waste lands; Concept of watershed – its characterization and management.

Unit 3: Soil Chemistry

Chemical composition of soil; Soil colloids - structure, composition, constitution of clay minerals, amorphous clays and other non-crystalline silicate minerals, oxide and hydroxide minerals; Charge development on clays and organic matter; pH-charge relations; Buffer capacity of soils. Inorganic and organic colloids- surface charge characteristics, diffuse double layer, zeta potential. Soil organic matter fractionation, humus formation and theories clay-organic interactions. Cation exchange – Hysteresis-definition. Nitrogen, potassium, phosphorus and ammonium fixation in soils and management aspects.

Unit 4: Soil Fertility

Essential elements in plant nutrition; Nutrient cycles in soil; Transformation and movement of nutrients (Macro and micro nutrients) in soil; Manures and fertilizers; Fate and reactions of fertilizers in soils; Slow release fertilizers and nitrification retarders- Soil fertility evaluation- Concepts and approaches ;. FCO Soil fertility evaluation – soil testing, plant and tissue tests and biological methods; Common soil test methods for fertilizer recommendation; Nutrient Management concepts- INM, IPNS, SSNM- Soil test-crop response correlations; Fertilizer application methods- Nutrient use efficiency- Macro and micronutrients. Nature, properties and development of acid, acid sulphate, saline and alkali soils and their management; Lime and gypsum requirements of soils; Irrigation water quality - EC, SAR, RSC. Fertility status of soils of India. Pollution: types, causes, and management. Carbon sequestration and carbon trading. Modern methods of soil, plant and fertilizer analysis; Flame photometry and inductively coupled plasma optical emission spectroscopy; Spectrophotometry - visible, ultra-violet and infrared; Atomic absorption spectrophotometry; Potentiometry and conductimetry; X-ray diffractometry; Mass spectrometry.

Unit 5: Soil Microbiology

Soil biota, soil microbial ecology, types of organisms. Soil microbial biomass, microbial interactions, unculturable soil biota. Microbiology and biochemistry of root-soil interface. Phyllosphere. Soil enzymes, origin, activities and importance. Soil characteristics influencing growth and activity of microflora. Microbial transformations of N, P, K, S, Fe and Zn in soil. Biochemical composition and biodegradation of soil organic matter and crop residues. Humus formation. Cycles of important organic nutrients. Biodegradation of pesticides, organic wastes and their use for production of biogas and manures. Biofertilizers – definition, classification, specifications, method of production and role in crop production.

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SYLLABUS FOR Ph.D. ENTRANCE EXAMINATION- ELECTRONICS AND COMMUNICATION ENGINEERING

Circuit Analysis:

Structure and operation, various configurations, input & output characteristics, BJT as an amplifier, DC analysis of various biasing circuits, stability, Graphical analysis of CE amplifier, h-parameter model (low frequency) of BJT. Circuit Design and Analysis using PSPICE – Schematics, attributes and types of analysis in PSPICE, use of PROBE. Design and analysis of current sources, current mirrors, and active loads, Applications and design of integrated circuits – Bipolar OPAMP circuits, CMOS OPAMP circuits, Active filters, Oscillators, Schmitt trigger circuit, Non-sinusoidal oscillators and timing circuits Design and analysis of Signal conditioning circuits, Instrumentation amplifier, switched capacitor filters, Current to voltage, voltage to current, voltage to frequency, frequency to voltage converters Design and analysis of Phase Locked loop and its application circuits.

Digital Electronics:

Number system , Boolean algebra , K Map **,** Design Procedure, adders, Subtractors , code conversion, Multiplexers/ Demultiplexers, encoder/decoders, decimal adders & amplitude comparators, Flip-Flops and their conversions, analysis and synthesis of synchronous sequential circuit, excitation table, state table & diagram. Design of synchronous counters, shift registers and their applications. MOS as a switching element concept of transfer characteristics, Input characteristics and output characteristics of logic gates, TTL, Tri-state logic, open collector output, NMOS, CMOS. Sequential memories, Random Access memories, Read-only memories.

Embedded System Design:

Design of Embedded systems, Microcontroller architectures, microcontroller based system design, case studies. Interfacing Memory and I/O devices, synchronous and asynchronous transfer, interrupts, DMA, Serial data transfer, GPIB, RS-232C, I2C, CAN bus protocols. RFID, Smart cards, PDA's, Zip drives.Development and troubleshooting tools, single board microcomputer kits, simulators, In Circuit Emulators, IDE, Logic analyzer. Introduction to Operating Systems, Process Management & Inter Process Communication, semaphores, conditional critical regions, event queues, deadlock, processor management, scheduling algorithms, queuing system model,Memory management, I/O subsystem, File System Organization, POSIX Thread ProgrammingReal-time.

Communication Systems:

Digital communication principles, FDM, TDM and WDM systems, PCM, delta modulation, transmission coding, code compression, Compading, CODECs, error detection and correction

codes, cyclic codes, convolution codes, data security, encryption/decryption algorithms. MODEMs, Shift Keying Techniques, Spread Spectrum modulation, FDMA, TDMA and CDMA. Telephone communication, switching networks, analog and digital exchanges, speech digitization and transmission, traffic engineering, numbering and charging plan, facsimile, WLL, radio paging and other telecommunication services, Mobile communication systems, cellular concepts, UMTS, frequency reuse, roaming, SMS, GSM, GPRS, CDMA and EDGE, GPS.

Data Communication Networks:

Data communication networks and services, application and layered architecture, OSI model, IEEE 802.3 and IEEE 802.11, Network topologies, LAN and MAC, Data link control, Bridging, switching, addressing, Transmission systems, circuit switching networks, routing, signaling and traffic management Packet switching networks, Internetworking – Repeaters, bridges, routers and gateways. Introduction to Routing protocols TCP/IP and Internetworking, TCP/IP protocol suite TCP/IP Sockets Client-Server, computing, Name Service, Application protocols over TCP/IP, IPV6, network architectures and protocols, Web server, SMIP server, DNS server, network security, ATM Networks, ISDN, BISDN, VoIP, VoDSL, VPN, MPLS-VPN, Metro-E network, VOIP. High speed LANs – Fast and Gigabit Ethernet, FDDI. Wireless LANs.Bluetooth, Wi-Fi WLAN, WAP and Mobile computing.

Artificial Neural Networks:

Basic neuron models: McCulloch-Pitts model, nearest neighbor model, radial basis function model, etc., Neural network models: multilayer perceptron, nearest neighbor based multilayer perceptron, associative memory; radial basis function based multilayer perceptron, etc. Learning algorithms: the back propagation algorithm, self-organization learning, winner-take-all competitive learning, evolutionary learning, etc. Applications: character recognition, signal restoration, etc.

Image Processing:

Image acquisition, Image representations, Image digitalization, Sampling, Quantization, Histograms, Image Quality, Noise in Images, Basic operations on images, Image Enhancement, Pixel intensity transformations, Histogram equalization and matching, noise removal, Edge sharpening, Spatial Filtering, Convolution, Image smoothing.

Internet of Things:

Introduction to IOT, Understanding IoT fundamentals , Arduino Simulation Environment, Arduino Uno Architecture, Sensor & Actuators with Arduino, Overview of Sensors working, IoT Protocols. Cloud Platforms for IOT.

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SYLLABUS FOR Ph.D. ENTRANCE EXAMINATION
PHARMACEUTICAL SCIENCES

Pharmaceutics

1. BCSclassification of drugs & its significance.
2. Discuss the different dosage forms. Study of drug stability and ICH guideline. Various parameters of packaging material applicable in pharmaceuticalproducts.
3. Brief introduction of pharmacokinetic parameter -biological half-life, volume of distribution, dissociation constant, area under the curve (AUC), clearance,bioavailability and bioequivalence. Compartment model.
4. Discuss Controlled drug delivery system (CDDS). Different polymers used as carrier in the development of drug formulation.
5. Discuss the drug targeting formulation -nanoparticles, liposomes, niosomes etc.

Pharmaceutical Chemistry

1. Stereochemical aspects involved in the new drug designing. Significance of green synthesis.
2. Mechanism and synthetic application of various name reaction. Discuss the synthesis, chemistry and synthetic application of heterocyclic compound.
3. Discuss different techniques of characterization of organic compounds. spectroscopy and atomic absorption spectroscopy, NMR spectroscopy, MassSpectroscopy etc.
4. Different techniques of chromatography and its application
5. Nomenclature**,** structure, classification, metabolic transformation, adverse effect and SAR of different category - Narcotic analgesics, Nonsteroidal anti-inflammatory drugs, Antipsychotic drugs, Chemotherapeuticagents, Antibiotics, Antiviral etc.

Pharmacology

1. Pharmacokinetic and pharmacodynamic parameter of drugs.
2. Drugs acting on Autonomic Nervous System and Central Nervous System.
3. Drugs acting on renal, blood and cardiovascular system.
4. Hormones and hormone antagonist.
5. Principles of pharmacological and clinical evaluation of drugs.

Pharmacognosy and Phytochemistry

1. Cultivation and standardization of medicinal plants
2. Plant tissue culture techniques and its application in relation to phytopharmaceuticals.
3. Natural sources, extraction, purification, isolation and characterization of Alkaloids, Glycosides, Terpenoids etc.
4. Study of some herbal formulation as drug and cosmetics.

Pharmacy Practice

1. Clinical trials and its implementation.
2. Brief introduction of community and hospital pharmacy.
3. Adverse drug reaction and clinical laboratory test.

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SYLLABUS FOR Ph.D ENTRANCE EXAMINATION
COMMERCE

Accounting and Auditing

Business EconomicsBusiness
Finance

Income-tax and Corporate Tax Planning

Banking and Financial Institutions

Business Statistics and Research Methods

Business Environment and International Business

Business Management and Human Resource Management

Marketing Management

Legal Aspects of Business

Accounting and Auditing

- Basic accounting principles; concepts and postulates
- Partnership Accounts: Admission, Retirement, Death, Dissolution and Insolvency of partnership firms
- Corporate Accounting: Issue, forfeiture and reissue of shares; Liquidation of companies; Acquisition, merger, amalgamation and reconstruction of companies
- Holding company accounts
- Cost and Management Accounting: Marginal costing and Break-even analysis;

Standard costing; Budgetary control; Process costing; Activity Based Costing (ABC); Costing for decision-making; Life cycle costing, Target costing, Kaizen costing and JIT

- Financial Statements Analysis: Ratio analysis; Funds flow Analysis; Cash flow analysis
- Human Resources Accounting; Inflation Accounting; Environmental Accounting
- Indian Accounting Standards and IFRS
- Auditing: Independent financial audit; Vouching; Verification ad valuation of assets and liabilities; Audit of financial statements and audit report; Cost audit
- Recent Trends in Auditing: Management audit; Energy audit; Environment audit; Systems audit; Safety audit

Business Economics

- Meaning and scope of business economics
- Objectives of business firms
- Demand analysis: Law of demand; Elasticity of demand and its measurement; Relationship between AR and MR
- Consumer behavior: Utility analysis; Indifference curve analysis
- Law of Variable Proportions: Law of Returns to Scale
- Theory of cost: Short-run and long-run cost curves
- Price determination under different market forms: Perfect competition; Monopolistic competition; Oligopoly- Price leadership model; Monopoly; Price discrimination
- Pricing strategies: Price skimming; Price penetration; Peak load pricing

Business Finance

- Scope and sources of finance; Lease financing
- Cost of capital and time value of money
- Capital structure & its theories
- Capital budgeting decisions: Conventional and scientific techniques of capital budgeting analysis
- Working capital management; Dividend decision: Theories and policies
- Risk and return analysis; Asset securitization
- International monetary system
- Foreign exchange market; Exchange rate risk and hedging techniques
- International financial markets and instruments: Euro currency; GDRs; ADRs

- International arbitrage; Multinational capital budgeting

Income-tax and Corporate Tax Planning

- Income-tax: Basic concepts; Residential status and tax incidence; Exempted incomes; Agricultural income; Computation of taxable income under various heads; Deductions from Gross total income; Assessment of Individuals; Clubbing of incomes
- International Taxation: Double taxation and its avoidance mechanism; Transfer pricing
- Corporate Tax Planning: Concepts and significance of corporate tax planning; Tax avoidance versus tax evasion; Techniques of corporate tax planning.
- Deduction and collection of tax at source; Advance payment of tax; E-filing ofincome-tax returns

Banking and Financial Institutions

- Overview of Indian financial system
- Types of banks: Commercial banks; Regional Rural Banks (RRBs); Foreign banks; Cooperative banks
- Reserve Bank of India: Functions; Role and monetary policy management
- Banking sector reforms in India: Basel norms; Risk management; NPA management
- Financial markets: Money market; Capital market; Government securities market
- Financial Institutions: Development Finance Institutions (DFIs); Non-Banking Financial Companies (NBFCs); Mutual Funds; Pension Funds
- Financial Regulators in India
- Financial sector reforms including financial inclusion
- Digitization of banking and other financial services: Internet banking; mobile banking; Digital payments systems
- Insurance: Types of insurance- Life and Non-life insurance; Risk classification and management; Factors limiting the insurability of risk; Re-insurance; Regulatory framework of insurance- IRDA and its role

Business Statistics and Research Methods

- Measures of central tendency
- Measures of dispersion
- Measures of skewness
- Correlation and regression of two variables
- Probability: Approaches to probability; Bayes' theorem
- Probability distributions: Binomial, poisson and normal distributions
- Research: Concept and types; Research designs
- Data: Collection and classification of data
- Sampling and estimation: Concepts; Methods of sampling - probability and non-probability methods; Sampling distribution; Central limit theorem; Standard error; Statistical estimation
- Hypothesis testing: z-test; t-test; ANOVA; Chi–square test; Mann-Whitney test (U-test); Kruskal-Wallis test (H-test); Rank correlation test

Business Environment and International Business

- Concepts and elements of business environment: Economic environment- Economic systems, Economic policies(Monetary and fiscal policies); Political environment- Role of government in business; Legal environment- Consumer Protection Act, FEMA; Socio-cultural factors and their influence on business; Corporate Social Responsibility (CSR)
- Scope and importance of international business; Globalization and its drivers; Modes of entry into international business
- Theories of international trade; Government intervention in international trade; Tariff and non-tariff barriers; India's foreign trade policy
- Foreign direct investment (FDI) and Foreign portfolio investment (FPI); Types of FDI, Costs and benefits of FDI to home and host countries; Trends in FDI; India's FDI policy
- Balance of payments (BOP): Importance and components of BOP
- Regional Economic Integration: Levels of Regional Economic Integration; Trade creation and diversion effects; Regional Trade Agreements: European Union (EU), ASEAN, SAARC, NAFTA
- International Economic institutions: IMF, World Bank, UNCTAD
- World Trade Organization (WTO): Functions and objectives of WTO; Agriculture

Agreement; GATS; TRIPS; TRIMS

Business Management and Human Resource Management

- Principles and functions of management
- Organization structure: Formal and informal organizations; Span of control
- Responsibility and authority: Delegation of authority and decentralization
- Motivation and leadership: Concept and theories
- Corporate governance and business ethics
- Human resource management: Concept, role and functions of HRM; Human resource planning; Recruitment and selection; Training and development; Succession planning
- Compensation management: Job evaluation; Incentives and fringe benefits
- Performance appraisal including 360 degree performance appraisal
- Collective bargaining and workers' participation in management
- Personality: Perception; Attitudes; Emotions; Group dynamics; Power and politics; Conflict and negotiation; Stress management
- Organizational Culture: Organizational development and organizational change

Marketing Management

- Marketing: Concept and approaches; Marketing channels; Marketing mix; Strategic marketing planning; Market segmentation, targeting and positioning
- Product decisions: Concept; Product line; Product mix decisions; Product life cycle; New product development
- Pricing decisions: Factors affecting price determination; Pricing policies and strategies.
- Promotion decisions: Role of promotion in marketing; Promotion methods - Advertising; Personal selling; Publicity; Sales promotion tools and techniques; Promotion mix
- Distribution decisions: Channels of distribution; Channel management
- Consumer Behaviour; Consumer buying process; factors influencing consumer buying decisions

- Service marketing
- Trends in marketing: Social marketing; Online marketing; Green marketing; Direct marketing; Rural marketing; CRM
- Logistics management

Legal Aspects of Business

- Indian Contract Act, 1872: Elements of a valid contract; Capacity of parties; Free consent; Discharge of a contract; Breach of contract and remedies against breach; Quasi contracts;
- Special contracts: Contracts of indemnity and guarantee; contracts of bailment and pledge; Contracts of agency
- Sale of Goods Act, 1930: Sale and agreement to sell; Doctrine of Caveat Emptor; Rights of unpaid seller and rights of buyer
- Negotiable Instruments Act, 1881: Types of negotiable instruments; Negotiation and assignment; Dishonour and discharge of negotiable instruments
- The Companies Act, 2013: Nature and kinds of companies; Company formation; Management, meetings and winding up of a joint stock company
- Limited Liability Partnership: Structure and procedure of formation of LLP in India
- The Competition Act, 2002: Objectives and main provisions
- The Information Technology Act, 2000: Objectives and main provisions; Cyber crimes and penalties
- The RTI Act, 2005: Objectives and main provisions
- Intellectual Property Rights (IPRs) : Patents, trademarks and copyrights; Emerging issues in intellectual property
- Goods and Services Tax (GST): Objectives and main provisions; Benefits of GST; Implementation mechanism; Working of dual GST

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SYLLABUS FOR PH.D. ENTRANCE EXAM- ENERGY and ECO-SUSTAINABILTY

Renewable energy systems

Solar Photovoltaic*: Solar radiation resources, measurement and Estimation; Mono crystalline and Poly crystalline solar cells, Thin film solar cells, Organic solar cells; Rooftop & Ground mount systems. SPV Modules and Arrays, Hotspots. Photovoltaic system design guidelines and methodology; Solar Photovoltaic pumping systems*

Solar Thermal*: Flat Plate Collectors; Concentrating Collectors; Solar Air Heating System Solar Drying, Solar Cooker; Solar Pond, Solar Distillation, Solar Detoxification. Solar Cooling System, Central Receiver Systems, Parabolic Trough Systems, Solar Furnaces*

Wind Energy Technology**:** *Types and Classification of Wind Energy Conversion Sources; Aerodynamic design principles Axial momentum, blade element and combine theory Rotor Characteristics and Maximum Power Coefficient Tip loss Correction; Wind Turbine Design Considerations; Wind Pumps and Performance Analysis Design Concepts; Wind Energy status in India*

Biomass Conversion Technologies: *Biomass availability, Characteristics of Biomass; Aerobic and Anaerobic Bioconversion process, Biogas production process, Process and technologies of slow and fast pyrolysis for fuel Production, Characteristics of Bio-oils and applications; Biomass Briquetting and Pelletization; Composting and Vermicomposting; Types of Gasifiers and their working; Biomass productivity Energy plantation and power programme*

Alternate Energy Technologies:

I. ***Hydrogen Energy:*** *Hydrogen as a fuel, Properties of Hydrogen and Sources of Hydrogen. Hydrogen Production Methods, Storage Methods, Environmental Benefits, Purification of Hydrogen. Hydrogen Production Units in India. Hydrogen Management, Transportation and Limitations.*
II. ***Fuel Cell:*** *Fuel Cell history, difference between batteries and fuel cell, Types of Fuel Cells; Components of fuel cells. Working principle of Fuel Cell, Performance Characteristics of Fuel Cell, R&D related to fuel cell development in India Fuel Cells; Tidal Energy*

Energy Conservation and Audit

Energy Audit, types of energy audit; approach; Energy audit instruments; Concept of energy management, energy demand and supply; Duties and responsibilities of energy managers, Energy conservation Act. Energy Conservation in Household, Transportation, Agricultural, service and Industrial sectors, Lighting, Heating Ventilation & Air Conditioning. Energy Efficient Practices and Technologies.

Ecology, Environment & Climate Change

Earth's temperature and atmosphere, nature of Sun radiations, Biological processes, Food chains, Ecological Cycles, Bio Diversity, Environmental degradation, pollutants, Thermal and radioactive pollution, air and water pollution, Climate Change global protocols

Centre of Excellence (Smart Devices & IoT Applications)

The Internet of Things (IoT) is a phrase that refers to physical substance that are make by software, sensors and different techniques that allow to communicate with other equipment and systems over the Internet. According to McKinsey IoT-connected instruments will reach 43 billion by 2023. The Internet of Things (IoT) market continues to expand. According to Digitalist, the IoT's economic impact might reach $11 trillion by 2025, accounting for 11% of global economic value. Machine Learning and Artificial Intelligence developments have simplified the automation of IoT devices. In essence, To deliver optimal automation, AI and machine learning are combined with IoT devices. As a result, the Internet of Things (IoT) has broadened its range of applications across a variety of industries. Applications of the Internet of Things (IoT) include smart environment, Logistic, smart animal farming, smart metering, smart cities, Home automation, eHealth, smart agriculture, etc.

Smart devices, which feature sensors, sophisticated computer units, and communication capabilities, are an essential component of the Internet of Things. Data from sensors is electronically turned into information (output) that can be used by 'intelligent' equipment or persons to make decisions. The data must be evaluated in order to gain insight into how "things" work. Big-data solutions that have been developed in recent years can manage substantially more data, both structured and unstructured.

The Industry 4.0 with all aspects of Interdisciplinary Cyber Physical System will be coordinated under the umbrella of Centre of Excellence for "Smart Devices & IoT" The research program in I"oT & CPS" will provide a platform for in-depth investigations to understand the processes and phenomena that are in operation leading to the development of CPS applications.

National Mission- Interdisciplinary Cyber Physical System" also addresses the rapid global rise of Cyber-Physical Systems. This has the potential to pose unprecedented challenges and stresses to our demographic dividend. It is a huge opportunity to develop new technologies by research, training and skilling in robotics, artificial intelligence, digital manufacturing, big data analysis, deep learning, quantum communication and Internet-of-Things.

There is a need to develop new technologies in services and manufacturing sectors; in agriculture, water, energy & traffic management; health, environment, infrastructure and Geo-Information Systems; security; financial systems and in combating crime.

Program offered

Ph.D (IoT & Cyber Physical System) (Regular/Part time)

Note- Students of any domain and discipline can opt for the program with eligibility criteria.

Eligibility criteria for admission to the Ph.D (IoT & Cyber Physical System) programme

The following are eligible to seek admission to the Ph.D. programme:

Candidates for admission to the Ph.D. programme shall have successfully completed:

1. A Master's degree programme (after 4 year undergraduate degree) with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 10- point scale (or an equivalent grade in a point scale wherever grading system is followed) or an equivalent degree from a foreign educational institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country to assess, accredit or assure quality and standards of educational institutions.
2. A candidate seeking admission after a 4-year/8-semester Bachelor's degree with Research should have a minimum CGPA of 7.5/10.
3. Candidates who have cleared the M.Phil. course work with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 10-point scale (or an equivalent grade in a point scale wherever grading system is followed) or an equivalent degree from a Foreign Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country to assess, accredit or assure quality and standards of educational institutions, shall be eligible for admission to the Ph.D. programme.
4. A person whose M.Phil. dissertation has been evaluated and recommended for award of the degree, may be admitted to the Ph.D. programme in any Institution on a provisional basis even before the viva-voice or final defence.
5. A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, may be allowed for those belonging to SC/ST/OBC (non-creamy layer)/Differently-Abled, Economically Weaker Section (EWS) and other categories of candidates as per the decision of the Commission from time to time, or for those who had obtained their master's degree before 19th September 1991.

Note: The eligibility marks of 55% (or an equivalent grade in a point scale wherever grading system is followed) and the relaxation of 5% to the categories mentioned above are permissible based only on the qualifying marks without including the grace mark procedures, if any.