



M. Phil. / Ph.D. Admission January 2018

Entrance Test Syllabus Details:

- ❖ Agri-Informatics
- ❖ Biomedical Engineering & Sciences
- ❖ Bioinformatics
- ❖ Biotechnology
- ❖ Computer Science & Engineering
- ❖ Electronics & Communication Engineering
- ❖ Environmental Sciences
- ❖ Education
- ❖ Economics
- ❖ English
- ❖ Law
- ❖ Management
- ❖ Mathematics
- ❖ Microbiology
- ❖ Pharmaceutical Sciences
- ❖ Physics
- ❖ Statistics



SYLLABUS FOR AGRI INFORMATICS

Usage of Land, Crop, Water & Natural Resources

Land Classification, Land Use Categories and their distribution, Agricultural Land Use, Productivity and Food Self-sufficiency, Agricultural Transformation and Crop Combination, Impact of Land Use on Groundwater Quality, Agro climate, areas affected by drought and waterlogging. Land Use Profile, Resource Capacity, Growth and Development, Environmental Impact Assessment of Land Use Patterns, Interpretation of Remotely Sensed Data for Land Use / Cover, Application of Satellite Remote Sensing and GIS data in management Planning of Natural Resources. Cropping Pattern, Area under different Crops, Crop production; Scope, Limitations & Strategies, Production Constraints & Strategies for Oilseeds, Pulses, Fiber Crops, Fodder Crops, and Commercial Crops, Production and Distribution of Quality Seed, Chemical Fertilizers and organic manures, Statewise fertilizer consumption and availability, Plant Protection, Rainfed Agriculture, Dry Land Farming, Irrigated lands, Sources of Irrigation Water, Development of efficient Irrigation System, Irrigation Wells and Pumps, Drainage of excess water, Reclamation of Waste Lands and degraded lands, Farm Power and Agricultural Machinery, Postharvest Technology, Agrifood Processing. Agricultural Credits, Bank Loans, Crop Insurance, Agricultural Trading, Human Resource Management.

Environmental Management, Laws & Standards

Constitutional Provisions for Environmental Protection: Specific Provisions for Environmental Protection in the Constitution of India, Provisions in the Directive Principles of State Policy. Environmental Acts, Rules and Notifications on the followings: Water (Prevention & Control of Pollution) Act and the Corresponding Rule, Air (Prevention & Control of Pollution) Act and the Corresponding Rule, Environment (Protection) Act and Rule, Hazardous Waste (Management & Handling) Rules, Public Liability Insurance Act and Rule, Wild life Protection Act. Concept of Sustainable Development: From Stockholm to Rio to Johannesburg. The Rio Declaration on Environment and Development. Agenda 21: An Overview, World Summit on Sustainable Development. Principles of ISO 14001: Commitment and Policy, Planning, Implementation, Measurement and Evaluation, Review and Improve. Salient points of ISO 14001. EIA: Steps in EIA: description of proposed activity, analysis of site selection procedure and alternate sites, baseline conditions / major concerns, description of potential positive and negative environmental, social, economic and cultural impacts Environmental Audit: ISO19011, Qualities of Environmental Auditor, Contents of EA reports, Environmental Audit Terminology, Environmental management System audit.

Application of Remote Sensing & GIS

Principles of Remote Sensing System: Definition of Remote Sensing. The Electromagnetic spectrum. Wave Phenomenon concept. Electromagnetic waves. Waves Description. The Particle nature of light. Infrared Radiation. Electromagnetic energy interaction: Interaction with earth surface features. Spectral reflectance of soil, water and vegetation. Principles of Remote Sensing System: Definition of Remote Sensing. The Electromagnetic spectrum. Wave Phenomenon concept. Electromagnetic waves. Waves Description. The Particle nature of light. Infrared Radiation. Sources of Electromagnetic radiation. Interaction of Electromagnetic radiation with particles. Electromagnetic energy interaction: Interaction with earth surface features. Spectral reflectance of soil, water, and vegetation. Satellites and sensors, Aerial photography: Introduction. Basic Elements of Air Photo Interpretation. Advantages of Aerial Photography over Ground Based Observation. Types of Aerial Photography. Basic Photogrammetry. Applications of Aerial Photography. Integration of Aerial Photography into GIS. Digital Image Processing: Image enhancement. Data classification. Geographical Information Systems and its applications. Digital Representation of Geographic data , Raster and Vector Based GIS data, Spatial analysis. Applications of Remote Sensing: Agriculture, Forestry, Geology , Hydrology , Flood delineation, Soil moisture , Sea ice, Land cover , Mapping , Oceans and coastal regions.

Soil and crop management

Soil types Soil texture, structure characteristics for suitability of crops soil fertility and productivity Agronomical measures to maintain fertility and productivity, soil organic matter in crop production Tillage and tith objectives, principles and kinds of tillage and implements effect of tillage modern concept of tillage zero tillage problem soils and their management, management of wasteland waterlogged and watershed. Manure and fertilizers soil fertility management composting techniques INM green and green leaf manures irrigation techniques Micro Irrigation WUE,IWCPE ratio Water requirement less water crop production technologies concept of advanced irrigation methods water management devices fertigation. Crop production technologies : season varieties seed rate sowing geometry manures weeds methods of weed management IWM and fertilizers critical stages for input requirement nutrient, irrigation weed management and aftercare of major field crops : rice, major and minor millets, redgram, blackgram, greengram, groundnut, sesame, soybean, castor, sunflower, cotton, sugarcane. Production technologies for Biofuel crops sweet sorghum, sugarbeet and jatropha forage and fodder crops preservation techniques. Hay silage making. Crop production in dry farming agro techniques for drylands soil erosion and conservation sustainable agriculture LEISA concepts organic farming bio pesticides and botanicals, IFS Concept.



SYLLABUS FOR BIOMEDICAL ENGINEERING & SCIENCES

ANATOMY AND PHYSIOLOGY

Cellular Organization, Tissue, Major Organ Systems, Homeostasis

BIOMECHANICS

Basic Mechanics, Mechanics of Materials, Viscoelastic Properties, Cartilage, Ligament, Tendon, and Muscle, Clinical Gait Analysis, Cardiovascular Dynamics

REHABILITATION ENGINEERING AND ASSISTIVE TECHNOLOGY

The Human Component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering, Practice of Rehabilitation Engineering and Assistive Technology

BIOMATERIALS

Materials in Medicine: From Prosthetics to Regeneration, Biomaterials: Properties, Types, and Applications, Lessons from Nature on Biomaterial Design and Selection, Tissue-Biomaterial Interactions, Guiding Tissue Repair with Bio-Inspired Biomaterials, Safety Testing and Regulation of Biomaterials, Application-Specific Strategies for the Design and Selection of Biomaterials

TISSUE ENGINEERING

Biological Considerations, Physical Considerations, Scaling Up, Implementation of Tissue Engineered Products, Future Directions: Functional Tissue Engineering and the“-Omics” Sciences

BIOINSTRUMENTATION

Basic Bioinstrumentation System Charge, Current, Voltage, Power, and Energy Resistance, Linear Network Analysis, Linearity and Superposition, Thevenin's Theorem, Inductors, Capacitors, A General Approach to Solving Circuits Involving Resistors, Capacitors, and Inductors, Operational Amplifiers, Time-Varying Signals, Active Analog Filters, Bioinstrumentation Design

BIOMEDICAL SENSORS

Biopotential Measurements, Physical Measurements, Blood Gases and pH Sensors, Bioanalytical Sensors, Optical Biosensors

BIO SIGNAL PROCESSING

Physiological Origins of Biosignals, Characteristics of Biosignals, Signal Acquisition, Frequency Domain Representation of Biological Signals, Linear Systems, Signal Averaging, Wavelet Transform and Short-Time Fourier Transform, Artificial Intelligence Techniques

BIOELECTRIC PHENOMENA

Neurons, Basic Biophysics Tools and Relationships, Equivalent Circuit Model for the Cell Membrane, Hodgkin–Huxley Model of the Action Potential, Model of the Whole Neuron

PHYSIOLOGICAL MODELING

Compartmental Modeling, An Overview of the Fast Eye Movement System, Westheimer Saccadic Eye Movement Model, The Saccade Controller, Development of an Oculomotor Muscle Model, A Linear Muscle Model, A Linear Homeomorphic Saccadic Eye Movement Model, A Truer Linear Homeomorphic Saccadic Eye Movement Model, System Identification

GENOMICS AND BIOINFORMATICS

Core Laboratory Technologies, Core Bioinformatics Technologies

COMPUTATIONAL CELL BIOLOGY AND COMPLEXITY

Computational Biology, The Modeling Process, Bionetworks, Introduction to Complexity Theory

RADIATION IMAGING

Emission Imaging Systems, Instrumentation and Imaging Devices, Radiographic Imaging Systems

MEDICAL IMAGING

Diagnostic Ultrasound Imaging, Magnetic Resonance Imaging (MRI), Comparison of Imaging Modes

BIOMEDICAL OPTICS AND LASERS

Essential Optical Principles, Fundamentals of Light Propagation in Biological Tissue, Physical Interaction of Light and Physical Sensing, Biochemical Measurement Techniques Using Light, Fundamentals of Photothermal Therapeutic Effects of Lasers, Fiber Optics and Waveguides in Medicine, Biomedical Optical Imaging

MORAL AND ETHICAL ISSUES

Morality and Ethics: A Definition of Terms, Two Moral Norms: Beneficence and Nonmaleficence, Redefining Death, The Terminally Ill Patient and Euthanasia, Taking Control, Human Experimentation, Definition and Purpose of Experimentation, Informed Consent, Regulation of Medical Device Innovation, Marketing Medical Devices, Ethical Issues in Feasibility Studies, Ethical Issues in Emergency Use, Ethical Issues in Treatment Use, The Role of the Biomedical Engineer in the FDA Process



SYLLABUS FOR BIOINFORMATICS

Major Bioinformatics Resources: NCBI, EBI, ExPASy, RCSB The knowledge of various databases and bioinformatics tools available at these resources, organization of databases: data contents and formats, purpose and utility in Life Sciences

Open access bibliographic resources and literature databases: Open access bibliographic resources related to Life Sciences viz., PubMed, BioMed Central, Public Library of Sciences (PLoS)

Sequence databases Formats, querying and retrieval Nucleic acid sequence databases: GenBank, EMBL, DDBJ; Protein sequence databases: Uniprot-KB: SWISS-PROT, TrEMBL, PIR-PSD Repositories for high throughput genomic sequences: EST, STS GSS, etc.; Genome Databases at NCBI, EBI, TIGR, SANGER Viral Genomes Archeal and Bacterial Genomes; Eukaryotic genomes with special reference to model organisms (Yeast, Drosophila, C. elegans, Rat, Mouse, Human, plants such as Arabidopsis thaliana, Rice, etc.)

3D Structure Database: PDB, NDB Chemical Structure database: Pubchem Gene Expression database: GEO, SAGE

Derived Databases Knowledge of the following databases with respect to: basic concept of derived databases, sources of primary data and basic principles of the method for deriving the secondary data, organization of data, contents and formats of database entries, identification of patterns in given sequences and interpretation of the same : InterPro, Prosite, Pfam, ProDom, Gene Ontology Structure classification database: CATH, SCOP, FSSP Protein-Protein interaction database: STRING

Compilation of resources: NAR Database and Web server Issues and other resources published in Bioinformatics related journals

Sequence Analysis File formats: Various file formats for bio-molecular sequences: GenBank, FASTA, GCG, MSF etc.

Basic concepts: Sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues **matrices:** basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived **Pairwise sequence alignments:** Needleman and Wunsch, Smith and Waterman algorithms and their implementation

Multiple sequence alignments (MSA): Use of HMM-based Algorithm for MSA (e.g. SAM method)

Sequence patterns and profiles: Repeats: Tandem and Interspersed repeats, repeat finding, Motifs, consensus, position weight matrices: Algorithms for derivation of and searching sequence patterns: MEME, PHI-BLAST, Scan Prosite and PRATT Algorithms for generation of sequence profiles: Profile Analysis method of Gribskov, HMMer, PSIBLAST

Protein and nucleic acid properties: e.g. Proteomics tools at the ExPASy server and EMBOSS

Taxonomy and phylogeny: Phylogenetic analysis algorithms such as maximum Parsimony, UPGMA, Transformed Distance, Neighbors-Relation, Neighbor-Joining, Probabilistic models and associated algorithms such as Probabilistic models of evolution and maximum likelihood algorithm, Bootstrapping methods, use of tools such as Phylip, Mega, PAUP Analysis of regulatory RNA's: Databases and tools

Structural Biology Experimental methods for Biomolecular structure determination: X-ray and NMR Identification/assignment of secondary structural elements from the knowledge of 3-D structure of macromolecule using DSSP and STRIDE methods Prediction of secondary structure: PHD and PSI-PRED methods

Tertiary Structure prediction: Fundamentals of the methods for 3D structure prediction (sequence similarity/identity of target proteins of known structure, fundamental principles of protein folding etc.) Homology Modeling, fold recognition, threading approaches, and ab-initio structure prediction methods

Structure analysis and validation: Pdbsum, Whatcheck, Procheck, Verify3D and ProsaII Critical assesment of Structure prediction(CASP) Structures of oligomeric proteins and study of interaction interfaces

Molecular modeling and simulations Macro-molecular force fields, salvation, long-range forces Geometry optimization algorithms: Steepest descent, conjugate gradient Various simulation techniques: Molecular mechanics, conformational searches, Molecular Dynamics, 4 Monte Carlo, genetic algorithm approaches, Rigid and Semi-Flexible Molecular Docking

Genomics Large scale genome sequencing strategies Genome assembly and annotation Genome databases of Plants, animals and pathogens Metagenomics Gene networks: basic concepts, computational model such as Lambda receptor and lac operon Prediction of genes, promoters, splice sites, regulatory regions: basic principles, application of methods to prokaryotic and eukaryotic genomes and interpretation of results Basic concepts on identification of disease genes, role of bioinformatics-OMIM database, reference genome sequence, integrated genomic maps, gene expression profiling; identification of SNPs, SNP database (DbSNP). Role of SNP in Pharmacogenomics, SNP arrays DNA microarray: database and basic tools, Gene Expression Omnibus (GEO), Array Express, SAGE databases DNA microarray: understanding of microarray data, normalizing microarray data, detecting differential gene expression, correlation

of gene expression data to biological process and computational analysis tools (especially clustering approaches)

Comparative genomics: Basic concepts and applications, BLAST2, MegaBlast algorithms, PipMaker, AVID, Vista, MUMmer, applications of suffix tree in comparative genomics, synteny and gene order comparisons Comparative genomics databases: Clusters of Orthologous Groups (COGs)

Functional genomics: Application of sequence based and structure-based approaches to assignment of gene functions – e.g. sequence comparison, structure analysis (especially active sites, binding sites) and comparison, pattern identification, etc. Use of various derived databases in function assignment, use of SNPs for identification of genetic traits Gene/Protein function prediction using Machine learning tools: supervised/unsupervised learning, Neural network, SVM etc

Proteomics Protein arrays: basic principles Computational methods for identification of polypeptides from mass spectrometry Protein arrays: bioinformatics-based tools for analysis of proteomics data (Tools available at ExPASy Proteomics server); databases (such as InterPro) and analysis tools Protein-protein interactions: databases such as STRINGS, DIP, PPI server and tools for analysis of protein-protein interactions Modeling biological systems Systems biology – Use of computers in simulation of cellular subsystems Metabolic networks, or network of metabolites and enzymes, Signal transduction networks, Gene 5 regulatory networks, Metabolic pathways: databases such as KEGG, EMP , MetaCyc, AraCyc

Drug design Drug discovery process Role of Bioinformatics in drug design Target identification and validation and lead optimization Different systems for representing chemical structure of small molecules like SMILES etc Generation of 3D coordinates of small molecules Structure-based drug design: Identification and Analysis of Binding sites and virtual screening Ligand based drug design: Structure Activity Relationship – QSARs and QSPRs, QSAR Methodology, Pharmacophore mapping *In silico* prediction ADMET properties for Drug Molecules

Vaccine design: Reverse vaccinology and immunoinformatics Databases in Immunology Principles of B-cell and T-cell epitope prediction



SYLLABUS FOR BIOTECHNOLOGY

Microbiology:

Prokaryotic and eukaryotic cell structure; Microbial nutrition, growth and control; Microbial metabolism (aerobic and anaerobic respiration, photosynthesis); Nitrogen fixation; Chemical basis of mutations and mutagens; Microbial genetics (plasmids, transformation, transduction, conjugation); Microbial diversity and characteristic features; Viruses.

Biochemistry:

Biomolecules and their conformation; Ramachandran map; Weak inter-molecular interactions in biomacromolecules; Chemical and functional nature of enzymes; Kinetics of single substrate and bi-substrate enzyme catalyzed reactions; Bioenergetics; Metabolism (Glycolysis, TCA and Oxidative phosphorylation); Membrane transport and pumps; Cell cycle and cell growth control; Cell signaling and signal transduction; Biochemical and biophysical techniques for macromolecular analysis.

Molecular Biology and Genetics:

Molecular structure of genes and chromosomes; DNA replication and control; Transcription and its control; Translational processes; Regulatory controls in prokaryotes and eukaryotes; Mendelian inheritance; Gene interaction; Complementation; Linkage, recombination and chromosome mapping; Extrachromosomal inheritance; Chromosomal variation; Population genetics; Transposable elements, Molecular basis of genetic diseases and applications.

Process Biotechnology:

Bioprocess technology for the production of cell biomass and primary/secondary metabolites, such as baker's yeast, ethanol, citric acid, amino acids, exo-polysaccharides, antibiotics and pigments etc.; Microbial production, purification and bioprocess application(s) of industrial enzymes; Production and purification of recombinant proteins on a large scale; Chromatographic and membrane based bioseparation methods; Immobilization of enzymes and cells and their application for bioconversion processes. Aerobic and anaerobic biological processes for stabilization of solid / liquid wastes; Bioremediation.

Bioprocess Engineering:

Kinetics of microbial growth, substrate utilization and product formation; Simple structured models; Sterilization of air and media; Batch, fed-batch and continuous processes; Aeration and agitation; Mass transfer in bioreactors; Rheology of fermentation fluids; Scale-up concepts; Design of fermentation media; Various types of microbial and enzyme reactors; Instrumentation in bioreactors.

Plant and Animal Biotechnology:

Special features and organization of plant cells; Totipotency; Regeneration of plants; Plant products of industrial importance; Biochemistry of major metabolic pathways and products; Autotrophic and heterotrophic growth; Plant growth regulators and elicitors; Cell suspension culture development: methodology, kinetics of growth and production formation, nutrient optimization; Production of secondary metabolites by plant suspension cultures; Hairy root cultures and their cultivation. Techniques in raising transgenics.

Characteristics of animal cells:

Metabolism, regulation and nutritional requirements for mass cultivation of animal cell cultures; Kinetics of cell growth and product formation and effect of shear force; Product and substrate transport; Micro & macro-carrier culture; Hybridoma technology; Live stock improvement; Cloning in animals; Genetic engineering in animal cell culture; Animal cell preservation.

Immunology:

The origin of immunology; Inherent immunity; Humoral and cell mediated immunity; Primary and secondary lymphoid organ; Antigen; B and T cells and Macrophages; Major histocompatibility complex (MHC); Antigen processing and presentation; Synthesis of antibody and secretion; Molecular basis of antibody diversity; Polyclonal and monoclonal antibody; Complement; Antigen-antibody reaction; Regulation of immune response; Immune tolerance; Hyper sensitivity; Autoimmunity; Graft versus host reaction.

Recombinant DNA Technology:

Restriction and modification enzymes; Vectors: plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome; cDNA and genomic DNA library; Gene isolation; Gene cloning; Expression of cloned gene; Transposons and gene targeting; DNA labeling; DNA sequencing; Polymerase chain reactions; DNA fingerprinting; Southern and northern blotting; In-situ hybridization; RAPD; RFLP; Site-directed mutagenesis; Gene transfer technologies; Gene therapy.

Bioinformatics:

Major bioinformatics resources (NCBI, EBI, ExPASy); Sequence and structure databases; Sequence analysis (biomolecular sequence file formats, scoring matrices, sequence alignment, phylogeny); Genomics and Proteomics (Large scale genome sequencing strategies; Comparative genomics; Understanding DNA microarrays and protein arrays); Molecular modeling and simulations (basic concepts including concept of force fields).



SYLLABUS FOR COMPUTER SCIENCE & ENGINEERING

Digital Logic:

Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point).

Computer Organization and Architecture:

Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.

Programming and Data Structures:

Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.

Algorithms:

Analysis, Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes P, NP, NP-hard, NP-complete.

Theory of Computation:

Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability.

Compiler Design:

Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.

Operating System:

Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.

Databases:

ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

Information Systems and Software Engineering:

information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project, design, coding, testing, implementation, maintenance.

Computer Networks:

ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security basic concepts of public key and private key cryptography, digital signature, firewalls.

Web technologies:

HTML, XML, basic concepts of client-server computing.



SYLLABUS FOR ELECTRONICS & COMMUNICATION ENGINEERING

Networks:

Network graphs: matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices. Solution methods: nodal and mesh analysis. Network theorems: superposition, Thevenin and Norton's maximum power transfer, Wye-Delta transformation. Steady state sinusoidal analysis using phasors. Linear constant coefficient differential equations; time domain analysis of simple RLC circuits, Solution of network equations using Laplace transform: frequency domain analysis of RLC circuits. 2-port network parameters: driving point and transfer functions. State equations for networks.

Electronic Devices:

Energy bands in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers. p-n junction diode, Zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, p-I-n and avalanche photo diode, Basics of LASERS. Device technology: integrated circuits fabrication process, oxidation, diffusion, ion implantation, photolithography, n-tub, p-tub and twin-tub CMOS process.

Analog Circuits:

Small Signal Equivalent circuits of diodes, BJTs, MOSFETs and analog CMOS. Simple diode circuits, clipping, clamping, rectifier. Biasing and bias stability of transistor and FET amplifiers. Amplifiers: single and multi-stage, differential and operational, feedback, and power. Frequency response of amplifiers. Simple op-amp circuits. Filters. Sinusoidal oscillators; criterion for oscillation; single-transistor and op-amp configurations. Function generators and wave-shaping circuits, 555 Timers. Power supplies.

Digital circuits:

Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs. Sequential circuits: latches and flip-flops, counters and shift-registers. Sample and hold circuits, ADCs, DACs. Semiconductor memories. Microprocessor(8085): architecture, programming, memory and I/O interfacing.

Signals and Systems:

Definitions and properties of Laplace transform, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT, z-transform. Sampling theorem.

Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems.

Control Systems:

Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID) control. State variable representation and solution of state equation of LTI control systems.

Communications:

Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem. Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM.

Electromagnetics:

Elements of vector calculus: divergence and curl; Gauss' and Stokes' theorems, Maxwell's equations: differential and integral forms. Wave equation, Poynting vector. Plane waves: propagation through various media; reflection and refraction; phase and group velocity; skin depth. Transmission lines: characteristic impedance; impedance transformation; Smith chart; impedance matching; S parameters, pulse excitation. Waveguides: modes in rectangular waveguides; boundary conditions; cut-off frequencies; dispersion relations. Basics of propagation in dielectric waveguide and optical fibers. Basics of Antennas: Dipole antennas; radiation pattern; antenna gain.



SYLLABUS FOR ENVIRONMENTAL SCIENCE

Unit – 1

Environmental Chemistry : Air pollution, sources of air pollutants, CFC's photochemical smog, effect of air pollution on vegetation, animals and human beings, Air pollution control measures carcinogens in the air. Global warming, Green house effect, Ozone depletion and its impact, acid rain. Water pollution – sources, heavy metal pollution noise pollutions, effect of noise pollution, prevention and control of noise pollution. Principles and applications of UV-Visible spectroscopy AAS, FES, IR, Nephelometry, Polargraphy, GC and HPLC.

Unit – 2

Environmental Earth Science : Interior of earth; Earth systems and its interaction. Earth's Materials – Minerals and their definition, Definition of resources and reserve. Earthquakes: causes, intensity and magnitude of earthquakes; geographic distribution of earthquake zones, volcanism: nature, extent and causes of volcanism, geographic distribution of volcanoes. The hydrological cycle, and its balance. Factors influencing the surface water and characteristics of stream flow, sub-surface water.

Unit – 3

Environmental Microbiology : Classification, microbes as bioindicators of pollution, role of microorganisms in environmental pollution and management, microbes of extreme environment. Bioaccumulation and Biomagnification. Advanced techniques in detection of microbes in air, water and soil.

Unit – 4

Environmental Biotechnology – Role of biotechnology in energy production, role of environmental biotechnology in field of prevention, deduction and monitoring and genetic engineering. Application of biotechnology to environmental problems. Biosensors – Types of biosensors. Applications of biosensors. – Composting – types of composting. GMO's Bioremediation, Applications, biofilters, microchips

Unit – 5

Solid waste Management – Sources, characteristics, classification, collection, storage, segregation, transportation and disposal methods – sanitary land filling, waste prevention and recycling, commonly recycling material and processes, recovery of biological conversion products, biogasification, energy recovery, energy and hazardous waste management classification of hazardous waste, characteristics listing criteria, hazardous waste management, hazardous waste management in India, municipals solid waster management roles 2000, biomedical waste management and handling rules 1998, pyrolysis, incineration. Hospital waste – characteristics and Management

Unit – 6

Occupational Health Hazards : Occupational Environment, Physical, Chemical, Biological agent. Occupational Hazards – physical hazards, chemical hazards, Biological hazards. Occupational diseases-Pneumoconiosis-silicosis, Anthracosis, Byssinosis, Bagassosis, Asbestosis, Farmers lung, Lead poisoning, Occupational cancer, Occupational Dermatitis, Radiation hazards.

Unit – 7

Environmental Biology – Ecosystem, Homeostasis, energy flow in a lake ecosystem, Lindemen model – climatic factors, influence of light on morphology and physiology of plants, characteristics of heliophytes and sciophytes, effect of low and high temperature on plants, mechanical and physiological effects of wind, characteristics of populations, biological interaction.

Unit – 8

Remote Sensing GIS and Disaster Management : Principle of Remote Sensing and its applications to Environment, types of sensors spectral reflectance and their characteristics, products used in Remote sensing, GIS and their use for environmental monitoring. Environmental Disaster – Types of Hazards, Hazard mitigation. Earthquake, volcanic, seismic Hazards – nature of destruction, ground subsidence, protection of earthquake and volcanic hazards, Landslides and mudflows floods and flood management, nature and frequency of flooding, man made disaster and Hazards.

Unit – 9

Biodiversity : Genetic diversity, Species diversity and ecosystem diversity, alpha, beta, and gamma diversity, endemism, significance of the endemism, Hot spots of Biodiversity, Red data book and IUCN categories, endangered species, vulnerable species. Rare species. Ecological consequences of reduction in biodiversity. Deforestation and its impact. Causes for depletion of biodiversity in India, Sacred grooves. Biosphere Reserves – A new concept of conservation – objectives and management, In situ and ex situ conservation.

Unit – 10

EIA and Environmental Laws : Framework of Environmental Impact assessment (EIA), simple methods of identification of impacts, matrices network, checklists. Methods of impact analysis,

public participation in Environmental decision making, EIA in project planning. Legal control of Environmental pollution in India with special reference to :

- i. The Wildlife protection Act – 1972
- ii. The Water prevention and control of pollution Act, 1974.
- iii. The Forest Conservation Act, 1980.
- iv. The Air prevention and control of pollution Act, 1981.
- v. The Environment protection Act. 1986.
- vi. Hazardous waste management rules-1989 ix Biological Diversity Act of India, 2002



SYLLABUS FOR EDUCATION

UNIT I: Philosophy of Education Relationship between Education and Philosophy

1. Conceptual analysis in education role of methodology, analysis of the concept of education.
2. Epistemological bases of curriculum logical relationship between objectives, knowledge and methods of teaching.
3. Value education need and different approaches

UNIT II: Sociology of Education

1. Education as a social system.
2. Socialization, culture and personality.
3. Education and social change, democracy and economic order.
4. Education and modernization; role of Educational technology.
5. Education and community with special reference to Indian Society

UNIT III: Educational Psychology

1. Growth and Development Principles, determining factors different dimensions; contributions of Piaget, Bruner, Ericson, Kohlberg, Chomsky.
2. Learning types Concepts and Principles relation to major theories of learning.
3. Major concepts and Principles and factors in group dynamics, motivation, remembering and forgetting as related to learning process

UNIT IV: Intelligence and Personality

1. Theories of intelligence, types of intelligence test; Emotional intelligence, Multiple Intelligence, creativity (Verbal and Non Verbal)
2. Personality and Mental Health Concepts, major theories of personality; Personality assessment; adjustment and mental health.

UNIT V: ICT in Education:

Educational Technology as systems approach to education. Systems approach in educational technology and its characteristics. Components of educational technology, software, hardware Multi media approach in Educational Technology.

1. Modalities of teaching difference between teaching and instruction, conditioning and training.

2. Programmed Instruction (origin, types, linear and branching, development of programmed instruction material linear / branching model, teaching machines, computer assisted instruction).
3. Concept of communication, Principles. Modes and Barriers of communication, Classroom communication (interaction verbal and non verbal).

UNIT VII: Teacher Education:

1. Objectives of Teacher Education at different levels Primary, Secondary and tertiary; Pre Service and in service teacher education (Need and Objectives).
2. Teacher Competencies Communication, organization, instruction and evaluation; National Curriculum Framework for teacher education; recent trends in teacher Education.
3. Issues and Challenges in teacher education Quality assurance in teacher education, recent trends in teacher education.

UNIT VII: Methodology of Educational Research Characteristics of educational research

1. Planning the research study; review of the literature purpose and references, using database and internet; formulation of objectives and hypotheses (different types), variables types and inter relationship, preparation of research proposal.
2. Research Paradigms in education: Quantitative, qualitative and mixed Characteristics and types Quantitative methods experimental (True experimental designs and quasi experimental designs), internal and external validity of results in experimental research; descriptive (survey, casual comparative, correlational programme evaluation) qualitative methods Ethnography, phenomenology, case study, historical research, mixed research strengths and weakness Characteristics of educational research.

UNIT VIII: Sampling and Tools/ Techniques of data collection

1. Sampling : Representative and biased sample; Random sampling techniques simple, systematic, stratified, cluster sampling and multi stage sampling; Non Random Sampling, technique convenience sampling, proportionate sampling, Quota sampling and snow ball sampling; sampling in qualitative research.
2. Tools / Techniques data collection: Characteristic of a good research tool, tests inventories and scales Types construction and Uses, Questionnaire Forms, Principles and Construction Administration of Questionnaires' Interview Types Characteristics and Guidelines for conducting Interviews Observation Types, Rating Scale, Check List, Schedules, Focus group discussion.

UNIT IX: Analysis of data I

1. Data types Nominal, ordinal, interval and ratio data levels individual and group
2. Description and Comparison of Groups Measures of Central Tendency Dispersion, Characteristics and Uses Normal distribution(NPC) characteristics Deviation from normality and underline causes Correlation Types (Spearman, Pearson, Biserial, Pointbiserial, Tetrachoric, partial and multiple) regression analysis

UNIT X Analysis of Data II

Testing of hypotheses; levels of significance, types of error, sampling distribution, sampling error, standard error: parametric test t test, F test, ANOVA , ANCOVA concepts ,assumption and uses Non Parametric tests chi-square, sign test, median test
Analysis of Qualitative data content analysis ,transcription



SYLLABUS FOR ECONOMICS

Module I- Micro Economic Analysis

Demand Analysis Marshallian, Hicksian and Revealed Preference Approaches Consumer Behaviour under Conditions of Uncertainty, Theory of Production and Costs, Pricing and output under different forms of market structure, Collusive and non- Collusive oligopolies, Different models of objectives of the firm Baumol, Morris & Williamson, Cournot, Sweezy, Factory-Pricing, General Equilibrium & Welfare Economics.

Module II- Macroeconomics

Classical approach: Implications Keynesian approach concepts Determinants of Effective Demand Relevance Economic Fluctuations-Hicks & Samuelson Approaches Measures to minimize economic fluctuations Phillips curve-Concepts Trade off Implications- New classical Macroeconomics: Propositions and Policy conclusions of Supply Side Economics and Rational Expectations Analysis Open Economy Macroeconomics concepts Simultaneous Equilibrium Implications.

Module III - Development and Planning

Sustainable Development various measures of economic development Human Development Index capability approach to development Development as freedom- Development management Development ethics- Development Vs Displacement Inclusive growth Gender substituted development Market failure Development planning State & Development State failure Emerging issues of Development Planning.

Module IV- Mathematical and Statistical Methods

Linear and Non-linear functions and their applications - Application of Differential and Integral Calculus in consumer behaviour and production theories Matrix algebra and its application. Measures of Central Tendencies and Dispersion Elementary theory of probability Binominal, Poisson and Normal Distribution Testing of Hypothesis Z, t, X^2 and F test Index numbers Time series.

Module V- Public Economics

Economic Functions of Modern Government Role of Government in Economic Planning and Market Governance Welfare foundations Budget- Types of budget concepts of deficits Reforms in Budgeting Zero Base Budgeting and Performance Budgeting Public Revenue Sources of Revenue Tax Revenue Effects of taxes on production, consumption, work efficiency, Savings Public Expenditure Effects of Public Expenditure on the Economy Evaluation of Public Expenditure: Cost Benefit Analysis Public debt Issues in Management Fiscal Policy Objectives Instruments As an instrument of growth and social justice.

Module VI- International Economics

Foreign trade and Economic Development Two gap model Foreign trade multiplier Heckscher Ohlin theory of International trade Secular Decline in Terms of Trade Prebisch Singer & Myrdal's thesis Balance of payment problem in LDCs , Traditional, Absorption & Monetary approaches to BOP Foreign exchange market & its functions impact of tariff & non-tariff on trade Regional trade Blocks WTO & India.

Module VII- Money, Banking & Finance

Money supply & Money Demand Role, Constituents & Functions of money - capital markets central Bank commercial banks- cooperative banks-Regional Rural banks-Technological developments in banking Mutual funds SEBI & RBI guidelines Insurance sector LIC-GIC-reforms in the Financial sector.

Module VIII- Environmental Economics

Natural Resources Classification Environmental costs Environmental Accounting Valuation of Natural Resources Green GDP Valuation of forests Environmental Economics-Public goods-Market Failure Common Property Resources Market Based Instruments Environmental Impact Assessment Environmental Policy in India- Global warning climate change

Module IX- Emerging Issues in the Indian Economy Poverty and Income Distribution

National Income accounting: Trends and major issues performance of different sectors problems of poverty, unemployment, migration, inflation & environment Economic reforms in India India on the eve of economic reforms-objectives, nature & structures of economic reforms impact of economic reforms India & WTO- India & GATS

Module X- Agricultural Economics

Agriculture and Economic Development Farming systems Theories of Agricultural Development Laws of returns Production Function Cobb-Douglas production function supply behavior of Agriculture- Agricultural Marketing Problems Farm Budgeting-Techniques Agricultural Price Policy Agricultural growth and productivity capital formation sustainable agriculture Green Revolution- Man land ratio-agricultural finance- NABARD WTO and Indian Agriculture.

SYLLABUS FOR ENGLISH

- Unit - I :** History of English Literature from the Age of Chaucer to the Modern Age.
- Unit – II :** English Language Studies.
- Unit – III :** Indian Writing in English.
- Unit – IV :** American Literature.
- Unit – V :** New Literatures in English (Major African, Caribbean, Latin American, Canadian and Australian writers and their works).
- Unit – VI :** Literary Criticism from Aristotle to T.S. Eliot.
- Unit – VII :** Modern Critical Theories.
- Unit – VIII :** Comparative Literature : Concepts and Major Applications.
- Unit – IX :** Translation Studies : Concepts and Major Applications.
- Unit – X :** Cultural Studies : Concepts and Relevance.



SYLLABUS FOR LAW

Unit -1: Jurisprudence Analytical School, Natural Law Theory, Historical School, Sociological Theory of Law – Concept of Person, Rights and Liability.

Unit-2: Judicial Process & Social Transformation Doctrine of Precedent – Ratio decidendi and Obiter dicta – Methods of Determining ratio decidendi – Stare-decisis -Judicial Activism – Concept of Social Transformation- Legal & non-legal factors – Social Justice-Empowerment of Women

Unit-3: Constitutional Law Fundamental Rights Concept of Equality – Freedom – Right to life & Liberty Freedom of Religion, Relation between part III & IV - Right to Constitutional remedies – Act.32 – International Human Rights Law.

Unit-4: Constitutional Law Federalism – Centre – State Relations – Organization of Govt.- Legislature, Executive, Judiciary – Theory of Separation of Powers – Power of amendment, Parliamentary Privileges.

Unit-5: International Law Relationship between International and Municipal Law – Subjects of International Law- State Responsibility – Law of the Sea – International Organizations – Law of Treaties

Unit-6: Research Methodology Concept and Meaning of Research – Reflective thinking – Nature & Objectives of Legal Research – Doctrinal & Non-doctrinal Legal Research – Formulation of Research Problem – Hypothesis – Observation – Questionnaire – Research report – Law Reform and Legal Research.

Unit-7: Human Resource Development Definition of Industry, Workman – Concept of Collective Bargaining – Dispute Settlement Mechanism – Welfare and Safety under Factories Act – Strike, Lockout, Layoff, Retrenchment & Closure

Unit-8: Intellectual Property Rights Economic & legal Justifications for protection of IPR – TRIPs and WIPO – Meaning and subject matter of Copyright – Infringement of copyright-Concept of patent–Ingredients of Innovation – Non-patentability – Procedure for getting patent – compulsory licensing – Definition of Trade mark – Registered Trade mark & Unregistered Trade mark – Passing off action – Concept of Industrial Design.

Unit-9: Environmental Law Concept of Environment – Environmental Law & Polity in India (Water Act, Air Act Environment Protection Act, Wildlife Protection Act) - International Environmental Principles – Conservation of Natural Resources – Common Law and Constitutional remedies

Unit-10: Corporate Law Registration of Companies – Memorandum & Articles of Association – Prospectus- Directors Powers & Functions- Indoor Management & Constructive Notice – Company Meetings – Prevention of oppression & Mismanagement of Companies – Winding up of Companies.



SYLLABUS FOR MANAGEMENT

Unit-I

Managerial Economics-Demand Analysis, Production function, Cost Output Relation Market Structures, Pricing theories, Advertising, Macro-economics, and National Income Concepts Infrastructure Management and Policy Business Environment Capital Budgeting.

Unit-II

The concept and significance of organisational behaviour-kills and roles in an organisation-classical, Neo-classical and modern theories of Organisational Structure-Organisational design understanding and managing individual behaviour Personality Perception Values Attitude Learning Motivation. Understanding and Managing group behaviour, Process-Inter-Personal and Group dynamics Communication-Leadership. Managing Change, Managing Conflicts, and organisational development.

Unit-III

Concepts and perspectives in HRM, HRM in changing environment Human Resource planning-Objectives, Process and Techniques Job analysis-Job Description Selecting human resources Induction, Training and Development Exit policy and implications Performance appraisal and Evaluation Potential assessment Job evaluation Wage determination Industrial Relations and Trade Unions Dispute resolution and Grievance Management Labour Welfare and Social security measures.

Unit-IV

Financial Management-Nature and Scope Valuation concepts and valuation of securities Capital budgeting decisions-Risk analysis Capital structure and Cost of capital Dividend policy-Determinants Long-term and short-term financing instruments Mergers and Acquisitions.

Unit-V

Marketing environment and Environment scanning; Marketing Information Systems and Marketing research; Understanding consumer and industrial markets, Demand Measurement and Forecasting; Market Segmentation-Targeting and positioning Product · decisions, product mix, Product Life Cycle; New product development; Branding and Packaging; Pricing methods and strategies. Promotion decisions-Promotion mix; Advertising; Personal selling; Channel management; Vertical marketing systems; Evaluation and control of marketing effort; Market of services; Customer · Relation Management; Uses of internet as marketing medium-other related issues like branding, market development, Advertising and retailing on the net. New issues in Marketing.

Unit-VI

Role and scope of production management; Facility location; Layout planning and analysis; Production planning and control-production process analysis; Demand forecasting for operations; Determinants of product mix; Production scheduling; Work measurement; Time and motion study; Statistical Quality Control. Role and scope of Operations Research; Linear Programming; Sensitivity analysis; Duality; Transportation model; Inventory control; Queuing theory; · Decision theory; Markov analysis; PERT/CPM.

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SYLLABUS FOR MATHEMATICS

Analysis:

Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation. Metric spaces, compactness, connectedness. Normed Linear Spaces. Spaces of Continuous functions as examples.

Linear Algebra:

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

Complex Analysis:

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

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in \mathbb{Z} , congruences, Chinese Remainder Theorem, Euler's ϕ -function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions.

Ordinary Differential Equations (ODEs):

Existence and Uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of

homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs):

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis :

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

Calculus of Variations:

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

Linear Integral Equations:

Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics:

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

Descriptive statistics, exploratory data analysis.

Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Chebyshev, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case). Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution. Standard discrete and continuous univariate distributions. Sampling distributions. Standard errors and asymptotic distributions, distribution of order statistics and range. Methods of estimation. Properties of estimators. Confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests, Likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference. Gauss-Markov models, estimability of parameters, Best linear unbiased estimators, tests for linear hypotheses and confidence intervals. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression. Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation. Simple

random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods. Completely randomized, randomized blocks and Latin-square designs. Connected, complete and orthogonal block designs, BIBD. 2^k factorial experiments: confounding and construction. Series and parallel systems, hazard function and failure rates, censoring and life testing. Linear programming problem. Simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1



SYLLABUS FOR MICROBIOLOGY

Historical Perspective: Discovery of microbial world; Landmark discoveries relevant to the field of microbiology; Controversy over spontaneous generation; Role of microorganisms in transformation of organic matter and in the causation of diseases.

Methods in Microbiology: Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition; Enrichment culture techniques for isolation of microorganisms; Light-, phase contrast- and electron-microscopy.

Microbial Taxonomy and Diversity: Bacteria, Archea and their broad classification; Eukaryotic microbes: Yeasts, molds and protozoa; Viruses and their classification; Molecular approaches to microbial taxonomy.

Prokaryotic and Eukaryotic Cells: Structure and Function: Prokaryotic Cells: cell walls, cell membranes, mechanisms of solute transport across membranes, Flagella and Pili, Capsules, Cell inclusions like endospores and gas vesicles; Eukaryotic cell organelles: Endoplasmic reticulum, Golgi apparatus, mitochondria and chloroplasts.

Microbial Growth: Definition of growth; Growth curve; Mathematical expression of exponential growth phase; Measurement of growth and growth yields; Synchronous growth; Continuous culture; Effect of environmental factors on growth.

Control of Micro-organisms: Effect of physical and chemical agents; Evaluation of effectiveness of antimicrobial agents.

Microbial Metabolism: Energetics: redox reactions and electron carriers; An overview of metabolism; Glycolysis; Pentose-phosphate pathway; Entner-Doudoroff pathway; Glyoxalate pathway; The citric acid cycle; Fermentation; Aerobic and anaerobic respiration; Chemolithotrophy; Photosynthesis; Calvin cycle; Biosynthetic pathway for fatty acids synthesis; Common regulatory mechanisms in synthesis of amino acids; Regulation of major metabolic pathways.

Microbial Diseases and Host Pathogen Interaction: Normal microbiota; Classification of infectious diseases; Reservoirs of infection; Nosocomial infection; Emerging infectious diseases; Mechanism of microbial pathogenicity; Nonspecific defense of host; Antigens and antibodies; Humoral and cell mediated immunity; Vaccines; Immune deficiency; Human diseases caused by viruses, bacteria, and pathogenic fungi.

Chemotherapy/Antibiotics: General characteristics of antimicrobial drugs; Antibiotics: Classification, mode of action and resistance; Antifungal and antiviral drugs.

Microbial Genetics: Types of mutation; UV and chemical mutagens; Selection of mutants; Ames test for mutagenesis; Bacterial genetic system: transformation, conjugation, transduction, recombination, plasmids, transposons; DNA repair; Regulation of gene expression: repression and induction; Operon model; Bacterial genome with special reference to *E.coli*; Phage λ and its life cycle; RNA phages; RNA viruses; Retroviruses; Basic concept of microbial genomics.

Microbial Ecology: Microbial interactions; Carbon, sulphur and nitrogen cycles; Soil microorganisms associated with vascular plants.



SYLLABUS FOR PHARMACEUTICAL SCIENCES

Natural Products :

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

Pharmacology :

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

Medicinal Chemistry :

Structure, nomenclature, classification, synthesis, SAR and metabolism of the following category of drugs, which are official in Indian Pharmacopoeia and British Pharmacopoeia. Introduction to drug design. Stereochemistry of drug molecules. Hypnotics and Sedatives, Analgesics, NSAIDS, Neuroleptics, Antidepressants, Anxiolytics, Anticonvulsants, Antihistaminics, Local Anaesthetics, Cardio Vascular drugs – Antianginal agents Vasodilators, Adrenergic & Cholinergic drugs, Cardiotonic agents, Diuretics, Anti-hypertensive drugs, Hypoglycemic agents, Antilipidemic agents, Coagulants, Anticoagulants, Antiplatelet agents. Chemotherapeutic agents – Antibiotics, Antibacterials, Sulphadruugs. Antiprotozoal drugs, Antiviral, Antitubercular, Antimalarial, Anticancer, Antiamoebic drugs. Diagnostic agents. Preparation and storage and uses of official Radiopharmaceuticals, Vitamins and Hormones. Eicosanoids and their application.

Pharmaceutics :

Development, manufacturing standards Q.C. limits, labeling, as per the pharmacopoeial requirements. Storage of different dosage forms and new drug delivery systems.

Biopharmaceutics and Pharmacokinetics and their importance in formulation. Formulation and preparation of cosmetics – lipstick, shampoo, creams, nail preparations and dentifrices. Pharmaceutical calculations.

Pharmaceutical Jurisprudence :

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

Pharmaceutical Analysis :

Principles, instrumentation and applications of the following: Absorption spectroscopy (UV, visible & IR). Fluorimetry, Flame photometry, Potentiometry. Conductometry and Polarography. Pharmacopoeial assays. Principles of NMR, ESR, Mass spectroscopy. X-ray diffraction analysis and different chromatographic methods.

Biochemistry :

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

Microbiology :

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

Clinical Pharmacy :

Therapeutic Drug Monitoring Dosage regimen in Pregnancy and Lactation, Pediatrics and Geriatrics. Renal and hepatic impairment. Drug – Drug interactions and Drug – food interactions, Adverse Drug reactions. Medication History, interview and Patient counseling.



SYLLABUS FOR PHYSICS

Mathematical Methods of Physics

Dimensional analysis; Vector algebra and vector calculus; Linear algebra, matrices, Cayley Hamilton theorem, eigenvalue problems; Linear differential equations; Special functions (Hermite, Bessel, Laguerre and Legendre); Fourier series, Fourier and Laplace transforms; Elements of complex analysis: Laurent series-poles, residues and evaluation of integrals; Elementary ideas about tensors; Introductory group theory, $SU(2)$, $O(3)$; Elements of computational techniques: roots of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, solution of first order differential equations using Runge-Kutta method; Finite difference methods; Elementary probability theory, random variables, binomial, Poisson and normal distributions.

Classical Mechanics

Newton's laws; Phase space dynamics, stability analysis; Central-force motion; Two-body collisions, scattering in laboratory and centre-of-mass frames; Rigid body dynamics, moment of inertia tensor, non-inertial frames and pseudoforces; Variational principle, Lagrangian and Hamiltonian formalisms and equations of motion; Poisson brackets and canonical transformations; Symmetry, invariance and conservation laws, cyclic coordinates; Periodic motion, small oscillations and normal modes; Special theory of relativity, Lorentz transformations, relativistic kinematics and mass-energy equivalence.

Electromagnetic Theory

Electrostatics: Gauss' Law and its applications; Laplace and Poisson equations, boundary value problems; Magnetostatics: Biot-Savart law, Ampere's theorem, electromagnetic induction; Maxwell's equations in free space and linear isotropic media; boundary conditions on fields at interfaces; Scalar and vector potentials; Gauge invariance; Electromagnetic waves in free space, dielectrics, and conductors; Reflection and refraction, polarization, Fresnel's Law, interference, coherence, and diffraction; Dispersion relations in plasma; Lorentz invariance of Maxwell's equations; Transmission lines and wave guides; Dynamics of charged particles in static and uniform electromagnetic fields; Radiation from moving charges, dipoles and retarded potentials.

Quantum Mechanics

Wave-particle duality; Wave functions in coordinate and momentum representations; Commutators and Heisenberg's uncertainty principle; Matrix representation; Dirac's bra and ket notation; Schroedinger equation (time-dependent and time-independent); Eigenvalue problems such as particle-in-a-box, harmonic oscillator, etc.; Tunneling through a barrier; Motion in a central potential; Orbital angular momentum, Angular momentum algebra, spin; Addition of angular momenta; Hydrogen atom, spin-orbit coupling, fine structure; Timeindependent perturbation theory and applications; Variational method; WKB approximation; Time dependent perturbation theory and Fermi's Golden Rule; Selection rules; Semi-classical theory of radiation; Elementary theory of scattering, phase shifts, partial waves, Born

approximation; Identical particles, Pauli's exclusion principle, spin-statistics connection; Relativistic quantum mechanics: Klein Gordon and Dirac equations.

Thermodynamic and Statistical Physics

Laws of thermodynamics and their consequences; Thermodynamic potentials, Maxwell relations; Chemical potential, phase equilibria; Phase space, micro- and macrostates; Microcanonical, canonical and grand-canonical ensembles and partition functions; Free Energy and connection with thermodynamic quantities; First- and second-order phase transitions; Classical and quantum statistics, ideal Fermi and Bose gases; Principle of detailed balance; Blackbody radiation and Planck's distribution law; Bose-Einstein condensation; Random walk and Brownian motion; Introduction to nonequilibrium processes; Diffusion equation.

Electronics

Semiconductor device physics, including diodes, junctions, transistors, field effect devices, homo and heterojunction devices, device structure, device characteristics, frequency dependence and applications; Optoelectronic devices, including solar cells, photodetectors, and LEDs; High-frequency devices, including generators and detectors; Operational amplifiers and their applications; Digital techniques and applications (registers, counters, comparators and similar circuits); A/D and D/A converters; Microprocessor and microcontroller basics.

Experimental Techniques and data analysis

Data interpretation and analysis; Precision and accuracy, error analysis, propagation of errors, least squares fitting, linear and nonlinear curve fitting, chi-square test; Transducers (temperature, pressure/vacuum, magnetic field, vibration, optical, and particle detectors), measurement and control; Signal conditioning and recovery, impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding; Fourier transforms; lock-in detector, box-car integrator, modulation techniques. Applications of the above experimental and analytical techniques to typical undergraduate and graduate level laboratory experiments.

Atomic & Molecular Physics

Quantum states of an electron in an atom; Electron spin; Stern-Gerlach experiment; Spectrum of Hydrogen, helium and alkali atoms; Relativistic corrections for energy levels of hydrogen; Hyperfine structure and isotopic shift; width of spectral lines; LS & JJ coupling; Zeeman, Paschen Back & Stark effect; X-ray spectroscopy; Electron spin resonance, Nuclear magnetic resonance, chemical shift; Rotational, vibrational, electronic, and Raman spectra of diatomic molecules; Frank – Condon principle and selection rules; Spontaneous and stimulated emission, Einstein A & B coefficients; Lasers, optical pumping, population inversion, rate equation; Modes of resonators and coherence length.

Condensed Matter Physics

Bravais lattices; Reciprocal lattice, diffraction and the structure factor; Bonding of solids; Elastic properties, phonons, lattice specific heat; Free electron theory and electronic specific heat; Response and relaxation phenomena; Drude model of electrical and thermal conductivity; Hall effect and thermoelectric power; Diamagnetism, paramagnetism, and ferromagnetism; Electron motion in a periodic potential, band theory of metals, insulators and semiconductors; Superconductivity, type – I and type - II superconductors, Josephson junctions; Defects and dislocations; Ordered phases of matter, translational and orientational order, kinds of liquid crystalline order; Conducting polymers; Quasicrystals.

Nuclear and Particle Physics

Basic nuclear properties: size, shape, charge distribution, spin and parity; Binding energy, semi-empirical mass formula; Liquid drop model; Fission and fusion; Nature of the nuclear force, form of nucleon-nucleon potential; Charge-independence and charge-symmetry of nuclear forces; Isospin; Deuteron



SYLLABUS FOR STATISTICS

Probability Distribution: Discrete and Continuous Probability Distributions,

Correlation & Regression: Partial and Multiple correlation, Multiple Regression

Sampling Techniques: Various sampling techniques (SRSWR, SRSWOR, Stratified, Systematic, Cluster, Multistage etc).

Estimators: Ratio and Regression estimators, Horvitz and Thomson estimator, Desraj, Murthy estimators.

Inference: Point Estimation, Characteristics of good estimators, Concept of completeness and sufficiency, MVUE, MLE and method of moment, Testing of hypothesis, Interval estimation, Non – parametric Tests.

Consistent Asymptotic Normal (CAN) Estimator, MLE in Pitman family, Likelihood Ratio Test (LRT), Bartlett's test for homogeneity of variance, Large sample test and Confidence interval based on CAN

Stochastic process : Markov chain, Poisson Process, Branching process , Auto –correlation:

Multivariate Analysis: Multivariate normal distribution, Hotelling T_2 , Multiple correlation and Multiple Regression, Classification and Discriminant analysis.

Linear model and Design of Expts: ANOVA, CRD, RBD, LSD, Analysis of Co-variance, Factorial Experiments, Confounding, BIBD, PBIBD

Regression analysis: Linear and non linear Regression, Robust and L-1 regression, Generalized linear model, Multicollinearity, Ridge regression, Principle component analysis

Operations Research : L.P.P., Transportation & Assignment problem, Non –linear programming problem, Quadratic programming problem, Inventory management, Sequencing and Scheduling, Game theory , Replacement models, PERT & CPM, Queuing models.

Industrial Statistics: Control charts for attribute and variables, Cusum Charts, Acceptance Sampling plans, Methods of forecasting, Reliability theory , Coherent system, Minimal path and cut sets, Concepts and types of risks models of life insurance.



SYLLABUS FOR GENERAL APTITUDE

The General Aptitude Test for admission shall comprise of 50 questions to be answered in 60 minutes. Questions will be of objective type with multiple choices out of which only one is correct. A candidate must select only the correct answer to score full marks. For each correct answer a candidate will earn 02 marks. There will be no negative marking. If a question has not been attempted no credit will be given. The questions will be distributed into various areas as follows and the detailed syllabus is given below:

Subject	No of Questions
Quantitative Aptitude	20
Analytical Ability and Logical Reasoning	10
Test of English	10
General Awareness	10
Total	50

Quantitative Aptitude (20 questions – objective type)

Number System, Percentage, Profit & Loss, Ratio, Proportion, Time, Speed & Distance, Interest and Average, Mensuration, Geometry, Algebra, Permutation, Combination and Probability. Data Interpretation, Bar Graphs, Tables, Calculations Based Table, Logic Based Table, Logic Based Caselet, Data Sufficiency and Analytical Reasoning, Basic statistical tools, standard deviation, correlation coefficient, regression, etc.

Analytical Ability and Logical Reasoning: (10 questions – objective type)

This section will test the logical reasoning and visio-spatial reasoning abilities of the candidate.

Test of English: (10 questions – objective type)

This section will test the basic understanding of the English language.

General Awareness: (10 questions – objective type)

This section will test the general awareness of the candidate and may include Current Affairs, Politics, History and Mythology, Philosophy, Fiction / Non Fiction, Art and Culture, Famous Personalities etc.

problem; Evidence of shell structure, single- particle shell model, its validity and limitations; Rotational spectra; Elementary ideas of alpha, beta and gamma decays and their selection rules; Nuclear reactions, reaction mechanisms, compound nuclei and direct reactions; Classification of fundamental forces; Elementary particles (quarks, baryons, mesons, leptons); Spin and parity assignments, isospin, strangeness; Gell-Mann- Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic kinematics.