YBN UNIVERSITY

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SCHOOL OF SCIENCE EXAMINATION
&
DETAILED SYLLABUS
OF SCIENCE

Pre-Ph.D. Course Work
2020

RAJAULATU, NAMKUM, RANCHI, JHARKHAND

Subject	Paper	Paper Code
Research Methodology (Common To All)	Paper-I	1Y1REM101

Unit – I : Introduction & Research Design:-

Nature and objectives of research, Methods of Research: historical, descriptive and experimental. Research process, research approaches, criteria for good research. Meaning of research design, need of research design, features of good design, different research designs and basic principles of experimental designs.

Unit – II: Data Collection & Analysis:-

Types of data, methods and techniques of data collection, primary and secondary data analysis. Historical methods, content analysis, devices used in data collection. Pilot study and pretest of tools, choice of data collection methods

Unit – III: Methods of Data Analysis:

Analysis of qualitative data based on various tools, Analysis of quantitative data and it presentation with tables, graphs etc.

Unit – IV: Research and Publication Ethics:

Introduction to philosophy: definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, nature of moral judgments and reactions Basic concept of Hypothesis, Formation of Hypothesis, Synopsis writing, Paper / thesis writing and report generation, writing Research Abstract, Introduction to review of literature. Result, Conclusion, Concepts of Bibliography and References. Significance of report writing, steps of report writing, Types of Research reports. Research Philosophy and Ethics, Publication Ethics.

Reference Books:-

Kothari C.R. Research Methodology (Methods and Techniques) New age publisher.

Donald R. Cooper. Pamela S. Schindler, Business Research Methods. Tata McGraw-Hill Co. Ltd.

Bandat and Picrsol, Random data Analysis and Measurement Procedures. Wiley interscience.

Raymond Greenlaw, Inline/Online Fundamentals of the Internet and the World Wide Web, Tata McGraw-Hill Co. Ltd

John W. Creswell. Research Design, SAGE publications, INC.

Trivedi R N & Shukla D.P., Research Methodology, College book depo. .Jaipur.

Subject	Paper	Paper Code
Computer Application (Common To All)	Paper-II	1Y1COA102

Unit – I

Basic knowledge of computer

Unit – II

Application of Computer in research.

Unit – III

Use of technology and other equipments in research

Unit – IV

Data analysis and software and analysis techniques: Use of multimedia tools, Generating charts / graphs in Microsoft excel, power point representation, web search, introduction to internet, use of internet and www. Using search engine like Google, Yahoo, etc. Introduction to UGC infonet, INFLIBNET and ERNET etc.

Reference Books:-

Sanders, D.H., Computer Today, NY: McGraw Hill, 1981

Sinha, P.K., Computer Fundamentals, New Delhi: BPB Publications, 1992

Cox, J. And Urban, P. "Quick Course in Microsoft Office. Galgotia Publications, New Delhi,1990.

Jain, Satish: "Introduction to Computer Science and basic Programming." BPB Publications, New Delhi, 1990.

Rajaraman, V., "Fundamental of Computers", Prentice Hall of India, New Delhi, 1996.

Saxena, S., "A First Coursein Computers", Vikas Publishing House Pvt. Ltd., New Delhi, 1998

Subject	Paper	Paper Code
Biochemistry	Elective Paper –I	1Y1BCY201

Unit - I

Microbial taxonomy: Approaches for identification up to species level (Principles and methods) Advances in protein techniques (purification and characteristics)Molecular diagnostic techniques for genetic disorders

Unit - II

Bioremediation: Microbial and phytoremediation. Effluent analysis: Sample collection, storage, physico-chemical and biological methods of analysis. Industrial enzymes: Amylase, protease, laccase, lipases.

Unit - III

Nanobiotechnology: Concept and applications Secondary metabolites: Natural products, isolation, purification, characterization and applications (alkaloid, tannins, flavonoids) Nutraceuticals: Concept, types, sources, production and application.

Subject	Paper	Paper Code
Biochemistry	Elective Paper –II	1Y1BCY202

Unit – I

Plant transformation methods including tissue culture, non-tissue culture based, Agrobacterium mediated co-cultivation, plant vectors, particle bombardment. Proteomics including recognition, sequencing, identification, differential analysis, identity, fading etc. Plant pathogens/ microbe/ insect interactions, plant defense proteins such as AI, PI, lectins, defensins, abiotic stress tolerance in plants.

Unit – II

Biotransformation reactions. Signal transduction: Nerve cell structure, Synaptic transmission at nerve muscle and central synapse, secondary messengers mediated synaptic transmission. Bioinformatics and database (protein and nucleotide) Fermentation technology and downstream processing

Subject	Paper	Paper Code
Biotechnology	Elective Paper –I	1Y1BTY201

Unit- I

pH, Buffers, Henderson-Hasselbalch equation, pH electrode Solutions, Methods of expressing concentration of solution. Methods to quantify proteins and nucleic acids. Spectrophotometry and spectroflurometry. Centrifugation in Biochemical research, relative centrifugal force, differential centrifugation, density gradient centrifugation, low speed, high speed, refrigerated and ultracentrifuge. Microscope, Numerical aperture, mangnification, bright field microscope, phase contrast, fluorescence, confocal, interference and polarization microscopes. Electron microscopes and specimen preparation, Radioactive isotopes in biological research, units of radioactivity, half life period, labelling, detection and measurement of radioactivity, Radioisotopes and safety.

Unit - II

Isolation and purification of biomolecules – lipids, proteins and nucleic acids Iodine value and saponification value, Solvent extraction, Precipitation of proteins, salt and organic solvents for protein precipitation, dialysis, thin layer chromatography, gel filtration, ion exchange chromatography, affinity chromatography, high performance liquid chromatography, gas liquid chromatography,polyacrylamide gel electrophoresis-native and SDS Isoelectric focusing, ELISA,DNA,RNA and plasmid isolation, agarose electrophoresis, competent cell preparation and transformation, restriction digestion, ligation and expression PCR techniques. Sequencing of DNA and aminoacid, Molecular markers RFLP,RAPD,AFLP,SCAR,SNP, Structural analysis of biomolecules, spectroscopical analysisGC,GC/MS,LC/MS,FT IR,NMR,X ray crystallography.

Subject	Paper	Paper Code
Biotechnology	Elective Paper –II	1Y1BTY202

Unit- I

Microbial staining techniques – simple staining and differential staining – bacterial culturemedia and methods. Sterilization techniques in microbiology – antibiotic sensitivity tests – diffusion and dilution techniques. Cultivation of fungi – cultivation of viruses. Molecular typing and phylogenetic analyses; Immunological techniques. Testing for the evaluation of immunomodulatory effects; Agglutination, precipitation. Western Blotting. Radio Immuno Assay, Immunofluorescence.

Unit - II

Environmental Analyses; soil and water sampling techniques – soil chemical analyses extraction of metals – microwave digestion-soil biological studies – soil microbiological studies – AM fungi and spore counts – water sampling – water chemical analyses – aquatic biological techniques – quadrat studies for terrestrial communities – culture of AM fungi – Algal culture. Plant anatomical, morphological techniques – taxonomic techniques – chemotaxonomy and numerical taxonomy – molecular characterization in the identification of new organisms.

Unit -III

Plant and animal tissue culture techniques, sterilization of explants, preparation of culture media-development of different protocols-inoculation culture maintenance-disinfestations of culture rooms Techniques in plant transformations. Animal physiology haematological analyses – respiratory testing – bioelectricity recording histological techniques. Free radical biology, In vitro study of anti exidants – free radical scavenging super oxide scavenging, nitric oxide scavenging, peroxide scavenging, antifungal and anti-microbial leprotic activities. Toxicity – systemic, local, ANS,CVS, anti diuretic anti cancer, analgesic anti inflammatory, anti asthmatic, immune stimulant, immune suppressor activities. Plant derived medicines – general methods of isolation, purification, identification and estimation of phytoconstituents.

Subject	Paper	Paper Code
Botany	Elective Paper –I	1Y1BOT201

Unit – I : Principles of Plant Biological and Physical Chemistry

Buffers, pH, pH electrodes, Solutions and methods of expression of concentration of solutions. Henderson- Hasselbalch equation and Iso-electric point of enzymes and proteins. Enzymes- Different types of enzymes- enzyme regulation, enzyme catalysis, isolation, purifications and storage of enzymes. Water relations, Osmosis and membrane transport principles in plants. Photosynthesis and photo-bioreactors. Allelopathy, Phyto allexins and quorum sensing in plants. Types of induced plant regulations- Vernalization, flower induction, fruit modifications and fruit ripening. Plant derived medicines- general methods of isolation, purification, identification and estimation of phyto-constituents.

Unit – II : Analytical and Botanical Separation Techniques

Plant secondary metabolites, analysis, isolation and purifications. Plant Lipids, proteins, amino acids, nucleic acids and pigments. Separation of Biomolecules and secondary metabolites by cold and heat methods, precipitation, salting out, dialysis and by using organic solvents. Separation by Chromatographic techniques- Paper, TLC, Column, Gel filtration, affinity, ion exchange, HPLC, HPTLC, Gas chromatography, Gas Liquid Chromatography, GCMS, LCMS, LC-TOF-MS (Liquid chromatography time-of-flight mass spectrometry). Separation by centrifugation methods- Differential centrifugation, relative centrifugation forces, density gradient centrifugation, low speed and high speed cooling ultracentrifuges. Structural elucidation, quantitative and qualitative analysis of Biomolecules by light and UV-spectroscopic analysis, BOMB Calorimeter, FTIR, ATR, AAS, ICPMS, EDS, NMR, X-Ray crystallography, Multi plate reader, ELIZA reader, Amino acid analyzer and Flow cytometry. Analysis and isolation of Biomolecules by electrophoresis techniques- Agarose, AGE, 2D gel electrophoresis, 3D gel electrophoresis, SDS and native PAGE. Lyophilization of samples.

Unit – III : Molecular and Microscopic Techniques

Plant DNA and RNA isolations, mitochondrial and chloroplast genome isolations, competent cell preparations, transformations, restriction digestion, ligation and expression of plant gens. PCR techniques and types, sequencing of DNA, RNA and amino acids. Molecular markers-Plant based molecular markers, RFLP, RAPD, AFLP, SCAR, SNP and SSR. Blotting techniques- Western, southern and Northern blotting. Microscopy- Microscopes, Numerical aperture, magnifications, bright field microscopy, Phase contrast, fluorescence, confocal, interference and polarization microscopes. Electron microscopes and specimen preparations. Microscopic specimens, plant anatomical specimen preparations by microtome techniques-taxonomictechniques- chemotaxonomy, numerical taxonomy, molecular taxonomy and DNA bar-coding. Molecular characterization and identification of new organisms.

Subject	Paper	Paper Code
Botany	Elective Paper –II	1Y1BOT202

Unit - I: Environmental Analysis

Soil and water sampling techniques- Soil chemical analysis- Extraction of metals, phyto remediation techniques- Microwave digestion- soil microbiological studies- Endophytic fungi, AM fungi types, plant relationship of AM fungi and spore counting. Multi parameter analysis of water samples. Water chemical analysis- Aquatic biological techniques. Environmental radioactivity analysis, radioisotopes, radio labeling of samples, detection methods, half life periods and safety guidelines. GIs and remote sensing application in plant diversity.

Unit - II: Microbial, Plant and Animal Tissue Culture Techniques

Plant and soil microbes interactions, isolation of microorganism from the soil, water and environment. Identification of organism by staining techniques and phylogenic analysis, Cultivation of soil microorganisms, AM fungi, Edible mushrooms and algae. Storage and transportation of samples for experiments, Safety guidelines and ethics. Aseptic culture and sterilization techniques. Antibiotic, antifungal and anti bacterial tests of plant samples. Diffusion and dilution techniques. Immunological tests: Agglutination and precipitation reactions, immunomodulatory and suppressive effects, radio immunoassay and immunofluorescence. Plant tissue culture techniques: culture units, green house technology, aseptic conditions and culture media. Different types of plant tissue culture methods- protoplasm culture, embryo, leaf, anther and root culture methods. Plant transformations and identifications. Animal cell culture techniques: Culture conditions, sterilizations, media types and cultivation protocols. Histological techniques: nitric oxide scavenging assay, in vitro study of antioxidants, free radical scavenging, super oxide scavenging, peroxide scavenging assays. Transgenic animals and CPCSEA guidelines.

Subject	Paper	Paper Code
Chemistry	Elective Paper –I	1Y1CHE201

Unit - I

Estimation of elements such C, N, and Halogens. Determination of empirical formula. Determination of Molecular Weight. Water and soil analysis. Standard methods of testing – Total solids, Total Dissolved solids, Suspended Solids, Alkalinity, Acidity, Hardness, Chlorides, Sulphate, D.O. B.O.D., C.O.D., T.K.N., Phosphates.

Unit - II

Purification of compounds and solvents. Organic synthesis, Inorganic synthesis, Various types of laboratory techniques for laboratory synthesis. Solvents used in laboratory. Errors-types of errors in measurements and their minimization, Precision & Accuracy, Modes of expressing accuracy, modes of expressing precision,

Unit - III

Reaction mechanisms, types of mechanisms, methods of determining mechanisms- Identification of products, determination of the presence of intermediates, Isotopic labeling, Kinetic evidence. Activation energy & its significance, Kinetics of fast and slow reactions, Macromolecules, types of macromolecules, determination of molar masses of macromolecules- osmotic pressure method, viscosity method and Sedimentation method.

Subject	Paper	Paper Code
Chemistry	Elective Paper –II	1Y1CHE202

Unit - I

Electron spin Resonance Spectroscopy- theory, instrumentation and applications. Use of micro-computers in research, Hardware and software consideration, Microcomputer languages. Presentation of data using graphs and charts- area, bar, column, line and pie diagram

Unit - II

Mossbauer spectroscopy- Principle, instrumentation and applications of Mossbauer spectroscopy. NDMR and INDOR spectroscopy – principles and applications, NQR spectroscopy, Polarography, Conductivity measurements, Nanomaterials and their uses. Conducting polymers.

Subject	Paper	Paper Code
Computer Science Engg.	Elective Paper –I	1Y1CSE201

Unit- I

Brief history of computers, generation of computers, application of computers in research.

Unit- II

Introduction of hardware & software of computers, operating systems and types of operating systems, Hierarchy of system engineering, Elements of Analysis modeling, Design Concepts and Principles, Software Testing Techniques & Stragies, Software Technical Metrics

Unit- III

Data processing tools & techniques, Security issue of computers, use of later. Basic objectives of cryptography, Image Encryption, Network Security

Subject	Paper	Paper Code
Computer Science Engg.	Elective Paper –II	1Y1CSE202

Unit - I

Use of MATLAB analysis, Introduction DBMS Concept , Query Processing and Optimization, Query Processing and Optimization, Concept of Object Oriented Database ORDBMS Query Language.

Unit - II

Introduction of soft computing, Unsupervised learning in Neural Network neural network based optimization, optimization of fuzzy system. Fundamental of genetic algorithm, Introduction to evolutionary algorithms.

Subject	Paper	Paper Code
Computer Science	Elective Paper –I	1Y1COS201

Unit - I

Software Product and Process Characteristics, Software Process Models: Linear Sequential Model, Prototyping Model, RAD Model, Evolutionary Process Models like Incremental Model, Spiral Model, Component Assembly Model, RUP and Agile processes. Software Process customization and improvement, CMM, Product and Process Metrics

Unit - II

Computer Network: Definitions, goals, components, structure, Architecture, Classifications & types, Growth, Complexity and applications etc. Layered Architecture: Protocol hierarchy, Connection Oriented & Connectionless Services, Service permative Design issues & its functionality. ISO-OSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP

Unit - III

Introduction: Basic Terminology, Data types and its classification, Algorithm complexity notations like big Oh,Array Definition, Representation and Analysis of Arrays, Single and Multidimensional Arrays, Address calculation, Array as Parameters, Ordered List and operations,Sparse Matrices, Storage pools, Garbage collection. Recursiondefinition and processes, simulating recursion, Backtracking, Recursive algorithms, Tail recursion, Removal of recursion

Subject	Paper	Paper Code
Computer Science	Elective Paper –II	1Y1COS202

Unit - I

Automata: Basic machine, FSM , Transition graph, Transition matrix, Deterministic and nondeterministic FSM'S, Equivalence of DFA and NDFA, Mealy & Moore machines, minimization of finite automata, Two-way finite automata.

Unit - II

Use of MATLAB analysis, SPSS, GRETL in research .Introduction to evolutionary algorithms, fundamental of genetic algorithm, simulated annealing, neural network based optimization, optimization of fuzzy system.

Subject	Paper	Paper Code
Mathematics	Elective Paper –I	1Y1MAT201

Unit - I: Complex Manifolds:-

Almost complex Manifolds, Nijenhuis Tensor, Eigen Values of an Almost Complex Structure, Existence Theorem and Integrability Condition of an Almost Complex Structure, Complex Manifolds, Almost Hermitian Manifolds, Some well-known classes of almost Hermitian Manifolds (Almost Kaehler Manifolds, Kaehler Manifolds, Nearly Kaehler Manifolds, Para-Kaehler Manifolds) and their Curvature Properties.

Unit - II: Cosmology:-

Heuristic Derivation of Einstein's Field Equations, Newtonian Approximation of Einstein's field Equations. Schwarzschild External Solution, Energy Momentum Tensor of Perfect Fluid, Schwarzschild Internal Solution, Friedmann-Robertson-Walker Cosmological Models with Cosmological Constant ; de-Sitter Model, Lemaitre Model, Eddington-Lemaitre Model. Exact Solution Connecting Radiation and Matter Dominated Eras of the FRW Models.

Subject	Paper	Paper Code
Mathematics	Elective Paper –II	1Y1MAT202

Unit - I: Special Functions:-

Gamma, Beta and Related Functions. Gaussian, Confluent and Generalized Hypergeometric Functions, The E-, G-, H-Function of One, Two and Severable Variables with their Properties, Special Cases and Derivatives, Hypergeometric Function of Two Several Variables, Classical and Other Orthogonal Polynomials with their Generalizations, Generating Functions, Some Useful Lemmas.

Unit - II: Fixed Point Theory:-

Definition and Examples of Fixed point and Common Fixed point, Contraction Mapping, Contractive Mapping, Non-Expansive Mapping, Lipschitz Mapping, Relation between these Mappings and Continuous Mapping, Banach Contraction Principle and its Generalizations, Fixed point Theorem of Brouwer and Schaunder, Fixed point theorem for Multifunctions.

Subject	Paper	Paper Code
Microbiology	Elective Paper –I	1Y1MBY201

General Microbiology: History of Microbiology, Microbial Evolution, Classification of Microorganisms, Bergey's Manual of Systematic Bacteriology, Cell. Architecture of microorganisms, Growth of microorganism, Microbial Diversity.

Environmental Microbiology: Concept of Habitat and Ecosystem, Flow of energy and Biogeochemical cycles, Microbial Interactions, Biological Nitrogen fixation, Aeromicrobiology, Soil microbiology and Aquatic microbiology.

Food and Industrial Microbiology: Food as a Substrate for Microorganism, Importance and use of microbes in Food and Beverage production, Food Spoilage and Food Borne Infections, Principles and methods of Food Preservation, Oriental food and mushrroom cultivation.

Microbial Genetics and Molecular Biology: Structure and functions of nuclic acids, Superhelicity in DNA, DNA Replication, Genetic code, Transcription,Translation, Regulation of Gene Expression, Mutations, Transposable elements, Various repair system for DNA, Transformation, Cojugation and Transduction in bacteria, Bacterial Plasmids.

Cell Biology: Cell Division and Chromosome Seggregation, Relationship between DNA replication and cell cycle, Protein trafficking, Signal transduction and Apoptosis.

Biochemistry and Microbial Physiology : Chemistry and Metabolism of Protein, Carbohydrates, and Lipids, Photosynthesis, Vitamins and their role as coenzymes, Respiratory Metabolism, Chemoautotropby, Bioenergetics, Enzyme.

Subject	Paper	Paper Code
Microbiology	Elective Paper –II	1Y1MBY202

Bacteria: Cyanobacteria and Prochlorophytes, Mycoplasma and Planctom:ces, Archaea, ~hotosynt~etic Eubacteria, Chemolithothrophs and Methoph!les, Gram-neg.ative Aerobic_ Eubacteria, Enteric Group and Related Eubactena, G_ram-negative Anaerobic Eubacteria, Spirochetes, Rickettsiasand CPJamy?ias, Gram-positive Endospore Forming Bacteria Gram-positive, Nonsporulatmg Eubacteria, Actinomycetes.

Fungi: Significance of Fungi to Human Welfare, Somatic structure, growth and Reproduction, Parasexual cycle, Classification of Fungi, General structure, Life cycle of typical members of Chytridiomvcota,. Ascomycota, Deuteromycota, Basidiomycota, Hypochytndiomycota, General Account o f Slime Moulds.

Immunology: Cells and tissues of immune system, Adaptive and Innate immunity, Soluble mediators of immunity, Immune response, Inflammation, Vaccination, Antigens, Antigen processing and presentation, Immunoglobulins, Antigen-antibody interaction, Major Histocompatibility Complex, T-cell -and B-cells, Cell Mediated Cytotoxicity, Immunological Tolerance, Autoimmunity, Hypersentive Reactions, Tumour Immunology, Transplantation Immunology.

Medical Microbiology: Mechanism of Pathogenesis, Clinical Microbiology, Serological Techniques, Skin and Respiratory System Infections, Alimentary and Urinogenital System Infection, Nervous System; Blood, Wound and Lymphatic System Infection.

Fermentation Technology: Isolation, preservation and improvement of Industrial strains, Media for industrial fermentation and development of inoculum, Microbial growth kinetics, Design and types of ferrnentaor, Control of Fermentation, Downstream processing, Industrial production of SCP, Baker's yeast, Enzymes , Organic acids,Polysaccarides, Alcoholic beveragesand Antibiotics.

Recombinant DNA Technology : Restriction enzymes, Recombination of DNA fragments, Vectors, Cloning Strategies, Shotgun cloning, cDNA cloning, DNA sequensing, Gene libraries, DNA, Genomic libraries DNAmicroarray, Direct DNA Transfer, Application of recombinant DNA technology in plants, animals and bacterial cell, medicine etc. Biotechniques and Instrumentation Microscopy, Spectroscopy, Chromatography, Centrifugation, Electrophoresis, Nanotechnology, Immunological Techniques, Immunofluorescence I mmuno.assay (ELISA), Immunoblotting , Isolation of pure antibodies, Monoclonal antibody production, PCR, Electrophoresis (DNA, Proteins) DNA, RNA & Protein blottmg

Subject	Paper	Paper Code
Physics	Elective Paper –I	1Y1PHY201

Unit - I

X-ray diffraction methods, Free electron theory in 3 dimensions, Fermi-Dirac distribution, Electrical conductivity and ohms law, Motion in magnetic fields-Hall effect, origin of energy gap, Kronig-Penny model, effective masses of electrons and holes in semiconductors, intrinsic carrier concentration, mobility, impurity conductivity, thermal ionization of donor and acceptor, Excitons: Frenkel and Mott-Wannier excitons, diamagnetism, paramagnetism, quantum theory or paramagnetism, Ferromagnetism: Ferromagnetic order-Curie point and exchange integral - spin waves - Ferromagnetic domains - coercivity and hysteresis, Ferroelectricity) single domain particles: blocking temperature – superparamagnetism

Unit - II

Optical processes in semiconductors-Electron-hole pair formation and recombination-radiative and no radiative recombination-band to band recombination, Absorption in semiconductors, indirect intrinsic transitions-exciton absorption, donor-acceptor and impurity-band absorption, low energy absorption, stokes shift in optical transitions of semiconductors, Near bandgap radiative transitions- Exciton recombination - Band to band recombination - donor acceptor and impurity band transitions, deep level transitions Nonlinear optics- second order and third order nonlinear phenomena, propagation of electromagnetic wave through nonlinear media, second harmonic generation, optical parametric oscillator and four wave mixing. Two photon absorption, Stimulated Raman Scattering, Coherent anti-Stokes Raman scattering,

Subject	Paper	Paper Code
Physics	Elective Paper –II	1Y1PHY202

Unit - I

Nuclear Physics: Particle Physics: The quark model - Colored quarks and gluons – Reaction and decays in the quark model – Charm beauty and truth, quark dynamics, Grand unified theories.

Astrophysics: Cosmology, redshift and the expansion of the universe, Matter density in the universe and the deceleration parameter, The perfect cosmological principle, Fundamental equations of cosmology, Some important models of the universe – The static model of Einstein – The Lemaitre Universe- The Friedmann model – The Steady state Universe – The Scalar-tensor theory, Observation tests of cosmological models.

Unit - II

Classical Mechanics:- Relativistic field theories- examples of relativistic field theories, Noether's Theorem

Statistical Mechanics:- The Boltzmann Transport Equation –H Theorem

Quantum Field Theory - Klein-Gordon Equation – K-G interpretation of negative energies, Dirac Equation- conserved current- interpretation of negative energy)

Electrodynamics:- Structure of space time, space-time diagrams, Relativistic Electrodynamics-Magnetism as a relativistic phenomenon, How the field transforms, electromagnetic field tensor.

Subject	Paper	Paper Code
Zoology	Elective Paper –I	1Y1ZOO201

Unit – I: Biodiversity & Taxonomic Studies

Biodiversity, genetic diversity, molecular diversity and taxonomy, DNA bar-coding, Conservation of diversity and endangered species. Collection, Preservation and Identification of Animals. Modern tools of Taxonomy (alpha beta and gamma level taxonomy), Application of molecular and computational tools for Phylogenic and Taxonomic studies

Unit – II: Field studies and EIA

Assessment of biodiversity in different types of ecosystems, sampling techniques and quantitative methods for biodiversity assessment. Environmental Impact Assessment (EIA): Definition, concepts & characteristics of EIA; participants, stages & types of EIA. Guidelines for EIA in India. Environmental Impact Statement (EIS) & Environmental Management Plan (EMP). Methods of impact identification

Unit – III: Biosafety and Ethics

Guidelines for Bio-safety, functioning of Institutional Biosafety committee, Institutional Animal ethics committee, and Institutional ethical committee , CPCSEA guidelines for animal experimentation , ICMR guidelines for experiments involving animals and humans, DBT guidelines for Biosafety practices to be followed

Subject	Paper	Paper Code
Zoology	Elective Paper –II	1Y1ZOO202

Unit – I: Tools and techniques

Principles and applications- Biochemical and Biophysical techniques-Techniques used for purification and characterization of biomolecules: Principles and applications of Centrifugation, Ultrafilteration, Chromatography - GC and HPLC, Electrophoresis, Blotting techniques- Southern, Northern and Western blotting, Spectrophotometry, X-ray crystallography. Microscopic techniques- Specimen preparation for TEM, SEM, shadow casting, freeze fracturing, freeze etching, negative staining, Principles and applications of Electron Microscopy-SEM, TEM, STEM, Fluorescence microscopy, Confocal microscopy, Microphotography

Unit – II: Histology and Histochemistry

Fixation and sectioning of tissue, embryos and cells. Microtomy, Cryotomy, Principles and applications of Immunohistochemistry and Immunoflurosecence, Histochemical staining for characterization of cell type and localization of enzymes, Lipids, Protein and Carbohydrates. Cell biology, Molecular biology, Genetic engineering techniques: Principles and applications of PCR and ELISA, Fluorescence insitu Hybridization (FISH), DNA microarray, DNA sequencing, Protein Microarray, Protein sequencing, Micronucleus test, Comet assay, Caspase assay and Live /dead cell viability assay method.

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