



UNIVERSITY OF GOUR BANGA, MALDA

Syllabus of M.Phil/Ph.D Entrance Examination in Zoology, 2018

Gross Description of Theoretical Papers and Allotted Marks

Paper	Name of the paper	Marks distribution
Paper I	Research Methodology	50
Paper II	Aptitude in Zoology	50
		Grand total = 100

PAPER – I: RESEARCH METHODOLOGY

[50]

UNIT 1: INTRODUCTION TO RESEARCH METHODOLOGY

Meaning of research, objectives of research, Types of research, Research approaches, Significance of research, Research methods versus methodology, Research and scientific method, Research process, Criteria of good research.

UNIT 2: RESEARCH DESIGN AND METHODS

Meaning of research design, Need for research design, Features of a good design, Important concepts relating to research design, Different research designs, Historical method, Descriptive method, Experimental method, Field study method, Case study method and statistical method.

UNIT 3: SCIENTIFIC WRITING

Preparation of manuscript for publication of research paper, Presenting a paper in scientific seminar, Thesis writing. Structure and components of research report, Types of Report: Research papers, Thesis, Research project reports, Pictures and graphs, Citation styles, Indexing of the journal, Writing a review paper, Bibliography, Journal impact factor, Concept of ISSN and ISBN.

UNIT 4: RESEARCH ETHICS

Ethical Issues, Ethical Committees, Intellectual Property Rights (IPR) and patent law, Reproduction of published material, Plagiarism: Steps to be taken to avoid plagiarism, Plagiarism detection softwares, Citation and acknowledgement, Reproducibility and accountability.

PAPER – II: APTITUDE IN ZOOLOGY

[50]

NON- CHORDATE STRUCTURE AND FUNCTION

1.**Non-chordate**: Diversity of form; 2.**Feeding, digestion, nutrition and metabolism**: Patterns of feeding and digestion in parasitic protozoans and lower metazoans; Comparative accounts: helminths, arthropods, molluscs and echinoderms; 3. **Respiration and circulation**: Comparative accounts of structures in non-chordates; Respiratory pigments; Mechanism of respiration: Arthropoda and Mollusca, Haemolymph and its significance; pulsatory mechanism; 4.**Excretion**: Comparative accounts of structures in non-chordates, Excretory mechanism: Annelida, Arthropoda, Osmoregulation in non-chordates; 5.**Nervous system and sense organs** :Evolution of nervous system and sense organs in non-chordates,; Organization in Crustacea and Insecta,; Chemical senses and animal orientation in non-chordate; Photoreception and photosensitivity in insects; 6.**Reproduction and development**: Comparative accounts of structures in non-chordates; Mode of reproduction in protozoans and helminths;

Reproductive hormones in non-chordates; Metamorphosis and diapause in insects, Moulting in Crustacea.

CELL BIOLOGY AND INHERITENCE BIOLOGY

Cell Biology

1. Cell membrane: Membrane structure and fluidity, membrane lipids and proteins, transport across cell membrane **2. Cell organelles** (structure and function): GERL system, mitochondria and plastids; cytoskeletons and molecular motors **3. Cell-cell interaction:** Adhesion junctions, tight junctions and gap junctions **4. Cell signalling:** Signalling molecules and their nature of receptors; pathways of signalling **5. Eukaryotic cell cycle:** Steps in cell cycle of yeast and eukaryotes. Regulation of CDK – cyclin activities; molecular basis of cellular check points, licensing factors **6. Eukaryotic chromosomes:** Structure of chromatin and chromosome, molecular anatomy of eukaryotic chromosomes – structure and organization of telomere, centromere and kinetochore, polytene and lamp-brush chromosome **7. Apoptosis:** Events and regulation of apoptosis; role of caspases **8. Cancer:** Genetic rearrangement in progenitor cells, oncogenes, tumour suppressor genes, metastasis, interaction of cancer cells with normal cells, therapeutic interventions of uncontrolled cell growth

Inheritance Biology

1. Concept of genes: Allele, multiple allele, pseudo allele, complementation tests, **2. Mendelian principles:** Dominance, segregation, independent assortment; deviation from Mendelian inheritance **3. Extensions of Mendelian principles:** Codominance, Incomplete dominance, gene interactions, pleiotropy, penetrance and expressivity, phenocopy **4. Genomic Imprinting:** Prader Willi and Angelman syndrome **5. DNA repair mechanism:** Types in prokaryotes and eukaryotes **6. Sex determination and Dosage compensation:** Drosophila, C. elegans and man **7. Recombination:** Homologous and non-homologous recombination, site-specific and transpositional recombination **8. Microbial genetics:** Methods of genetic transfer- transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating

PARASITOLOGY AND IMMUNOLOGY

Parasitology

1. Types of parasites and hosts: Basic concept of parasitism, symbiosis, phoresis, commensalism and mutualism **2. Biological vectors:** Importance in transmission of parasites causing human diseases with special references to Chagas' disease, sleeping sickness, filariasis **3. Human parasites:** Ultra structure and biology of Plasmodium spp., Leishmania donovani, Entamoeba histolytica; host range, mode of infection, clinical symptoms and pathogenesis, treatment protocol of clonorchiasis, taeniasis and cysticercosis, angiostrongyliasis **4. Zoonotic diseases:** Toxoplasmosis, echinococcosis, toxocariasis with emphasis on their zoonotic mode of transmission, development and

prevention and control **5. Molecular parasitology** :Molecular basis of antigenic variation and diversity in helminth and protozoan parasites; molecular organization and gene structure in *Plasmodium falciparum*; strategies of molecular cloning and protection against malaria; probe technology for parasite diagnosis

Immunology

1. Key concept of immunology **2. Innate immunity:** Cells, tissues and organs of immune system; Mechanism of phagocytosis and inflammation; Complement system: components and pathways of complement activation; Cytokines: family, examples and functions **3. Adaptive immunity:** Nature of antigens: epitopes, haptens and CD molecules; Immunoglobulin classes; Antigen-antibody reaction; T cells and B cells: types and activation **4. Hypersensitivity:** Type I and Type II **5. Applied immunology:** Vaccination— types and characteristics; monoclonal antibody production and enzyme-linked immunosorbent assay.

HISTOLOGY AND HISTOCHEMISTRY

Histology

1. Basic concepts of histological techniques: Tissue fixation, embedding, microtomy, staining and mounting. **2. Epithelial tissue:** Characteristics and function of epithelial tissues; Ultrastructure of transport, synthetic-secretory and specialized epithelial cells, **3. Muscle tissue:** Characteristics, ultrastructure and function of muscle proteins and cells, Molecular aspects of muscle contraction, **4. Connective tissue:** Tropocollagen synthesis; glycosylation and post transcriptional modification and structure of RNA, **5. Extra-cellular matrix:** Organization and chemistry; structure and composition

Histochemistry

1. Enzyme and non-enzyme histochemistry: General idea **2. Neurochemistry and immunohistochemistry:** Outlines and introduction **3. Principles and methods:** Histochemical localization of carbohydrates, proteins, nucleoproteins and lipids in tissues, **4. Use of colloidal gold in histochemistry** **5. Inorganic constituents of tissues and organs** **6. Histophysiology of tissues and organs:** Vertebrate liver and invertebrate hepatopancreas; Caudal neurosecretory system in fishes; Bone marrow **7. Use and application of biopsy materials for diagnostic histochemistry and histophysiology**

CHORDATE STRUCTURE AND FUNCTION

1. Vertebrate body plan: Biological design of vertebrate body ;Mechanics of body support and movement; Mechanics of swimming, diving, flying and gliding **2. Origin of jaws and its suspension:** Functional and evolutionary significance; Cranial kinesis in feeding mechanisms **3. Respiration and cardiovascular system:** Respiratory system in

vertebrates and its evolution; Embryonic development of cardiovascular system; Structure and function of lymphatic system; **4. Nervous system and sensory organs:** Evolution and functions of peripheral nervous system; Functional associations of parts of central nervous system in vertebrates; Lateral line system and electroreception; Organs of olfaction and taste, Echolocation in bat; Evolution of vestibular system **5. Comparative anatomy:** Brain, kidney, heart and aortic arches in vertebrates

ECOLOGY AND ENVIRONMENTAL BIOLOGY

1. Principles in ecology: Ecosystem, food chains, food web, ecotone and edge effect, energy flow in ecosystem, mesocosm, noosphere; limiting factors: temperature and light; Animal association: parasitism and symbiosis ;Habitat and niche: habitat and microhabitat; niche concept **2. Population ecology:** Life tables and survivorship curves; Population cycles in discrete time logistic population models — recruitment functions, qualitative behaviour of difference equations; Population regulation: density-dependent and density-independent mortality factors and their interactions; Predation : predator and prey models, oscillation in population size (prey population growth rate, predator population growth rate, joint predator-prey population growth rate); Ecological modeling: concept, components and application **3. Metapopulation:** metapopulation concept, models, structure and fluctuations; effect of migration and local population demographics on metapopulation, genetic variation in a metapopulation **4. Ecoenergetics and biogeochemical cycles:** Concepts of primary and secondary productivity, measurement of ecosystem productivity (satellite and other methods), limits to primary and secondary production, patterns in primary production, temporal and spatial variations in primary production; Global cycling of water, carbon, sulfur, and nitrogen **5. Pollution:** Source and effects of air, sound, soil and water pollution and their control; solid waste management **6. Biome and conservation ecology:** Concept of biome, conservation of natural resources and wildlife, in situ and ex situ conservations; Red Data Book; conservation of wetlands; methods of cryopreservation **7. Fresh water ecology:** Characteristics, limiting factors, nutrient status, classification of fresh water organisms, fresh water biota, lentic and lotic communities, zonation of rivers/streams and wetlands **8. Animal behavioUr:** Concepts of ethology, stereotyped and acquired behaviour (classical conditioning, instrumental learning, habituation and imprinting); social behaviour, altruistic behaviour, biological rhythms **9. Biomonitoring and bioremediation:** Biological agents as marker of environmental pollution; Pesticide remediation using bacterial system

METABOLIC REGULATION AND MOLECULAR BIOLOGY

Metabolic Regulation

1.Carbohydrate: Forms and functions; glucose metabolism pathways and regulation (role of class II a histone deacetylases **2.Protein:** Amino acids: structure and classification; primary, secondary, tertiary and quaternary structures of protein; Ramachandran plots; transamination and deamination **3.Lipids:** Classification and metabolism; β -oxidation of fatty acid **4.Enzymes:** Classes, action, activation energy; factors affecting enzyme action; inhibition of enzyme action; enzyme kinetics: Michaelis-Menten equation; ribozyme **5.Molecular signaling:** Toll-like receptor signaling pathway; signal transduction pathway mediated by ras protooncogenes; notch signaling pathway in *Drosophila* **6.Bioenergetics:** Principles of bioenergetics, oxidative phosphorylation, electron transport system **7.Biotransformation:** Metabolism of xenobiotic compounds

Molecular Biology

1.Basic principles in molecular biology and recombinant DNA technology : DNA replication, transcription and translation in eukaryotes, Restriction endonucleases: types and functions; role in restriction map construction, Cloning vectors: types, characteristics and function; construction of rDNAs and cloning, Molecular techniques: southern blot analysis, site directed mutagenesis, cDNA library, DNA sequencing, DNA profiling, Si RNA **2.Molecular biology of viruses:** Assembly pathway of ϕ X 174; λ DNA: cloning with λ phage; genetic map and gene products of M13; SV 40 genome; replication cycle: polyoma virus, adenovirus, retrovirus (HIV) **3.Molecular basis of mutation:** Base pair substitution, addition and deletion; Changes in genetic information (sickle-shaped RBC);Mutations induced by chemicals (Ames test to screen mutagenicity) and radiation; Molecular characterization of human colon and rectal cancer, **4.Molecular medicine and gene therapy:** Stem cell: definition, characteristics, types and sources; stem cell therapy in humans; cancer stem cells; molecular biology of cancer: cells of origin in cancer and cancer immunotherapy; Thalassaemia (α and β): aetiology (molecular basis) and therapeutic aspects;Ubiquitin proteasome system— role in development of Alzheimer's disease, Parkinson's disease and muscle wasting

QUANTITATIVE BIOLOGY AND BIOINFORMATICS

1. **Preliminary concept:** Importance of statistics in biology and important terminologies: variable, population, data, and quantitative inheritance, 2. **Graphical representation of data:** Charts (histogram/Ogive curve/frequency curve), 3. **Central tendency:** Mean, median and mode, 4. **Variability:** Mean deviation and standard deviation, co-efficient of variation, 5. **Frequency distribution:** Concept of probability,

Binomial and Poisson distribution, Normal distribution, computation of best fitting normal distribution; skewness, Kurtosis and moments, **6. Hypothesis testing and test of significance:** t test, χ^2 -test, Z-test, F-test and r-test; p -value determination, **7. Quantitative genetics :** Continuous variation and quantitative inheritance, statistical analysis of polygenic traits; additive alleles, Heritability: broad sense and narrow sense heritability, Laws of probability in genetic events: application of binomial theorem, χ^2 – analysis: role in evaluating the influence of chance on genetic data; **8. Bioinformatics** Bioinformatics and its scope, Turning DNA into proteins: genomics and proteomics, History of sequence analysis; sequence analysis programs: genetics computer group and Omega, Molecular biology software: sequence similarity searching with FASTA, multiple sequence alignment using CLUSTAL W and CLUSTAL X, phylogenetic analysis using PHYLIP, annotating sequence data using genotator, Web-based resources: NCBI and EBI; database (virtual library): MEDLINE and SCI

TAXONOMY AND EVOLUTION

Taxonomy

1. Elementary idea of taxonomy: definition, basic concept and importance of systematics and taxonomy, **2. Taxa and species :** Phylogenetic groups, monophyly, polyphyly and paraphyly, Problem with parthenogenetically and asexually reproducing individuals **3. Taxonomic procedure:** Collections, preservation and method of identification of animals, Taxonomic keys; importance of classification **4. Methodologies in systematics:** Morphology based taxonomy, numerical taxonomy, Cytotaxonomy and chemotaxonomy, molecular systematics, DNA fingerprinting and molecular markers for detection/evaluation of polymorphism, RFLP and RAPD **5. Theories of biological classification:** Essentialism, nominalism, empiricism, cladism and evolutionary classification, their merits and demerits **6. Phenetic methods:** Similarity and distance measure using continuous data **7. Biodiversity and management:** Definition, indices and levels, biodiversity indicators— surrogate species, taxon based biodiversity indicators **8. Zoological nomenclature:** Process of typification and different zoological types, International code of zoological nomenclature (ICZN), Binominal and trinominal nomenclature

Evolution

1 .Evidences of evolution from homeotic genes, oncogenes and transposons **2. Origin of life:** modern theories - DNA and RNA world **3. The origin of genetic variation:** Genes and genomes, gene mutations, mutation as a random process, recombination and variation, karyotypic alterations **4. Variation:** Sources of phenotypic variation, Hardy-Weinberg principle, frequencies of alleles, genotype and phenotype, inbreeding, variation among populations **5. Species and speciation:** Biological and phylogenetic

species concept, genetic basis of reproductive barriers, models of speciation: allopatric, peripatric, parapatric and sympatric **6.Origin and evolution of bird and man**
7.Gradualistic vs. non-gradualistic theories, founder principle, punctuated equilibrium theory, neutral theory, endosymbiotic theory, genetic load, genetic drift, and bottle neck principle **8.Evolution of social behavior**: Costs and benefits of social life; altruism and reciprocity, cooperation, costs and benefits of group living, prisoner's dilemma game theory; Kin selection and Hamilton's kinship theory; selfish behaviour and origin of selfish herd **9.Evolution of reproductive behavior**: Theories of male ornamentation and striking courtship displays; sexual selection **10.Parental care and investments**: Parent-offspring conflicts; polyandry and polygynous mating system

ANIMAL PHYSIOLOGY

1.Cellular physiology: Basic structure and function, Transport across the membrane, Neurons and transmission of nerve impulse **2.Physiology of blood**: Blood constituents and functions, Erythrocyte development and destruction, leucocyte production, Blood coagulation: Intrinsic and extrinsic clotting pathways, Blood groups and transfusion **3.Cardiovascular physiology**: Heart as a pump: cardiac cycle and cardiac output, Electrical activity of heart (ECG), Cardiovascular homeostasis in health and diseases **4.Physiology of respiration**: Respiratory pigments, Mechanism of respiration and its regulation, Gaseous exchange and transport (CO₂ and O₂), Respiratory disorders **5.Endocrine Physiology**: Functions and clinical implication of hormones secreted from thyroid, pancreas, adrenal, testes and ovary, Biosynthesis and metabolism of steroid hormone(s) **6.Neurophysiology**: Electrical activity of brain (EEG), Sleep-wake cycle and sleep disorder, Speech, learning and memory, Neurotransmitters, Hypothalamic regulation of hormonal function (with emphasis on pituitary hormones) and clinical implication; **7. Special senses**: Physiology of vision: Components of visual pathway and mechanism of vision in mammals; defects and correction of vision, Physiology of hearing: Vestibular pathway and mechanism of hearing; hearing defects and tests

BIOPHYSICAL PRINCIPLES AND INSTRUMENTATION

1. Principles and uses of analytical instruments: Colorimeter, spectrophotometer, ELISA, flow cytometry and FACS **2.Microscopy**: Light microscopy, phase-contrast microscopy, fluorescence microscopy, confocal microscopy, SEM and TEM **3.Chromatographic techniques**: Column chromatography, TLC, GC-MS, HPLC, HPTLC, Ion-exchange chromatography, gel exclusion chromatography and affinity chromatography **4.Electrophoresis**: PAGE (native and SDS), agarose gel electrophoresis, 2-D gel electrophoresis and isoelectric focusing **5.Centrifugation**: Basic principles of sedimentation, differential and density gradient centrifugation **6.Crystallography and X-ray diffraction**, Basic idea of NMR, Endoscopy, USG, CT scan and MRI **7.Polymerase chain reaction**: Types and their applications

APPLIED ZOOLOGY

1. Apiculture: Types and castes of honey bees, structure of hive, and bee flora, Equipments for bee culture and honey extraction, Composition of honey, wax and their economic importance; processing and preservation of honey, Disease and enemies of bees

2. Sericulture : Types of silk moths and their distribution in India, life cycle of silk moth, Moriculture and its management, Rearing of silk moth: rearing equipments and CSB recommended low cost rearing house, strategies of silk worm breeding and quality control, Reeling of silk from cocoon; chemistry of silk and commercial importance of sericulture ,Disease and enemies of silk moth and their control

3. Lac culture: Lac insect and their distribution in India; life cycle of lac insect, factors affecting life cycle, Process of scientific cultivation of lac insect and processing of lac; chemistry and use of lac, Cultivation of food plant and its management, Disease and enemies of lac insect and their control

4. Aquaculture: Fisheries resources in India (inland and off-shore), Important ichthyofauna in West Bengal; exotic fishes, their commercial merits and demerits ,Induced breeding, composite fish culture and cage culture; hybridization techniques , Methods of processing and preserving fish , Fish by-products and their economic importance, Biology and commercial importance of oil sardines/mackerels/Bombay duck, Prawn culture: important Indian species; culture techniques; diseases and management ,Pearl culture: pearl oysters in India and their cultivation, biological process of pearl formation, economic importance of pearl

5. Poultry farming : Common indigenous and exotic breeds and their characteristics ,Tools and techniques for poultry bird rearing, Poultry feed and poultry disease,

6. Dairy farming : Cattle breeds in India, their economic importance and management, Cattle breeding: techniques, merits and demerits, Cattle feed: processing and nutritive values, Dairy products;

7. Vermiculture: Types of earthworm species and their distribution in India, Biological process and techniques of vermicomposting, Importance of vermicomposting: application and limitation

ENTOMOLOGY

General Entomology

1. Basic idea of entomology: Elementary idea on entomology: scope, objectives and its prospect, Structure and functional distinctiveness of insect responsible for high species diversity and numerical dominance, Origin, evolution, adaptive radiation and ecological fitness of insects

2. Insect classification: Principles of insect classification, Major insect orders: classification up to the families

3. Integument: Basic structure, chemistry and biosynthesis, sclerotization and its regulation, Derivatives of integument and evolutionary advantages

4. External morphology : Segmentation and division of body, General morphology and related modification of head, mouth parts, antennae, thorax and abdomen, Structure of wing, venation and morphological variation ,Pre and post

genital appendages **5.Maintenance system:** Digestion and assimilation:Gut structure, digestive enzymes and physiology of digestion, Dynamics of insect plant interaction in respect of chemical environment of plant and nutritional strategies of insect, Extra intestinal digestion, Role of microbes in digestion; Circulation: Basic plan of body circulation, Structure of heart and vessels, Composition of haemolymph and function, Haemocytes, cellular and humoral immunity; Excretion:Basic physiology of insect excretion and excretory products, Structure of malpighian tubules and its function, cryptonephridial conditions: Salt and water balance; Respiration:Basic structure of trachea, tracheoles, air-sacs, spiracles ,Respiratory pigments, Ventilation mechanism and their control ;Reproduction: Basic organization of male and female insect,Reproductive strategies including parthenogenesis, Differentiation of body pattern of insect during embryonic development, Distintiveness of life cycle of insect **6.Control system:** Nervous system and sense organ: Structure of brain, ganglia, nerves and receptors, Reception and transmission of stimuli, Mechanism of sound and light production; Endocrine and exocrine glands: Structure of neurosecretory cells and endocrine glands,Insect hormones, types, functions, mechanism of action and regulation of titres; Muscular system:Structure of muscle and disposition in body, Neuromuscular junction and muscular activity, Muscle development and maintenance **7.Ethology and behaviour:** Social behaviour with reference to honey bee, termite and ant, Behaviour of borer, leaf miner and gall forming insects, Aerodynamics and migration, Intra-specific and interspecific chemical communication in insects, Camouflage, warning colouration and defensive behaviour, Reproductive behaviour and parental care; Photoperiodism; Insect as decomposer

Agricultural and Medical Entomology

1.Origin of agricultural insect pest and their categories **2.Concept of threshold levels:**Economic threshold level and economic injury level (EIL), determination of EIL and calculation of economic decision level;Pest surveillance, sampling methods and forecasting, importance of GIS tool for pest management, generation of pest forecasting equation **3.Some major pests:** Insect pests of rice, jute, mango, banana, litchi, their bionomics, damage symptoms, consequences of damage and suggested protection procedure,Stored grain pests: stages of life cycle, damage symptoms, consequences of damage and suggested protection procedure **4.Insecticides and their application:** Classification of insecticides, important types of insecticides, formulations, mode of action, insecticide residues in environment, phyto-toxicity of insecticidal formulations, first aid antidotes, insecticide act- 1968: important provisions; Evaluation of insecticide toxicity, insecticide synergism, potentiation and antagonism, factors affecting the toxicity of insecticides, insecticide compatibility and selectivity ;Insecticide metabolism, pest resistance to insecticides, insect pest resurgence, history of pest outbreak and its probable causes; Pest control by insecticides, sources, mode of action,

bio-accumulation, application of bio-rational insecticides ;Safe use of insecticides, diagnosis of insecticide poisoning and first aid antidotes **5. Concept of pest management strategy:** Outline of different categories of pest management strategies and their limitations; Integrated pest management (IPM): concept and components, tactics and strategies, brief histories of successfully implemented IPM, community IPM, low input sustainable agriculture; Methods of pest suppression with suitable agronomic practices, importance of traditional knowledge for pest suppression; Molecular tools for pest control: insect growth regulators, semiochemicals ;brief note on autocidal process for insect pest control ;Outline of insect repellents, anti-feedants and attractants; Compounds of plant origin for pest control; Importance of beneficial insect diversity associated with agricultural field, necessity of its conservation, pest control by bio-agents; Quarantine and legislative measures for preventing spread of pests **6. Economic and commercial entomology:** Introduction to some commercially important insects and their useful products, Introduction to house hold insects such as of books and papers, pantry, textile, woodwork and furniture; their damages and control, Mass production of bio-control agents and bio-rational insecticides; **7. Medical entomology:** Zoonotic diseases- Plague, leishmaniasis and human African trypanosomiasis- causes and remedies; Vector biology: Important vectors in India, mode of transmission of pathogens by vectors and control strategies with special reference to mosquito , sand flies and fleas; Myiasis: Causes, pathogenicity and remedy; Insects associated with cadavers; Insects for forensic study; Poisonous insects and the nature of toxins

MICROBIOLOGY

Medical Microbiology

1. General aspects of medical microbiology : Pathogenic agents: protozoa, bacteria, fungi and viruses, Pandemic, epidemic and endemic, Host-microbes interaction (molecular basis), **2. Microbiological media and culture techniques:** Bacterial culture media: Types and composition, Culture media for fungi, Bacteria culture techniques: Streak dilution and pour-plating; mixed and pure culture, **3. Antimicrobial agents and chemotherapy:** Classification of antibacterial agents, mechanism of action and development of resistance , Antifungal and antiviral drugs, Antibiotic susceptibility testing: agar dilution, disk diffusion and E-test methods; MIC, FIC and MBC determination **4. Microbial diseases:** Tuberculosis: clinical stages or states of Mycobacterium tuberculosis infection; biomarkers and diagnostics; immune response, vaccine and vaccination strategies; Cholera: aetiology, transmission, clinical spectrum, diagnosis, treatment protocol; cholera vaccine; Hepatitis: virus biology and evolution ; infection and disease manifestation; laboratory diagnosis, treatment, and prevention and control; H1N1 infection: origin and evolution of H1N1 virus infecting humans; clinical features, treatment and control; Deep fungal skin diseases: systemic mycoses,

subcutaneous mycoses and opportunistic infection **5.Zoonoses:** zoonotic mode of infection, pathogenesis and clinical features, diagnosis, treatment and control of the followings: Viral zoonosis: rabies; Bacterial zoonosis: leptospirosis; Protozoan zoonosis: toxoplasmosis; Helminthic zoonosis: cystic echinococcosis; Microbial diseases of body system (pathogenicity and treatment): nematode infection to eyes, dental caries and periodontal disease, peptic ulcer; Clinical Immunology: sampling and serological detection of microbial infection; **8.Epidemiology and public health microbiology:** Disease transmission: mode of transmission of microbial agents, Vector biology of dengue, chikungunya and malaria, Nosocomial infection: types, factors and prevention; important bacteria associated with hospital infection; problems associated with MRSA infection, Strategies controlling microbial infection: chemotherapy, vector control and vaccination programs

Food and Environmental Microbiology

1.Microbial diversity: Characteristics and outline classification of protozoa, bacteria, fungi and virus; General criteria for the identification of bacteria: morphological, biochemical, serological and molecular consideration ;Bacterial growth, metabolism and genetics, and gene swaping **2.Microorganisms in food processing:** Fresh and processed meats and seafoods; vegetable and fruit products; milk, fermented and nonfermented dairy products;Role of microorganisms in food preservation; plant essential oils in food preservation—their role in controlling food spoilage bacteria **3.Food Poisoning caused by microorganisms:** bacterial food poisoning; clinical features, diagnosis and treatment of bacterial food poisoning; parameters of foods affecting microbial growth **4.Probiotics:** characteristics, sources and medical importance; selective enumeration of probiotic microorganisms in food; factors influencing the functionality of probiotic bacteria in dairy products **5.Food borne and water borne diseases:** Botulism: aetiology, transmission and epidemiology, clinical features, diagnosis and treatment; Clostridium difficile -associated disease: transmission, clinical spectrum, diagnosis, therapeutic management, control measures; Amebiasis: aetiology, transmission, clinical features, diagnosis, treatment and control; Cyclosporiasis: aetiology, transmission and outbreaks, clinical features, diagnosis, treatment and control;Viral diarrhea: aetiological agents, transmission, clinical features, and treatment and control **6.Air borne diseases:** Diphtheria and Pertussis: aetiology, transmission, clinical features, treatment and control; SARS and measles: disease transmission, clinical features, treatment and control **7.Marine microbes and climate change:** impact of climate change on the marine bacterioplankton communities; bacterial activity and temperature; climate and plankton ecology; linking bacteria to climate changes; potential impacts of climate change on bacterioplankton diversity and structure **8.Environmental monitoring using microorganisms:** enzyme-based biosensors; whole cell-based biosensors; immunosensors; DNA-based biosensors;

biomems, biomimetics; biotransformation of toxic heavy metals **9.Control of microorganisms in food and environment:** control of access (cleaning and sanitation) and means of controlling food microorganisms; antimicrobial preservatives, irradiation, novel processing technologies and combination of methods (Hurdle concept). Physical methods of controlling environmental microorganisms and use of disinfectants **10.Biological warfare and bioterrorism:** microorganisms as potential agents of warfare or terror, defense against bioterrorism.

IMMUNOLOGY

Immunobiology

1.Antigen-antibody mediated immune responses: Immunogenicity versus antigenicity; factors that influence immunogenicity; Antigenic determinants on immunoglobulins; antibody-mediated effector functions; Pattern recognition by cells of the innate immune system; Organization and expression of immunoglobulin genes; **2. Major histocompatibility complex and immune responses:** General organization and inheritance of the MHC;MHC molecules and genomic map of MHC gene Cellular distribution of MHC molecules and regulation of MHC expression;Immune responsiveness and disease susceptibility of MHC; **3. Antigen presentation by T cell, and T-cell and B-cell mediated responses:**Antigen processing and presentation;T-cell receptor; T-cell maturation, activation and differentiation;B-cell generation, activation and differentiation **4. Mechanisms of immune effector system:**Cell-mediated effector responses: general principles of effector T cells and effector responses; cytotoxic T cells; natural killer cells; antibody-dependent cell-mediated cytotoxicity;Leukocyte migration and inflammation: lymphocyte recirculation; cell-adhesion molecules; neutrophil extravasation; lymphocyte extravasation; Hypersensitive reactions: Immune complex-mediated (Type III) hypersensitivity; Type IV or Delayed-Type Hypersensitivity (DTH) **5.The immune system in health and disease:** Immune response to infectious diseases: viral infections; bacterial infections; Protozoan diseases; diseases caused by parasitic worms (Helminths); emerging infectious diseases;Vaccines: active and passive immunization; designing vaccines for active immunization; whole-organism vaccines; purified macromolecules as vaccines; recombinant-vector vaccines; DNA vaccines; multivalent subunit vaccines; AIDS and other immunodeficiencies: primary immunodeficiencies; AIDS and other acquired or secondary immunodeficiencies; Autoimmunity: organ-specific autoimmune diseases; systemic autoimmune diseases; proposed mechanisms for induction of autoimmunity; treatment of autoimmune diseases; Cancer and the Immune System: malignant transformation of cells; oncogenes and cancer induction; tumors of the immune system; tumor antigens; immune response to tumors; tumor evasion of the immune system

Applied Immunology

1. Pharmacological relevance in immunity: Inflammatory mediators and intracellular signalling; Immune response in human pathology: infections caused by bacteria, viruses, fungi, and parasites; Immune response in human pathology: Autoimmunity; Neuroimmunoendocrinology: regulation of the immune system by neuroendocrine hormones, regulation of nervous system by immune factors

2. Drugs and immune system: Anti-allergic drugs: types and their effects; Drugs for the treatment of airway disease; Influence of antibacterial drugs on the immune system; Effect of cytotoxic drugs on immune system; Effect of immunosuppressive drugs/agents in transplant rejection

3. Immunodiagnosis: Techniques and technologies for quantitation of immunologically relevant molecules; Substances and the cells and their uses for diagnostic purposes; Agglutination reaction, precipitation reaction, immunodiffusion, immunoelectrophoresis, radioimmunoassay, ELISA, flow cytometry, FACS, PCR, western blot analysis; Immunodiagnosis of cancer and infectious diseases,

4. Immunotherapeutics: Vaccines: pharmacological effects of vaccination and new developments, Plasma-derived immunoglobulins: pharmacokinetics and medical use; Perspectives of immunotherapy in the management of asthma and other allergic conditions; Immunomodulators: anti-infective activity, probiotics and prebiotics, mild plant and dietary immunomodulators; Corticosteroids: chemical structures, modes of action, pharmacological effects, pharmacokinetics, clinical indications, side effects ; Non-steroidal anti-inflammatory drugs: types, mode of action and effects ; Disease-modifying antirheumatic drugs: chemistry and targets, effects, therapeutic uses, current research directions; Cancer immunotherapy: mechanism of action of antibody immunotherapy of cancer; biological activity of CTLA-4 antibody; role of immune and inflammatory cells in antitumor immunity and tumor promoting inflammation; generation and regulation of antitumor immunity; cancer vaccines

5. Immunotoxicology: Mechanisms of immunotoxicity by pharmaceuticals; Procedures for preclinical testing of direct immunotoxicity, sensitizing capacity; Procedures for immunotoxicity testing in humans; immunotoxicity regulations

6. Transplantation immunology: Immunologic basis of graft rejection; Clinical manifestations of graft rejection; General immunosuppressive therapy; Specific Immunosuppressive Therapy; Immune tolerance to allografts; Clinical transplantation

7. Immunogenetics: Preliminary concepts, study of polymorphic genes – HLA, KIR, and their association with disease susceptibility