Detailed course matrix and scheme of evaluation for M.Sc. in Life Sciences (CBCS scheme) effective from 2016-17

SEMESTER – I

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Hrs / week</th>
<th>Total credits</th>
<th>Duration of examination (hrs)</th>
<th>Maximum marks</th>
<th>*Internal Assessment</th>
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Practical

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SEMESTER – II

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Practical

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*Internal Assessment:
Theory (30 marks): Class test – 15 marks; Seminar Report – 05 marks; Seminar Presentation – 05 marks; Attendance – 05 marks
Practical (30 marks): Class test – 15 marks; Class Record – 10 marks; Attendance – 05 mark
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**Semester – IV**

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*Internal Assessment:
Theory (30 marks / 15 marks): Class test – 15/05 marks; Seminar Report – 05/2.5 marks; Seminar Presentation – 05/2.5 marks; Attendance – 05/05 marks
Practical (30 marks): Class test – 15 marks; Class Record – 10 marks; Attendance – 05 marks

**Research Project: Examination will include evaluation of dissertation, oral presentation and viva-voce: (50+10+10) = 70 marks; Internal assessment (15+15) = 30 marks will be evaluated on the basis of mid-semester poster presentation & colloquium showing research progress.**
Semester I

LS101T: ORGANISMAL BIOLOGY

52 hours: 4 credits

Unit 1: Variety of Life
6 hours

Histology: Simple and complex plant tissues; epithelial, connective, muscle and nerve tissue in animals.

Unit 2: Nutrition
4 hours

Autotrophic nutrition:
Grouping organisms according to energy and carbon sources, importance of photosynthesis, structure of leaf, photosynthetic pigments, biochemistry of photosynthesis, metabolism of glycerate phosphate and triose phosphate, factors affecting photosynthesis, C4 photosynthesis, mineral nutrition of plants and animals, compensation points.

Heterotrophic nutrition:
Forms, feeding mechanisms in a range of animals, the alimentary canal in humans, nervous and hormonal control of digestive secretions, summary of fate of absorbed food materials, nutrition in humans.

Unit 3: Energy utilisation
4 hours
Cellular respiration, ATP generation, gaseous exchange in flowering plants, gaseous exchange in mammals, respiratory diseases in Man, ATP utilization during exercise and training.

Unit 4: Transportation
9 hours
Transportation in Plants: Movement of water through flowering plants, transpiration and movement of water through leaf, ascent of sap in xylem, uptake of water and mineral salts by roots, translocation of mineral salts, translocation of organic solutes in phloem.

Transportation in Animals: Water and nutrient transport at cellular level, General characteristics of blood vascular system in animals, composition of blood, formation of tissue fluid, functions of mammalian blood heart and circulation, blood vessels. Fluid transport across intestinal epithelium and blood-brain barrier.

Unit 5: Coordination and control
6 hours
Plants: Plant movements, growth substances, synergism and antagonism, phytochrome and effects of life on plant development, vernalisation and flowering

Animals: Evolution of nervous system, sensory receptors, structure and function of receptors in vertebrates and non-vertebrates; skeletal system, neuro-muscular coordination.

Unit 6: Homeostasis, Excretion & Osmoregulation
7 hours
Control systems in biology, control of blood glucose and temperature. Significance of excretion and osmoregulation, nitrogenous excretory products and environment, Excretion and osmoregulation in representative animals, formation of urine in humans, human kidney, ADH, control of blood pH and blood sodium level. Water conservation in plants and algae.
Unit 7: Growth & Reproduction  
13 hours

Definition of growth, patterns of growth, measurement of growth, growth and development in flowering plant, role of hormones in human growth and development.

Asexual reproduction- types, advantages and disadvantages, artificial propagation in plants, cloning, sexual reproduction in flowering plants & vertebrates. Human reproductive system, sexual reproduction in humans, human intervention in reproduction.

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Recommended readings:


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Unit 1 01 hour
Introduction: Development and scope of Biochemistry, Biochemical composition of living organisms.

Unit 2 07 hours
Carbohydrates metabolism: Glycolysis-entry of other carbohydrates into glycolysis, the fates of pyruvate, the citric acid cycle, the energetics of glucose metabolism. Enzymatic control of glycolysis and TCA cycle. Outline of pentose phosphate pathway and its significance. The Cori’s cycle, Outline of gluconeogenesis and glycogen metabolism. The amphipathic and integrating role of the citric acid cycle. Substrate level phosphorylation. Regulation of blood sugar level and Diabetes mellitus. Glycogen storage disorder.

Unit 3 09 hours

Unit 4 09 hours
Lipids, Bio-Membranes and their metabolism: Classification of lipids and biological function. Fatty acids; classification based on structure, properties of fatty acids. Acyl glycerols; Hydrolysis, Rancidity, acid, saponification and iodine values. Phosphoglycerides; structures and biological roles, Sphingolipids; phosphosphingolipids - sphingomyelins; Glycosphingolipids - gangliosides and cerebrosides. Prostaglandins; An overview of biological roles, structure of PGE₂ and PGF₂α. Waxes of biological importance, Lipoproteins; types and functions, Membranes; Behaviour of amphipathic lipids in water, formation of micelles, bilayers and vesicles. Lipoproteins- types and functions. Functions and chemical composition of biological membranes, Fluid mosaic model. Steroids- Function of cholic acid, cholesterol, androgen and estrogens. The beta- oxidation pathway- even and odd numbered saturated and unsaturated fatty acids, Structure and functions of fatty acyl synthase. Energetics of total oxidation. General scheme of biosynthesis of fatty acids, Outline of cholesterol biosynthesis. Ketone bodies, atherosclerosis

Unit 5 06 hours

Unit 6 09 hours
Bioenergetics and biological oxidation: Bioenergetics- Energy transformations in living systems, free energy concept; Exergonic and endergonic reactions, ATP and other high energy compounds, energy coupling of Biological oxidation; Step-wise process of biological oxidation, standard reduction potentials of some biochemically important half-reactions, calculation of energy yields from biological oxidation reduction reactions. Mitochondrial electron transport chain-components, schematic representation indicating sites of ATP synthesis. Oxidative phosphorylation-Chemiosmotic theory (an outline)
Unit 7

Enzymes: Introduction, Classification Characteristic and their specificity. Theories of interaction between active sites and substrate, Energy of activation, cofactors, coenzymes. Enzyme assays and International Units

Enzyme kinetics; Factors affecting the rate of enzyme-catalyzed reactions- enzyme concentration, substrate concentration, pH, and temperature. Michaelis-Menten equation, Significance of $K_m$ and $V_{max}$ and their determination using LineWeaver- Burk plots.


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Recommended readings:

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Unit 1: Reproduction in Plant kingdom

**Non Vascular Plants**: Concept of asexual and sexual reproduction in nonvascular plants, Regeneration, Alternation of generation (metagenesis/heterogenesis), Sporophytes and Gametophytes.  
**Vascular plants**: Induction of flowering; flower as a modified determinate shoot. Floral organs, transition of shoot apex to flowering apex, Flower development: genetic and molecular aspects, ABC model (*Arabidopsis thaliana*).

Unit 2: The Anther wall

Structure and functions, microsporogenesis, callus deposition and its significance. Microgametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC system; Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; abnormal features: Pseudomonads, polyads, massulae, pollinia.

Unit 3: The ovule

Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Female gametophyte–megasporegenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of Polygonum type); Organization and ultrastructure of mature embryo sac.

Unit 4: Pollination and fertilization

Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization, polyembryony and apomixes.

Unit 5: Reproduction in animal kingdom

**Invertebrates**: Concept of Asexual and sexual reproduction in invertebrates, Reproductive structures and Reproduction in Coelenterates, Annelida, Arthropoda (with special reference to insects), Mollusca and Echinodermata, hormones and pheromones and their role in sex differentiation and gonadal activity, Gamete diversity and comparative embryonic development, Role of endosymbionts in reproductive manipulation of invertebrates.

**Vertebrates**: Reproductive structures and Reproduction in Fishes, Amphibians, Reptiles, Birds and Mammals, environmental and hormonal control of sex differentiation and gonadal activity, Reproductive patterns, Ovipary, Oovivipary and vivipary.

Unit 6: Reproduction in mammals

**The female reproductive system**: comparative anatomy and physiology (rat and human), ovarian hormones, two cell theory of Estrogen biosynthesis, Autocrine, Paracrine and Endocrine regulation of ovarian functions, Reproductive cycles (rat and human) and their regulation, sperm transportation in the female reproductive tract.

**The male reproductive system**: comparative anatomy and physiology (rat and human), testes and sex accessory glands, spermatogenic cycle (kinetics and hormonal regulation), testicular endogens, Autocrine, Paracrine and Endocrine regulation of testicular functions, sperm transportation in male tract (rat and human), Semen and its biochemical nature.
Unit 7: Fertilization 07 hours

Pre-fertilization events, biochemistry of fertilization and post fertilization events, implantation and its hormonal regulation, delayed implantation, Placenta as an endocrine tissue, foeto-placental unit, gestation and its hormonal regulation, reproductive health (male and female), Human Contraception and Human assisted reproductive Technologies (ET, EFT, IUT,ZIFT, GIFT, ICSI, PROST), sperm bank, in vitro fertilization (IVF), Demographic terminologies used in family planning.

Unit 8: Regulation of reproduction 03 hours

The pituitary gland: functional cytology, adenohypophyseal hormones, the hypothalamus, the neuro secretory cells, mammary gland and endocrinology and lactation

Recommended readings:

Plant reproductive biology:


Animal reproductive biology:

Unit 1: Historical Review of Evolutionary Concept
06 hours
Pre-Darwinian ideas – List of contributors influencing Darwin indicated as a timeline. Lamarckism – Merits and demerits. Darwinism – Merits and demerits, Post-Darwinian era – Modern synthetic theory; biomathematics and the theory of population genetics leading to Neo-Darwinism

Unit 2: Life’s Beginnings
05 hours

Unit 3: Evidences of Evolution
04 hours
Paleobiological – Concept of Stratigraphy and geological timescale; fossil study (types, formation and dating methods). Anatomical – Vestigial organs; Homologous and Analogous organs (concept of parallelism and convergence in evolution). Taxonomic – Transitional forms/evolutionary intermediates; living fossils. Phylogenetic – a) Fossil based – Phylogeny of horse as a model. b) Molecule based – Protein model (Cytochrome C); gene model (Globin gene family)

Unit 4: Sources of Evolution – Variations as Raw Materials of Change
06 hours
Types of variations – Continuous and discontinuous; heritable and non-heritable. Causes, classification and contribution to evolution – Gene mutation; chromosomal aberrations; recombination and random assortment (basis of sexual reproduction); gene regulation . Concept of micro- and macro-evolution – A brief comparison

Unit 5: Forces of Evolution – Qualitative Studies Based on Field Observations
07 hours
Natural selection as a guiding force – Its attributes and action Basic characteristics of natural selection. Colouration, camouflage and mimicry, Co-adaptation and co-evolution, Man-made causes of change – Industrial melanism; brief mention of drug, pesticide, antibiotic and herbicide resistance in various organisms. Modes of selection, Polymorphism, Heterosis and Balanced lethal systems. Genetic Drift (Sewall Wright effect) as a stochastic/random force – Its attributes and action. Basic characteristics of drift; selection vs. drift, Bottleneck effect. Founder principle

Unit 6: Forces of Evolution – Quantitative Studies Based on Biomathematics
05 hours
Population genetics – Gene pool; gene/allele frequency; genotypic frequency; phenotypic frequency (simple problems for calculation). Conservation of gene frequencies (when selection does not operate) – Hardy-Weinberg’s Law of Genetic Equilibrium. Alterations in gene frequency (when selection operates) – Calculation based on Selection Coefficient and Fitness. Fluctuations in gene frequency (when drift operates) – Calculation based on standard deviation
Unit 7: Product of Evolution – Speciation

Concept of species as a real entity, Mechanisms of speciation – Allopatric; sympatric; peripatric, Patterns of speciation – Anagenesis and Cladogenesis; Phyletic Gradualism and Punctuated Equilibrium (Quantum Evolution), Basis of speciation – Isolating mechanisms

Unit 8: End of Evolution – Extinction

Periodic extinctions, Mass-scale extinctions – Causes and events

Unit 9: Evolution of Plants and Fungi

Origin of land plants – Terrestrial algae and Bryophytes; alternation of generations. Early vascular plants – Stelar evolution; Sporangium evolution. Angiosperms – Phylogeny of major groups. Fungi

Unit 10: Human Ancestry and Phylogeny


Recommended readings:

LS105T: BIOCHEMICAL INSTRUMENTATION

26 hours: 2 credits

Unit 1: Spectroscopic Techniques
Principle of UV-Visible absorption spectrophotometry, instrumentation and applications, Flourimetry:
Phenomena of fluorescence, intrinsic and extrinsic fluorescence, instrumentation and applications

Unit 2: Chromatography
Basic principles of chromatography: Partition coefficient, concept of theoretical plates, various modes of chromatography (paper, thin layer, column), preparative and analytical applications, LPLC and HPLC. Principle and applications of: Paper Chromatography, Thin Layer Chromatography. Molecular Sieve Chromatography, Ion Exchange Chromatography, Affinity Chromatography

Unit 3: Electrophoresis

Unit 4: Centrifugation
Principle of centrifugation, basic rules of sedimentation, sedimentation coefficient, various types of centrifuges, different types of rotors, differential centrifugation, density gradient centrifugation (Rate zonal and Isopycnic)

Recommended readings:
Organismal biology

Plant organismal biology:
1. Free hand section of Stem: Helianthus (Normal), Cucurbita and Peperomia (Special features).
2. Study of leaf anatomy of Isobilateral (Nerium) and Dorsiventral leaf (Ficus)
4. Determination of water potentials by following drops methods.
5. Separation of chlorophylls and carotenoids by ascending paper chromatography

Animal organismal biology:
1. Identification and functions of scales (fishes), claws, nails, hairs, horns, feathers, Hoofs and nests.
2. Skulls in vertebrates: Frog, Bird, Mammal, rabbit, dog, man, turtle.
3. Histology sections of Testis, Ovary, Liver, Pancreas, Kidney, Spleen, intestine.
4. Determination of oxygen consumption and metabolic rate in fish.
5. Rate of protein digestion by trypsin.
6. Determination of Acetylcholine activity in tissues
7. Demonstration of dissections – digestive, nervous and reproductive system of male and female cockroach, silk moth, Rat; Mounting: setae of earthworms and mouth parts of cockroach.

Biological chemistry

1. Extraction and assay of acid phosphates from peas.
2. Extraction and assay of Invertase from yeast.
3. Extraction and assay of Urease from horse-gram.
4. Analysis of kinetic parameters of salivary amylase (Specific activity, $K_m$ and $V_{max}$)
5. Estimation of reducing glucose.
8. Estimation of AChE activity and acetylcholine content
Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

Reproductive biology

Plants
- Morphology of the reproductive parts of flower
- Tests for pollen viability: *in vitro* pollen germination, Tetrazolium test
- Vegetative reproduction: Artificial methods (Grafting, Cutting, Gootee and Layering).
- Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.
- Pollen grains: Fresh and acetylolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs,fresh material), ultrastructure of pollen wall(micrograph); Pollen viability: Tetrazolium test.germination: Calculation of percentage germination in different media using hanging drop method.
- Ovule: Types-anatropous, orthotropous, amphiropous/campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs).
- Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.

Animals
- Identification of sperms in insects, Annelida, Amphibians and Mammals (Slides).
- Sperm count and mobility (Rat/Humans)
- Examination of vaginal smear rat from live animals
- Examination of histological sections (photomicrographs or permanent slides) of rat and human: testes, epididymis, accessory glands of male reproductive system, ovary, fallopian tube, uterus, cervix and vagina.
- Study of modern contraceptive devices.
- Dissection of male and female reproductive systems of *Bombyx mori*, Cockroach and Rat.

Evolutionary biology

Evidences of fossils
1. Study of types of fossils (e.g. trails, casts and moulds and others) and Index fossils of Palaeozoic era
2. Connecting links/transitional forms - Eg. *Euglena, Neopilina, Balanoglossus, Chimaera, Tiktaalik, Archaeopteryx, Ornithorhynchus*
3. Living fossils - Eg. *Limulus, Peripatus, Latimeria, Sphaenodon*
4. Vestigial, Analogous and Homologous organs using photographs, models or specimen

Variations
5. Sampling of human height, weight and BMI for continuous variation
6. Sampling for discrete characteristics (dominant vs. recessive) for discontinuous variations e.g. hitch-hiker's thumb, dexterity, tongue rolling, ear lobe (data categorization into 16 groups based on the combination of 4 traits; assigning each subject to the respective group)

Selection Exemplifying Adaptive strategies
7. Coloration, Mimetic form, Co-adaptation and co-evolution; Adaptations to aquatic, fossorial and arboreal modes of life) using specimens

Neo-Darwinian Studies
8. Calculations of genotypic, phenotypic and allelic frequencies from the data provided
9. Simulation experiments using coloured beads/playing cards to understand the effects of selection and Genetic drift on gene frequencies

**Phylogeny**

10. Digit reduction in horse phylogeny (study from chart),
11. Study of horse skull to illustrate key features in equine evolution
12. Study of monkey and human skull - A comparison to illustrate common primate and unique Hominine features

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LS201T: PARASITOLOGY & PATHOLOGY

52 hours: 4 credits

Unit 1:

**Introduction to Parasitology**: Comparative aspects of symbiosis (mutualism, commensalism, parasitism), types of hosts (definitive, intermediate, paratenic, accidental, reservoir host) and parasites (ectoparasites & endoparasites, facultative & obligatory parasites, pseudoparasites, occult parasitism, aberrant parasitism), host-parasite interactions (hypobiosis, zoonosis).

**Ecology & evolution of parasites**: Parasite ecology, parasite populations (macro & microparasites, population structure, multiple species infections), modes of parasitic reproduction (asexual, viviparity, hermaphroditism), parasitic transmission, epidemiology and parasite evolution.

Unit 2: Molecular Parasitology: Molecular mechanisms of susceptibility & resistance, immunity & immune responses, and xenobiotics.

Unit 3: Animal parasites

Life-cycle, biology, distribution, disease and clinical management of a protozoan parasite: *Entamoeba histolytica*, *Plasmodium* sp., *Trypanosoma* sp., *Leishmania* sp.

Life-cycle, biology, distribution, disease and clinical management of helminth, nematode and arthropod parasites: Flat worms, blood flukes, liver flukes, intestinal flukes and lung flukes, hookworms, pinworms, lungworms, root knot nematodes, Ascarids; lice, bugs, fleas, ticks & mites.

Unit 4: Plant parasites and pests

Classification, occurrence, biology and management of plant parasites: *Cuscuta*, *Striga*, *Viscum*, *Loranthus*.

Agriculturally important insect pests and parasites: Pests and parasites of commercially important crops (vegetables, cereals, pulses, fruits etc.)

Unit 5: Introduction to plant & animal pathology:

Importance of plant diseases, disease concept, disease description and diagnosis, disease cycle terminology, life-cycle strategies of plant pathogens, host-pathogen interactions and co-evolution.

Principles of animal pathology including etiology, course and termination of diseases.

Unit 6: Plant pathogens:

Fungal: Study of Oomycetes, Ascomycetes, Basidiomycetes as disease causing agents; disease cycle, host resistance, gene for gene concept, disease management with special emphasis on biological control.
**Bacterial, Viral and Nematode pathogens of plants**: Life cycle of selected pathogens affecting agricultural crops (Beans, tomato, rice, grapes, citrus, groundnuts, Ladies finger, tobacco), integrated management by cultural, chemical, biological and host resistance method, importance of plant quarantine in disease management. **10 hours**

**Unit 7: Study of animal pathogenesis**: Various degenerations, infiltration, necrosis, endogenous and exogenous pigmentations associated with animal pathology, circulatory and growth disturbances, reversible and irreversible cell injuries, different types of inflammation with special emphasis on chemical mediators. **3 hours**

Stress and age-related disorders, terminal diseases and their management **4 hours**

**Unit 8: Fungal, viral and bacterial diseases of animals including disease management**: Foot & mouth diseases of cattle, bird flu, mastitis in cattle, Grasserie, Flacherie, Muscardine, Pebrine (in silkworm and economically important insects), cocciodiosis, scrapie, brucellosis, Q fever, marine white spot disease. **5 hours**

**Recommended readings:**

5. JD Smyth, An Introduction to Animal Parasitology, 3rd edition, CUP, 1994
8. JD Smyth, An Introduction to Animal Parasitology, 3rd edition, CUP, 1994

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LS202T: IMMUNOLOGY
52 hours: 4 credits

Unit 1: Introduction to Immunology: Historical account; Cells and organs of immune system; Lymphocytes, their origin and differentiation (B-Lymphocytes and T-Lymphocytes); antigens, types and classification; complement system and its biological functions; types of immune responses; mechanism of immune response. 7 hours

Unit 2: Types of Immunity: Innate and acquired, humoral and cellular;
Humoral immunity - B-lymphocytes and their activation; structure and function of immunoglobulins; immunoglobulin classes and subclasses, genetic control of antibody production, monoclonal antibodies and diagnosis, idiotypes and idiotypic antibodies
Cellular immunity - Major histocompatibility complex. Thymus derived lymphocytes (T cells) their classification, antigen presenting cells (APC) - macrophages, dendritic cells, langerhans cells, their origin and functions; mechanisms of phagocytosis; identification of cell types of immune system; immunosuppression, immune tolerance. 13 hours

Unit 3: Immune hypersensitivity: Mechanisms of T cell activation, cytokines and their role in immune response; Leukocyte migration and inflammation; hypersensitivity of macrophage activation and granuloma formation, immune regulations, immune response to infectious organisms, Vaccines. 6 hours

Unit 4: Immunotechniques and their applications: Immunodiffusion, immunoblot, immunofluorescence, immunoaffinity, ELISA, agglutination, immunoprecipitation, immunoelectrophoresis, cross-linking. 10 hours

Unit 5: Transplantation and Grafting: Graft rejection, evidence and mechanism of graft rejection, prevention of graft rejection, immunosuppressive drugs, HLA and disease, mechanisms of immunity to tumor antigens. 10 hours

Unit 6: Autoimmunity: Auto-antibodies in humans, pathogenic mechanisms, experimental models of auto immune diseases, treatment of auto immune disorders. 6 hours

Recommended readings:

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LS203T: MICROBIOLOGY

52 hours: 4 credits


Unit 2: Culturing, maintenance and control of Microbes: Micro and macro nutrients, growth factors. Nutritional types of bacteria. Types of media (simple, complex, special), isolation, purification, Mass culturing, maintenance, effect of environmental factors on microbial growth- temperature, moisture, light, oxygen etc., control of microbial growth (disinfection and sterilization). Growth kinetics, generation time, growth curve. Aerobic, anaerobic, batch, continuous and synchronous cultures. IMViC tests.

Unit 3: Food & Dairy Microbiology: Microbes in food, food spoilage, food preservation, fermented foods, toxins and food poisoning. General account of Milk and milk products, contamination of milk, source of contamination, microflora of milk and milk products, pasteurization, preservation of milk and dairy products.

Unit 4: Agricultural microbiology: Micro flora of rhizosphere, rhizoplane, and phylloplane, Biological Nitrogen fixation, application of mycorrhizae and biofertilizers.

Unit 5: Atmospheric and aquatic microbiology- Air borne microbes, air samplers, air borne diseases, Microbes of marine and fresh water, microbes in potable water, water purification, waste water and sewage disposal, bioremediation.

Unit 6: Industrial microbiology: Industrially useful microbes, microbial fermentation - alcohol, wine and yoghurt, microflora of humans and domestic animals.

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Recommended readings:

5. Thomas D. Brock, Michael T. Madigan, Biology of Microorganisms, Science, 10th edition
10. Funke Case Tortora, Cram, Microbiology, Education – 2006
LS501T: MOLECULAR GENETICS
52 hours: 4 credits

Unit 1: Introduction to molecular genetics


Unit 2: Organization of genome

The genome (prokaryotic, eukaryotic and mitochondrial), Organization of chromatin, histones, nucleosome, structure of anaphase chromosome, ultrastructure of centromere, types of chromosome (based on number and position of centromere), function of centromere (secondary and tertiary constriction, NOR), Telomeres, Special types of chromosomes (Polytene and lampbrush), physiology of chromosomes, Non coding DNA and genes, repetitive DNA sequences, satellite DNA.

Unit 3: DNA replication, repair and recombination

The replicon- unit of replication (mapping of origin of replication, replicon in bacterial vs eukaryotic genomes, rolling circle model of DNA replication, bacterial replication and cell cycle, plasmid propagation and plasmid incompatibility), Primosomes and Replisomes (apparatus for DNA replication, DNA polymerases, Okazaki fragments, Leading and L lagging strand synthesis, common events in priming replication at origin, methylation regulating initiation at origin), DNA repair mechanisms, recombination (breakage and reunion involves heteroduplex DNA, Holliday junction).

Unit 4: Transcription and post-transcriptional modifications

Transcription complex (promoters, factors, RNA polymerases), initiation- elongation-termination of transcription, mono-cistronic and poly-cistronic RNAs, Transcription factors and their functions (zinc-fingers, helix-loop-helix, leucine zippers, homeo domains, steroid receptors), inhibitors of transcription, Post transcriptional modifications of m-RNA, t-RNA and r-RNA, apparatus for nuclear splicing (spliceosome and lariat formation, alternative splicing, self-splicing by group I introns).

Unit 5: Translation


Unit 6: Protein sorting

Introduction, signal sequences, translocation of secretory proteins across ER, protein modification in ER, protein targeting to mitochondria and chloroplast, protein targeting to the nucleus, receptor mediated endocytosis and sorting of internalised proteins, inhibitors of protein synthesis.

Unit 7: Epigenetics

Introduction, heterochromatin and histone interactions, polycomb and trithorax, CpG Islands, genomic imprinting, epigenetic effects and inheritance, prions.
Unit 8: Gene regulation in prokaryotes, eukaryotes and phages

04 hours

Transcriptional and post-transcriptional control of gene expression in prokaryotes and eukaryotes: control at initiation (RNA polymerase-promoter interactions), a panoply of operons (Lactose and Tryptophan operon), control of RNA structure (termination and anti-termination), Phage strategies (lytic cascade and lysogenic repression).

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Recommended readings:


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Unit 1: Foundations of Research
Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied research.

Unit 2: Research Design
Need for research design: Features of good design, important concepts related to good design - Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs.

Unit 3: Data Collection, Analysis and Report Writing

Unit 4: Ethical Issues
Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement.

Recommended readings:

LS205P: PARASITOLOGY, PATHOLOGY & IMMUNOLOGY

52×2 hours: 4 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.

**Parasitology & Pathology**

1. Field collection & identification of protozoan parasites
   - *Trypanosoma*
   - *Plasmodium*
   - *Amoeba*
   - *Nosema bombycis*
   - *Leishmania*
   - *Trichomonas,*
   - *Entamoeba*
   - *Toxoplasma*
   - *Gregarina,*
   - *Giardia and Eimeria,*

2. Field collection & identification of Parasitic Arthropods (lice, fleas, Ticks, mites, Uzi fly)

3. Field collection & identification of vectors: Mosquitoes, Leaf hoppers, Thrips and Jassids

3. Field collection & identification of soil and animal nematode parasites and platyhelminthes.

4. Methods of studying plant diseases - Scoring, Collection and preservation of samples

5. Culturing of Nematodes – Isolation and pathogenesis

6. Identification of disease pathology in
   - Plants: Tikka of ground nuts, Blast of rice, Mosaic of bhindi, Powdery mildew of grapes, Leaf spot of bean, Citrus canker.
   - Animals: Grasserie, Flacherie, Muscardine, Pebrine, Foot and mouth diseases, Mastitis in cattle, coccidiosis, Scrapie, Brucellosis, Bird flu, Q Fever, Marine White Spot Disease in fishes.

7. Identification of insect pests of agricultural crops – Leaf roller, mealy bugs, stem borers, sap suckers.

8. Field Visit to study crop diseases.

**Immunology:**

1. Separation of serum from blood samples
2. Isolation and enumeration of lymphocytes using haemocytometer
3. Isolation and enumeration of spleen cells
4. Purification of IgG from serum by ammonium sulphate fractionation method – Dialysis
5. ABO Blood group typing
6. VDRL/ WIDAL test
7. Immunodiffusion tests: Ouchterlony double immunodiffusion method (DID) and Single Radial immunodiffusion (SRID, Mancini method)
8. Demonstration of ELISA
9. Immunoelectrophoresis: Countercurrent IEP & Rocket IEP
10. Isolation and enumeration of lymphocytes using haemocytometer
11. Survey of structural plant defences: viz. cuticle, wax, lignin, bark, thorns, prickles, trichomes, armour in different plants species including thigmonasty, camouflage, mimicry.

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Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

**Microbiology**
1. Study of disinfectants and different methods of sterilization
2. Preparation of media for culturing bacteria, fungi and yeast
3. Isolation and identification of microbes – from soil and plant materials
4. To perform sub-culturing – streaking techniques (T streaking)
5. Study bacterial growth curve & effect of pH, temperature, UV light on bacterial growth.
6. Staining of microorganisms – Gram staining, Negative staining AFB staining, staining of fungi.
7. To perform antibiotic resistance assay
8. Enumeration of CFU of E. coli by serial dilution and spread plate method
9. Conjugation experiment
10. Microbes of milk and milk products – SPC
11. Milk quality testing by Methylene blue dye reductase test
12. Measurement of fungal microbes
13. Field visits: Dairy and Brewery

**Molecular Genetics**
1. Isolation of nucleic acids from plant (young leaves, Allium cepa) and animal (butterfly or silkworm larva, adult Uzi fly, Drosophila larva) by CTAB and SDS-Proteinase K method
2. Isolation of plasmid DNA from bacterial culture using DNA extraction kit
3. Extraction of total RNA from bacterial culture using RNA isolation kit
4. Estimation of DNA content by Diphenylamine (DPA) method
5. Estimation of RNA by Orcinol method
6. Estimation of protein by Bradford method
7. Separation of nucleotide bases by paper chromatography
8. Agarose gel electrophoresis of DNA and RNA
9. Polyacrylamide gel electrophories of proteins
**********Semester III**********

LS301T: GENOMICS & PROTEOMICS

52 hours: 4 credits

Unit 1: Genomics and the Human Genome project: History, organization and goals of human genome project. Mapping strategies, current status of various maps; DNA segment nomenclature, Human genome diversity, Organization of human genome, Mitochondrial genome, Gross base composition of nuclear genome, Gene density, CpG islands, RNA-encoding genes, Functionally identical/similar genes, Diversity in size and organization of genes. General aspects of the structure of E. coli, Arabidopsis, rice, yeast, Drosophila, C. elegans and mouse genome

13 hours

Unit 2: Gene families: Multigene families – Classical gene families, families with large conserved domains, families with small conserved domains, Gene super families, Gene families in clusters, Pseudogenes, Repetitive DNA and transposable elements, Origin of gene families (Haemoglobin, Myoglobin as examples).

6 hours

Unit 3: Comparative Genomics: Whole genome analysis, Genome sequence, micro assay, molecular phylogeny, Overview of prokaryotic and eukaryotic genomes, C-value, number of genes and complexity of genomes, Conservation and diversity of genomes, Comparative genomics as an aid to gene mapping and study of human disease genes. Comparative genomics of mitochondria and chloroplast genomes.

7 hours

Unit 4: Genome wide analysis: Global study of Genome activity, Transcriptome and its analysis, Proteomics, Synthetic genomics

6 hours

Unit 5: Protein characterization: Amino acids; proteins as polypeptides- classification of proteins, Backbone flexibility- Φ and ψ- Properties of amino acids-Hydrophobicity, EIIIP, Molecular weight, α and β propensities etc. Proteome and Proteomics Proteins as workhorse molecules of life, -protein separation & analysis using 2D Gel Electrophoresis, protein arrays; Liquid chromatography, Mass spectrometry- Protein-protein interaction; Detection of functional linkages.

7 hours

Unit 6: Protein structure analysis: Structure prediction of primary, secondary and tertiary structure of proteins-SCOP, DALI/DD, CATH classification. Interatomic forces and protein structure, covalent interaction, hydrogen bonds, hydrophobic and hydrophilic interaction, charge/dipole interaction, Vander waals forces, steric interaction, Determining protein structure, Homology modeling, CASP, Ab initio prediction, Molecular dynamics & conformational energy calculation, Prediction of function.

13 hours

Recommended readings:

LS302T: GENETIC ENGINEERING & BIOTECHNOLOGY

52 hours: 4 credits

Unit 1: Introduction to Recombinant DNA technology: An overview of structure and function of nucleic acids, role of enzymes used in Genetic Engineering (endo- & exonuclease, RNase, DNase, restriction endonucleases) DNA methylation, RNA modification, role of kinases, phosphatases, bacteriophage polynucleotide kinase, Ligases. Vectors employed in recombinant DNA technology, – cloning plasmids (pBR322, pUC19/18, Ti) cosmids, phagemids, shuttle vectors, ARS, mini chromosomes, BACs, PACs, YACs, Expression vectors used for expression of proteins in bacteria, yeast, plants and animal cell lines.

Unit 2: Gene cloning and expression: Various techniques and strategies used in gene cloning in prokaryotes (E. coli) and eukaryotes (S. cerevisiae, Pichia pastoris), gene transfer methods: Physical, Chemical and Biological. Transformation into bacteria and yeast, transfection into plant and animal cells, selection of recombinant cells, expression of recombinant proteins.

Unit 3: Gene Screening and Isolation: Isolation and purification of nucleic acids, Construction of genomic and cDNA libraries, Selection of probes and labeling, Blotting of DNA / RNA and hybridization, Colony, plaque screening and hybridization.

Unit 4: DNA sequencing: Dideoxy and chemical methods, sequence assembly, automated sequencing, and applications of DNA sequencing (synthetic oligonucleotides), Next Generation Sequencing (NGS).

Unit 5: Application of recombinant DNA technology: Overview of transgenic plants and GMO (Bt cotton, golden rice, tomato, corn, brinjal, cow, sheep, poultry, fish). Gene therapy: rationale, types of gene therapy (additive, replacement), gene therapy vectors (viral, non-viral), gene therapy drawbacks, gene therapy clinical trials and outcome, integration of gene and cell therapy.

Unit 6: Bioethics and IPR
Introduction to ethics: deontology & consequentialism, ethics codes, relationship to law; Human subject research: history and standards; federal regulation of research, protection; Genetics & ethics: privacy and confidentiality, discrimination & commercialization; Introduction to IPR, Patents-Gene Patenting, Trademarks, Copyrights, Industrial Designs, Geographical Indications, Future Developments of Intellectual Property Rights.

Unit 7: Animal cell culture & tissue engineering
Media for culturing cells and tissues. Preparation of animal cell culture media, sterilization and storage. Sterilization of various equipments and apparatis. Short-term primary culture, adherent and suspension cells, maintenance of cell lines. Cryopreservation.
Stem cell isolation and culture, mechanical forces, cell adhesion and migration, polymeric scaffolds, biomimetic materials, tissue engineering using bone as an example.

Unit 8: Plant tissue culture
Media constituents, selection, preparation, isolation of single cells, suspension cultures, applications of cell culture. Cellular totipotency, cytodifferentiation, organogenic differentiation, somatic embryogenesis, practical applications of haploid cell production, techniques of plant regeneration from pollen embryos, gynogenesis, haploid production through distant hybridization, diploidization to raise homozygous diploids, applications, limitations, triploid production, callusing, organogenesis, applications of endosperm culture, transgenic plants.
Unit 9: Bioprocess engineering
Screening and selection of industrial microorganisms, Bioreactors – types, basic functions, design and components, construction, temperature control, aeration, agitation systems, sterilization of fermenters, air supply and medium, aseptic inoculation and sampling methods.

4 hours

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Recommended readings:

- Genes VIII by Benjamin Lewis. Oxford University & Cell Press, 2003
- Genetic Engineering Vol. 1-4 (Williamson Edition)
- Recombinant DNA by Watson et al., 1983.
- Intellectual property rights: innovation, governance and the institutional, Birgitte Andersen, Law – 2006

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LS303T SYSTEMS BIOLOGY
52 hours: 4 credits


Unit 2: Control of enzyme activity & metabolic pathways: Introduction, control of activities of the single enzymes, controlling the activity by change in covalent structure of enzymes, models account for the behavior and regulation of enzymes, significance of allosteric and cooperative behavior of enzymes. Metabolic pathways - general consideration, amplification of signals, formulation of theories for control of metabolic pathways, examples Regulation of glycolysis, gluconeogenesis and glycogen metabolism. 13 hours

Unit 3: Enzymes in organized systems:
- Models of multi-enzyme complexes
- Pyruvate dehydrogenase from E.coli and mammalian Tissues.
- Tryptophan synthase. 6 hours

Unit 4: Gene expression: Introduction, analysis of gene expression, different tools available for analysis of gene expression, measurement of gene expression by Micro arrays, RNAi types of micro arrays, analysis of micro array gene expression data, Relating Expression data to other biological information – Predicting binding sites of proteins to DNA, Predicting protein-protein interactions and protein functions, Predicting functionally conserved modules, Reverse-engineering of gene regulatory networks. 13 hours

Unit 5: Introduction to proteomics and genomics: Genomics and Proteomics as a foundation for Systems Biology, Strategies relating to In-silico Modeling of biological processes, Metabolic Networks, Signal Transduction Pathways, Gene Expression Patterns. Applications of Systems Biology Markup language (SBML), E-cell and V-cell Simulations and Applications; Synthetic genomics – Methods and applications 9 hours

Unit 6: Bioinformatics in Drug and Vaccine Design: Introduction, The drug discovery process, Techniques in drug and vaccine designing. 4 hours

Recommended readings:

2. ICRF handbook of genome analysis, by NK Spurr, BD Young, SP Bryant. Volumes I & II. - Blackwell science publishers.
3. ICRF handbook of genome analysis, by NK Spurr, BD Young, SP Bryant. Volumes I & II. - Blackwell science publishers
### LS304T: OPEN ELECTIVE

48-56 hours: 4 credits

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Open Elective offered by Department of Life Sciences

Human Health & Hygiene

4 hours / week | 4 credits

Unit 1: Human health & disease

WHO definition of health, disease, disorder; classification of diseases based on source, global distribution of diseases. Vaccination, types of vaccines Smallpox and the role of vaccination, vaccination programmes, safety and effectiveness of vaccines.

Unit 2: Common infectious diseases

Definition of pathogens, terminologies used in infectious disease (aetiology, epidemiology, vector, incubation period, infective period, causative agent, carrier, notifiable disease, epidemic, endemic, pandemic, signs, symptoms, prevention/prophylaxis, treatment).

Water-borne diseases – causative agent, transmission, signs and symptoms, treatment and prevention of Cholera, Typhoid and Paratyphoid.

Air-borne diseases - causative agent, transmission, signs and symptoms, treatment and prevention, resurgence of T.B., Influenza (H1N1)

Vector-borne diseases - causative agent, transmission, signs and symptoms, treatment and prevention, eradication of Malaria, Filaria, Chickungunya, Dengue, Swine

STDs - causative agent, transmission, signs and symptoms, detection, treatment and prevention, eradication of AIDS, Syphilis, Gonorrhoea,

Unit 3: Disinfectants, antiseptics & antibiotics

History (Pasteur, Lister), various antiseptics (hypochlorites, phenol, ethanol, isopropanol, aldehydes, detergents, Chloroxylenol), sterilization techniques (heat treatment, steam treatment, radiation).

Antibiotics (biostatic, biocidal), most commonly used antibiotics, mechanism of action of antibiotics, antibiotic resistance.

Unit 4: Genetic and Life-style disorders

Cardiovascular disorders (atherosclerosis, coronary thrombosis, myocardial infarction, angina), causes and treatment (pacemakers, heart transplant).
Cancer (benign, malignant, oncogenes, metastasis), causes of cancer, prevention and control.

Diabetes (Type I and type II), genetic predisposition, worldwide incidence, clinical symptoms and control.

Ageing (Alzheimer’s disease, osteoarthritis, rheumatoid arthritis).

Unit 5: Linkages between Environment and Health 5 hours
Understanding linkages between Environment and Public Health: Effect of quality of air, water and soil on health. Perspective on Individual health: Nutritional, socio-cultural and developmental aspects, Dietary diversity for good health; Human developmental indices for public health

Unit 6: Climate Change and Implications on Public Health 7 hours
Global warming - Agricultural practices (chemical agriculture) and Industrial technologies (use of non-biodegradable materials like plastics, aerosols, refrigerants, pesticides); Manifestations of Climate change on Public Health- Burning of Fossil fuels, automobile emissions and Acid rain

Unit 7: Perspectives and Interventions in Public Health 7 hours
Epidemiological perspectives — Disease burden and surveillance; Alternative systems of medicine - Ayurveda, Yoga, Unani, Siddha and Homeopathy (AYUSH); Universal Immunization Programme (UIP); Reproductive health - Youth Unite for Victory on AIDS (YUVA) programme of Government of India. Occupational health hazards- physical-chemical and biological. Occupational diseases- prevention and control

Recommended readings:

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Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

Genomics & Proteomics:

1. Restriction mapping of plasmid DNA
2. RAPD analysis
3. RFLP analysis
4. DNA fingerprinting analysis: Parentage detection
5. Demonstration of EST/ STS/ Microarray analysis
6. Homogenization, fractionation and separation of enzymes/ proteins in plants and animals
7. 2D-PAGE separation of proteins

Systems Biology:

1. Visit to IISc / NCBS (CCAMP) for demonstration of Mass spectroscopy & Microarray platforms
2. Metabolomics: LDH assay
4. Methods to detect chemically modified proteins through Western blotting

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Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Callus Induction Techniques
2. Artificial seed production
3. Production of haploid plants by anther and pollen culture
4. *Agrobacterium* mediated transformation
5. Isolation and purification of plasmid DNA from *E. coli*
6. Fibroblast culture from chick embryo
7. Cell disruption techniques
11. Estimation of percentage of ethanol from fermented broth
12. Estimation of Lactic acid from fermented broth.
14. Production of wine using yeast
15. Micro injection and transformation

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Unit 1: Stem Cells: Definition and characteristics, classification of stem cells (Embryonic stem cells and adult stem cells), stem cell niche, stem cell division and its control, induced pluripotent stem cell generation & application, hemopoietic stem cell disorders: classification and manifestations, principle and procedure of bone marrow transplantation.  

8 hours


6 hours

Unit 3: Cancer Biology: Different types of tumors, factors and mechanism involved in tumor formation, oncogenes, tumor suppressor genes, methods of detection of cancer, tumor markers, treatment-chemotherapy, radiotherapy, immunotherapy and gene therapy for cancer.  

7 hours

Unit 4: Human Microbial diseases: Mode of infection, symptoms, epidemiology and control of AIDS, Hepatitis B, Rabies, Tetanus, Typhoid, STD, TB, Cholera, Aspergillusosis, Histoplasmosis, Cryptococcosis, Leprosy, H5N1 and H1N1; Arboviral diseases: Yellow fever, Dengue, Japanese Encephalitis, Chickungunia, Kyasanur forest disease-epidemiology and management.  

8 hours

Unit 5: Haematology and transfusion science: Structure, function and production of blood cells, platelet structure and function haemostasis, fibrinolysis, thrombosis. Types of anaemias, haemoglobinopathies and thalassaemias, Haematological malignancy. Transfusion science, Genetics, inheritance, structure and role of red cell antigens, The preparation, storage and use of blood components, the selection of appropriate blood components for transfusion and possible adverse effects, immune mediated destruction of blood cells, health and safety aspects of handling blood.  

11 hours

Unit 6: Disease diagnostics: Nervous system, perspective and behaviour, Neural disorders and repair. DNA finger printing in Forensic science and Disease diagnosis. Enzymes in diagnosis of human diseases and Health care. Acetylcholinesterase, angiotensin converting enzyme (ACE), Pseudocholinesterase, 5'- nucleotidase (5NT), Glucose-6-phosphate dehydrogenase (GPD) and other red cell enzymes; CK isoforms, Immunoreactive trypsinogen (IRT) and Chymotrypsin; Amylase isoenzymes, Macroamylases, Isoenzymes (CK, LD, ALP). SGOT and SGPT. Diagnosis of Diabetes mellitus and Glucosurea. Prosthetics and their applications; Biomedical ethics.  

12 hours

Recommended readings:  
- Enzyme Technologies for pharmaceutical and biotechnological applications by Herbert A Kirst, Wu-Kuang Yeh, Milton J.  
- Hematology, by William J. Williams, Ernest Beutler, Allan JU. Erslev, Marshall A. Lichtman  
- Cruickshank et al. Medical microbiology
- Atul B. Mehta, A. V. Hoffbrand, Haematology at a glance - Medical – 2005

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LS 402T: BIOINFORMATICS & COMPUTATIONAL BIOLOGY

4 hrs / week | 4 credits

Unit 1: Introduction to Bioinformatics and Computational biology: Branches of Bioinformatics, Applications of Bioinformatics. Biological databases: Introduction, Classification of Biological databases, Biological data retrieval systems

Unit 2: Sequence Comparison and Database Search: Introduction, Pair wise alignment, global alignment, local alignment, multiple sequence alignment, scoring a multiple alignment, multiple sequence alignment methods

Unit 3: Dynamic programming approach, Progressive alignment, iterative refinement methods, pattern matching in DNA and protein sequences, PAM matrices, BLAST, FAST and FASTA.

Unit 4: Molecular phylogenetics: Introduction, application of phylogenetic trees, basic terminology- taxa, taxanomy, root, leaf, node, tree, branch, clade, dendogram, cladogram, rooted tree, unrooted tree, scaled tree.


Unit 6: Computer programming: Basics of linux, C, C++, Java, Perl & HTML programming

Recommended readings:
1) Zhumur Ghosh and Bibekanand Mallick, Bioinformatics, Principles and Applications, Oxford University Press, New Delhi, 2008
3) Joao Carlos Setubal et. al., Introduction to Computational Molecular Biology, PWS publishing company, Boston.
4) David W. Mount, Bioinformatics, Sequence and Genome analysis, CBS Publishing House
Mathematical biology

Unit 1: Ratio and Proportions, fractional notations, Permutations and Combinations. 3 hours

Unit 2: Functions: Linear functions, polynomials, simple rational functions, exponential functions (growth and decay), natural logarithmic functions and periodic functions (sine and cosine only) 4 hours

Unit 3: Derivatives and Chain Rule, implicit differentiation. 6 hours

Unit 4: Applications: Extrema, graph sketching, optimization, related rates. 6 hours

Unit 5: Accumulated change and definite integrals (using definite integrals for finding area) for functions. 5 hours

Unit 6: Partial Differentiation. 2 hours

Biostatistics:


Random sampling. Simple random sampling and stratified random sampling. Use of random number tables, sample size determination. 6 hours


Unit 4: Test of Significance & Design of Experiments: Statistical hypothesis. Type–1 and Type–2 errors, level of significance, size and power of a test. Definition of Chi-square, t and F distributions. Central limit theorem. Tests for the mean, equality of two means, variance (for large and small samples). Large samples tests for proportions. Chi-square test for goodness of fit and for independence of attributes in contingency tables. Confidence interval.

Analysis of variance. One-way and two-way classified data. Design of experiments. Analysis of completely randomized, randomized block and nested designs. 10 hours

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Recommended readings:


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LS 404T: APPLIED BIOLOGY

4 hrs / week | 4 credits

Unit 1: Apiculture

Biology of Bees, Rearing of Bees, Diseases and Enemies, Bee Economy, Entrepreneurship in Apiculture.

Unit 2: Sericulture & Lac culture

Biology of silkworm, Rearing of silkworms, Pests and Diseases, Entrepreneurship in sericulture.

Biology & distribution of lac insect, extraction of lac and economic importance

Unit 3: Animal Husbandry

a) Poultry - farming techniques, breeds, poultry diseases, economic value.
b) Dairy – breeds of cattle, milch breed, draught breed, dual purpose, common diseases and control, exotic and cross breeds, techniques adopted in cattle breeding.
c) Piggery – different breeds, maintenance and marketing of products.

Unit 4: Aquaculture

Aquarium fish keeping: scope as cottage industry, exotic and endemic species; biology of aquarium fishes (guppy, molly, sword tail, gold fish, angel fish, butterfly fish, blue morph, anemone fish); food and feeding; fish transportation

Pisciculture: Importance, fresh water techniques, brackish and marine fish culture in India, diseases and their control, Pearl culture in India.

Unit 5: Commercial crops

a) Floriculture – commercial production of Roses, Anthurium, Gladiolas, tuberose, Jasmine- propagation and cultivation practices
b) Mushrooms – types, cultivation practices and marketing
c) Plantation crops -Economic importance: coffee, tea, rubber, cardamom; timber-yielding plants: teak, rosewood, Terminalia, Pterocarpus, Shorea; Social forestry, Agro-forestry, Silviculture.

Unit 6: Medicinal botany

History, scope, indigenous medicinal sciences; Ayurveda (definition, origin, panchamahabhutas, saptadhatu, tridosha concept, rasayana, common plants used in treatments), Siddha (origin, basis and plants used), Unani (history, concept)

Conservation of endangered and endemic medicinal plants (definition, red list criteria, botanic gardens, ethnomedicinal plant gardens, biosphere reserves, sacred groves, national parks, ex-situ conservation)

Ethnobotany and folk medicines in India (definition, methods of study, applications, natural products to cure certain diseases – jaundice, cardiac problems, infertility, diabetes, blood pressure, skin diseases)

Recommended readings:

5. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.
9. Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.

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LS405P: Biomedical Sciences & Bioinformatics

Biomedical Sciences:

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Estimation of SGOT in blood samples by standard curve method
2. Estimation of SGPT in blood samples by standard curve method
3. Estimation of LDH in blood samples by standard curve method
4. Estimation of Creatinine in blood samples by standard curve method
5. Estimation of Cholesterol – hypercholesteremia samples
6. Estimation of Bilirubin
7. Estimation of blood glucose by glucose oxidase method
8. Immunoassay for detection of typhoid (kit method)
9. STD detection by agglutination method (kit method)
10. Chromosomal analysis, bright field technique, GTG and CBC banding
11. NOR staining and sex chromosome identification
12. Identification of organelles by marker enzymes: SDH, LDH, acid phosphatase
13. Fluorescence technique, Q & C banding, FISH

Bioinformatics:

1. Searching bibliographic databases for relevant information;
2. Sequence retrieval from nucleic acid and protein databases;
3. Restriction mapping; Sequence (FASTA and BLAST) searches;
4. Pair wise comparison of sequences; Multiple alignment of sequences; Evolutionary studies / Phylogenetic analysis;
5. Identification of genes in genomes; RNA folding; Primer Design;
6. Protein databank retrieval and visualization;
7. Superposition of structures; Secondary structure prediction of proteins;
8. Identification of membrane proteins;
9. Pattern searching in proteins (PROSITE);
10. Pattern searching in nucleic acids; Validation of 3D structures;

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LS406P: Research project & Dissertation

12 hours / week | 6 credits

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- Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing / exploring a real life problem. The students are expected to pursue an in-house research project preferably in alignment with their practical syllabi. An internal guide from the Department of Life Sciences will be assigned to the student. S/he will be responsible for keeping track of the student’s progress towards submission of the final dissertation. Additionally, the student may approach him/her at any point of time seeking guidance / suggestion, if required.

- In the mid-semester (date to be announced at the beginning of the semester), the students will be expected to make a poster presentation of their research project highlighting background literature review and showcasing results obtained thus far. S/he will also be required to give a colloquium on the topic. Both the poster and the colloquium will be evaluated by the members of an internal committee constituted by the Coordinator / Chairman of the Department. This will count towards internal assessment (IA).

- After the student has completed his/her research project within the stipulated time, s/he will be required to submit two copies of dissertation approved both by the external as well as internal guide, present the results in an open seminar, and defend the theses through a viva-voce conducted in accordance with existing regulations.