

SEMESTER III

ZY3CT11 ANIMAL PHYSIOLOGY

ZT3CT12 CELL AND MOLECULAR BIOLOGY

ZY3CT 13 MICROBIOLOGY AND BIOTECHNOLOGY

ZY3CT14 IMMUNOLOGY

ZY3CP15 PRACTICAL - 3: CELL AND MOLECULAR BIOLOGY,
MICROBIOLOGY AND BIOTECHNOLOGY

ZY3CP16 PRACTICAL - 4: ANIMAL PHYSIOLOGY AND IMMUNOLOGY

ZY3CT11 ANIMAL PHYSIOLOGY

90 Hours. (5hrs/week)

Credit-4

Objectives:

- To study and compare the functioning of organ systems across the animal world
- To give an over view of the comparative functioning of different systems in animals
- To learn more about human physiology

Module I. Nutrition, Digestion and Absorption

8 hrs.

Nutrition in animals, mechanisms of food intake in different animals.

Physiology of digestion and absorption. Structural and biochemical adaptations to special dietary pattern, symbiotic digestion.

Neuronal and hormonal regulation of nutritional intake, hunger drive, thirst.

Obesity- causes and consequences, outline of hormonal involvement, Leptin: synthesis, secretion and its role in adipogenesis.

Prerequisite: Human digestive system: structure and function, gastro-intestinal and nutritional disorders.

Module II. Circulation

10 hrs.

Circulatory mechanisms and fluid compartments, movement of body fluids by somatic muscles, open system, closed system, lymph channels.

Circulatory shock, Circulatory arrest.

Types of hearts- chambered heart, tubular heart, ampullar heart, lymph heart, neurogenic and myogenic heart. Pace makers and specialized conducting fibers. Cardiac cycle, cardiac output, blood pressure, effect of drugs on heart beat, effects of exercise on cardiovascular physiology. ECG - its principle and significance. Blood buffers, Human congenital heart diseases.

Prerequisite: Anatomy of human heart, composition of blood. Haemopoiesis.

Module III. Respiration

8 hrs.

Respiration in invertebrates and vertebrates.

Pulmonary ventilation, respiratory muscles, surfactants. Respiratory centers and periodic breathing. Regulation of respiration. Respiration in unusual environment – foetal and neonatal respiration, high altitude, diving. Structure and functioning of respiratory pigments. Metabolic rate : basal metabolic rate and its measurement.

Pre-requisite: Respiratory organs with special reference to arthropods and vertebrates.

Module IV. Osmoregulation and Excretion

6 hrs.

Osmoregulation in fresh water, marine and terrestrial animals.

Excretion in vertebrates. Physiology and regulation of urine formation, Hormonal regulation of urine formation. Regulation of water balance, electrolyte balance and acid-base balance. Dialysis, artificial kidney, kidney transplantation.

Prerequisite: Vertebrate kidney, Structure of nephron, excretory products, kidney disorders.

Module V. Nerve Physiology

10hrs.

Neuroanatomy of the central and peripheral nervous system. Electrical and chemical transmission. Synaptic transmission. Modifications of synaptic transmission during fatigue, acidosis, alkalosis, hypoxia and drugs. Mechanism of excitatory and inhibitory pathway. Neuromuscular Junction: organization and properties of neuromuscular junction, neuromodulators. Neural control of muscle tone and posture.

Prerequisite: Structure of neuron. Neurotransmitters. EEG, MRI, memory, neural disorders in man.

Module VI. Sensory and Effector Physiology**12 hrs.**

Classification of somatic senses and somatic receptors, exteroceptors, interoceptors, modality of sensation, secondary sense cells, transduction, relationship between stimulus, intensity and response, sensory coding. Chemical senses: taste, smell, mechanism of reception.

Mechanoreceptors: hair cell, organs of equilibrium, vertebrate ear, mechanism of hearing, electro and thermoreceptors.

Vision: Structure of invertebrate and vertebrate eye. Physiology of vision.

Pain: pain receptors, headache and thermal senses, pain suppression (analgesia).

Tactile sensation: touch receptors, transmission of signals, special problems of premature infants, Physiological role of touch and environment in premature infants- Kangaroo care, infant massage, supportive environment.

Prerequisite: *structure of skin, eye and ear.*

Module VII. Muscle Physiology**8 hrs.**

Comparative physiology of skeletal, smooth and cardiac muscles. Skeletal muscle- ultra structure and molecular organization. Red and white muscles, muscle proteins. Mechanism of muscle contraction and relaxation. Energetics of muscle contraction. Effect of exercise on muscles. Catch muscle and fibrillar muscle.

Prerequisite: *simple muscle twitch, latent and refractory periods, tetanus, tonus, fatigue, oxygen debt.*

Module VIII. Thermoregulation**5 hrs**

Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.

Impact of temperature on the rate of biological functions. Arrhenius equilibrium, Q₁₀.

Temperature compensation and temperature regulation in poikilotherms and homiotherms. Adaptations for extreme environments, aestivation and hibernation.

Module IX. Endocrinology**15 hrs.**

Invertebrate and vertebrate endocrine system. Endocrine glands. Synthesis, physiologic role, control and mechanisms of hormone action. Neuro-endocrine regulation of hormone action. Bioamines, Eicosanoids, Chalcones, Lumones, Phytohormones, Synthetic hormones.

Prerequisite: *Hormones as messengers, hormonal control of homeostasis. Disorders of hormonal imbalance in Man.*

Module X. Reproductive physiology**8 hrs**

Anatomy and histology of adult testis and ovary. Reproductive cycles of mammals and their hormonal control. Physiology of implantation, pregnancy, parturition, and lactation.

Impact of senescence and age on reproduction.

Prerequisites: *spermatogenesis, Oogenesis, egg-sperm interaction*

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ZY3CT12 CELL AND MOLECULAR BIOLOGY**90 Hours (5 hrs/week)****Credit- 4****Objectives:**

- To help study the structural and functional details of the basic unit of life at the molecular level
- To motivate the learner to refresh and delve into the basics of cell biology
- To introduce the new developments in molecular biology and its implications in human welfare

Module I. Cellular Membranes**6 hrs.**

Membrane structure and chemistry, dynamic nature of the plasma membrane, membrane functions, membrane potentials, ion channels.

Prerequisite: membrane transport – Diffusion and osmosis, Facilitated diffusion, Active transport, Bulk transport. Nucleus and nuclear membrane

Module II. Cell junctions, Cell adhesion and Extracellular matrix**10 hrs.**

Extracellular matrix: Basal membrane and laminin, Collagen, Proteoglycan, Fibronectin. Interaction of cells with extracellular matrix: Integrins. Focal adhesion and hemidesmosomes. Interaction of cells with other cells: Selectins, Immunoglobulins, Cadherins, Adherens. Junctions and desmosomes. Tight junctions, Gap junctions and Plasmodesmata.

Module III. Cell Organelles**6 hrs.**

Endoplasmic reticulum, Golgi complex, Ribosome, Mitochondria.

Prerequisite: Lysosome, Chloroplasts, Peroxisomes and Glyoxysomes

Module IV. Cytoskeleton and Cell Motility**5 hrs.**

Microtubules, Microfilaments, Intermediate filaments, Molecular motors, Non muscle motility and contractility.

Module V. Cell Signaling**15 hrs.**

Extracellular messengers (signaling molecules), role of Calcium and Nitric oxide (NO) as intracellular and intercellular messengers.

Receptors: G- Protein coupled receptors, Receptor tyrosine kinases (RTK), Ion channel receptors, Cytokine receptors (Tyrosine kinase linked receptors).

Second messengers: Cyclic-AMP, Cyclic-GMP, Inositol 1,4,5-trisphosphate (IP₃), Di-acyl glycerol (DAG). Signaling pathways: G-protein coupled receptor (GPCR) and cyclic AMP pathway – role of protein kinase A (PKA), GPCR pathway in rod cells, Receptor protein tyrosine kinase and Ras-MAP kinase pathway, JAK-STAT pathway, Calcium phosphatidyl- inositol pathway, Phospho Inositide 3-kinase (PI-3 kinase), Transforming growth factor (TGF) signaling pathway. Regulation of signaling pathways. Convergence, divergence and crosstalk among different pathways.

Prerequisite: Basic principles of cell communication

Module VI. Cellular Reproduction**5 hrs.**

Cell cycle: Steps in cell cycle, Control of cell cycle, Checkpoints in cell cycle. Control of cell division and cell growth.

Apoptosis- extrinsic and intrinsic pathways, significance

Prerequisite: Mitosis, meiosis and Structure of chromosome.

Module VII. Cancer

8 hrs.

Basic properties of a cancer cell, Types of cancer, Causes of cancer, Genetics of cancer, Tumour suppressor gene, Oncogene.

New strategies for combating cancer: Immunotherapy, Gene therapy, Inhibiting cancer promoting proteins, Inhibiting formation of new blood vessels.

Module VIII. Gene Expression

20 hrs.

Relationship between genes and proteins. Transcription in prokaryotes and eukaryotes-rRNA, tRNA and mRNA, RNA processing in prokaryotes and eukaryotes, Translation in prokaryotes and eukaryotes, initiation, elongation and termination, post transcriptional modifications, protein sorting, signal sequences and signal hypothesis.

Pre-requisite: *Gene and Genetic code*

Module XI. Gene Regulation

15 hrs.

Regulation of gene expression in *E. coli* : Catabolite repression, *Trp* operon in *E.coli*-repression and attenuation, *Ara* operon in *E.coli*-positive and negative controls. Riboswitches. General introduction to gene regulation in eukaryotes at transcriptional, post transcriptional and translational levels, transcription factors, enhancers and silencers, Chromatin-remodelling complexes, RNA interference (RNAi).

Pre-requisite: *Fundamentals of gene regulation, Lac operon*

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- Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. 2009. *Molecular Biology of the Gene*. Pearson.

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ZY3CT 13 MICROBIOLOGY AND BIOTECHNOLOGY**72 Hours (30+42) (4hrs/week)****Credit- 4****Objectives:**

- To provide an over view of the microbial world, its structure and function
- To familiarize the learner with the applied aspects of microbiology
- To give students an intensive and in-depth learning in the field of biotechnology
- To understand the modern biotechnology practices and approaches with an emphasis in technology application, medical, industrial, environmental and agricultural areas
- To familiarize the students with public policy, biosafety, and intellectual property rights issues related to biotechnology

MICROBIOLOGY**30hrs.****Module I. Introduction to Microbiology****3 hrs.**

Methods of Microbiology, Main group of microorganisms, general characters. Classification, approaches to microbial classification, outline classification, Bergey's manual.

Prerequisite: Discovery of microorganisms. Contributions of Scientists to the field of Microbiology-Anton Von Leewenhoek, Edward Jenner, Lazaro Spallanzani, Louis Pasteur, Joseph Liter, Robert Koch and Alexander Flemming.

Module II. Functional Anatomy of Prokaryotic Cells**3 hrs.**

Cell structure, plasma membrane, cytoskeleton, cytoplasm, nucleoid, cytoplasmic inclusions. The prokaryotic cell envelope, peptidoglycan structure, gram positive and negative cell walls. Components outside the cell wall: capsules, slime layers and s- layers, pili and fimbriae, flagella and motility. The endomembrane system, mitochondria and chloroplasts, cell wall and pellicle in protists.

Prerequisite: Morphology, size, shape and cell arrangement.

Module III. Microbial Metabolism**4 hrs.**

Energy acquisition by chemotrophs and phototrophs, glycolysis (Embden- Meyerhof pathway). Fermentation, anaerobic oxidations, chemosynthesis. Photosynthesis, carbon assimilation. Regulation of metabolism.

Module IV. Nutrition and Growth**3 hrs.**

Common nutrient requirements, nutritional types, growth factors, uptake of nutrients by the cell. Culture media. Reproduction and exponential growth, the growth curve. Physical requirements for bacterial growth and influence of environmental factors on growth.

Module V. Microbial Interactions and Microbial Ecology**4 hrs.**

Symbiosis, commensalism. Mutualism between microbes, microbes and plants, microbes and animals. Cooperation, competition, predation, antagonism. Parasitism, plant parasites, animal parasites.

Module VI. Virology**3 hrs.**

Properties of viruses, structure and chemical composition, genetic composition eclipse, host interaction and specificity. Classification, RNA virus, DNA virus, plant virus, animal virus, bacteriophage, lysis and lysogeny, Viral replication. Virioids and prions. Nature and significance. Pathogenic virus, oncovirus.

MODULE VII. Applied Microbiology

10 hrs.

Bacteria of air, water and soil. Microbes associated with food production and spoilage, microbiology of milk and dairy products. Epidemiology of human diseases, Mechanism of microbial pathogenicity. Normal microbial population on human body, microbial diseases, Nosocomial infections. Medical mycology. Control of microorganism- physical, chemical and antimicrobial agents. Biological weapons and bioterrorism.

BIOTECHNOLOGY

42 hrs.

Module I. Introduction to Biotechnology

2 hrs.

Historical aspects, definitions and scope of Biotechnology. Biotechnology in India.

Module II. Tools and Techniques in Recombinant DNA Technology

12 hrs.

Vectors: cloning and expression vectors - Plasmids, Ti and Ri plasmids, cosmids, phasmids, phagemids, bacteriophage, SV40, vectors with combination features; PUC19 and Bluescript vectors, shuttle vectors, viral vectors, BAC and YAC vectors. Restriction enzymes and DNA modifying enzymes.

Polymerase chain Reaction- different types and applications. Chromosome walking, chromosome jumping, DNA foot printing. Molecular Markers and Probes-SNP, VNTR, RAPD, RFLP, SSR, STMS, FISH and GISH. DNA sequencing methods- Maxam and Gilberts chemical degradation method, Sanger and Coulson method, Automated DNA sequencers. Site directed mutagenesis, molecular chimeras.

Cloning Methodologies - Gene isolation : Shot gun method, Genome libraries, cDNA libraries, Chemical synthesis. Splicing and integration of isolated gene- cohesive end ligation, homopolymer tailing, extending linkers. Methods of rDNA transfer to host cells- CaCl_2 treatment, Virus delivery. Selection and screening of the transformed cells, Blue-white screening, Colony hybridization methods, Reporter genes, Fusion proteins.

Prerequisite: Blotting techniques- Southern, Northern, Western, Dot Blot, DNA finger printing.

Module III. Animal Biotechnology

12 hrs.

Cell and Tissue culture: Basic techniques of mammalian cell culture, disaggregation of tissue and primary culture, maintenance of cell culture and cell separation. Growth media: Physicochemical properties, natural and artificial, Balanced salt solutions, Complete Media, Serum, Serum-Free Media and protein free media and their applications. Biology and characterization of cultured cells, measurement of viability and cytotoxicity. Manipulation of cultured cell and tissues- scaling up of animal cell culture, cell synchronization, cell transformation, organ and histotypic culture. Tissue engineering: strategies and developments in tissue engineering, Biomaterials. Contamination: Source of contamination, Type of microbial contamination, Monitoring, Eradication of contamination, Cross-Contamination. Cryopreservation - importance and process of cryopreservation, cryopreservation of embryos, Cryogenics.

Transfection Methods: CaPO_4 precipitation, Short Gun, Electroporation, Lipofection, Microinjection, Agrobacterium mediated gene transfer. Somatic cell nuclear transfer- reproductive cloning and therapeutic cloning. Gene knockout and knockin technology. Applications of transgenic animals.

Stem cell culture : General and historical aspects, properties and types of stem cells, advantages and disadvantages, stem cell niche, application of stem cell technology in medicine.

Module IV. Biotechnology in Healthcare

4 hrs.

Disease prevention – DNA vaccines. Disease diagnosis - Probes, Monoclonal antibodies, detection of genetic disorders. Disease treatment - Therapeutic proteins, hormones and growth factors. RNAi, Drug targeting, Gene therapy. Forensic medicine. Biosensors-different types, applications - medical and non medical. Introduction to Biochips and their application in modern sciences.

Module V. Biotechnology in Industry and Agriculture

5 hrs.

Metabolite production. Antibiotics, Organic acids, Amino acids, Vitamins, Upstream processing, downstream processing.

Microbial enzymes and biotransformation- Microbial production of enzymes, fermentation, Enzyme engineering and applications. Food industry- Single cell protein, probiotics. Transgenic plants- Plants with resistance to Pests, plants with increased shelf life. Biofertilizers and microbial inoculants, biotechnology of nitrogen fixation, biocontrol agents, biopesticides, bioinsecticides, Terminator gene technology -concept and basics.

Module VI. Environmental Biotechnology

3 hrs.

Sewage treatment. Solid waste management. Biodegradation of xenobiotic compounds. Bioremediation and Biorecovery. Microbial leaching and mining. Biofuels. Transgenics and environment.

Module VII. Intellectual Property Rights, Biosafety and Bioethics

4 hrs.

Introduction to Intellectual Property Rights, Types of IP: Patents, Trademarks, Copyrights.

Basics of Patents Types of patents; Indian Patent Act 1970; Recent Amendments, Protection of New GMOs. IPs of relevance to Biotechnology and few Case Studies (Rice, Neem, Curcumin). Introduction to History of GATT, WTO, WIPO and TRIPS.

Biosafety concepts and issues. General guidelines for recombinant DNA research activity. Biosafety protocol 2000.

Bioethics: Principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc. Ethics in post genomic era-genetic testing and genetic screening.

REFERENCES

Microbiology

Arora, D.R. and Arora, B. 2008. *Text Book of Microbiology*. CBS Publishers and Distributors, New Delhi

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ZY3CT 14 IMMUNOLOGY**Total: 54 Hours. (3hrs./ week).****Credit- 3****Objectives:**

- To provide an intensive and in-depth knowledge to the students in immunology
- To help the learner to understand the role of immunology in human health and well-being
- To familiarize the students the new developments in immunology

Module I. Overview of the Immune System**3 hrs.**

Types of Immunity- Innate and acquired, Passive and active. Pattern recognition receptors- scavenger receptors and Toll – like receptors. Humoral and cell-mediated immune responses. Haematopoiesis. B-cell and T-cell maturation and differentiation.

Prerequisite: Historical perspective and early theories of immunity, Components of immune system, cells, tissues and organs involved in immune system.

Module II. Antigens and Antibodies**8 hrs.**

Antigen processing and presentation. Monoclonal antibodies and abzymes. Genetic model compatible with Ig structure. Multi- gene organization of Ig genes. Variable region gene arrangements. Generation of antibody diversity. Expression of Ig genes and regulation of Ig genes transcription. Antibody genes and antibody engineering.

Prerequisite: Antigen-structure and properties, Haptens, Adjuvants, Epitopes, Immunoglobulins-structure, classes and functions.

Module III. Antigen –Antibody Interactions**2 hrs.**

Antigen- Antibody reactions. Biological consequences of antigen-antibody reaction.

Prerequisite: Types of antigen-antibody reactions - Cross-reaction, Precipitation, Agglutination.

Module IV. The Complement System**5 hrs.**

Terminal sequence of complement activation (MAC). Classical, Alternate and Lectin Pathways. Complement activation, Regulation of complement system. Biological consequences of complement activation. Complement deficiencies.

Module V. Immune Effector Mechanisms**5 hrs.**

Inflammatory Cells. Types of Inflammation- acute and chronic. Chemokines. Role of cytokines in immune system. Properties and functions of Cytokines. Therapeutic uses of cytokines.

Module VI. Hypersensitivity**4 hrs.**

Allergy and hypersensitivity. Genetics of allergic response in humans.

Prerequisite: Types of Hypersensitivity

Module.VII. Major Histocompatibility Complex**8 hrs.**

General organization and inheritance of MHC. MHC molecules and genes. Genomic map of H-2 Complex in the mouse. HLA Complex in humans. MHC-peptide interaction. Expression of MHC molecules on different cell types. Regulation of MHC expression. MHC and graft rejection. MHC and disease susceptibility. Biological significance of MHC. HLA typing

Module.VIII. Immunity in Health and Disease**15 hrs.**

Immune response during bacterial (tuberculosis), Parasitic (Malaria) and viral (HIV) infections. Congenital immunodeficiency diseases (SCID, WAS, CVI, Ataxia, CGD, LAD). Acquired Immunodeficiency Disease (AIDS). Autoimmunity. Organ- specific autoimmune diseases. Systemic auto-immune diseases. Animal

models for autoimmune disease. Evidences implicating CD4⁺ T cell, MHC and TCR in autoimmunity. Induction of autoimmunity. Treatment of autoimmune diseases.

Transplantation immunology. Immunologic basis of graft rejection. Clinical manifestation of graft rejection. General and specific immunosuppressive therapy. Clinical transplantation. Tumour immunology. Vaccines, Whole organism vaccines, Purified macromolecules as Vaccines, Recombinant vector vaccines, Synthetic peptide vaccines, Multivalent subunit vaccines.

Module IX. Immunological Techniques

4hrs.

Serological Reactions. Radio-allergosorbent Test (RAST). Immunoprecipitation. Immunofluorescence. Flow cytometry and fluorescence. Immunoelectron microscopy.

REFERENCES

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**ZY3CP 15 PRACTICAL 3: CELL AND MOLECULAR BIOLOGY,
MICROBIOLOGY AND BIOTECHNOLOGY**

72 Hours (4hrs./week)

Credit-2

Cell and Molecular biology and Biotechnology

Squash preparation of grasshopper testis to study meiotic stages.

Squash preparation and identification of salivary gland chromosomes in *Drosophila* / *Chironomus* larva.

Determination of mitotic index in the squash preparation of onion root tip.

Effect of drugs on cell division (Colchicine or any other inhibitor)

Preparation of Microtome section, spreading and histochemical staining of carbohydrates (PAS), Protein (Bromophenol blue), lipids (Sudan Black), DNA (Fuelgen stain).

Cell fractionation and Differential Centrifugation to isolate mitochondria and nuclei

Isolation of genomic DNA using Agarose gel electrophoresis

Isolation of Plasmid DNA.

Microbiology

Sterilization, disinfection and safety in microbiological laboratory.

Preparation of culture media

(a) liquid media – nutrient broth , peptone water

(b) Solid media – Nutrient Agar, MacConkey's Agar.

(c) Semi solid agar

(d) Firm agar. Culturing

of microorganism –

(a) broth culture

(b) pure culture techniques- streak plate, pour plate culture, lawn culture, stab culture

(c) serial dilution and standard plate count, calculation of CfU/ml in water samples. Isolation and preservation of bacterial culture.

Identification of microorganisms-

(a) Staining techniques- gram staining of mixed cultures, negative staining and spore staining. Antibiotic sensitivity (different natural fluids)

(a) Oxidase test

(b) Catalase test

(c) Oxidation/fermentation (O/F) test

Staining and enumeration of microorganisms:

(a) using haemocytometer

(b) nephelometry/ Turbidimetry

Environmental sample analysis.

a) Coliform count in water

b) Isolation and enumeration of soil bacteria

c) Identification of symbiotic bacterioids from root nodules of leguminous plants Bacteriological analysis of milk- methylene blue reductase test.

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ZY3CP16 PRACTICAL 4: ANIMAL PHYSIOLOGY AND IMMUNOLOGY**72 Hours (4hrs/week)****Credit - 2****Animal Physiology**

Rate of salivary amylase activity on starch (colorimetry) Effect of different pH on salivary amylase activity (colorimetry)

Influence of temperature on salivary amylase activity – Calculation of Q₁₀

Effect of drugs on the heartbeat of cockroach (Result with graphical representation corresponding to different concentration and time intervals expected)

Oxygen consumption in fish (normal and stressed). Graphical representation and interpretation. Kymograph: working principle and applications.

Virtual Practicals in Physiology

(Use of PhysioEX 9.0 : *Laboratory Simulations in Physiology* by P.Zao., T.Stabler., L.A.Smith and E .Griff. 2011.is suggested) for muscle and nerve physiology practical for class room training and for practical examination in order to replace Frog as per UGC guidelines).

Any four of the following:

(1) Muscle Twitch and the Latent Period

(2) The effect of stimulus Voltage on Skeletal Muscle Contraction

(3) Tetanus

(4) Fatigue

(5) Receptor Potential

(6) The Action Potential Threshold

(7) Importance of Voltage –Gated Na⁺ Channels

Differential count of Human WBC

Haematocrit and ESR of Human

blood Feeding activity of paramecium

Observation on the effect of decreasing PO₂ of water on the respiratory rate of a fish and determination of the lactic acid content of the muscle

Effect of different concentration of NaCl solution (0.1%-2%) on the diameter of RBCs (preferably human) and determination of the concentration , which is isotonic to the blood from a plot of diameter of RBC against concentration of NaCl

Immunology

Separation of lymphocytes from whole blood.

Separation of T and B lymphocytes

Blood Typing in Man.

WIDAL Test.

Western Blotting –Demonstration

ELISA -Demonstration

Rocket Immuno electrophoresis- Demonstration

Note:

Virtual Practical developed by the Ministry of Human Resources, Govt. of India and available in the web site: www.vlab.ac.in can be availed for demonstration.