Center for Animal Sciences

M.Sc. Program in Life Sciences (Specialization: Animal Sciences)

Semester – II

Course Code	Course Title	L (hr)	T (hr)	P (hr)	Cr
	Core Courses*				
LSS.507	Immunology	2	1		3
LSS.508	Molecular Biology	2	1		3
LSS.509	Animal Physiology	3	1		4
LAS.510	Nutrition & Metabolism	2	1		3
LAS.526	Lab Course (Practicals) -II			8	4
	Elective Courses (Opt any one)				
LAS.552	Animal Cell Culture & Applications	2			2
LPS.514	Techniques in Life Sciences	2			2
	Inter-Disciplinary (ID) Course				
LAS.451	Basics in Neuroscience	2			2
	Seminar				
LAS.596	Seminar-II	1			1
	Total Credits				**24**

L: Lectures; T: Tutorial; P: Practical; Cr: Credits; *Compulsory Courses

Examination Pattern

A: Continuous Assessment: Based on Objective Type Tests (10 Marks), Term paper (10 Marks), and Assignemnets(s) (5 Marks)

B: Pre-Scheduled Mid Semester Test-1: Based on Objective Type & Subjective Type Test (By Enlarged Subjective Type) (25 Marks)

C: Pre-Scheduled Mid Semester Test-2: Based on Objective Type & Subjective Type Test (By Enlarged Subjective Type) (25Marks)

D: End-Term Exam (Final): Based on Objective Type Tests (25 Marks)

Core Courses

LSS.507: Immunology **3 Credits**

Learning Objective: The objective of this course is to provide basics of immune system where students will learn the components and molecules of immunity and various immune responses at cellular level that work together to protect the host, autoimmune disorders and immunotechniques.

Unit	Syllabus	Lectures
1.	**Immune System:** Recognition of self and non-self, Humoral immunity-immunoglobulins, basic structure, classes and subclasses, structural and functional relationships, nature of antigen, antigen-antibody reaction, estimation of affinity constants. **Molecular Mechanisms of Antibody Diversity and Cellular Immunity:** Organization of genes coding for constant and variable regions of heavy chains and light chains, antibody diversity & class switching. Lymphocytes, cytokines, interferons, interleukins, antigen recognition-membrane receptors for antigens.	14
2.	**Complement System and Major Histocompatibility System:** Complement components, their structure and functions and mechanisms of complement activation by classical, alternative and lectin pathway. Structure and functions of Major Histocompatibility Complex (MHC) and Human Leukocyte Antigen (HLA) system, polymorphism, distribution variation and function. Association of MHC with disease and superantigen, recognition of antigens by T and B-cells, antigen processing, role of MHC molecules in antigen presentation and co-stimulatory signals, & tumor immunology.	14
3.	**Hypersensitivity:** Types, features and mechanisms of immediate and delayed hypersensitivity reactions, immunity to microbes, immunity to tumors, AIDS and immune-deficiencies, hybridoma technology and vaccine, natural, synthetic and genetic, development of vaccine for diseases like AIDS, cancer and malaria.	12
4.	**Monoclonal Antibodies and Diagnostic Immunology:** Production, characterization and applications in diagnosis, therapy and basic research, immunotoxins, concept of making immunotoxins. Methods for immunoglobulin determination-quantitative and qualitative antigen and antibody reactions, agglutination-precipitation, immunoflourescence and immunoblotting and assessment of human allergic diseases.	14

Suggested Reading:

1. Kindt, T.J., Osborne, B.A. and Goldsby, R.A. (2007). *Kuby Immunology* .7th Edition. W.H. Freeman, USA.
2. Abbas. (2008). *Cellular and Molecular mmunology*. CBS Publishers & Distributors, India.
3. Charles, A. and Janeway, J.R. (1994). *Immunobiology: The immune system in health and disease.* Blackwell Publishing, USA.

4. Delves, P.J., Roitt, I.M. and Seamus, J.M. (2006). *Roitt's essential immunology (Series–Essentials).* Blackwell Publishers, USA.
5. Elgert K.D. (2009). *Immunology: Understanding the immune system*. Wiley-Blackwell, USA.
6. Paul, W.E. (1993). *Fundamental immunology.* Raven Press, SD, USA.
7. Sawhney, S.K. and Randhir, S. (2005). *Introductory practical biochemistry*. Alpha Science International Ltd. New Delhi, India.
8. Tizard (2008). *Immunology: An Introduction*. Cengage Learning, Thompson, USA.

LSS.508: Molecular Biology **3 Credits**

Learning Objective: This course is designed for detailed understanding the molecular processes of DNA replication, transcription, translation, and regulation of gene expression.

Unit	Syllabus	Lectures
1.	**Structure and Conformation of Nucleic acids:** Structure of DNA, Denaturation and Renaturation, Conformation of nucleic acids (A, B, Z), Organelle DNA: mitochondria and chloroplast DNA. **Genome Organization:** Chromosome Structure, Chromatin and its regulation, nucleosome and its assembly, nucleolus, repetitive DNA, transposons & retrotransposons, interrupted genes, gene shuffling.	14
2.	**DNA Replication:** Prokaryotic and eukaryotic DNA replication, Mechanism of DNA replication, Enzymes and accessory proteins involved in DNA replication, Replication errors, DNA damage, repair & recombination, genome editing.	14
3.	**Transcription and mRNA Processing:** Types of RNA, Prokaryotic &, eukaryotic transcription, general and specific transcription factors, Regulatory elements and mechanisms of transcription regulation, Transcriptional and posttranscriptional gene silencing: Initiation, Elongation & Termination of transcription, Capping, Polyadenylation, Splicing, editing, mRNA stability, RNA interference and microarray analysis, RNA editing, RNA sequencing, Operon Concept.	14
4.	**Translation:** Genetic code, prokaryotic & eukaryotic translation, the translation machinery, mechanisms of chain initiation, elongation and termination, regulation of translation, co-and post- translational modifications, epigenetics, control of gene expression at transcription and translation level.	12

Suggested Reading:

1. Fasman, G.D. (1989). *Practical Handbook of Biochemistry and Molecular Biology*. CRC Press, Taylor and Francis Group, UK.
2. Gupta, P.K. (2005). *Cell and Molecular Biology*. Rastogi publications, Meerut, India.
3. James, D.W.,Baker,T.A., Bell, S.P., Gann, A. (2009). *Molecular Biology of the Gene*. Benjamin Cummings, USA.
4. Jocelyn, E.K., Elliott, S.G., Stephen, T.K. (2009). *Lewin's Genes X.* Jones & Bartlett Publishers, USA.
5. Johnson, A., Lewis, J., Raff, M. (2007). *Molecular Biology of the Cell*. Garland Science, USA.

Additional reading:

6. Lodish, H.,Berk, A., Chris, A.K. and Krieger, M. (2008). *Molecular Cell Biology*. W.H. Freeman, USA.
7. Sambrook, J., Fritish, E.F., Maniatis, T. (2000). *Molecular cloning: A laboratory manual*. Cold Spring Harbor Laboratory Press, New York.

LSS.509: Animal Physiology **4 Credits**

Learning objective: This is a specialized course for animal sciences students. This course will provide an introduction to the basic physiological principles common to humans and other animals. The course will include basic physical and chemical processes in animal tissues, detailed consideration of organ systems. We will emphasize human physiology, but also will consider other animal systems for comparison.

Unit	Syllabus	Lectures
1.	**Blood and Circulation:** Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. **Cardiovascular System:** Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above. **Respiratory System:**- Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.	18
2.	**Digestive System:** Digestion, absorption, energy balance, BMR. **Excretory System:** Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.	18
3.	**Nervous System:** Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. **Sense Organs:** Vision, hearing and tactile response.	18
4.	**Endocrinology:** Endocrine glands, basic mechanism of hormone action, hormones and diseases Thermoregulation - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.**Musculoskeletal System:** Bones of the skeleton, muscles, cartilage, tendons, ligaments, joints, and other connective tissues.	18

Suggested Reading:

1. Brody, T. (1998). *Nutritional Biochemistry*. Academic Press, USA.
2. Devlin, T.M. (2005). *Textbook of Biochemistry with clinical correlations*. John Wiley &Sons Inc. USA.
3. Guyton. (2007). *Textbook of medical physiology*. 11th Edition. Elsevier India Pvt. Ltd. New Delhi.
4. Hill, R.W, Wyse, G. A. and Anderson, M. (2008). *Animal physiology*. Sinauer Associates

Inc. USA.
5. Murray, R.K. (2009). *Harper's illustrated biochemistry*. Jaypee Publishers, New Delhi, India.
6. Tyagi, P. (2009). *A textbook of Animal Physiology*.Dominant Publishers and distributors, New Delhi, India.

LAS.510: Nutrition and Metabolism **3 credits**

Learning Objective: This course is designed to cover the advanced aspects of biochemistry and biological molecules, including their biosynthesis and mechanisms by which they facilitate biochemical reactions. This course lso aims to provide detailed knowledge regarding the biological basis of nutrition and the mechanisms by which diet and its components can influence health.

Unit	Syllabus	Lectures
1.	**Nutrition and Exercise:** Energy requirement for aerobic and anaerobic exercises, Importance of exercise in preventing life style diseases - Diabetes, CVD, hypertension, obesity and osteoporosis, Recommended dietary allowances, water and dehydration, Vitamins & Minerals, Formula diets and crash diets, Balanced diets, Dietary standards, Carbohydrate loading, Food preservatives, Additives and anti-nutrients, Toxic effects of food: sources, active agents and effects.	12
2.	**Metabolism of Carbohydrates:** Glycolysis, Gluconeogenesis, TCA cycle, HMP shunt, bioenergetics, disorders of carbohydrate metabolism.	8
3.	**Metabolism of Lipids:** Biosynthesis and oxidation of saturated and unsaturated fatty acids, glycerides, phospholipids and cholesterol, bioenergetics, lipoproteins and their significance, disorders of lipid metabolism.	12
4.	**Amino Acid Metabolism:** Biosynthesis of protein, general catabolism of aminoacids, deamination, transamination, urea cycle, disorders of aminoacid metabolism **Nucleic Acid Metabolism:** Biosynthesis of purine and pyrimidine nucleotides, Disorders of purine and pyrimidine metabolism - gout, aciduria, xanthinuria.	14

Suggested Reading:

1. Review of Physiological Chemistry, Harper H.A. (1997), Lange Medical Publications, Los angeles.
2. Text book of Clinical Biochemistry, T.A. Ramakrishnan (1994), Publications,Chennai.
3. Clinical Chemistry in Dignosis and Treatment, Jean E Zilwa, Peter A. Pannale,Philip R. (1988), New York.
4. Text book of Biochemistry with Clinical Correlations, Devlin D.T. (1997), NewYork, John wiley and Sons.
5. An Introduction to Practical Biochemistry, Plummer D.T. (1997) New Delhi, TataMcGraw Hill Publishing Company.
6. Biomedical Instrumentation and Measurements, Cromwell L.Weibel F.J. and Pfeiffer E.A. (1996), New Delhi, Prentice Hall.

Elective Courses:

LAS.552: Animal Cell Culture & its Applications **2 credits**

Learning Objective: The goal of this course for students is to acquire the necessary theoretical knowledge on isolation of animals cells for *in vitro* studies, maintenance of animal cells *in vitro*, manipulation of animal cells *in vitro*, and application of molecular techniques to *in vitro* situations.

Unit	Syllabus	Lectures
1.	**Introduction to Animal Cell Culture:** Historical Background, Biology of Animal Cell and Cell-Cell interactions, Importance of Serum and Serum-free media, Culturing and subculturing of Animal Cells, In vitro transfection of Animal Cells, Cell-based assays, Cell differentiation and Movement, Animal Cell culture facility.	12
2. & 3.	**Cell Culture Types and Characterization:** Primary cell culture, tissue culture, organ culture, Cell line immortalization, Cell line preservation & Characterization, Kayotype analysis, cellular markers, Commercial Cell lines, and Insect cell culture.	12
4.	**Animal Cell Culture Applications:** Cancer Research, vaccine manufacture, Gene and stem cell therapy, Production of Recombinant Proteins, IVF Technology, Scaffolds & tissue engineering, Toxicology studies.	12

Suggested Reading:

1. Freshney, R.I. (2010). *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*. Wiley-Blackwell, 2010. 6th Edition.
2. Davis, J. M. (2008). Basic Cell Culture. Oxford University Press. New Delhi.
3. Davis, J. M. (2011). Animal Cell culture. John Willy and Sons Ltd. USA.
4. Freshney R. I. (2005). Culture of Animal Cells. John Willy and Sons Ltd. USA.
5. Butler, M. (2004). Animal Cell Culture and Technology. Taylor and Francis. New York, USA.
6. Excerpts from research protocols & manuals, additional handouts & research journals.

LPS.514: Techniques in Life Sciences **2 credits**

Learning Objective: The goal of this course for students is to acquire the necessary theoretical knowledge of various laboratory and analytical instruments.

Unit	Syllabus	Lectures
1.	**Laboratory Techniques:** Sterilization techniques, Spectrometry: Colorimetry, mass, UV, IR, NMR and atomic absorption spectrophotometery, Centrifugation: Principle and applications, Ultracentrifugation. Chromatography: Principle, procedure and applications of thin layer chromatography (TLC), gel filtration and ion exchange, affinity chromatography, GC, GLC, HPLC and FPLC.	8
2.	**Microscopy:** Light microscopy, phase contrast microscopy, fluorescent microscopy, scanning electron microscopy (SEM/FESEM), transmission electron microscopy (TEM), micrometry and photomicrography, Histochemistry, Scanning-probe microscopy, Atomic force microscopy, CLSM.	12
3.	**Nucleic Acids:** Isolation, purification and analysis of nucleic acids. Electrophoresis: Principle of gel electrophoresis, polyacrylamide gel electrophoresis (PAGE and SDS-PAGE), agarose gel electrophoresis, pulse field gel electrophoresis (PFGE) and 2-Dimensional gel electrophoresis. Polymerase chain reaction (PCR): Principle, types and applications, PCR based markers: RAPDs, SSRs, SNPs, ISSRs, and SCARs etc. Blotting techniques: Southern, Northern, Western, Dot blotting and hybridization, DNA fingerprinting.	8
4.	**Flow Cytometry:** Cell sorting, Hybridoma technology/Production of antibodies, Histochemical and Immunotechniques, Immunochemical Techniques, Developing Monoclonal and Polyclonal antibodies, Immunocytochemistry, Radioimmunoassay (RIA), Enzyme Linked Immunosorbent Assay (ELISA) and Autoradiography. Mutation Analyses Techniques: Restriction mapping, SSCP analyses, DNA sequencing-manual and automated methods. Cell and tissue culture techniques: Plants and animals.	8

Suggested Reading:

1. Brown, T.A. (2010). Gene cloning and DNA analysis: An Introduction. 6th Edition, Wiley-Blackwell Publisher, New York.
2. Goldsby, R.A., Kindt, T.J. and Osborne, B.A. (2008). Kuby Immunology. 6th Edition, W. H. Freeman & Company, San Francisco.
3. Gupta, P.K. (2005). Elements of biotechnology. Rastogi Publications, Meerut.
4. Gupta, S. (2005). Research methodology and statistical techniques, Deep & Deep Publications (P) Ltd. New Delhi.
5. Kothari, C.R. (2008.) Research methodology(s). New Age International (P) Ltd., New Delhi
6. Lewin, B. (2010). Genes X, CBS Publishers & Distributors. New Delhi.
7. Mangal, S.K. (2007). DNA Markers In Plant Improvement. Daya Publishing House,NewDelhi.
8. Nelson, D. and Cox, M.M. (2009). Lehninger Principles of Biochemistry. W.H. Freeman and Company, New York.

9. Primrose. S.B. and Twyman, R. (2006). Principles of Gene Manipulation and Genomics. Blackwell Publishing Professional, U.K.
10. Sambrook, J. (2006). The Condensed Protocols from Molecular Cloning: A Laboratory Manual. Cshl Press. New York.
11. Sambrook, J. and Russell, D.W. (2000). Molecular Cloning: A Laboratory Manual (3 Vol-set). 3rd Edition, CSHL Press, New York.
12. Sawhney, S.K. and Singh, R. (2005). Introductory Practical Biochemistry. Narosa Publishing House, New Delhi .
13. Slater, A., Scott, N.W. and Fowler, M.R. (2008). Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University Press, USA.
14. Wilson, K. and Walker, J. (2006). Principles and Techniques of Biochemistry and Molecular biology. 6th Edition, Cambridge University Press India Pvt. Ltd., New Delhi.

Inter Disciplinary Course:

LAS.451: Basics in Neuroscience **2 credits**

Learning Objective: This is an interdisciplinary course to acquaint the students of different streams with a basic knowledge and understanding of human nervous system.

Unit	Syllabus	Lectures
1.	**Introduction to Nervous System:** Basic anatomy, parts of central nervous system & peripheral nervous system.	8
2.	**Introduction to Neurons:** The Neuron Doctrine, The Nissl and Golgi stains, Components of neurons, Classification and types of neurons, Cytology of neurons, Dendrites structure and function, Axons structure and functional aspects, ultrastructure, myelination and synapses.	10
3.	**Structure and Function of Glial Cells:** Different types of glial cells: astrocytes, oligodendrocytes and Schwann cells, Types of astrocytes – type I & II astrocytes, fibrous and protoplasmic astrocytes, Importance of astrocytes in glutamate metabolism and blood brain barrier, Functions of other glial cells: oligodendrocyte and microglial cells, Microglial phenotypes, overview of glial and neuronal relationship in the CNS, Glial – neuronal interplay in the CNS.	10
4.	**Action Potential & Neurotransmitters:** Action potentials & channels responsible for action potential, All or None law, Nernst Equation; Neurotransmitters: Excitatory neurotransmitters & inhibitory neuro transmitters.	8

Suggested Reading:

1. Guyton. (2007). *Textbook of medical physiology*. 11th Edition. Elsevier India Pvt. Ltd. New Delhi.
2. Hill, R.W, Wyse, G. A. and Anderson, M. (2008). *Animal physiology*. Sinauer Associates Inc. USA.
3. Tyagi, P. (2009). *A textbook of Animal Physiology*. Dominant Publishers and distributors, New Delhi, India.

LAS.526: Lab Course (Practicals) – II

1. Measurement of vital parameters: Blood pressure, Blood glucose, Heartbeat (ECG), Pulse Rate, and Glucose tolerance test
2. Spirometry
3. ELISA
4. Western blotting
5. Dot blot technique
6. Double immuno diffusion
7. Determination of BOD/COD
8. RNA/DNA isolation
9. Polymerase Chain Reaction
10. cDNA synthesis and RT-PCR analysis
11. Gene cloning: Primer designing, Restriction digestion, ligation, transformation and screening

Note: *Practicals may be added/modified depending on the available faculties/facilities/latest advancements

LAS.596: Seminar – II

Learning Objective: The students select a specific topic based on a research articles related to the review article chosen in the first semester and prepare a presentation of approximately 15 minutes. The students also prepare a short report of 10-15 pages.

Evaluation Criteria: Students are evaluated for total of 100 marks, out of which 50 marks are for the methodology understanding, data interpretation, and organization of content, presentation and discussion. The remaining 50 marks are for the short report submitted by the student.

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