Department of Animal Sciences

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

(Academic Session 2018 - 19)

Semester – II

Course Code	Course Title	Type	L (hr)	T (hr)	P (hr)	Cr
	Core Courses*					
LAS.521	Animal Physiology	**CC**	**4**	**-**	**-**	**4**
LAS.522	Immunology	**CC**	**3**	**-**	**-**	**3**
LAS.523	Molecular Biology	**CC**	**3**	**-**	**-**	**3**
LAS.527	Essentials of Genetics	**CC**	**3**	**-**	**-**	**3**
LAS.540	Lab Course (Practical) – II	**CC**	**-**	**-**	**10**	**5**
	Discipline Elective Courses (Opt any one)					
LAS.525	Nanobiology	**DE**	**2**	**1**	**-**	**3**
LAS.529	Genetic Engineering	**DE**	**2**	**1**	**-**	
	Inter-Disciplinary (ID) Course					
LAS.528	Basics in Neuroscience	**ID**	**2**	**-**	**-**	**2**
	Seminar					
LAS.542	Seminar – I	**SK**	**1**	**-**	**-**	**1**
	Total Credits					**24**

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

Examination Pattern

A: Continuous Assessment: [25 Marks]

i. Surprise Test (minimum three) - Based on Objective Type Tests (10 Marks)
ii. Term paper (10 Marks)
iii. Assignment(s) (5 Marks)

B: Pre-Scheduled Mid Semester Test-1: Based on Subjective Type Test [25 Marks]

C: Pre-Scheduled Mid Semester Test-2: Based on Subjective Type Test [25Marks]

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

E: Practical: (Annexure - A)

F: Seminar (Annexure - B)

Core Courses:

LAS.521: Animal Physiology **4 Credits**

Learning objective: This is a specialized course for the Animal Sciences and Biochemistry 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. The course mainly emphasizes 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, haemostic control mechanisms, Biochemistry of blood, plasma proteins, and blood coagulation. **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.	15
2.	**Digestive System:** Foregut, midgut, and hindgut fermentation in animals, ruminant and mogastric digestive system, absorption, energy balance, and 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.	15
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.	15
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.	15

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.
6. Tyagi, P. (2009). A Textbook of Animal Physiology. Dominant Publishers and distributors, New Delhi, India.

LAS.522: 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 the 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 relationship, 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.	12
2.	**Complement System and Major Histocompatibility System:** Complement components, their structure & function 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.	12
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.	11
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, assessment of human allergic diseases.	10

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 Immunology. 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.

LAS.523: 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.	12
2.	**DNA Replication and Repair:** 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. Basic concepts of recombinant DNA technology.	12
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.	11
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.	10

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.

LAS.527: Essentials of Genetics **3 Credits**

Learning Objective: Students will learn the basic and essential principles of inheritance.

Unit	Syllabus	Lectures
1.	**Mendelian Principles and Concept of Gene:** Dominance, segregation, independent assortment, allele, multiple alleles, pseudoallele, complementation tests. **Extension of Mendelian Principles:** Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.	12
2.	**Gene Mapping Methods:** Linkage maps, tetrad analysis, mapping with molecular markers, mapping by somatic cell hybrids, development of mapping population. **Human Genetics:** Pedigree analysis, LOD score for linkage testing, karyotypes, genetic disorders. **Quantitative Genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.	12

3.	**Gene Concept:** Fine structure of gene, Benzer's experiments, complementation analysis and recombination. **Recombination:** Site-specific, homologous, transposition and non-homologous end joining (NHEJ). **Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis, applications in reverse and forward genetics, mutations and Hardy Weinberg equilibrium, molecular basis of spontaneous and induced mutations.	11
4.	**Extra-Chromosomal Inheritance:** Chloroplast and mitochondrial inheritance, structural and numerical alterations of chromosomes: deletion, duplication, inversion, translocation, ploidy and their genetic implications.	10

Suggested Reading:

1. Anthony, J. F., Miller, J. A., Suzuki, D. T., Richard, R. C., Gilbert, W. M. (1998). An Introduction to Genetic Analysis. W.H. Freeman publication, USA.
2. Atherly, A. G., Girton, J. R., Mcdonald, J. F. (1999). The Science of Genetics. Saundern College publication.
3. Snusted, D. P., Simmons, M. J. (2010). Principles of Genetics. John Wiley & Sons, New York.
4. Gupta, P. K. (2009). Genetics. Rastogi publications, Meerut, India.
5. Gupta, P. K (2008). Cytology, Genetics and Evolution. Rastogi publications, Meerut, India.

Additional reading:

6. Jocelyn, E. K., Elliott, S. G., Stephen, T. K. (2009). Lewin's Genes X. Jones & Bartlett Publishers, USA.
7. Schaum, W. D. (2000). Theory & problems in Genetics by Stansfield, outline series McGrahill, USA.
8. Tamarin, R. H. (1996). Principles of Genetics, McGrawhill, USA.

Discipline Elective Courses:

LAS.525: Nanobiology **3 (2 L + 1 T) Credits**

Learning Objective: The goal of this course for students is to acquire the interdisciplinary knowledge of basic concepts of nanoscience, biomaterials, characterization techniques and biomedical aspects of nanomaterials.

Unit	Syllabus	Lectures
1.	**Nanoscience**: Definition and concepts, nanomaterials including biomaterials classification, properties, applications. Criteria for suitability of nanostructures for biological applications.	8
2.	**Biomaterials**: Synthesis, properties, functionalization and characterization techniques including electron microscopy (scanning and transmission), atomic force microscopy; nanoparticle analyzer, zeta potential measurement, electrochemical analyzer, flow cytometry, spectroscopic techniques including spectrophotometer, spectro-fluorimeter, FTIR.	7
3.	**Materials in Medicine** (focus on cancer and cardiovascular diseases): Nanostructures for drug delivery and therapeutics, bio-inspired nanomaterials nanomaterials in diagnosis, fluorescent nanomaterials, bioimaging, biosensor-based techniques like optical, colorimetric, and electrochemical, point-of-care diagnostics tools like lab-on-chip device, lateral flow immunoassay and microfluidic devices.	8
4.	**Nanotoxicity**: Effect of nanomaterials on human health, nanomaterial-cell interaction and characterization, recent progress and challenges in the risk assessment of nanomaterials.	7

Suggested Reading:

1. Bagchi, D., Bagchi, M., Mariyama, H. and Shahidi, F. (2013). Bio-Nanotechnology: A Revolution in Food, Biomedical and Health Sciences. Wiley–Blackwell publication.
2. Rai, M., Duran, N. and Southam, G. (2011). Metal Nanoparticles in Microbiology. Springer publication.
3. Udupa, N., Gupta, P. D. (2009). Nanotechnology in Health Care. Shyam Prakashan publication.
4. Xie, Y. (2012). The Nanobiotechnology Handbook. CRC Press.
5. Murty, B. S., Shankar, P., Raj, B., Rath, B. B.and Murday, J. (2013). A Textbook of Nanoscience and Nanotechnology. Tata Mc Graw Hill Publication.

LAS.529: Genetic Engineering **3 (2 L + 1 T) Credits**

Learning Objective: The aim of this core-course is to acquaint the students to versatile tools and techniques employed in recombinant DNA technology. A sound knowledge on methodological repertoire allows students to innovatively apply these in basic and applied fields of biological research.

Unit	Syllabus	Lectures
1.	**Tools of Genetic Engineering:** Restriction enzymes, Enzymes in genetic engineering, recombinant cloning vectors & their biology (Plasmid-, Phage-, and yeast-based), transformation and selection, genomic and cDNA library construction & DNA-sequencing techniques, RFLP, RAPD and AFLP techniques.	7
2.	**Recombinant Expression Systems & Mutagenesis:** prokaryotic (Fusion proteins, surface display, removal of selectable marker genes, secretion into periplasm & medium) & eukaryotic (Sachharomyces cerevisiae, Pichia pastoris, Baculovirus-insect, Mammalian cell expression system), oligonucleotide-directed and site-directed mutagenesis.	8
3.	**Molecular Biotechnology of Microbial Systems:** Vaccines (subunit-, peptide-, attenuated-, DNA- and vector-based), Enzymes, Antibiotics, Bioremediation, Gene therapy.	7
4.	**Molecular Biotechnology of Eukaryotic Systems:** Engineering of plants (Ti-based system, Chloroplast engineering, Insect resistance, Salt & Drought stress & Oxidative stress), Transgenic animals (Transgenic mice, Transgenic livestock, Transgenic poultry), Regulation of recombinant DNA technology, Concerns about safety of consuming genetically modified foods, concerns about the impact of genetically modified organisms on the environment.	8

Suggested Reading:

1. Molecular Biotechnology: Principles and Applications of Recombinant DNA by Bernard J. Glick, Jack J. Pasternak, Cheryl L. Patten, 4th edition.
2. Principles of Gene Manipulation by Sandy B. Primrose, Richard Twyman, Bob Old Seventh edition.
3. An introduction to genetic engineering, Third edition by Dr. Desmond S.T. Nicholl.
4. Molecular cloning by R. Green and Joseph Sambrook, 4th Edition, CSHL Press.

Inter Disciplinary Course:

LAS.528: Basics in Neuroscience (IDC) **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 and its control over the entire body.

Unit	Syllabus	Lectures
1.	**Introduction to Nervous System:** Basic anatomy, parts of central nervous system & peripheral nervous system.	7
2.	**Introduction to Neurons:** The neuron doctrine, 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.	8
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.	8
4.	**Action Potential & Neurotransmitters:** Action potentials & channels responsible for action potential, all or none law, Nernst equation; neurotransmitters: excitatory neurotransmitters & inhibitory neuro transmitters.	7

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 Text Book of Animal Physiology. Dominant Publishers and distributors, New Delhi, India.
4. Levitan, I. B., Kaczmarek, L. K. (2015). The Neuron: Cell and Molecular Biology. Oxford University Press, USA; 4th edition.
5. Kandel, E. R., Schwartz, J. H., Jessell, T. M. (2012). Principles of Neural Science. McGraw-Hill Companies; 5th edition.
6. Matthews, G. G. (2000). Neurobiology: Molecules, Cells and Systems. Wiley-Blackwell; 2nd edition.

LAS.540: Lab Course (Practical) – II — 5 Credits

Learning Objectives: The lab course-II is designed to acquaint the students with a fundamental knowledge in human physiology, measurement parameters toward understanding the pathophysiology, and techniques involved in identification and quantification of protein expression and molecular biology techniques.

1. Measurement of vital parameters: Blood pressure, Blood glucose, Heartbeat (ECG), Pulse Rate, and Glucose tolerance test.
2. DigiFrog: Online animal dissection module – 1.
3. Spirometry
4. ELISA
5. Western blotting
6. Dot blot technique
7. Double immunodiffusion
8. Determination of BOD/COD
9. RNA/DNA isolation
10. Polymerase Chain Reaction
11. cDNA synthesis and RT-PCR analysis
12. 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.542: Seminar – I — 1 Credit

Learning Objective: To improve student's scientific aptitude and presentation skills. The student should select a specific topic based on a review / research article and prepare a presentation of approximately 15 - 20 minutes. The student should also prepare a short report of 6-10 pages.

Annexure – B

Examination Pattern

Credit Seminar: I

Seminar:	**[50 Marks]**
a. *Report submission -*	*10 Marks*
b. *Contents -*	*10 Marks*
c. *Presentation skills -*	*10 Marks*
d. *Innovation -*	*10 Marks*
e. *Question & Answers -* (Interaction session)	*10 Marks*

Updated on: 25-5-2018