

Center for Animal Sciences

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

Semester – I

Course Code	Course Title	L (hr)	T (hr)	P (hr)	Cr
	Foundation Courses*				
LAS.500	Introduction to Animal Sciences	1			NC
LSS.501	Biostatistics	2			2
LSS.502	Research Methodology	2			2
	Core Courses*				
LSS.503	Biochemistry	2	1		3
LSS.504	Microbiology	2	1		3
LSS.505	Cell Biology	2	1		3
LSS.506	Essentials of Genetics	2	1		3
LAS.525	Lab Course (Practicals) -I			8	4
	Elective Courses (Opt any one)				
LAS.551	Animal Systematics & Biodiversity	2			2
XXX.xxx	Opt any course across Life Sciences	2			2
	Inter-Disciplinary (ID) Course				
LAS.401	Fundamentals of Cell Biology	2			2
	Seminar				
LAS.595	Seminar-I	1			1
	Total Credits				25

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)

Foundation Courses

LAS.500: Introduction to Animal Sciences

1 Non-credit

Learning Objective: This course will help students to familiarize with the Animal Sciences. Students will be oriented and understand its role in environment, human life, and its applications in environment, industry and for human health.

Unit	Syllabus	Lectures
1.	Animal Sciences: Scope, Importance & Career opportunities; Classical Zoology to Modern Animal Biotechnology; Timeline of animal research and industry; Overview of the courses offered under this program.	4
2.	From Benchtop to the Bedside: Animal cell; in vitro and in vivo animal model systems; Animal Research; Animal welfare and ethics; Global, Biological, Social, and Industry Perspectives and latest trends in Animal Sciences.	4

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. Verma, A. and Singh, A. (2013). *Animal Biotechnology: Models in Discovery and Translation*. 1st Edition. Academic Press.
3. W. Stephen Damron (2012). *Introduction to Animal Science*. Prentice Hall. 5th Edition
4. M.M. Ranga (2007). *Animal Biotechnology*. 3rd edition

LSS.501: Biostatistics

2 credits

Learning Objective: This course will help students to understand the complex outcome of their results using biostatistical approaches in testing hypothesis, designing experiments, analyzing experimental data and interpreting the results.

Unit	Syllabus	Lectures
1.	Overview of Biostatistics: Differences between parametric and non-parametric statistics, Univariate and multivariate analysis, Confidence interval, Errors, Levels of significance, Hypothesis testing.	6
2.	Descriptive Statistics: Measures of central tendency and dispersal, Histograms, Probability distributions (Binomial, Poisson and Normal), Sampling distribution, Kurtosis and Skewness.	8
3.	Experimental Design and Analysis: Sampling techniques, Sampling theory, Various steps in sampling, Collection of data-types and methods.	8
4.	Inferential Statistics: Student's t-test, Paired t-test, Mann-Whitney U-test, Wilcoxon signed-rank, One-way and two-way analysis of variance (ANOVA), Critical difference (CD), Least Significant Difference (LSD), Kruskal-Wallis one-way ANOVA by ranks, Friedman two-way ANOVA by ranks, χ^2 test. Standard errors of regression coefficients, Comparing two regression lines, Pearson Product-Moment Correlation Coefficient, Spearman Rank Correlation Coefficient, Power and sampling size in correlation and regression.	14

Suggested Reading:

1. Norman, G. and Streiner, D. (2008). Biostatistics: The Bare Essentials, Decker Inc. USA, 3rd edition.
2. Myra L. Samuels, Jeff Witmer, Andrew Schaffner (2003). Statistics for the life sciences. Prentice Hall publishers, 4th edition
3. Sokal, R.R. and Rohlf, F.J. (1994). Biometry: The Principles and Practices of Statistics in Biological Research. W.H. Freeman publishers. 3rd edition.
4. Emden, H.V. Statistics for Terrified Biologists. Blackwell publishers. 2008.

LAS.502: Research Methodology**2 credits**

Learning Objective: To ensure that the student understands various aspects of research methods, ethics, technical and scientific writings and literature search.

Unit	Syllabus	Lectures
1.	General Principles of Research: Meaning and importance of research, critical thinking, formulating hypothesis and development of research plan, review of literature, interpretation of results and discussion.	8
2.	Technical Writing: Scientific writing that includes the way of writing synopsis, research paper, poster preparation and presentation, and dissertation.	10
3.	Library: Classification systems, e-Library, web-based literature search engines.	4
4.	Biosafety: Good laboratory practices, Biosafety for human health and environment. Biosafety issues for using cloned genes in medicine, agriculture, industry, and ecoprotection. Gene pollution, Biological invasion, Risk and safety assessment from genetically engineered organisms, special procedures for r-DNA based products Bioethics: Ethical theories, Ethical considerations during research, data manipulations, subject consent, Animal testing. Animal rights, Perspectives and methodology, Ethical issues of the human genome project Intellectual Property Rights (IPRs): Concept of IP and IPR, various forms of IP – Patents, Copyright, Industrial Designs, trade secrets, trade Secrets, geographical Indications and Plant breeder's right. Fair use, plagiarism and open access publishing.	14

Suggested Reading:

1. Gupta, S. (2005). Research methodology and statistical techniques. Deep & Deep Publications (p) Ltd. New Delhi.
2. Kothari, C.R. (2008). Research methodology (s). New Age International (p) Limited. New Delhi.
3. Fleming, D. O. and Hunt, D.L. (2006). Biological Safety: Principles and Practices. American Society for Microbiology, USA.
4. Rockman, H. B. (2004). Intellectual Property Law for Engineers and Scientists. Wiley-IEEE

Press, USA.

5. Shannon, T. A. (2009). An Introduction to Bioethics. Paulist Press, USA.
 6. Vaughn, L. (2009). Bioethics: Principles, Issues, and Cases. Oxford University Press, UK.
- WHO (2005). Laboratory Biosafety Manual. World Health Organization.

Core Courses

LSS.503: Biochemistry

3 credits

Learning Objective: The course is designed to teach fundamental and basics of biochemistry and to prepare them for advanced aspects of biochemistry such as nutrition and metabolism.

Unit	Syllabus	Lectures
1.	Principles of Biophysical Chemistry: pH, Buffer, Reaction kinetics, Thermodynamics, Colligative properties, Structure of atoms, Molecules and chemical bonds. Stabilizing interactions: Van der Waals, Electrostatic, Hydrogen bonding & Hydrophobic interactions.	6
2.	Composition, Structure and Function of Biomolecules: Carbohydrates, Lipids, Proteins, Nucleic acids and Vitamins., Bioenergetics.	16
3.	Enzymology: Classification, Principles of catalysis, Mechanism of enzyme catalysis, Enzyme kinetics, Enzyme regulation, Isozymes and Clinically important enzymes.	8
4.	Bioenergetics and metabolism: Thermodynamics, Carbohydrates, Lipids, Amino Acids and Nucleotides.	16

Suggested Reading:

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2010). *Biochemistry*. W.H. Freeman & Company. USA.
2. Mathews, C.K., Van Holde, K.E. and Ahern, K.G. (2000). *Biochemistry*. Oxford University Press Inc. New York.
3. Nelson, D. and Cox, M.M. (2008). *Lehninger Principles of Biochemistry*. BI publications Pvt. Ltd. Chennai, India.
4. Shukla AN (2009). *Elements of enzymology*. Discovery Publishing. New Delhi, India.
5. Voet, D. and Voet, J.G. (2008). *Principles of biochemistry*. CBS Publishers & Distributors. New Delhi, India.

LSS.504: Microbiology

3 credits

Learning Objective: Students will learn the basics of microbes, microbial growth and their applications in day to day life.

Unit	Syllabus	Lectures
1.	Prokaryotic, Eukaryotic microbes: Cell structure and function, Classifications. Bacteria, Fungi, Protozoa, Algae, and viruses, Structure of major viruses, and Viral replication.	12
2.	Growth, nutrition & control: Phases in bacterial growth, Growth Curve, Calculation of G-time, Physical and environmental requirements of growth,	14

	Microbial nutritional requirements, Types of culture media. Physical and Chemical methods, Antimicrobial drugs, Antibiotic assays, and Drug resistance in bacteria.	
3.	Microbial Genetics: Methods of genetic transfers – transformation, conjugation, transduction and sexduction, mapping genes by interrupted mating, fine structure analysis of genes.	10
4.	Applied Microbiology: Environmental microbiology, Microbial ecology, Aquatic Microbiology, Food, Dairy and Agricultural Microbiology, Industrial Microbiology. Major bacterial diseases of animals and plants, Airborne, Food-borne, Soil-borne, Nosocomial and Sexually Transmitted/Contagious Diseases, Principles of disease and epidemiology, Host-Microbe relationship, Viral pathogenesis, Major viral diseases of plants and animals.	16

Suggested Reading:

1. Bauman, R.W. (2011). *Microbiology with Diseases by Body System*. Benjamin Cummings, USA.
2. Capuccino, J.G. and Sherman, N. (2004). *Microbiology-A Laboratory Manual*. Benjamin Cummings, USA.
3. Pelczar, M. J., Chan, E.C.S. and Krieg, N.R. (1993). *Microbiology: Concepts and Applications*. McGraw-Hill Inc. USA.
4. Pommerville, J.C. (2010). *Alcama's Fundamentals of Microbiology*. Jones & Bartlett Publishers, USA.
5. Prescott, L.M., Harley, J.P. and Klein, D.A. (2004). *Microbiology*. McGraw-Hill Science, USA.

Additional Reading:

6. Strelkauskas, A., Strelkauskas, J. and Moszyk-Strelkauskas, D. (2009). *Microbiology: A Clinical Approach*. Garland Science, New York, USA.
7. Tortora, G.J., Funke, B.R. and Case, C.L. (2009). *Microbiology: An Introduction*. Benjamin Cummings, USA

LSS.505: Cell Biology

3 credits

Learning Objective: Students will understand the structures and basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles and their related functions.		
Unit	Syllabus	Lectures
1.	Introduction to the Cell: Evolution of the cell, molecules to cell, prokaryotes and eukaryotes. Membrane Structure and Function: Models of membrane structure, Membrane proteins, Membrane carbohydrates, Membrane transport of small molecules, Membrane transport of macromolecules and particles.	12
2.	Structural Organization and Function of Intracellular Organelles: The lysosomes, Ribosomes, The peroxisomes, The golgi apparatus, The endoplasmic reticulum, Mitochondria and chloroplast, Structure of	14

	mitochondria and chloroplast, Oxidation of glucose and fatty acids, Electron transport oxidative phosphorylation, Chloroplast and photosynthesis.	
3.	The Cytoskeleton: The nature of cytoskeleton, Intermediate filaments, Microtubules, Actin filaments, Cilia and centrioles, Organization of the cytoskeleton. Cell Communication: Cell adhesions, Cell junctions and the extra cellular matrix, Cell-cell adhesion and communication, Cell matrix adhesion, Collagen the fibrous protein of the matrix, Noncollagen component of the extra cellular matrix.	14
4.	Cell Division and Cell Cycle: Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.	14
Suggested Reading:		
<ol style="list-style-type: none"> 1. Alberts, B., Bray, D., Lews, J., Raff, M., Roberts, K. and Watson, J.D. (2010). <i>Molecular Biology of the cell</i>. Garland publishers, Oxford. 2. Celis, J.E. (2006). <i>Cell biology: A laboratory handbook</i>, Vol 1, 2, 3. Academic Press, UK. 3. Gupta, P.K. (2008). <i>Cytology, Genetics and Evolution</i>. Rastogi publications, Meerut, India. 4. Karp, G. (2010). <i>Cell and Molecular Biology: Concepts and Experiments</i>. John Wiley & Sons. Inc. New Delhi, India. 		

LSS.506: Essentials of Genetics

3 credits

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

Unit	Syllabus	Lectures
1.	Mendelian Principles & Concept of Gene: Dominance, segregation, independent assortment, Allele, multiple alleles, pseudoallele, complementation tests. Extensions 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 using somatic cell hybrids, development of mapping population in plants. Human Genetics: Pedigree analysis, LOD score for linkage testing, karyotypes, genetic disorders. Quantitative Genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.	14
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	14

4.	Extra-Chromosomal Inheritance: Chloroplast and Mitochondrial inheritance, Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.	14
Suggested Reading:		
<ol style="list-style-type: none"> 1. Anthony, J.F., Miller, J.A. , Suzuki, D.T., Richard, R.C., Gilbert, W.M. (1998). <i>An introduction to Genetic Analysis</i>. W.H. Freeman publication, USA. 2. Atherly, A.G., Girton, J.R., Mcdonald, J.F. (1999). <i>The science of Genetics</i>. Saundern College publication. 3. Snusted, D.P., Simmons, M. J. (2010). <i>Principles of Genetics</i>. John Wiley & Sons, New York. 4. Gupta, P.K. (2009). <i>Genetics</i>. Rastogi publications, Meerut, India. 5. Gupta, P.K (2008). <i>Cytology, Genetics and Evolution</i>.Rastogi publications, Meerut, India. 		
Additional reading:		
<ol style="list-style-type: none"> 6. Jocelyn, E.K., Elliott, S.G., Stephen, T.K. (2009). <i>Lewin's Genes X</i>. Jones & Bartlett Publishers, USA. 7. Schaum, W.D. (2000). <i>Theory & problems in Genetics by Stansfield, outline series</i>McGrahill, USA. 8. Tamarin, R.H. (1996). <i>Principles of Genetics</i>, McGrawhill, USA. 		

Elective Courses

LAS.551: Animal Systematics & Biodiversity

2 credits

Learning Objective: This is a specialized subject for the students of Animal Sciences where they would appreciate the diverse life forms and their categorization.		
Unit	Syllabus	Lectures
1.	Biosystematics: Taxonomy, Classical and quantitative methods of taxonomy, Classification and Biological nomenclature, Concept of species, Speciation: Allopatry, Sympatry, Parapatry and Peripatry; Reproductive isolation mechanisms and the species problem.	10
2.	Classification: Classification of plants, animals and micro-organisms with major emphasis on animals.	8
3.	Natural History of Indian Subcontinent: Major habitat types of the subcontinent, geographic origins and migrations of species, common Indian mammals, birds, seasonality and phenology of the subcontinent.	8
4.	Biodiversity: Geological Time Scale, mass extinctions, continental drift theory, Importance of biodiversity, types & patterns of biodiversity, Measurement of biodiversity, Diversity indices, keystone species, alien species, Endemism and hotspots, Conservation strategies of biodiversity & Loss of Biodiversity, IUCN Red List, World heritage sites, Indian case studies on conservation.	10
Suggested Reading:		
<ol style="list-style-type: none"> 1. Mayr, E. and Ashlock, P.D. (1991). <i>Principles of Systematic Zoology</i>. Mcgraw-Hill, 2nd 		

edition.

- Schuh, R.T. and Brower, A.V.Z. (2009). *Biological Systematics: Principles and Applications*. Comstock Publishing Association, 2nd edition.
- Edward, O. Wilson (1999). *Diversity of Life*. W.W Norton & Company

Note: Opt any one Elective Course from across Life Sciences of 2 Credits.

Inter Disciplinary Course

LAS.401: Fundamentals of Cell Biology

2 credits

Learning Objective: This is an interdisciplinary course to acquaint the students of different streams with a very basic knowledge and understanding of the basic unit of life: Cell, its structure, composition and function.

Unit	Syllabus	Lectures
1.	An Overview: Life at the cellular and molecular level. Introduction to the topics include cellular energetics, membrane phenomena, genetics, and molecular biology.	8
2.	Introduction to the Cell: The evolution of the cell, from molecules to first cell, from prokaryotes to eukaryotes, prokaryotic and eukaryotic genomes, from single cell to multicellular organism.	8
3.	Membrane Structure and Function: Biomembrane at a glance, models of membrane structure, membrane proteins, membrane carbohydrates, and membrane transport.	8
4.	Structural Organization of Intracellular Organelles: The subcellular organelles: lysosomes, ribosomes, peroxisomes, golgi apparatus, endoplasmic reticulum, nucleus, mitochondria, and chloroplast.	8

Suggested Reading:

- Gupta, P.K. (2005). *Cell and Molecular Biology*. Rastogi publications, Meerut, India.
- James, D.W., Baker, T.A., Bell, S.P., Gann, A. (2009). *Molecular Biology of the Gene*. Benjamin Cummings, USA.
- Johnson, A., Lewis, J., Raff, M. (2007). *Molecular Biology of the Cell*. Garland Science, USA.
- Lodish, H., Berk, A., Chris, A.K. and Krieger, M. (2008). *Molecular Cell Biology*. W.H. Freeman, USA. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. (2010).
- Molecular Biology of the cell*. Garland publishers, Oxford.
- Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. John Wiley & Sons. Inc. New Delhi, India.

LAS.525: Lab Course (Practicals) – I

1.	Laboratory instrumentation
2.	Preparation of Buffers and Solutions
3.	Biochemical estimation and analysis of Proteins, Lipids and Carbohydrates
4.	SDS-and native polyacrylamide gel electrophoresis
5.	Gel filtration and Ion-exchange chromatography
6.	Cell structure: Compound, Fluorescence, and Electron microscopy
7.	Histochemistry: Fixation, Sectioning, Embedding, Processing and Staining
8.	Immunocytochemistry
9.	Identification of cell mitosis and meiosis stages
10.	Speciment identification, DNA barcoding & Construction of phylogenetic trees

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

LAS.595: Seminar-I

Learning Objective: To improve student's scientific aptitude and presentation skills. The students select a specific topic based on a review article 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 literature survey/background information, organization of content, presentation and discussion. The remaining 50 marks are for the short report submitted by the student.

Updated on: 22-07-2016