

Department of Animal Sciences

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

(Academic Session 2018 - 19)

Semester – III

Course Code	Course Title	Type	L (hr)	T (hr)	P (hr)	Cr
	Core Courses*					
LAS.551	Developmental Biology	CC	3	-	-	3
LAS.552	Cancer Biology	CC	2	-	-	2
LAS.570	Lab Course (Practical) – III	CC	-	-	8	4
	Discipline Elective Courses (Opt any one)					
LAS.553	Vascular Biology	DE	2	1	-	3
LAS.554	Neurobiology and Degeneration	DE	2	1	-	
	Seminar					
LAS.543	Seminar – II	SK	1	-	-	1
	Compulsory Foundation[#]					
LAS.502	Research Methodology	CF	2	1	-	3
LAS.503	Basic Statistics for Sciences	CF	2	-	-	2
	Research*					
LAS.599	Project (Part – I)	SK	-	-	12	6
	Total Credits					24

[#]**Note:** In case of technical difficulty to offer the compulsory foundation courses at the department/university level, the student may opt through MOOCs (online) from the SWAYAM portal.

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.551: Developmental Biology

3 Credits

Learning Objective: The course in developmental biology is an introduction to animal development and places special emphasis on mammalian and human development. The principal objective is to introduce students to the developmental processes that lead to the establishment of the body plan of vertebrates and the corresponding cellular and genetic mechanisms.

Unit	Syllabus	Lectures
1.	Basic Concepts of Development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.	10
2.	Patterns of Development: Differential cell affinity; gametogenesis, fertilization, cleavage, early vertebrate development: neurulation, ectoderm, mesoderm and endoderm	12
3.	Transcriptional and Translational Regulation of Developmental Processes: Molecular regulators of development; enhancers and Cancers; activation of chromatin; translational control of oocyte messages; selective degradation of mRNAs; chromosome sex determination in mammals, <i>Drosophila</i> ; hermaphroditism	11
4.	Cell Fate Specification and the Embryonic Axes: Morphogenesis in <i>Dictyostelium</i> ; axes and pattern formation in <i>Drosophila</i> , amphibians and chick; vulva formation in <i>C. elegans</i> ; eye lens induction, limb development and regeneration in tetrapods; germ cell determination in nematodes and insects; teratogenesis.	12

Suggested Reading:

1. Darwin, C. R. (1911). On the origin of species by means of natural Selection, or preservation of favored races in the struggle for life. Hurst Publishers, UK.
2. Dawkins, R. (1996). The Blind Watchmaker, W.W. Norton & Company Jones and Bartlett Publishers.
3. Futuyma, D. J. (2009). Evolution. Sinauer Associates Inc. USA.
4. Hake, S. and Wilt, F. (2003). Principles of Developmental Biology. W.W. Norton & Company, New York, USA.
5. Hall, B. K. and Hallgrímsson, B. (2007). Strickberger's Evolution. Jones and Bartlett Publishers, India.
6. Lewin, R. (2004). Human Evolution - An Illustrated Introduction. Wiley-Blackwell, USA.
7. Scott, F. and Gilbert, S. F. (2010). Developmental Biology. Sinauer Associates, Inc. USA.
8. Slack, J. M. W. (2005). Essential Developmental Biology, Wiley-Blackwell, USA.

Learning Objective: This course will ensure the importance of understanding cell biology in the study of cancer: its cause, progression, mechanism and treatment. This course also describes the various cancer prevention mechanisms including risk assessment, screening, and lifestyle and environmental modification and management of human health.

Unit	Syllabus	Lectures
1.	Biology and Classification of Cancer: Classification, phenotype of a cancer cell, causes of cancer –DNA tumor viruses, RNA tumor viruses, cell cycle and its control-role of protein kinases, checkpoints, kinase inhibitor and cellular response. Different forms of cancers, diet and cancer, screening and early detection, tumor markers and molecular tools for early diagnosis of cancer.	8
2.	Basis of Cancer: Oncogenes, tumor suppressor genes, aberrations in signaling pathways, oncogenic mutations in growth promoting proteins, mutations causing loss of growth-inhibition and cell cycle control, role of carcinogens and DNA repair in cancer.	7
3.	Oncogenesis and Apoptosis: Intracellular proteolytic cascade, cascade of caspase proteins, adapter proteins, Bcl-2, IAP family proteins, Extracellular control of cell division, tumor necrosis factor and related death signals.	7
4.	Metastasis and Cancer therapy: Heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinase and tumor cell division, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection, different forms of cancer therapy (chemotherapy, radiotherapy and surgery), use of signal targets towards therapy of cancer and gene therapy.	8

Suggested Reading:

1. Dimmock, N. J. and Primrose, S. B. (2005). Introduction to Modern Virology. Bookbarn International, UK.
2. Ford, C. H. J., Casson, A. G. and Macdonald, F. (2004). Molecular Biology of Cancer. Bios Scientific Publishers, USA.
3. King, R. J. B. and Robins M. W. (2006). Cancer Biology. Prentice Hall, USA.
4. Margaret, A. K. and Peter, J. S. (2005). Introduction to the Cellular and Molecular Biology of Cancer. Oxford University Press, USA.
5. Neoptolemos, L. J. (1994). Cancer: A Molecular Approach. Blackwell Publishing, USA.
6. Phillis, R., Goodwin, S. and Palladino, M. A. (2002). Biology of Cancer. Benjamin-cummings Publishing Company, USA.

Discipline Elective Courses:**LAS.553: Vascular Biology****3 (2L + 1T) Credits**

Learning Objectives: This course is designed for the students of Animal Sciences who wish to pursue their research careers in the field of vascular biology. This course will cover cellular and integrated vascular functions under both normal and pathological conditions such as atherosclerosis, diabetes, hypertension and stroke, which are the leading cause of morbidity and mortality in the modern world.

Unit	Syllabus	Lectures
1.	Vascular Biology: Introduction, normal vascular, structure, growth as well as development and function of the vascular system. Vascular dysfunction in various pathophysiological states including endothelial and smooth muscle dysfunction, inflammation, atherosclerosis, diabetes, aging, neurological diseases, metabolic disorders, pulmonary diseases and hypertension.	8
2.	Cardiovascular Biology: Basic cardiovascular physiology, cardiovascular system including blood coagulation system, platelet biology, haemostasis & thrombosis, molecular mechanisms underlying cardiovascular diseases, molecules and signalling pathways involved in the pathology of vascular diseases.	7
3	Vascular Disorders: Diseases of the aorta involving leaky blood vessels, age-related macular degeneration, peripheral vascular disease, stroke, vascular oncology, neurological vascular diseases, platelet in cardiovascular diseases, diseases of the circulatory system including arterial diseases, venous diseases, lymphatic diseases.	8
4	Vascular Medicine: Non-invasive method for the diagnosis and treatment of circulatory system related pathological states. Novel drugs including antiplatelet drugs, devices, diagnostic methods including vascular angiography, imaging modalities, and other therapeutic approaches to better diagnose, prevent, or treat cardiovascular diseases.	7

Suggested Reading:

1. Michael, R. J. and Christopher, J. W. (2011). Vascular Disease: Diagnostic and Therapeutic Approaches. Cardiotext Publishing. 1st Edition.
2. Minar, E. and Schillinger, M. (2013). Peripheral Vascular Disease: Basic & Clinical Perspectives. Future Medicine Ltd.
3. Rasmussen, T. E., Clouse, W. D., and Tonnessen, B. H. (2008). Handbook of Patient Care in Vascular Diseases. Lippincott Williams & Wilkins. 5th Edition.
4. Bhatt, D. L. (2008). Platelets in Cardiovascular Disease. Imperial College Press.
5. Kirali, K. (2015). Coronary Artery Disease - Assessment, Surgery, Prevention. InTech Publication.
6. Bozic-Mijovski, M. (2015). Thrombosis, Atherosclerosis and Atherothrombosis - New Insights and Experimental Protocols. InTech Publication.

LAS.554: Neurobiology and Degeneration**3 (2L + 1T) Credits**

Learning Objective: This course emphasizes the basis of major diseases affecting the nervous system and has been developed for the students of Animal Sciences to gain enough knowledge in brain disease mechanisms. The course will deal on the clinical, neuropathological, physiological and molecular features of human disorders. Diseases to be discussed will include: neurodegenerative diseases (Alzheimer's, Parkinson's, expanded repeat disease Huntington's), neurodevelopmental disorders: muscular dystrophies, dystonia, stroke, epilepsy, anxiety or schizophrenia, among others.

Unit	Syllabus	Lectures
1.	Introduction to Human Brain and Nervous System; Metabolic functions of the Brain; Energy Requirements; Oxidative stress; Factors contributing to the neurodegeneration.	6
2.	Alzheimer's disease: Mechanism(s) of AD pathogenesis and pathophysiology, e.g. amyloid cascade hypothesis, tau, and the therapeutic approaches. Review of recently completed clinical trials and treatment prospects. Parkinson's Disease: genetics - alpha synuclein, parkin, DJ1, PINK1, and LRRK2. Gene therapy for PD.	8
3.	Huntington's Disease, multiple sclerosis, clinical overview of FTD and ALS, channelopathies, autism. Stroke, ischemic brain damage and traumatic brain injury, epilepsy.	8
4.	Therapeutic intervention: Current treatment strategies including Pharmaceutical and Natural products based therapies for various human neurodegenerative diseases.	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.
4. Mason, P. (2011) *Medical Neurobiology*. OUP USA publishers; 1st edition.
5. Amaral, D., Geschwind, D., and Dawson, G. (2011) *Autism Spectrum Disorders*. OUP USA publishers; 1st edition
6. Charney, Dennis, S., (2013) *Study guide for Neurobiology of Mental Illness*. Cram 101 Publishers.
7. Dennis S. Charney, Nestler, E. J., Sklar, P., and Buxbaum, J. D. (2013). *Neurobiology of Mental Illness*. OUP USA publishers; 4th edition.
8. Zigmond, M. J, Coyle, J. T., and Rowland, L. P. (2014). *Neurobiology of Brain Disorders: Biological Basis of Neurological and Psychiatric Disorders*. Academic Press; 1st edition.

Compulsory Foundation Courses:

Learning Objective: To ensure that the student understands various aspects of research methods, ethics, technical and scientific writings and literature search. This course will also help the students to understand the complex outcomes of their results using biostatistical approaches in testing hypothesis, designing experiments, analyzing experimental data and interpreting the results.

Unit	Syllabus	Lectures
1.	Scientific Writing: Literature survey and review, sources of literature, methods of literature review and techniques of writing the reviewed literature. Understanding a research problem, selecting the research problem, steps in formulation of a research problem, formulation of research objectives, and construction of a hypothesis.	8
2	Basic principles of experimental designs, data collection, processing, and interpretation. Basics of citation and bibliography/reference preparation styles, report presentation.	7
3.	Biosafety for Human Health and Environment. Good laboratory practices (GLP), biosafety issues for using cloned genes in medicine, agriculture, industry. Genetic pollution, risk and safety assessment from genetically engineered organisms.	8
4	Ethical theories, ethical considerations during research, ethical issues related to animal testing and human project. Intellectual property rights (IPRs), patents and copyrights, fair use, plagiarism and open access publishing.	7

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. Kothari, C. R. and G. Garg (2014): Research Methodology: Methods and Techniques, 3rd ed., New Age International Pvt. Ltd. Publisher
7. Kumar, R. (2014): Research Methodology – A Step-By-Step Guide for Beginners, 4th ed., Sage Publications.
8. Jerrold, H. Z. (2010): Biostatistical Analysis, Fifth ed., Pearson.

9. Sokal, R. F and Rohlf, F. J. (2011): Biometry, Fourth Ed., W.H. Freeman Publishers.

LAS.503: Basic Statistics for Sciences

2 Credits

Learning Objective:		
To provide the understanding and use of Statistical techniques for students of science departments.		
Unit	Syllabus	Lectures
1.	Descriptive Statistics: Meaning, need and importance of statistics. Attributes and variables. Measurement and measurement scales. Collection and tabulation of data. Diagrammatic representation of frequency distribution: histogram, frequency polygon, frequency curve, ogives, stem and leaf plot, pie chart.	7
2.	Measures: Measures of central tendency, dispersion (including box and whisker plot), skewness and kurtosis. Linear regression and correlation (Karl Pearson's and Spearman's) and residual plots.	7
3.	Random variables and Distributions: Discrete and continuous random variables. Discrete Probability distributions like Binomial, Poisson and continuous distributions like Normal, F and student-t distribution.	8
4.	Differences between parametric and non-parametric statistics. Confidence interval, Errors, Levels of significance, Hypothesis testing. Parametric tests: Test for parameters of Normal population (one sample and two sample problems) z-test, student's t-test, F and chi-square test and Analysis of Variance (ANOVA). Non-Parametric tests: One sample: Sign test, signed rank test, Kolmogrov-Smirnov test, run test. Critical difference (CD), Least Significant Difference (LSD), Kruskal-Wallis one-way ANOVA by ranks, Friedman two-way ANOVA by ranks.	8
Suggested Reading:		
1. P. L. Meyer, Introductory Probability and Statistical Applications, Oxford & IBH Pub, 1975. 2. R. V. Hogg, J. Mckean and A. Craig, Introduction to Mathematical Statistics, Macmillan Pub. Co. Inc., 1978. 3. F. E. Croxton and D. J. Cowden, Applied General Statistics, 1975. 4. P. G. Hoel, Introduction to Mathematical Statistics, 1997.		

LAS.570: Lab Course (Practical) – III

4 Credits

Learning Objectives: The lab course-III is designed to acquaint the students with animal handling, immunological techniques, blood cell isolation, cellular toxicity based biochemical assays and advanced cell biology and molecular biology techniques.

1. Animal handling: mice/rat/rabbit (tutorials only)
2. DigiFrog: Online animal dissection module – 2
3. Perfusion
4. Polyclonal antibody raising
5. Isolation of Lymphocytes from whole blood
6. Cell trypsinization and Cell count (Hemocytometer)
7. MTT Assay
8. Cell cycle monitoring by flow cytometry
9. Microscopic examination of human parasite life cycles (amoeba, cestodes, nematodes, and plasmodium)
10. Animal cell transfection (lipid based and electroporation)
11. Determination and estimation of adulterants in foods: honey, fats, oils, and spices

12. Plan and preparation of suitable therapeutic diets based on patient needs for various disease/disorders

Note: Practicals may be added / modified from time to time depending on available faculties / facilities.

LAS.543: Seminar – II

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.

LAS.599: Project (Part – I)

6 Credits

Learning Objective: The objective of project (part I) would be to ensure that the student learns the nuances of the scientific research and writing skills. Herein the student will have to write her/his research project outline (synopsis) including an extensive review of literature with simultaneous identification of scientifically sound (feasible and achievable) objectives backed by a comprehensive and detailed methodology.

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