Centre for Animal Sciences

Ph.D. Program in Animal Sciences

Semester – I

Course Code	Course Title	L (hr)	T (hr)	P (hr)	Cr
Core Course*					
LSS.701	Research Methodology& Computer Applications	3	1		4
Elective courses (Part-I: opt any two or three courses listed below)**					
LAS.702	DNA Damage & Repair in Human Health	3	1		4
LAS.703	Advances in Molecular Cell Biology	3	1		4
LAS.704	Neuroendocrinology	3	1		4
LAS.705	Advances in Biotechnology	3	1		4
(Part-II: opt any one or two courses of 4 credits each from the Life Sciences)**					
XXX.xxx	**Any Life Sciences Ph.D. Course**	3	1		4
	Total Credits				**20**

L: Lectures; T: Tutorials P: Practical; Cr: Credits
***Compulsory Course**
****** **Total No. of elective credits should not be less than 16.**

Examination Pattern

A: End-Term Exam (Final): Based on short and long descriptive type test (100 Marks)

LSS.701: Research Methodology & Computer Applications. 4 Credits

Learning Objective: This course will help students to plan, execute, and understand the research and complex outcome of their results using biostatistical approaches in testing hypothesis, designing experiments, analyzing experimental data and interpreting the results. Further 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. **Technical Writing:** Scientific writing, Writing synopsis, Research paper, Poster preparation, oral presentations and Dissertations.	18
2.	**Introduction and Principles of Good Lab Practices:** Good laboratory practices, Biosafety for human health and environment. Biosafety issues for using cloned genes in medicine, agriculture, industry, and eco-protection, Biological containment and physical containment, CDC Biosafety levels, Biosafety in Clinical laboratories and biohazard management, Physical, Chemical & Biological hazards. **Research Ethics:** Ethical theories, Ethical considerations during research, data manipulations, subject consent, Animal testing. Animal rights, Perspectives and methodology & Ethical issues of the human genome project, Plagiarism.	18
3.	**Fundamentals of Computer and its Applications:** Parts of computer, Hardware, BIOS, Operating systems, Binary system, Logic gates and Boolean Algebra. Application software: Spreadsheet applications, Word-processing applications, Presentation applications, Internet browsers, Reference Management, and Image processing applications. Computer language: Basic DOS commands, AutoHotKey scripting language, HTML and basic structure of a webpage, Designing websites. World wide web: Origin and concepts, Latency and bandwidth, Searching the internet, Advanced web-search using Boolean logic, Cloud computing.	18
4.	**Bioinformatics:** Organization, management and analysis of biological data, use of computers in data analysis, biological databases - DNA sequence databases and protein sequence databases, BLAST, FASTA, multiple sequence alignment, *in silico* approaches for drug designing, primers in biology (design and types of primers) genome projects (human, *Arabidopsis* and other genome projects), NCBI, UCSC and other database searches.	18

Suggested Reading:

1. Gupta, S. (2008). *Research Methodology and statistical techniques*. Deep & Deep Publications (P) Limited, New Delhi.
2. Kothari, C. R. (2014). *Research methodology (s).* New Age International (p) Limited. New

Delhi.
3. Sahay, Vinaya and Pradumna Singh (2009). *Encyclopedia of Research Methodology in life sciences.* Anmol Publications. New Delhi.
4. Kauda J. (2012). *Research Methodology: A Project Guide for University Students*. Samfunds literature Publications.
5. Dharmapalan B. (2012). *Scientific Research Methodology*. Narosa Publishing
6. Norman, G. and Streiner, D. (2008). *Biostatistics:* The Bare Essentials.3/e (with SPSS). Decker Inc. USA.
7. Rao, P. P., S. Sundar and Richard, J. (2009). *Introduction to Biostatistics and Research Methods.* PHI learning.
8. Christensen, L. (2007). *Experimental Methodology*. Boston: Allyn& Bacon.
9. Fleming, D. O. and Hunt, D.L. (2006). *Biological Safety: Principles and Practices*. American Society for Microbiology, USA.
10. Rockman, H. B. (2004). *Intellectual Property Law for Engineers and Scientists*.
Wiley-IEEE Press, USA.
11. Shannon, T. A. (2009). *An Introduction to Bioethics*. Paulist Press, USA.
12. Vaughn, L. (2009). *Bioethics: Principles, Issues, and Cases.* Oxford University Press, UK.
13. WHO (2005). *Laboratory Biosafety Manual*. World Health Organization. House ISBN: 978-81-8487-180-7.

LAS.702: DNA Damage & Repair in Human Health. **4 Credits**

Learning Objective: This course deals with various aspects of DNA repair, replication, and mutagenesis. A particular focus point will be the interrelationships among repair processes and other important cellular functions. While the focus of the course is on recent developments in the field of DNA repair and human diseases and the specific topics will vary from year to year.

Learning outcome: The student will be expected to have gained knowledge in the fields of DNA damage-repair and various human diseases resulting with the poor-error prone DNA repair machinery.

Essential Background Knowledge Required: Biochemistry and Metabolism; Advanced Genetics.

Unit	Syllabus	Lectures
1.	**Oxidative Stress**: Chemical and biological effects, production and consumption of oxidants, antioxidants as supplements, metal catalysts and non-metal redox catalysts, and redox biology (response of various transcription factors (TFs) e.g., p53, NF-kB, AP-1, STAT3, HIF1α, and Pax6/8).	18
2.	**Oxidative Stress and Diseases**: Contribution of oxidative stress towards development and progression of neurodegenerative diseases (Alzheimer's, Parkinson's, and Huntington's disease), cardiovascular diseases (Ischemia) and cancer (Lung and Pancreatic cancer).	18
3.	**DNA Damage**: Sources of DNA damage (endogenous and exogenous),	18

	types of DNA damage: [i) oxidation of bases, ii) alkylation of bases, iii) hydrolysis of bases, iv) bulky adduct formation, and v) mismatch of bases].	
4.	**DNA Repair**: DNA damage-repair signalling mechanisms (role of PARP-1, XRCC1, BRCA1,p53, and DNA-PK). **Single-strand break repair (SSBR)**: emphasis on base excision repair (BER) pathway. **Double-strand break repair (DSBR)**: emphasis on non-homologous end joining (NHEJ) pathway. **DNA damage and human diseases**: Comparisons between nuclear vs. mitochondrial DNA damage and repair, and pathological effects of poor nuclear DNA repair and mitochondrial DNA repair. **DNA repair modulation**: Effect of herbals on DNA repair, small molecules for cancer therapeutics, and caloric restriction for DNA repair.	18

Suggested Reading:

1. Lodish, H., Berk, A., Zipursky, SL., Matsudaira, P., Baltimore, D., Darnell, J. (2008), Molecular Cell Biology. Freeman, HW.
2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. (2007), Molecularbiology of the cell. Garland publishing.
3. Watson, J. D., Baker, TA., Bell, SP., Gann, A., Levine, M., Losick, R. (2008), Molecular Biology of the Gene. CSHL Press.
4. DNA Repair and Human Health. (2011), Edited by Sonya Vengrova, ISBN 978-953-307-612- InTech.
5. Heydari, AR., Unnikrishnan, A., Lucente, LV., Richardson, A. (2007), Caloric restriction andgenomic stability. *Nucleic Acid Research*.
6. Hegde, ML.,Mantha, AK., Hazra, TK., Bhakat, KK., Mitra, S., Szczesny, B. (2012), Oxidative genome damage and its repair: Implications in aging and neurodegenerative diseases.*Mech Ageing Dev*. 133(4):157-168.
7. Helleday, T., Petermann, E., Lundin, C., Hodgson, B., Sharma, RA. (2008), DNA repairpathways as targets for cancer therapy. *Nature Reviews Cancer* **8**, 193-204.

LAS.703: Advances in Molecular Cell Biology. 4 Credits

Learning Objective: The principal aim of the course is to equip students with a detailed knowledge of molecular and cell biology in the context of human diseases. The main objective of this course is to prepare students for current and upcoming research topics and also enhance their career prospects in the expanding Life Sciences sector including public-funded research laboratories or private industry.

Learning outcomes:(i) Students will gain a detailed and up-to-date understanding of molecular biology and cell biology, and **(ii)** Knowledge of how alterations or defects in molecular cell processes may lead to disease, such as cellular dysfunction leading to degenerative diseases, cell

cycle dysregulation in cancer, and how mutations result in genetic diseases.

Unit	Syllabus	Lectures
1.	**DNA Biology:** DNA topology and chromatin structure which affects the processes of DNA replication, repair, and transcription. Alternative DNA structures; Triplex-, G-quadruplex, cruciform-DNA, how these DNA structures induces DNA damage, repair, and genetic instability and various diseases. The molecular mechanisms by which protein complexes repair different forms of DNA damage.	18
2.	**RNA Biology:** Types of RNAs and Non-coding RNA; miRNA, piRNA, long non-coding RNA, etc. Biological roles of non-coding RNAs and regulation of gene expression by non-coding RNA in cancer and other diseases.RNA binding proteins in cancer, Epigenetic mechanisms and how they affect gene expression which leads to disease conditions.	18
3.	**Cancer & Signalling Pathways**: Cancer associated Signalling pathways; Akt Signaling, MAP kinase Signaling, PARP, apoptosis, p53 signaling, Caspase Signaling, NF-kB Signaling, JAK, STAT3 pathways, PTEN, mTOR signaling pathway,Wnt signaling pathways, VEGF signaling pathway,Toll-like receptor signaling pathway.	18
4.	**Advanced Molecular Cell Biology Techniques:** Chromatin-immunoprecipiation assays, DNA-footprinting, gel-shifts assays, Southern blotting, Northern blotting, Western blotting, antibody production, Co-immunoprecepitation, in vitro translation, yeast two hybrid system, DNA sequencing, PCR, genomics, microarrays, proteomics, cells transfection, RNA-Seq, Flow-cytometry, fluorescence microscope.	18

Suggested Reading:

1. Jan Barciszewski, (2003) Non-Coding RNAs: Molecular Biology and Molecular Medicine, Springer Publisher.
2. Ondrej Slaby, (2012) MicroRNAs in Solid Cancer: From Biomarkers to Therapeutic Targets (DNA and RNA: Properties and Modifications, Functions and Interactions, Recommendations and Applications), Nova Science Publishers.
3. Lauren Pecorino (2012) Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics, Oxford Edition.
4. Bruce Alberts (2008) Molecular Biology of the Cell, Garland Science
5. Lewis C. Cantley, Tony Hunter, Richard Sever (2014) Signal Transduction: Principles, Pathways, and Processes, Cold Spring Harbor Laboratory Press.

LAS.704: Neuroendocrinology. **4 Credits**

Learning Objective: The principal aim of the course is to equip students with basic and advanced endocrine biochemistry, physiology and pathophysiology which provide the basis for understanding endocrine disorders.

Learning Outcomes: (i) Students will gain a scholarly research in Endocrinology and Metabolism, **(ii)** Students will gain hands on experience in order to acquire the knowledge necessary for the critical analysis of the results of endocrine laboratory tests, and **(iii)** Students will gain exposure to the Endocrinology of Reproduction.

Unit	Syllabus	Lectures
1.	**Aims and Scope of Neuroendocrinology:** General introduction to hormone, neurosecretions. Hormonal mechanism of integration, neuroendocrine system and neurosecretion. Concept of brain plasticity, neuroendocrine integration, master Gland, hormones of Pituitary, hypothalamic hormones, metabolic disorders like obesity, diabetes etc.	18
2.	**Male Reproductive System:** Testis structure, spermatogenesis, paracrine and autocrine regulation. Concept of seasonal breeding. The feedback mechanism of hormonal regulation, hormonal assay by ELISA, RIA.	16
3.	**Female Reproductive System:** Ovary structures, Origin of GnRH cells, migration and site of release, reproductive cycles in females. Chemotrophic factors involved during early GnRH development and adult GnRH System. Interplay of hormones during Reproductive cycle.	18
4.	**Hypothalamic Pituitary Disorders:** Sterility: Male and Female, regulation of male and female fertility. Puberty and mechanism of puberty, reproductive disorders like IHH and Kallmann syndrome, precocious puberty.	18

Suggested Reading:

1. Norris, D.O., and Carr, J.A. *Vertebrate endocrinology*, 5th Edition. Academic Press, 2012. Nelson, David L., and Cox, Michael M., *Lehninger Principles of Biochemistry*, 5thEdition. WH Freeman & Company, New York, 2008.
2. Widmaier, E.P., Raff, H., and Strang, K.T. *Vander's Human Physiology*, 13th Edition.McGraw-Hill Higher Education, 2013.
3. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., and Scott, M.P. *Molecular Cell Biology*, 7th Edition. W.H. Freeman, 2012.
4. Rhoades, R.A., Tanner, G.A., Medical Physiology, 2nd ed., Lippincott Williams and Wilkins, 2003.

LAS.705: Advances in Biotechnology. **4 Credits**

Learning Objective: The aim of this advanced 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.	**Molecular Cloning Systems:** Commercially available cloning vector systems, genomic and cDNA library construction& DNA-sequencing techniques.	12
2.	**Recombinant Expression Systems, Mutagenesis &Protein Engineering:** 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.	18
3.	**Molecular Biotechnology of Microbial Systems:** Monoclonal & recombinant antibodies & applications, vaccines (subunit-, peptide-, attenuated-, DNA- and vector-based), molecular diagnostics.	18
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, Biology of stem cells and stem cell therapies.	24

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
5. Essentials of Stem Cell Biology, Third Edition, Robert Lanza & Anthony Atala, Academic Press.

Semester	Total Credits
Semester - I	20
Total:	**20**

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