Ph.D. Molecular Medicine Course Work

S.No.	Course Code	Course Title	L	T	P	Cr	E
1	LML.701	Research Methodology and Biostatistics	5			5	100
2	LML.702	Bioethics, Biosafety and Good Laboratory Practices	4	-	-	4	100
3	LML.703	Trends in Molecular Medicine	5	-	-	5	100
4	LML.704	Advanced Techniques in Cellular and Molecular Biology	5	-	-	5	100
5	LMS.799	Seminar	-	-	-	1	100
TOTAL						20	600

LML.701: Research Methodology and Biostatistics **Credit Hours: 5.**

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 of biological research.

Unit:1 **20 Lectures**

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 and Presentations and Dissertation; IPR and related issues.

Unit:2 **20 Lectures**

General Statistics: Difference between parametric and non-parametric statistics, Univariant and multivariant analysis, Confidence interval, Errors, Levels of significance, Hypothesis testing. Measures of central tendency and dispersal, Histograms, Probability distributions (Binomial, Poisson and Normal), Sampling distribution, Kurtosis and skewness

Unit:3 **25Lectures**

Comparative Statistics: Comparing means of two or more groups: 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), Fisher's LSD (Least significant difference), Kruskal–Wallis one-way ANOVA by ranks, Friedman two-way ANOVA by ranks, Chi-square test

Regression and correlation: 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.

Unit: 4 **25 Lectures**

Fundamentals of computer: 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.

Suggested Reading:

1. Gupta, S. (2008). *Research Methodology and Statistical Techniques*.Deep and Deep Publications (P) Limited, New Delhi.
2. Kothari, C. R. (2014). *Research Methodology (s)*.New Age International (p) Limited. NewDelhi.
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*. SamfundsLiterature Publications.
5. Dharmapalan B. (2012). *Scientific Research Methodology*.Narosa Publishing House ISBN: 978-81-8487-180-7.
6. Norman, G. and Streiner, D. (2008). *Biostatistics: The Bare Essentials*.3/e (with SPSS). Decker Inc. USA.
7. Rao, P. P., Sundar,S.,and Richard, J. (2009). *Introduction to Biostatistics and ResearchMethods*.PHI learning.
8. Christensen, L. (2007). *Experimental Methodology*. Boston: Allyn & Bacon.
9. Clive Opie (2004). *Doing Educational Research- A Guide for First time Researchers.* New Delhi: Vistar Publications.
10. Fraenkel, J.R., Wallen, N.E. (2009). *How to Design and Evaluate Research in Education.* 7th edition, New York: McGraw Hill.
11. Kumar Ranjit (2011). *Research Methodology: A Step-by-Step Guide for Beginners Field*. Sage Publications.

LML.702: Bioethics, Biosafety and Good Laboratory Practices Credit Hours: 5.

Learning Objective: The students will be learning the best laboratory practices, basic principles of biosafety, bioethics from the research, clinical and medical prospective..

Unit:1 20 Lectures

Introduction and Principals of Good Lab Practice: Good laboratory practices, Biosafety for human health and environment. Biosafety issues for using cloned genes in medicine, agriculture, industry, and ecoprotection. Biological warfare, Biological containment and physical containment, CDC Biosafety levels, Biosafety in Clinical laboratories and biohazard management.

Unit:2 20 Lectures

Bioethics and Biosafety in Molecular Biology: Gene pollution, Biological invasion, Risk and safety assessment from genetically engineered organisms, special procedures for r-DNA based products.

Unit:3 25 Lectures

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**,**

Unit:4 25 Lectures

Medical and Clinical Ethics: Code of Ethics in Medical/clinical laboratories, healthcare rationing, ethical issues of xenotransplantation, Ethics involved in embryonic and adult stem cell research, Ethics in Assisted Reproductive Technologies: animal and human cloning and *in-vitro* fertilization, the element of Informed Consent, Ethical issues in MTP and Euthanasia.

Suggested Reading:

1. Fleming, D. O. and Hunt, D.L. (2006). *Biological Safety: Principles and Practices*. American Society for Microbiology, USA.
2. Rockman, H. B. (2004). *Intellectual Property Law for Engineers and Scientists*. Wiley-IEEE Press, USA.
3. Shannon, T. A. (2009). *An Introduction to Bioethics*. Paulist Press, USA.
4. Vaughn, L. (2009). *Bioethics: Principles, Issues, and Cases.* Oxford University Press, UK.

5. WHO (2005). *Laboratory Biosafety Manual*. World Health Organization.

Related Weblinks:

1. http://www.absa.org/resbslinks.html
2. http://bch.cbd.int/protocol/
3. http://global.oup.com/uk/orc/law/ip/macqueen2e/resources/weblinks/
4. http://www.icgeb.org/~bsafesrv/

LML.703: Trends in Molecular Medicine **Credit Hours: 4.**

Learning Objective: The students will understand the background of molecular medicine i.e. molecular/cell biology relevant to medical applications. It will enhance their understanding how normal cellular processes change, fail or are destroyed by disease development, in particular for genetic diseases and role of modern therapeutics

Unit:1 **18 Lectures**

Molecular basis of Metabolic, Infectious and Non-infectious diseases: Human genetics relevant to molecular medicine, human genome organization and variations, single nucleotide polymorphisms, multiple gene polymorphisms, single and multi-gene diseases, gene-environment interactions in disease manifestation, genetic and physical mapping of human genome and identification of diseases gene, gene therapy and recombinant molecules in medicine and therapeutic development. Antiviral therapies, vehicles for genetic therapies, construction of knock-out and transgenic animals.

Unit:2 **18 Lectures**

Signal Transduction and its Role in Human Diseases: Cellular and tissue microenvironment in diseases, drug resistance with convention chemotherapies, clinical trials, adjuvant therapies, monoclonal antibodies as drugs, nanobiotechnology and its applications in molecular medicine, next generation sequencing techniques.

Unit:3 **18 Lectures**

Stem Cells and Regenerative Medicine: Stem cells and their properties, classification of stem cells: Hematopoietic Stem Cells, mesenchymal Stem Cells, Embryonic Stem Cells, Fetal Stem Cells, adult stem cells, cancer stem cells, isolation, identification and characterization of stem cells, tissue and organ culture, tissue Engineering and transplantation techniques.

Unit:4 **18 Lectures**

Molecular Pharmacogenetics and Therapeutics: Gene therapy and recombinant molecules in medicine and therapeutic development. Antiviral therapies, vehicles for genetic therapies, construction of knock-out and transgenic animals, Stem cell research and its application in human health, pharmacogenomics, its application and role in developing novel therapies. RNAi and human diseases, alternate splicing and human disease

Suggested Reading:

1. Littwack, G. (2008). *Human Biochemistry and Disease.*Academic Press.
2. Trent, R. J. (2012). *Molecular Medicine,* Fourth Edition: Genomics to Personalized Healthcare. Academic Press.
3. Elles, R., Mountfield, R. (2011). *Molecular Diagnosis of Genetic Diseases*.Springer Publication.
4. Lanza, R., Gearhart,J. (2009). *Essential of Stem Cell Biology*. Elsevier Academic Press.
5. Lanza, R., Klimanskaya, I. (2009). *Essential Stem Cells Methods*. Academic Press.
6. Mao, J. J., Vunjak-Novakovic (2008). *Translational Approaches in Tissue Engineering & Regenerative Medicine*. Artech House INC Publications.
7. Lanza, R. (2007). *Principles of Tissue Engineering, 3rd Edition*. Academic Press.
8. Stein. (2011). *Human Stem Cell Technology and Biology: A Research Guide and Laboratory Manual.* Wiley-Blackwell.

Related Weblinks:

1. www.stemcells.wisc.edu
2. http://stemcells.nih.gov/info/scireport/Pages/2006report.aspx

3. *stemcells.nih.gov/*
4. http://instem.res.in/

LML.704: AdvancedTechniques in Cellular and Molecular Biology. Credit Hours: 5.

Learning Objective: The students will understand the molecular processes of DNA replication, transcription, and translation, and how they are managed in cells and the advanced techniques based of these processes.

Unit:1 18 Lectures

Genomics: Chromatin remodeling studies, ChIP and chromatin dynamics, *in-vitro* transcription and translation (IVT and IVTT), Southern, Northern and dot blotting, selection of DNA/ RNA probes, PCR, RT and real time PCR, ChIP on ChIP and cDNA arrays, models to study DNA damage repair and replication, EMSA, reporter assays for finding active regions in DNA, construction of cDNA and genomic libraries.

Unit:2 18 Lectures

Proteomics: Protein expression systems: bacterial, yeast and mammalian, tagging of recombinant proteins with His or FLAG tags, fluorescent proteins: green, red or yellow; protein localization studies, performing import-export inhibition assays, recombinant proteins and human health.

Unit:3 18 Lectures

Molecular Biology tools for interactomics: DNA-DNA, DNA-protein, RNA-DNA, RNA-Protein, protein-protein interactions and their role in signal transduction, 6-C technique, DNase protection assay, two and three hybrid systems (yeast and mammalian), Immunoprecipitation, pull down assays, FISH and confocal analysis for intracellular interactions, appropriate antibody selection for immune-assays, types and applications of ELISA, confocal and live cell imaging, flow cytometer and cell sorting.

Unit:4 18 Lectures

Culture techniques: mammalian cell culture, media for animal cell culture, construction of cell lines, transfection, electroporation, cell lines as *in-vitro* model for research, MTT assay, zvmography, flow cytometry and cell cycle analysis; Microscopy.

Suggested Readings:

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. (2013*). Lewin's Genes X*. Jones & Bartlett Publishers, USA.
5. Johnson, A., Lewis, J., Raff, M. (2007). *Molecular Biology of the Cell*. Garland Science, USA.
6. Lodish, H., Berk, A., Chris, A.K. and Krieger, M. (2012). *Molecular Cell Biology*. W.H. Freeman, USA.

LMS.799: Credit Seminar **Credit Hours: 1.**

Learning Objective: This will help the student in developing the effective oral and writing skills to communicate scientific data and ideas and make them aware about the recent trends and developments in molecular medicine.

Non-Credit Seminar:

Learning Objective: There are 03 the mandatory seminars during Ph.D. tenure as detailed below:

Synopsis seminar: Students will present this seminar at the time of synopsis submission and if desired by the experts the candidate may be asked to repeat the seminar after incorporating the suggested correction.

Mid term seminar: Students will present these seminars once every year after synopsis submission.

Pre-submission seminar: Students will present this seminar before submission of their thesis; The internal faculty may suggest changes so that overall quality of the work and thesis may be improved.