

Centre for Human Genetics and Molecular Medicine

Scheme of Programme Ph.D. Life Sciences with specialization Human Genetics

S.No	Paper Code	Course Title	L	T	P	Cr
1	LSL.701	Research Methodology and Biostatistics	5	-	-	5
2	LSL.702	Bioethics, Biosafety and Good Laboratory Practices	4	-	-	4
3	HGL.703	Advanced Human Cytogenetics and Molecular Genetics	5	-	-	5
4	HGL.704	Advanced Human Genomics and Epigenetics	5	-	-	5
5	HGS.700	Seminar	1	-	-	1
		Total Credit Sem-1	20	0	0	20

L: Lectures, T: Tutorial, P: Practical, Cr: Credit

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

Course Objective: To teach students the basics of research, scientific writing, literature search and paper writing.

Unit 1**20 Hours**

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 Hours**

General Statistics: Difference between parametric and non-parametric statistics, Univariate and multivariate 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**25 Hours**

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 Hours**

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, Auto HotKey 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 Readings:

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 Litteratur 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., S. Sundar and Richard, J. (2009). *Introduction to Biostatistics and Research Methods*. 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.

LSL.702: Bioethics, Biosafety and Good Laboratory Practices

Credit Hours:4

Unit 1

20 Hours

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 Hours

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 Hours

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 Hours

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/>

HGL.703: Advanced Human Cytogenetics and Molecular Genetics Credit Hours: 5

Course Objectives: With the advances in cytogenetic technology, information regarding human genomics, disease and cancer genetics, chromosome evolution and the relationship of nuclear structure to function have grown in spurts. Human Molecular Genetics is a vast field that provides understanding of the structure and function of the normal human genome. Human molecular genetics not only forms the cutting edge of biomedical research, but at the same time it has immediate application to the diagnosis of disease and has great potential for treating disease. Thus it is of major interest to all students of biological science and medicine, and to a wide range of biomedical researchers.

Unit 1 18 lectures

Advanced Human Cytogenetics: GTG banding and Nomenclature of human chromosomes; Structure of X and Y chromosome; X and Y Pairing and Pseudoautosomal region; Molecular mechanism of X inactivation Molecular Cytogenetics methods-FISH, CGH, SKY, Cytogenetics of Cancer.

Unit 2 18 lectures

Tissue culture techniques: Whole Blood Culture, Bone Marrow Culture, Amniocyte Culture, Chorionic villi culture, Skin Fibroblast culture.

Unit 3 18 lectures

DNA structure and Gene Regulation: DNA structure and superstructure, DNA replication initiation and termination, Chromosomal compaction and mechanism of gene regulation, Mechanism of mutation and DNA repair.

Unit 4 18 lectures

Techniques in Molecular Genetics: Isolation and purification of RNA , DNA (genomic and plasmid) and proteins, Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, Isolation of specific nucleic acid sequences, In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms, DNA sequencing methods, strategies for genome sequencing, .RFLP, RAPD and AFLP techniques

Suggested reading:

1. Griffiths, A.J.F., Wessler, S.R. and Carroll, S.B. (2012). *An Introduction to Genetic Analysis*. W.H. Freeman Publication, New York.
2. Gillham, N. W.(2011). *Genes, Chromosomes and Disease.: From Simple Traits, to Complex Traits, to Personalized Medicine*. Pearson.
3. Hein, S. and Mitelman, F. (2009). *Cancer Cytogenetics*. Wiley-Blackwell.
4. Klug, W.S., Cummings, M.R., Spencer, C.A. and Palladino, M.A. (2012). *Concepts of Genetics*. Pearson.
5. F Vogel A.G. Motulusky. *Human Genetics: Problems and Approaches*. Second Completely Revised Edition, Springer-Verlag. (latest edition)

- Golder N. Wilson, M.D., Ph.D. *Clinical Genetics-A Short Course*. A John Wiley and Sons, Inc., Publication. (latest edition)

HGL.704: Advanced Human Genomics and Epigenetics

Credit Hours:5

Course Objectives: The aim of the course is to make students understand the advanced concepts of genetics and basic principles of epigenetics.

Unit 1

18 lectures

Recombinant DNA Technology: Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; Expression of recombinant proteins using bacterial, animal and plant vectors; Isolation of specific nucleic acid sequences, Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors; protein sequencing methods, Detection of post translation modification of proteins; Methods for analysis of gene expression at RNA and protein level.

Unit 2

18 lectures

Pharmacogenomics and Overview of Human Genome Project: Concept of individual based treatment, Drug Metabolism; Genetic makeup and Drug Response; High throughput screening for drug discovery; Identification of drug targets; Pharmacogenetics and drug development, Personalized Medicine; goals of Human Genome Project, its implications on research and human society; Strategies for genome sequencing; Early, next and third generation DNA sequencing methods; Personalized medicine.

Unit 3

18 lectures

Introduction and molecular mechanisms of Epigenetics: Mechanisms of DNA methylation; Histone modifications; Chromosomal position effect and gene variegation; Epigenetic control of gene activity; Analysis of gene-specific DNA methylation; Methods of assessing genome-wide DNA methylation; Model organism of epigenetic: *Drosophila*

Unit 4

18 lectures

Epigenetic Epidemiology: Effects of diet and environmental agents on epigenetic processes; Impact of microbial infections on the human epigenome; Cancer epigenetic, Role of epigenetic in immune disorders; imprinting disorders in humans.

Suggested reading:

- Tollefsbol T.(2011). *Handbook of Epigenetics*, Elsevier Publications
- Carey N. (2013). *The Epigenetics Revolution: How Modern Biology Is Rewriting Our Understanding of Genetics, Disease, and Inheritance*. Columbia Univ Pr.
- Wallach J (2014). *Epigenetics: The Death of the Genetic Theory of Disease Transmission*. Kindle Publications, Columbia University Press.
- Francis R.C. (2012). *Epigenetics: How Environment Shapes Our Genes*. W.W. Norton and Company, New York.
- Jocelyn, E. K., Elliot, S. G. and Stephen, T. K. (2009), *Lewin's Gene X*. Jones & Barlett.
- Korf, B.R. (2006). *Human Genetics and Genomics*. Wiley Blackwell.

7. Lodish, H., Berk, A., Chris, A. K., Krieger, M. (2008), *Molecular Cell Biology*. W.H. Freeman, USA.

HGS.700 Seminar

Credit Hours: 1