University of Mysore
Department of Studies in Genetics and Genomics
Revised Syllabus for Ph.D. Course work -2017
Subject: Ph.D in GENETICS
Paper I Advanced Research Methodology 64 hrs.

Unit I: Laboratory Biosafety 4 hrs

National and international guidelines, personal protection, handling and disposal of hazardous materials (chemical and physical agents), prevention of biological hazards, spillage and waste disposal, good laboratory practices.

Unit II: Animal and Human Ethics 4 hrs

Utility based approach, Measures to Prevent cruelty to experimental animals, Hygiene and welfare of animals in captivity, Diseases of caged animals, Prenatal diagnosis, genetic manipulations and their ethical issues, Benefits and risk of participating in a clinical trial, Legal and social and ethical issues, Plagiarism.

Unit III: Experimental designs/ Methodology 8 hrs

Necessity of objective wise design - pure versus applied research, Nature and scope of research methodologies in Genetics, Literature survey; Immunohistochemical, Cytological, Genetic and Molecular tools; Identification of research gaps; testing theories or generating theories; selection and formulation of hypothesis**:** a) Null Hypothesis b) Hypothesis driven c) observation based hypothesis.

Unit IV: Presentation and writing Skills 8 hrs

(a) Presentation Technology – style and techniques involved in presentation skills. (b) How to End on a Powerful note: need to summarize; (c) Importance of Questions and Answers session. (d) Writing scientific articles/ papers (e) Thesis writing

Unit V: Methods and Applications 16 hrs

Induction and screening of mutations (EMS, Radiation, P-element), Real-Time PCR, HPLC, 2D gel electrophoresis, Mass Spectrophotometry, Protein expression and purification, ELISA, Flow Cytometry, NGS methods (Dye based-Illumina, pH based-Ion Torrent/Proton, Nanopore), ChIP Seq, RNA Seq and Methylome Seqencing X-ray Crystallography, Dosimetry, Tissue Culture, Hybridoma Technology, Molecular Markers and their applications, Gene Knockout and Gene Targeting (CRISPR-Cas9, Gene Therapy, RNAi), Recent developments in Hi-Res Microscopy (Discuss using relevant papers).

Unit VI Seminal Papers **12 hrs**

Journal article discussion on important discoveries in genetics

1) Watson and Crick
2) Khorana genetic code
3) Sidney Brenner C. elegans model system intro
4) Paul Berg recombinant DNA technology
5) Seymour Benzor fine structure of gene
6) Sanger Sequencing paper
7) Lee Hartwell suppressor mutation paper
8) LacZ as a reporter gene
9) Crispr-Cas9
10) Bob Horwitz nobel prize apoptosis
11) Kerry Mulles PCR paper
12) Ubiquitin

Unit VII

Biostatistics **4 hrs**

Seminal paper discussion on important genetics papers that involves statistical tests used to achieve significance from large datasets.

Unit VIII

Animal and Cellular Models in Genetics and Disease **8 hrs**

Student will be able to understand strengths and weaknesses of different model organisms and their suitability for research. Utilization of organ specific cell lines for expression studies. Students will be able to understand generation of various disease models and their use, including transgenic mouse models and the use of induced pluripotent stem cells.

References for Unit VI

1) Watson Jd, Crick Fh. Genetical implications of the structure of deoxyribonucleic acid. *Nature*. 1953, 30;171(4361):964-967.

2) Söll D, Ohtsuka E, Jones DS, Lohrmann R, Hayatsu H, Nishimura S, Khorana HG. Studies on polynucleotides, XLIX. Stimulation of the binding of aminoacyl-sRNA's to ribosomes by ribotrinucleotides and a survey of codon assignments for 20 amino acids. *Proc Natl Acad Sci U S A*. 1965, 54(5):1378-1385.

3) S. Brenner. The Genetics of *Caenorhabditis elegans*. *Genetics*. 1974, 77(1): 71–94.

4) Jackson, D.A., Symons, R.H. and Berg, P. Biochemical method for inserting new genetic information into DNA of Simian Virus 40: circular SV40 DNA

containing lambda phage genes and the galactose operon of Escherichia coli, *Proc. Nat. Acad. Sci. USA*, 1972, 69, pp. 2904-2909.

5) Benzer, S., On the topology of the genetic fine structure. *Proc. Natl. Acad*. *Sci. USA*, 1959,45: 1607–1620.

6) Sanger F, Coulson AR. A rapid method for determining sequences in DNA by primed synthesis with DNA polymerase. *J Mol Biol*. 1975, 25;94(3):441-448.

7) Leland H. Hartwell,* Joseph Culotti, and Brian Reid. Genetic Control of the Cell-Division Cycle in Yeast, I. Detection of Mutants. *Proc Natl Acad Sci U S A*. 1970; 66(2): 352–359.

8) Jinek M, Chylinski K, Fonfara I, Hauer M, Doudna JA, Charpentier E. A programmable dual-RNA-guided DNA endonuclease in adaptive bacterial immunity. *Science,* 2012, 17;337(6096):816-821.

9) Sulston J. E., Horvitz H. R. Post-embryonic cell lineages of the nematode, *Caenorhabditis elegans*. *Dev. Biol*. 56, 1977, 110–156 10.1016/0012-1606(77)90158.

10) Saiki RK, Scharf S, Faloona F, Mullis KB, Horn GT, Erlich HA, Arnheim N. Enzymatic amplification of beta-globin genomic sequences and restriction site analysis for diagnosis of sickle cell anemia. Science. 1985, 20;230(4732):1350-1354.

11) Ciechanover, A., Heller, H., Elias, S., Haas, A.L. and Hershko, A. ATP-dependent Conjugation of Reticulocyte Proteins with the Polypeptide Required for Protein Degradation. *Proc. Natl. Acad. Sci. USA* 1980, 77, 1365–1368.

References for Unit VII

12) Veerappa AM, Kusuma Lingaiah, SangeethaVishweswaraiah, Megha N Murthy, Raviraj V Suresh, Dinesh S Manjegowda, and Nallur B. Ramachandra. Impact of Copy Number Variations Burden on Coding Genome in Humans Using Integrated High Resolution Arrays. *Genet. Res., Camb.,* 2014, 96, e17. doi:10.1017/S0016672314000202

13) Sangeetha V, Avinash MV, Mahesh PA, Jayaraj BS, Chaya SK, Ramachandra NB , Molecular interaction network and pathway studies of ADAM33 potentially relevant to asthma, *Annals of Allergy, Asthma & Immunology* 2014, (113 (4):418–424.e1

14) Veerappa AM, Raviraj VS, Sangeetha V, Kusuma L, Megha Murthy, Dinesh SM,Prakash P and Ramachandra NB. Global patterns of large copy number variations in the human genome reveal complexity in chromosome organization. *Genet. Res., Camb.* 2015, 97, e18. doi:10.1017/S0016672315000191.

15) Cho YS, Chen CH, Hu C, Long J, Ong RT, Sim X, et al. Meta-analysis of genome-wide association studies identifies eight new loci for type 2 diabetes in east Asians. *Nat Genet.* 2011, 11;44(1):67-72. doi: 10.1038/ng.1019.

16) Cross-Disorder Group of the Psychiatric Genomics Consortium, Lee SH, Ripke S, Neale BM, Faraone SV, Purcell SM, Perlis RH, Mowry BJ et al.Genetic relationship between five psychiatric disorders estimated from genome-wide SNPs**.** *Nat Genet*. 2013, 45(9):984-94. doi: 10.1038/ng.2711.