SYLLABUS FOR PhD ENTRANCE – Multi-disciplinary Research Unit (MRU)

Subject: MRU

1. Cell Biology and Technique of Animal Cell Culture

A. Cell organization

B. Fundamental cellulae processes

- DNA replication, transcription, translation and its regulation
- DNA repair and recombination and method of detection
- cell cycle and its detection
- telomere organization, Mechanism of its maintenance and methods of detection
- Cell communication and cell signaling includes Wnt/β-catenin Pathway, PI3K/AKT/mTOR Pathway:, RTK/RAS/MAPK Pathway, p53 Pathway
- Regulation and mechanism of apoptosis

C. Methods of animal cell culture: cell lines and primary cell culture

2. Cancer

- Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, virus-induced cancer, metastasis, interaction of cancer
- cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.
- Cancer stem cell

3. Stem cell and tissue regeneration biology and artificial organ development

4. Innate and adaptive immune system

5. HUMAN PHYSIOLOGY (basic)

6. INHERITANCE BIOLOGY

A. Mendelian principles : Dominance, segregation, independent assortment.

B. Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests

C.Extensions of Mendelian principles : Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

D. Gene mapping methods : Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

E. Extra chromosomal inheritance : Inheritance of Mitochondrial and chloroplast genes,

maternal inheritance.

F. Microbial genetics : Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

G.Human genetics : Pedigree analysis, lod score for linkage testing, karyotypes, genetic Disorders includes sickle cell and thelessimia.

H. Quantitative genetics : Polygenic inheritance, heritability and its measurements, QTL mapping.

I. Mutation : Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

J) Structural and numerical alterations of chromosomes : Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

7.Comminicable diseases:

A. Concept of outbreak, epidemic and pandemic

B. Prevalent communicable disease in India: Pulmonary tuberculosis, COVID 19, Swine flue, Maleria, Dengue, Chickengunea,Japnese Encephalitis, Maleria etc.

8. METHODS IN BIOLOGY

A. Molecular Biology and Recombinant DNA technoligies:Isolation and purification of RNA , DNA (genomic and plasmid) and proteins,

B. Different separation methods: Analysis of RNA, DNA and proteins by one and two dimensional gel, electrophoresis, Isoelectric focusing gels,

C. Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems.

D. Methods of introduction of DNA into live cells (transformation, transfection and transduction)

E. Expression of recombinant proteins using bacterial and animal vectors.

F. Isolation of specific nucleic acid sequences

G. Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors.

H. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and

eukaryotic organisms.

I.Protein sequencing methods, detection of post translation modification of proteins.

J. DNA sequencing methods, strategies for genome sequencing including SANGARS and NGS methods

H. Methods for analysis of gene expression at RNA and protein level, large scale

expression, such as micro array based techniques, RFLP, RAPD and AFLP techniques

K. Histochemical and Immunotechniques:Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, fluocytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

L. Biophysical Method:

- Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR
- spectroscopy
- Molecular structure determination using X-ray diffraction and NMR,
- Molecular analysis using light scattering, different types of mass spectrometry and
- surface plasma resonance methods.

8. Intellectual property right and Indian patent law patent law and proceedings by professional patent atornies.