

JM 302 (Aug) 3:0

Human Genetics and Genomics

Course Instructors: Anuranjan Anand

Brief Outline of the course:

Molecular basis of heredity and variation, Chromosomes and genes, cell cycle, cell cycle controls, mechanism of cell division, replication origins, centromeres and telomeres, genetic linkage and chromosome mapping, functional genomics with emphasis on whole genome based approaches, epigenetic regulation of genome dynamics and gene expression, epigenetic regulation of disease manifestation, Nanotechnology and understanding of Biological systems

Detail Course Outline:

Molecular basis of heredity and variation

DNA, the genetic material; how genes determine traits and evolution

Principles of genetic transmission Mendelian inheritance and probability, segregation in human pedigrees,

Genetic analysis, modified mendelain ratios

Chromosomes and genes

Stability of chromosomal complements, mitosis and meiosis, heredity and chromosomes

Genetic linkage and chromosome mapping

Genetic mapping with emphasis in human pedigrees, Mapping by tetrad analysis, a closer look at complementation.

Genetic variation

Mutations, repair and recombination, variation in chromosome number and structure, single nucleotide polymorphisms, copy number variations, current state-of-art technologies for identifying variations in the genomes.

Functional genomics with emphasis on whole genome based approaches

In the light of basic topics covered in (2) to (6) above, advancements in the area of a genetic disorder and an infectious disorder will be taken up with highlights of research in the last 5 years.

Yeast as a model system to study gene function

Cell division and Cell cycle: Major phases in cell cycle, cell cycle controls, mechanism of cell division, replication origins, centromeres and telomeres

Chromatin dynamics : Nucleography, Genome architecture, rearrangements and genomic

disorders, Organization of eukaryotic genome into chromatin. Chromatin modifications and remodeling, Interaction of non-histone proteins with chromatin as a factor for dynamic chromatin structure, chromatin modification and remodeling during stem cell differentiation.

Transcriptional regulation : in Bacteria, Virus and Eukaryotes, Role of chromatin structure, Transcription and disease.

Molecular basis of DNA repair : DNA repair in prokaryotes and Eukaryotes, chromatin repair, Transcription couple repair, DNA repair machinery as target for therapeutics.

DNA replication : Replication of virus, replication of prokaryotic genome, Eukaryotic genome replication, Special features of chromatin replication.

Translational control : in viruses, prokaryotes and Eukaryotes, with special emphasis on disease and therapeutics.

Epigenetic determinants of Diseases: AIDS, Cancer and Diabetes.

Nanotechnology and Understanding of Molecular Biology: Basic science and application

Basic principals behind molecular biology techniques: DNA sequencing, PCR analysis, Southern, northern and western blot analysis, DNA microarray, Chromatin immunoprecipitation (ChIP)

Genetic analysis approaches in pre-genome sequencing and post-genome sequencing era

Yeast two-hybrid screening, Use of mass spectrometry, Microarray analysis, Generation of permanent cell line, Real time PCR analysis, Chromatin immunoprecipitation (ChIP)assay, Atomic Force Microscopy.

Details of the curriculum activity:

1. Two written Examination (Mid term and Final).
2. One seminar on selected paper.
3. There will 3-4 guest lectures by the Scientists from other institutes.

Pre-requisition:

Basic concept of Biochemistry: B Sc/B Tech/ M Sc (Biochemistry, Biotechnology/ Organic Chemistry with special paper on Biochemistry).

References:

1. Annu Rev of Biochemistry
2. Annu Rev of Genetics
3. Methods in Enzymology
4. Current Protocol in Molecular Biology
5. Reviews from Nat Rev, TIBS, Curr Opins, Cell and Mol Cell
6. Text Books:
 - Principles of Biochemistry: Lehninger (Fourth Ed)
 - Biochemistry: Lubert Stryer (Fifth Ed)
 - Molecular Cell Biology : Lodish (Fifth Ed)
 - Chromatin and Disease: Ed. Kundu T K and Dasgupta D (Springer press)
 - Molecular Biology of the Cell by Bruce Alberts et al.
 - Molecular Biology of the Gene by James Watson et al.
 - Epigenetics: Ed. Allis, Jenuwein, Reinberg (CSHL press)

NB: If any one wish to audit this course, is most welcome but needs to have a prior approval from the Academic section of JNCASR and have to full fill all the requirement of the course.