

**SECOND SEMESTER 2022-2023**

# Course Handout Part II

Date: 16-01-2023

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

***Course No.* : BIOT F346**

## **Course Title : Genomics**

## **Instructor-in-Charge : AMARTYA SANYAL**

**1. Scope and Objective of the Course:**

Genomics is a highly inter-disciplinary field to study genome(s) and to decode the functional information hidden in DNA sequences. It employs high-throughput technologies for collective and comprehensive characterization of sequence, structure, function, and evolution of genomes using powerful computational and statistical methods. This course is designed to teach you the fundamentals of genome architecture, organization, variation, and function, including regulatory mechanisms both at genetic and epigenetic levels. The course will introduce you to the modern genomics technologies and practices for genome and epigenome interrogations, functional genomics, structural genomics, comparative genomics, DNA copy number assessment, genome-wide association studies, etc. You will also learn the recent breakthroughs in genomics and genomic technologies and their impact on human health and disease, especially in the field of precision medicine. Moreover, this course will bring a broader understanding of systems biology approach to integrate datasets generated from a plethora of related ‘omics’ techniques (such as genomics, transcriptomics, proteomics, metabolomics, epigenomics, etc.) to model complex biological systems.

Upon successful completion, students will gain knowledge and skills to:

1. Describe how next-generation sequencing (NGS)-based genomics experiments are used to diagnose, predict, and treat human diseases
2. Evaluate current scientific literature on genomics and communicate their findings in layman’s terms
3. Design experiments applying current genomics technologies to study genome(s) and genome function
4. Apply genomics technologies to assess the genetic risks of common and complex diseases which can guide genomics-based personalized healthcare services
5. Discuss and debate societal and ethical impacts resulting from advances in genomics

**2. Textbooks:**

1. Genomes, TA Brown, 3rd Edition, Garland Science Publishing
2. Introduction to Genomics, Arthur M. Lesk, 2nd Edition. Oxford University Press.

**3. Reference books**

1. Microbial Genome Methods, Kenneth W Adolph, CRC Press.
2. Genome Analysis, A Laboratory Manual, Vol. 4, Mapping Genomes, Bruce Birren, Cold Spring Harbor Laboratory Press.

**4. Course Plan:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Lecture No.** | **Learning objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1-6 | **Studying Genomes** | Genomes, Transcriptomes and Proteomes, Studying DNA and RNA, Understanding a Genome Sequence, Understanding How a Genome Functions, Concept of Epigenome | T1: Ch. 1-6 and Class notes |
| 7-10 | **Genome Anatomies** | Eukaryotic Nuclear Genomes, Genomes of Prokaryotes and Eukaryotic Organelles, Virus Genomes and Mobile Genetic Elements | T1: Ch. 7-9 & Class notes |
| 11-16 | **How Genomes Replicate and Evolve** | Genome Replication, Mutations and DNA Repair, Recombination, How Genomes Evolve, Molecular Phylogenetics | T1: Ch. 15-19 & Class notes |
| 17-25 | **How Genomes Function** | Accessing the Genome, Assembly of the Transcription Initiation Complex, Synthesis and Processing of RNA, Regulation of Genome Activity including Epigenetic Regulation, Synthesis and Processing of the Proteome | T1: Ch. 10-14 & Class notes |
| 26-31 | **Mapping, Sequencing and Interpreting Genome** | Human genome project, Genome sequencing techniques and approaches, Next-generation sequencing, Techniques to study genome function and epigenome | Class notes |
| 32-35 | **Genome Variation** | Types of variation between human genomes- SNPs, indels, CNVs, etc., pathogenic DNA variants, Detection and analysis of genetic variations | Class notes |
| 36-40 | **Systems biology** | Applications of ‘omics’ data in health and disease, WGS, GWAS, Precision medicine, Social and Ethical impacts of genomics | T2: Ch. 11 & Class notes |

**5. Evaluation Scheme:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage (Marks)** | **Date & Time** | **Nature of Component** |
| Mid semester examination | 90 mins | 30% (60 marks) | 14/03/2023  11.30 - 1.00PM | Closed Book |
| Quizzes | Variable | 20% (40 marks) | Continuous evaluation  (Quizzes will be conducted during class hours) | Closed Book |
| Assignments | Variable | 10% (20 marks) | Continuous evaluation | Open Book |
| Comprehensive examination | 180 mins | 40 % (80 marks) | 10/05/2023  AN | 20% Open Book + 20% Closed Book |

**6. Chamber Consultation Hour:** The specific timings and logistics of consultation will be provided after discussion with the students.

**7. Notices:** Notices will be displayed on the course pages of CMS or through email.

**8. Make-up Policy:** Prior permission has to be obtained from the Instructor-in-Charge for make-ups. No make-up for assignments.

**9. Academic Honesty and Integrity Policy:** All the students are required to maintainacademic honesty and integrity throughout the semester and academic dishonesty in any form is unacceptable.

It is highly desirable that you attend the lectures regularly for better understanding of the course content. Obtaining feedback from students is a significant means for instructors to improve their teaching. Therefore, you are encouraged to provide constructive feedback about the course and presentation to the instructor on a regular basis to enhance your learning experience.

### Instructor-in-Charge