Date: 08-Feb-2021

COURSE HANDOUT (PART II)

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

Course No. : **BIO F243**

Course Title : **GENETICS**

Instructor-in-Charge : **MANOJ KANNAN**

Instructor : **SHILPI GARG**

1. Scope and objectives of the course:

The course aims at presenting concepts of modern genetics and its applications in biotechnology. Beginning with a background of classical genetics including basic models of inheritance, microbial and phage genetics, the course moves on to molecular genetics - structure and function of nucleic acid, mutations, DNA repair and recombination, that will provide the basis for understanding expression and regulation of genes in prokaryotes and eukaryotes, human genetics and genomics, non-nuclear inheritance and population genetics. Finally, the course also presents selected applications of these topics in the field of biotechnology.

2. Text Book:

Tamarin, Robert H. Principles of Genetics (7/e). New Delhi: Tata McGraw-Hill, 2002.

3. Reference Books:

- Klug, William S., et. al. Concepts of Genetics (10/e). Chennai: Pearson India Education Services Pvt. Ltd., 2019.
- Das, H.K. (ed.). Gene and Its Engineering. New Delhi: Wiley India Pvt. Ltd., 2014.
- Brooker, Robert. Genetics: Analysis and Principles (4/e). New York: McGraw-Hill, 2011.
- Hartwell, Leland et. al. Genetics: From Genes to Genomes (International edition). New York: McGraw-Hill, 2004.
- Cummings, Michael R. Human Genetics (India edition). New Delhi: Cengage Learning India Pvt. Ltd., 2009.
- Freifelder, David. Microbial Genetics (2/e). New Delhi: Narosa Publishing House, 2009.

4. Course Plan:

Mod. No.	Lecture Session Details	Ref. (TB chap.)	Learning Outcomes
1	*Lecture 1: Getting introduced to genetics* Introduction to genetics; orientation to the course	Chap. 1	• To construct crosses from the given problem statement • To predict phenotypes and genotypes of a given cross, as well as the probability of each outcome • To infer what is the underlying gene interaction that operates resulting in the given phenotype • To be able to infer the type of inheritance (dominant/recessive; autosomal/sex-linked) given a pedigree chart • To construct pedigree chart from the given problem statement
	Lectures 2-4: Mendel and Extensions to Mendel Basic modes of heredity; Mendelian genetics and its extensions: gene interactions, multiple allelism	Chap. 2	
	Lectures 5-6: Other inheritance patterns Sex-linked Inheritance; human pedigree analysis	Chap. 5	
2	*Lectures 7-9: Linkage and mapping in Eukaryotes* Diploid mapping; two point test cross, three point test cross; haploid Mapping (tetrad analysis); somatic crossing over	Chap. 6	• To be able to designate gene symbols in *Drosophila* • To calculate the map distances between loci, given the offspring data of diploids and haploids
	Lectures 10-12: Linkage and mapping in Prokaryotes Bacterial transformation: detection, competence, DNA uptake and transformation mapping; bacterial conjugation: Hfr transfer, recombination in recipient cells, and conjugation mapping	Chap. 7	• To be able to differentiate between the various modes of gene transfer in bacteria and phages • To calculate the map distances between genes in bacteria

	Lectures 13-15: Phage genetics Genetic recombination in phages; Fine structure of T4 rII locus; Transduction: DNA transfer, co-transduction, linkage mapping, mapping by co-transduction	Chap. 7, 15, 16, 18	• To calculate co-transduction frequencies and hence estimate the relative gene order between bacterial genes
3	*Lectures 16-18: Chemistry of Gene* Nucleic acids and their structures; supercoiling DNA replication in prokaryotes and Eukaryotes	Chap. 9	• To compare and contrast the mechanisms and machinery of replication, transcription and translation between prokaryotes and eukaryotes • To learn about various types of mechanisms how mutations occur • To predict the type and consequences of mutations at the protein and organism level
	Lectures 19-22: Gene Expression principles Transcription in prokaryotes and eukaryotes; RNA splicing and RNA editing; translation in prokaryotes and eukaryotes	Chap. 10, 11	
	Lectures 23-25: DNA: Mutation, Repair and Recombination Fluctuation test and genetic fine structure; Spontaneous vs. induced mutations; DNA repair, damage reversal, excision repair and double strand break repair; Recombination	Chap. 12	
4	*Lectures 26-29: Regulation of gene expression in Prokaryotes* Operon model: lac and trp operons; Lytic and lysogenic cycles in phage lambda; post-transcriptional regulation	Chap. 14	• To understand the control circuity operation in operons • To predict whether a given operon will be inducible or repressible, or constitutive, given the host genotype

	Lectures 30-32: Organization of genetic material in eukaryotes Packaging of DNA in eukaryotes; repetitive and unique sequences; split and overlapping genes; genome organization	Chap. 15 + Class notes	• To compare and contrast the gene structure and genome organization of eukaryotes and prokaryotes • To understand the varying layers of control that exist in eukaryotic gene expression • To understand how combinatorial control works in eukaryotes
	Lectures 33-35: Regulation of gene expression in Eukaryotes Control of transcription in eukaryotes; chromatin remodeling and epigenetics; transposable elements; cancer genetics	Chap. 16 + Class notes	
5	*Lectures 36-37: Non-nuclear inheritance* Maternal effects and cytoplasmic inheritance	Chap. 17	• To understand how non-nuclear inheritance differs from the typical Mendelian inheritance patterns • To know the relative strengths and weaknesses of various model organisms used by modern genetics researchers
	Lectures 38-39: Recent advances in genetics Guest lectures may be held	Class notes	

5. Evaluation Scheme:

#	Evaluation Component	Duration	Marks (% weightage)	Date and Time	Remarks
1	Mid-semester Test	90 min.	50 (25%)	01-Mar-2021 9:00 to 10:30 AM	
2	Comprehensive Examination	120 min.	60 (30%)	01-May-2021 FN	
3	Team-based Learning activities	Variable	60 (30%)	-	See Note (i) below
4	Learning Portfolio	-	10 (5%)	-	See Note (ii) below
5	Class Participation and Initiative	-	20 (10%)	-	See Note (iii) below
6	Bonus credit	-	Up to 4 marks (2%)	-	See Note (iv) below

Notes:

(i) Teams have the power to drive powerful forms of learning, more than individuals working alone and even more than groups. Hence a substantial part of the work in this course will be done in teams. **Team-based Learning** includes both individual components and team-based components as detailed below:

- Individual Readiness Assessment Tests (iRATs) = 20 marks
- Team RATs (tRATs), Team Project and Peer evaluation = 40 marks

The adjusted team score would incorporate the peer evaluation multiplier as well.

(ii) A **Learning Portfolio** is an in-depth analysis of yourself as a learner in a particular learning situation, in this case – in this course. In the second half of the course, you will be asked to create a learning portfolio. The structure of a Learning Portfolio is as follows:

- Reflective Narrative (5-10 pages)
- Appendices: Documents, etc., that support that comments about learning discussed in the Narrative

Key Questions to be addressed in the narrative:

1. <u>WHAT did you learn in this course</u>?
   a. Of the major learning goals for the course, and you will honestly describe to what degree you believe you achieved each one.
   b. What *Foundational Knowledge* did you acquire? *Application*? *Integration*, etc.
2. <u>HOW did you learn</u>?
   a. What helped you learn? What didn't?
   b. What does this tell you about yourself as a learner? About the learning process itself?
3. <u>What is the VALUE to you, of what you learned</u>?
   a. For your: Personal life? Social interactions? Civic responsibilities? Professional life?
4. <u>What is your PLAN for FUTURE LEARNING</u>?
   a. WHAT ELSE do you want to learn?
   b. HOW would you learn THAT?

(iii) In-class quizzes (using *Socrative* tool) will be held regularly throughout the semester. Giving these and showing active participation during the classes (say, by asking questions and responding to the instructor, interacting across the teams during the TBL sessions) would count toward the **Class Participation and Initiative**.

(iv) Visiting during chamber consultation hour, appraising the instructor personally of one's learning and progress are some items that qualify for fetching **bonus credit**. Any other act or gesture that demonstrates one's proactive approach would also be counted, subjected to the discretion of the instructor.

6. **Academic Conduct Policy:**
It is expected that all students follow the highest standard of academic practice when participating in any evaluation component. Having a zero–tolerance for academic dishonesty, any case of misconduct, however minor, will be dealt with appropriately, and may be reported to the Examination Committee for necessary administrative action.

7. **Grading Policy:**
Award of grades would be guided by the histogram of marks and course average. If a student does not give sufficient opportunity for being assessed by the instructor, either by missing an evaluation component (listed in the *Evaluation Scheme* specified in item 5) entirely, or by not applying oneself to the task seriously, he/she may be awarded 'NC' report. For a student on the borderline of two grades, the bonus credit would be used for increasing the grade, if required.

8. **Make-up Policy:**
If a student misses any of the evaluation components due to a genuine reason (serious medical causes leading to hospitalization, personal/family emergencies or absence from classes due to official purposes) there exists a provision to apply for make-up. Due to their nature, make-up for in-class activities cannot be sought. However, in case of a genuine case, Prior permission must be taken from the Instructor-in-Charge whenever possible, before applying; otherwise, he must be informed at the earliest after missing the component. The decision to grant make-up is taken by the Instructor-in-Charge and shall be final.

9. **Chamber consultation hour:** To be announced in class by the instructors.

10. **Course Announcements and Notices**:
All announcements regarding the course will be made in the lecture classes or by email.

Instructor-in-Charge
BIO F243