UNIVERSITY OF SARGODHA

DEPARTMENT OF PLANT BREEDING & GENETICS

COURSE OUTLINE SPRING 2020

Course Title: Molecular Genetics

Course Code: PBG-310

Credit Hours: 3(2-1)

Instructor: Dr. Saeed Rauf

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DESCRIPTION & OBJECTIVES

* to build understanding of the structure, function, expression and replication of genetic material
* regulation of gene expression
* to familiarize student with basic concept of
  + recombinant DNA technology
  + development of transgenic organisms
  + marker assisted selection
  + Integration of novel molecular techniques with plant breeding

READINGS

**Text Books**

1. Klug, W. S. and M. R. Cummings. 2010. Concepts of Genetics. Dorling Kindersley, Pvt.(Ltd.) New Delhi, India.
2. Brown T.A. 2012. Introduction to Genetics: A Molecular Approach. 2nd ed., Garland Science, Taylor & Francis, New York and London.
3. Bilgrami, K. S. and A. K. Pandey. 1992. Introduction of Biotechnology. CBS Publishers & Distributers, New Delhi, India.
4. Maniatis, T., E. F. Fritsch and J. Sambrook, 1989. Molecular Cloning. A Laboratory Manual. Cold Spring Harbour, USA.

**Reference Material**

Beurton PJ, Raphael Falk, Reheinberge HJ (2002): The concept of gene in development and evolution historical and epistemological perspective. Cambridge University Press.

CONTENTS

* DNA as genetic material, chemistry of nucleic acids
* DNA replication; types of RNA, DNA transcription and translation.
* Transposable elements, Construction of genetic linkages map.
* Recombinant DNA technique, Genetic transformation, various types and techniques of developing transgenic plants.
* Marker assisted analysis and QTL mapping.
* Features of the genetic code, split gene and redundant DNA.
* Gene mutation, molecular basis of gene mutation, factors affecting mutation rate.

COURSE SCHEDULE

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| **Week** | | **Lecture** | **Course Schedule** | | | | | | | **Date** |
| **Topic** | | | **Source** | | | **Assignment** |
| 1 | |  | The origin of molecular genetics | | | Book 2: 1-10 | | | Assignment1: Presentation of 3D model of DNA | 13-1-2020 to 17-1-2020 |
| Book 2; Chapter 2: 12-23 |
|  | |  | Heredity material Protein vs. Nucleic acid | | | Book 1:2-18 | | | Assignment No2: Cell Structure and Functions |
| 2 | |  | Nucleic acid:  Structure of DNA | | | Book 1:Chapter 2:21-47 | | |  | 20-1-2020 to 24-2-2020 |
|  | Genetic Codon and Structure of DNA | | | Book 2; Chapter 7: 113-129 | | |  |
| 3 | |  | Replication of DNA molecule | | | | Book 1:Chapter 3:53-79  Book 2: Chapter 10 186-205 | |  | 27-1-2020 to 31-1-2020 |
|  | Enzymatic machinery for replication | | | | Book 1:Chapter 3:53-79  Book 2: Chapter 11: 153-168  Internet material | |  |
| 4. | |  | Genes, prokaryotic genes  Genes in eukaryotic nucleus | | | | Book 2: Chapter 31-48 | |  | 3-2-2020 to 7-2-2020 |
|  | Gene Expression:  Transcription | | | | Book 2: Chapter 4; 49-58 | |  |
| 5. | |  | Types of RNA molecules | | | | Book 2: Chapter 5; 75-94 | |  | 10-2-2020 to 14-2-2020 |
|  | Translation;  Information transfer and Protein synthesis | | | | Book 2: Chapter 5; 95-111  Chapter 8;  133-155 | |  |
| 6. | |  | Transposable elements | | | | Book 2: Chapter 6; 52-66 | |  | 17-2-2020 to 21-2-2020 |
|  | Insertion sequences (IS); Composite Transposons; Excision of transposable elements | | | | Book 2: Chapter 7; 86-96 | | Determination of genetic diversity through molecular markers (Collection of Reference material) |
| 7. |  | | Rearrangement in host DNA  Transposable elements of Eukaryotes | Book 5; Chapter 11: 153-168 | | |  | | | 2-3-2020 to 6-3-2020 |
|  | | Mid Term Examination | | | | | | |
| 8. |  | | Application of transgenic Plant | | Book4: Chapter8: 331-391. | | | Assignment 4: Genetically engineered diseases resistance in crop specie | | 9-3-2020 to 13-3-2020 |
|  | | Invitro Amplification of DNA by the polymerase | | Book 6: Chapter 2 Page 179. | | |  | |
| 9. |  | | Plant Biotechnology and its application | | Book4: Chapter8: 283-330. | | |  | | 16-3-2020 to 20-3-2020 |
|  | | Plant Biotechnology and its application | | Book4: Chapter8: 283-330. | | | Assignment 5: Role of Plant breeding in post genomic era | |
| 10. |  | | Class Discussion and Quiz | | | | | | | 23-3-2020 to 27-3-2020 |
|  | | Development of molecular marker for use in plant genotyping | | Book 3: 179-225 | | |  | |
| 11. |  | | Development of molecular marker for use in plant genotyping | | Book 3: 179-225 | | |  | |
| 12. |  | | Recombinant DNA technique, | | Book2: Chapter8: 331-391. | | |  | | 30-3-2020 to 3-4-2020 |
|  | | Genetic transformation various types | | Book4: Chapter8: 331-391. | | |  | |
| 13 |  | | Development of transgenic plants | |  | | |  | | 6-4-2020 to 10-4-2020 |
|  | | Mutation and DNA Repair  The causes of mutations  Errors in replication are a source of point mutations Replication errors can also lead to insertion and deletion mutations | | Book 2:  Chapter: 16  313-317 | | |  | |
| 14 |  | | Mutagens are one type of environmental agent that causes damage to cells There are many types of chemical mutagens  There are also several types of physical mutagens | | Book 2:  Chapter: 16  318-322 | | |  | | 13-4-2020 to 17-4-2020 |
|  | | 16.2 DNA repair Direct repair systems fill in nicks and correct some types of nucleotide modification Many types of damaged nucleotide can be repaired by base excision Nucleotide excision repair is used to correct more extensive types of damage Mismatch repair corrects errors of replication | | Book 2:  Chapter: 16  323-330 | | |  | |
|  | | DNA breaks can also be repaired In an emergency, DNA damage can be bypassed during genome replication  Defects in DNA repair underlie human diseases, including cancers | | Book 2:  Chapter: 16  331-336 | | |  | | 20-4-2020 to 24-4-2020 |
| 15 |  | | Control of Gene Expression The importance of gene regulation  Gene regulation enables bacteria to respond to changes in their environment  Gene regulation in eukaryotes must be responsive to more sophisticated demands | | Book 2:  Chapter: 9  157-160 | | |  | | 27-4-2020 to 1-5-2020 |
|  | | Four genes are involved in lactose utilization by E. coli 162 The regulatory gene codes for a repressor protein 164 Glucose also regulates the lactose operon. Operons are common features in prokaryotic genomes | | Book 2:  Chapter: 9  161-169 | | |  | |
| 16. |  | | Final Class Discussion/ Final Examination | | | | | | |  |

RESEARCH PROJECT

1. 3-D DNA model

ASSESSMENT CRITERIA

Sessional: 8 (Class Attendance: 2, Presentation: 4, Assignments: 2)

Mid Term Test: 12

Final Term Test: 20

RULES AND REGULATIONS

1. Bonus marks according to student contributions in class/lecture discussions

2: Students have to complete all assignments within Targets