EVEN SEMESTER LECTURE PLAN		
Name of the college: Government College of Arts, Science and Commerce, Sanquelim Goa		
Name of Faculty: Dr. Nisha Kevat	**Subject: Botany**	
Paper code: BOC 109 (Molecular Biology and Genetic Engineering)	**Program/Course: T.Y B.Sc.**	**Division: -**
Academic year: 2024 - 2025	**Semester: VI**	**Total Lectures: 60**

Course Objectives:

This course is designed to have a basic understanding of the fundamental concepts of molecular biology such as structure of DNA, its synthesis and regulation of gene expression and to apply the knowledge in recombinant DNA technology.

The theoretical and practical components of this course will provide a deeper understanding of various techniques in obtaining recombinant DNA and the varied applications of genetic engineering

Expected Course Outcome:

- Gain knowledge of the concepts of molecular biology such as structure of nucleic acids, replication, transcription and translation.
- Understand gene structure, regulation and modification of RNA.
- Understand the concepts of recombinant DNA technology and gene cloning and its various applications

Student Learning Outcome

- Learn about the research development in the discovery of genetic information
- Familiarize the molecular structure of DNA & RNA and its salient features
- Gain knowledge about the central Dogma of Molecular Biology
- Learn about the fascinating area of Genetic engineering and its application in Crop Development & vaccine development

Month	Lectures From:	To:	No. of Lect. allotted	Topic, Subtopic to be covered	Exercises/Assignments	ICT Tools	Reference books
December (1st Week)	09/12/2024	14/12/2024	4 h	**Topic 1**:Introduction to syllabus, Unit 1: Nucleic acids - Carriers of genetic information	Revise the previous BOC 106 paper for nucleic acid	Power point presentation, Dishtavo Recorded lectures, You tube study videos	1. Agarwal, **P** (2017). Basic Concepts of Genetic Engineering. Pearson India Education Services, Chennai. 2. Alberts, B, Johnson, A, Lewis, J, Raff, M, Roberts, **K** and **Walter**, **P** (2014). Essential Cell Biology. 4th edition. Garland
				Topic 2: Historical perspective	Referencing work for the Historical aspects of DNA as genetic information		
				Topic 3: DNA/RNA as genetic material (Griffith's Experiment)	Referencing work for the Historical aspects of DNA as genetic information		
				Topic 4: Hershey & Chase; Avery, McLeod & McCarty; Fraenkel-Conrat's experiment).	Referencing work for the Historical aspects of DNA as genetic information		
December (2nd Week)	16/12/2024	21/12/2024	4 h	**Topic 5: Unit 2:** The Structures of DNA and RNA/genetic material; DNA Structure: Salient features of double helix (Watson and Crick),	To study the structure of DNA & RNA from the models available in the Botany Lab	Power point presentation	
				Topic 6: Types of DNA, Types of RNA	To study the structure of DNA & RNA from the models available in the Botany Lab	Power point presentation	

				Topic 7 : Denaturation and Renaturation, cot curves;	Youtube links to study the Denaturation & renaturation will be shared to watch for the better understanding of the topic	Power point presentation	Science, New York. 3. Brown, **TA** (2017). Genomes 4. 4th edition. Garland Science, New York. 4. Chatterjee, R (2015). Molecular Biology of the Gene. Sapna Book. House, Bengaluru. 5. Dubey, **RC** (1993). A Textbook of Biotechnology. S. Chand and Company Pvt. Ltd., New Delhi. 6. Glick, **BR** and **Pasternak**, **JJ** (2003). Molecular Biotechnology: Principles and
				Topic 8: Organization of DNA - Prokaryotes, Viruses, Eukaryotes	Additional referencing work in Library		
January (3rd Week)	02/01/2025	05/01/2025	4 h	**Topic 9:** Structure of nuclear DNA v/s Organelle DNA.	To create the comparative account of Nuclear DNA & organelle DNA based on theory that was thought.		
				Topic 10: Unit 3: The replication of DNA; Genetic code	To study the replication using the model kept in Botany Lab		
				Topic 11: Central and revised dogma of molecular biology;	To study the replication using the model kept in Botany Lab	Power point presentation	
				Topic 12: General principles - Modes of replication, bidirectional replication.	To study the replication using the model kept in Botany Lab	Power point presentation	
January (4th Week)	06/01/2025	11/01/2025	4 h	**Topic 13**: Models of DNA replication (Rolling circle, Theta replication and semi-discontinuous replication).	Youtube links will be shared to be watched after the theory class explanation for the better understanding of the subject	Power point presentation	
				Topic 14: Models of DNA replication (Rolling circle, Theta replication and semi-discontinuous replication). Continued….	Youtube links will be shared to be watched after the theory class explanation for the better understanding of the subject	Power point presentation	
				Topic 15: Replication of linear dsDNA	Youtube links will be shared to be watched after the theory class explanation for the better understanding of the subject	Power point presentation	

				Topic 16: Enzymes involved in DNA replication	Youtube links will be shared to be watched after the theory class explanation for the better understanding of the subject	Power point presentation	Applications of Recombinant DNA. ASM Press, Washington D.C. 7. Griffiths, AJ, Miller, JH, Suzuki, DT, Lewontin, **RC** and **Gelbart**, **WM** (2000). An Introduction to Genetic Analysis. W. H. Freeman, New York. 8. Khushu, **S** (2019). Molecular Genetics and Biotechnology. ABD Publishers, Jaipur. 9. Klug, WS, Cummings, MR, Spencer, **CA** and **Palladino**, **MA** (2017). Concepts of Genetics.
January (5^{th} Week)	13/01/2025	18/01/2025	4 h	**Topic 17**: Unit 4: Transcription; Enzymes in transcription;	Assignment will be given to prepare the model of Transcription so that they learn better about the RNA synthesis	Power point presentation	
				Topic 18: Basic features of transcription - initiation,	Assignment will be given to prepare the model of Transcription so that they learn better about the RNA synthesis	Power point presentation	
				Topic 19: Basic features of transcription - elongation and termination,	Assignment will be given to prepare the model of Transcription so that they learn better about the RNA synthesis	Power point presentation	
				Topic 20: promoters and enhancers.	Assignment will be given to prepare the model of Transcription so that they learn better about the RNA synthesis	Power point presentation	
January (6^{th} Week)	20/01/2025	25/01/2025	4 h	**Topic 21**: Unit 5: Translation; Enzymes in translation;	Assignment will be given to prepare the model of Transcription so that they learn better about the RNA synthesis	Power point presentation	
				Topic 22: Basic features of translation - initiation	Assignment will be given to prepare the model of Translation so that they learn better about the RNA synthesis	Power point presentation	
				Topic 23: Translation Elongation & Termination	Assignment will be given to prepare the model of Translation so that they learn better about the RNA synthesis	Power point presentation	

				Topic 24: Post-translational processing and modification.	Assignment will be given to prepare the model of Transcription so that they learn better about the RNA synthesis	Power point presentation	11th edition. Pearson Education, Boston.
January/ February (7^{th} Week)	27/01/2025	01/02/2025	4 h	**Topic 25**: Unit 6: Gene structure, regulation and modification of RNA; Gene organization in prokaryotes and eukaryotes;	To make the students to prepare the RNA model	Power point presentation	10. Kulkarni, **VM** (2018). Molecular Biology: Concepts and Applications. McGraw-Hill Education, New Delhi. 11. Lewin, B (2019). Genes XII. Jones & Bartlett Learning, Sudbury, MA. 12. Lewin, B, Cassimeris, L, Lingappa, VR, Plopper, **G** and **Sakai**, **RK** (2015). Genes IX. Jones & Bartlett Learning, Sudbury, MA. 13. Lodish, H, Berk, A,
				Topic 26: Gene regulation in prokaryotes	Library referencing work for the gene regulation study.	Power point presentation	
				Topic 27: Gene regulation in eukaryotes.	Library referencing work for the gene regulation study.	Power point presentation	
				Topic 28: Split genes - concept of introns and exons	Referencing work in the library	Power point presentation	
February (8^{th} Week)	03/02/2025	08/02/2025	4 h	**Topic 29**: **Unit 5:** removal of introns, spliceosome machinery	Selected research articles will be given to understand the concept of gene regulation	Power point presentation	
				Topic 30: splicing pathways,	Selected research articles will be given to understand the concept of gene regulation	Power point presentation	
				Topic 31: alternative splicing;	Selected research articles will be given to understand the concept of gene regulation	Power point presentation	
				Topic 32: Eukaryotic mRNA processing and stability (5’ cap, 3’ poly A tail);	Youtube link will be shared so that students can watch them for better understanding of the post translational mechanism	Power point presentation	
February (9^{th} Week)	10/02/2025	15/02/2025	4 h	**Topic 33:** Ribozymes;	Referencing work in Library	Power point presentation	

				Topic 34: RNA silencing	Youtube link will be shared after the theory explanation	Power point presentation	Kaiser, CA, Krieger, M, Bretscher, **A** and **Ploegh**, H (2015). Molecular Cell Biology. W.H. Freeman, New York. 14. Malacinski, **GM** (2019). Essentials of Molecular Biology. Jones & Bartlett Learning, Sudbury, MA. 15. Nagar, **S** and **Adhav**, **M** (2009). Practical Biotechnology and Plant Tissue Culture. S. Chand and Company Ltd., New Delhi. 16. Primrose, **SB** and
				Topic 35: Unit 7: Recombinant DNA technology; Definition of gene and recombinant DNA,	One or two research article will be shared to understand the application of Genetic engineering in agriculture and the students will be asked to write the review of 15 lines on it	Power point presentation	
				Topic 36: Steps in genetic engineering.		Power point presentation	
February (10^{th} Week)	17/02/2025	22/02/2025	4 h	**Topic 37:** Enzymes used in recombinant DNA technology (Restriction enzymes,	One or two research article will be shared to understand the application of Genetic engineering in agriculture and the students will be asked to write the review of 15 lines on it	Power point presentation	
				Topic 38: DNA Ligase, DNA modifying enzymes)			
				Topic 39: Cloning Vectors: pBR322, Ti plasmid,	Students will be asked to prepare 5 min lecture on YAC & phage	Power point presentation	
				Topic 40: YAC; λ phage,			
February/ March (11^{th} Week)	24/02/2025	01/03/2025	4 h	**Topic 41 :** M13 phage,	Students will be asked to prepare 5 min lecture on M13 & COSMID	Power point presentation	
				Topic 42 : Cosmid;		Power point presentation	
				Topic 43: DNA isolation and sequencing (Sanger & Coulson, Maxam & Gilbert)	Youtube link will be shared with the students for further better understanding about the concept and they will be asked to write the 5 key points about the	Power point presentation	

				Topic 44 : DNA isolation and sequencing (Maxam & Gilbert)	understanding of the DNA isolation method	Power point presentation	**Twyman**, **RM** (2006). Principles of Gene Manipulation and Genomics. 7th edition. Wiley-Blackwell, Hoboken, New Jersey, United States. 17. Purohit, **SS** (2008). Biotechnology: Fundamentals and Applications. Agrobios, Jodhpur. 18. Rao, **CR** (2016). Molecular Biology and Genetic Engineering. Universities Press, Hyderabad. 19. Russell, **PJ** (2010). i-Genetics - A Molecular Approach. 3rd edition. Benjamin
March (12th Week)	24/02/2025	01/03/2025	4 h	**Topic 45 :** Unit 8: Methods of gene transfer; Gene transfer (Agrobacterium - mediated and gene gun);	One or two research article will be shared to understand the application of Genetic engineering in agriculture and the students will be asked to write the review of 15 lines on it	Power point presentation	
				Topic 46: Selection of transformants;		Power point presentation	
				Topic 47: selectable marker (antibiotic resistant markers, herbicide resistant markers)	Youtube link will be shared and some research article which will aksed to watch and read for better understanding about the concept	Power point presentation	
				Topic 48: Reporter genes (Luciferase, GUS, GFP)	For understanding the Role of reporter gene, abstract of one research article will be shared to understand its application in research	Power point presentation	
March (13th Week)	03/03/2025	08/03/2025	4 h	**Topic 49:** Hairy root culture.	Youtube link will be shared so that students can watch them for better understanding of the topic	Power point presentation	
				T**opic 50:** Unit 9: Gene cloning: Construction of genomic and cDNA libraries		Power point presentation	

				Topic 51: screening of DNA libraries;		Power point presentation	Cummings, U.S.A. 20. Sharma, **A** (2017). Principles of Genetic Engineering. Tech-Max Publications, Mumbai. 21. Singh, **R** (2016). Genetic Engineering: Fundamentals and Applications. PHI Learning Private Limited, New Delhi. 22. Snustad, **DP** and **Simmons**, **MJ** (2012). Principles of Genetics. John Wiley & Sons Inc., U.S.A. 23. Stewart, **CN Jr** (2008). Plant Biotechnology & Genetics: Principles, Techniques and
				Topic 52: complementation, colony hybridization;		Power point presentation	
March (14th Week)	10/02/2025	01/03/2025	4 h	**Topic 53:** Southern, Northern and Western blotting;	Youtube link will be shared so that students can watch them for better understanding of the topic	Power point presentation	
				Topic 54: Polymerase Chain Reaction.		Power point presentation	
				Topic 55: Techniques of DNA fingerprinting (RFLP, RAPD, AFLP).		Power point presentation	
				Topic 56 : Techniques of DNA fingerprinting (AFLP).		Power point presentation	
March (15th Week)	17/02/2025	01/03/2025	4 h	**Topic 57:** Unit 10: Applications of genetic engineering; Pest resistant (Bt-cotton);	They will be asked to provide a list of at least 10 genetically engineered plants besides what was taught in class	Power point presentation	
				Topic 58: ; herbicide resistant plants (Round Up Ready soybean);	Youtube link will be shared so that students can watch them for better understanding of the post translational mechanism	Power point presentation	
				Topic 59: Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice);	Ethical issues related with the genetically modified crops will b asked to be read by the students	Power point presentation	

				Topic 60: Role of transgenics in bioremediation (Superbug);	Limitation of genetically modified crops will be asked to be read by the students	Power point presentation	Applications. John Wiley & Sons Inc., U.S.A. 24. Verma, **PS** and **Agarwal**, **VK** (2009). Molecular Biology. S. Chand and Company Ltd., New Delhi. 25. Verma, **S** (2019). Genetic Engineering: Principles and
March (16^{th} Week)	24/02/2025	01/03/2025	4 h	**Topic 61:** edible vaccines; Industrial enzymes (Protease, Lipase);	Review article on the application of genetic engineering will be shared and students will be asked to write the review of 10 lines	Power point presentation	
				Topic 62: Genetically Engineered Products – Human Growth Hormone; Humulin; Superweeds; Bioethics and Biosafety concerns.	Small review will be asked to be written by the students on the current status of the Genetically engineered crops in India	Power point presentation	
				Topic 63: Revision		NA	
				Topic 64: Revision			

March/ April (l7th Week)	31/03/2025	05/04/2025	4 h	**Revision**			Methods. Himalaya Publishing House, Mumbai. 26. Watson, JD, Baker, TA, Bell, SP, Gann, A, Levine, **M** and **Losick**, **R** (2014). Molecular Biology of the Gene. 7th edition. Cold Spring Harbor Laboratory Press, New York. 27. Yadav, R (2020). Molecular Biology Techniques. Academic Publishers, Kolkata.
April (l8th Week)	07/04/2025	12/04/2025	4 h	**Revision**			

***Assessment Rubrics**

Component	Max Marks
ISA 1	10 Marks
ISA 2	10 Marks

Practical	50 Marks
Project	100 Marks
Semester End Exam	80 Marks

*Note: Data filled in the above form is sample data.