ADIKAVI SRI MAHARSHI VALMIKI UNIVERSITY, RAICHUR

SYLLABUS

B.Sc. Three Year Degree Program for the Subject

Microbiology

With Effect from 2024-25

DISCIPLINE SPECIFIC CORE COURSE (DSC) FOR SEM I - IV, SKILL ENHANCEMENT COURSE (SEC) FOR SEM IV/V/VI and ELECTIVE COURSES FOR SEM V AND VI

As per N E P (Revised): 2024

B.Sc. Semester–III
Discipline Specific Course (DSC)-Microbiology

Course Title:-Molecular Biology and Genetic Engineering
Course Code:- C3MB1T1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessmet Marks	Summative assessment Marks	Total Marks
DSC-5	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs):

At the end of the course students will be able to:

CO1: Understand concepts involved in transcription, translation, regulation of gene expression in Prokaryotes and Eukaryotes.

CO2. Students will understand the process of molecular basis, Mutations, DNA repair mechanisms and protein synthesis.

CO3. Understand the protein synthesis in eukaryotes, translation process and regulation mechanisms in bacteria.

CO4. Students will learn tool of genetic engineering, terminologies, recombination techniques and DNA isolation, transfer and screening techniques.

Unit	Title: Molecular Biology and Genetic Engineering PARTA: Molecular Biology	60 hrs/ sem
Unit I	**Molecular basis of Life:** Introduction to DNA Structure and Watson Crick model of DNA, DNA as a genetic material- Griffith experiment of Transformation, Proof that genetic information stored in DNA, Enzymatic approach to prove DNA mediates transformation by A very, MacLeod and McCarty, Hershey and Chase experiment to prove DNA carries the genetic information in T2 bacteriophage.. Organization of genes in mitochondria and chloroplast **(8 hrs)** **Mutations and repair mechanisms** Nature and types of mutations: Point mutation and Frame shift mutations. Detection of mutations. DNA damage and repair mechanism (SOS and Excision) **(3 hrs)** **Protein Synthesis in prokaryotes**: Transcription – Transcription bubble, RNA Polymerase and regulation by lac operons. Translation – process of initiation, elongation and termination. **(4 hrs)**	15 hrs
Unit II	**Protein Synthesis in Eukaryotes**: **Transcription**: Eukaryotic RNA polymerases - RNA polymerase I, II, III. Mechanism of RNA polymerase. Transcription factors, TATA Box, Post transcriptional modifications	15 hrs

	Translation: Structure and processing of tRNA and Ribosome., Formation of initiation complex. Stages of translation - Initiation, Elongation and termination. Role of eIFs. Elongation of polypeptide - EF-Tu, EF-G, peptide bond formation, peptidyl transferase activity, translocation, eEFs. Termination. Post translational Modifications **(7 hrs)** **Regulation of transcription :** Positive and negative transcriptional control in bacteria. Operon concept, polycistronic mRNA. *lac* operon - negative inducible, allolactose, mutants of *lac* operon structure of *lac* repressor, mechanism of binding of repressor to operator. Catabolite repression of *lac* operon. Regulation by lac repressor and CAP. *trp* operon regulation - repressor control, regulation by Gal operon in Eukaryotes **(5Hrs)** **Regulation through modification of gene structure:** DNase I hypersensitivity, histone modifications, chromatin remodelling, DNA methylation. Regulation through RNA processing and degradation. Regulation through RNA interference **(3 hrs)**	
Unit III	**Tools of genetic engineering**: Definition of genetic engineering, milestones in genetic engineering, prospects and problems of genetic engineering. **(2 hrs)** **Tools in Microbial Genetic Engineering**: Restriction modification systems-Types, Mode of action, nomenclature, applications of restriction enzymes in genetic engineering. DNA modifying enzymes and their applications: DNA polymerases, Methylases, Terminal deoxynucleotidyl transferase, kinases, phosphatases and DNA ligases. **(4 hrs)** **Cloning Vectors**: Definition and Properties. Characteristics of cloning vectors. Plasmid vectors: pBR and pUC series. Bacteriophage lambda, cosmids, BACs, YACs. Use of linkers and adaptors. **(4 hrs)** **Expression vectors**: Baculovirus based vectors, mammalian SV40-based expression vectors. **(3 hrs)** **Cloning host**- Escherichia coli and Saccharomyces cerevisiae as Cloning host **PCR** – Working Principle and applications **(2 hrs)**	15 hrs
Unit IV	**DNA Isolation, transfer and Screening methods** **Isolation and Detection of DNA**: Isolation of DNA and plasmid DNA, restriction digestion and ligation of DNA, Agarose gel electrophoresis, Blotting techniques-Southern blotting, Northern blotting, Western blotting. **(4 hrs)** **DNA transfer methods**: Calcium chloride mediated gene transfer, Agrobacteriutm mediated DNA transfer, Electroporation and Micro-injection. **(4 hrs)** **Screening and selection of recombinant host cells**: Insertional activation - antibiotic selection. Inactivation - Blue white selection. In situ colony/DNA hybridization and in Immunological techniques	15hrs

	(3 hrs) Gene Library: Construction of Genomic library and cDNA library **(2 hrs)** DNA finger printing technique – Principle and Applications, Merits and Demerits **(2 hrs)**	

Recommended books:

1. Karp, G., Iwasa, J., & Marshall, W. (2023). *Karp's Cell and Molecular Biology* (10th ed.). Wiley.
2. Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T. (2021). *Lewin's Genes XIII* (13th ed.). Jones & Bartlett Learning.
3. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2020). *Molecular Biology of the Gene* (8th ed.). Pearson.
4. Malacinski, G. M. (2018). *Freifelder's Essentials of Molecular Biology* (5th ed.). Jones & Bartlett Learning.
5. Berg, J. M., Tymoczko, J. L., Gatto, G. J., & Stryer, L. (2019). *Biochemistry* (9th ed.). W.H. Freeman.
6. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular Biology of the Cell* (6th ed.). Garland Science.
7. Tropp, B. E. (2012). *Molecular Biology: Genes to Proteins* (4th ed.). Jones & Bartlett Learning.
8. Allison, E. A. (2015). *Fundamental Molecular Biology* (3rd ed.). Wiley.

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
InternalAssessmentTest1	10
InternalAssessmentTest2	10
Total	**20Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–III
Discipline Specific Course (DSC)
Practical: Molecular Biology and Genetic Engineerin g

Course Title:4.2-Molecular Biology and Genetic Engineering

Course Code: C3MCB1P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-6	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs):

At the end of the course, students will be able to:

CO 1: Students get Expertise in GLP, SOP in molecular biology experiments thoroughly.
CO 2: Hands on Expertise in the field of molecular biology Experiments such bacterial genome extraction, isolation, plasmid isolation.
CO 3: These practical will serves platform for molecular biology field and explore the knowledge in molecular biology research.
CO:4 Students will get expertise in DNA, RNA estimation, Studying semiconservative model of replication, mutant selection by Replica plate method and DNA fingerprinting techniques.

List of the Experiments, each will have 4hrs / Week (Minimum 12 experiments)

1. Good Laboratory Practices and Safety Measures of Biohazard materials.
2. Study of Micropipette operation and calibration.
3. Standard operating procedure for molecular biology tools/equipment's.
4. Preparation of Buffers and Reagents.
5. Isolation of Bacterial Genomic DNA.
6. Isolation of Plasmid from *E. Coli* Cells.
7. Detection of DNA by gel electrophoresis.
8. Estimation of DNA by DPA colorimetric/spectrophotometric method.
9. Estimation of RNA by orcinol colorimetric/ spectrophotometric method.
10. Estimation of Total free Amino acids.
11. Extraction and estimation of protein from Animal/plant source by salt precipitation and organic solvent method.
12. Study of semi-conservative replication of DNA through micrographs / schematic representations
13. DNA fingerprinting technique through micrographs / schematic representations
14. Identifying Mutants by Replica plate technique.
15. Study of Plasmids by Chart

    a) pBR322

    b) pUC18and19

    c) SV40

    d) Bacteriophages

Books recommended:

References:

1. Brown, T. A. (2023). Genetics: A molecular approach (4th ed.). Cdn. Stancly Phonics Ltd.
2. Colwell, R. R. (2012). Microbial diversity (2nd ed.). Academic Press.
3. Davis, R. W., Bolstein, D., & Roth, J. R. (1980). A manual for genetic engineering. Cold Spring Harbor Laboratory.
4. De Robertis, E. D. P., & De Robertis, E. M. F. (2017). Cell and molecular biology (8th ed.). Lea & Febiger.
5. Karp, G. (2023). Cell biology (10th ed.). McGraw Hill.
6. American Society for Microbiology. (2020). Recombinant DNA (3rd ed.). American Society for Microbiology.
7. Nicholl, D. S. T. (2020). An introduction to genetic engineering (4th ed.). Cambridge University Press.
8. Peters, P. (2015). A guide to genetic engineering (3rd ed.). WMC Brown.
9. Salle, A. J. (2019). Fundamental principles of bacteriology (10th ed.). Tata McGraw Hill.
10. Smith, J. (2018). Molecular biology (6th ed.). Faber and Faber Publications.
11. Stanier, R. Y., & Ingraham, J. L. (2019). General microbiology (6th ed.). Prentice Hall of India.
12. Watson, J. D. (2020). Recombinant DNA (4th ed.). Scientific American Books.