VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
Jnana sagara campus, Vinayaka nagara, Cantonment,
Bellary.-583105

DEPARTMENT OF STUDIES IN MICROBIOLOGY

UG (UNDER GRADUATE)
SYLLABUS
(V Semester)

With effect from 2023-24

5th Semester Syllabus for B.Sc. in Microbiology

Program Name	**B. Sc in MICROBIOLOGY**	Semester	**V**
Course Title	**MOLECULAR BIOLOGY**		
Course Code:	**21BSC5C5MBL**	No. of Credits	**04**
Contact hours	**60 Hours (4Hoursperweek)**	Duration of SEA/Exam	**2hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Outcomes (COs):

After the successful completion of the course, the student will be able to:

CO1.Understand concepts involved in replication, transcription, translation, regulation of gene expression in bacteria and Eukaryotes.

CO2.Differentiate the process of replication, transcription, translation, regulation of gene expression in bacteria and Eukaryotes.

CO3.Understand the genetic switch in bacteriophages.

CO4.Compare and contrast housekeeping, constitutive, inducible and repressible genes.

CO5.Outline regulatory mechanisms in bacteria to control cellular processes

Content

UNIT 1:DNA Replication and Prokaryotic transcription. **DNA Replication:** Bacterial Cell cycle. Replicon. *OriC*. Bidirectional replication. Steps in Initiation of replication. DNA polymerases, Replication fork, replisome. Mechanism of DNA polymerase III. Ligase, Eukaryotic DNA polymerases. Termination of replication. Extra chromosomal replicons. Replication of DNA strand with 5' end, linear end, replication of adenovirus and ϕ29 DNAs, rolling circle in replication of phage genomes, F plasmid, Replication of ColE1DNA.Replication of mtDNA, D-loop. Replication of telomeres. **Prokaryotic transcription:** Transcription bubble, Stages of transcription, Bacterial RNA polymerase - structure and mechanism, recognition of promoters and DNA melting, abortive initiation. Elongation, Termination, anti termination. Phage T7 RNA polymerase, alternative sigma factors - transcription of heat shock genes, phage SPO1 genes, sporulation in *Bacillus*.Stringentresponse in *E.coli*.	**15 Hrs**
UNIT 2:Transcription **Eukaryotic Transcription**: Eukaryotic RNA polymerases - RNA polymerase I, II, III. Mechanism of RNA polymerase in detail. Promoters, Transcription factors, basal apparatus, promoter clearance, elongation. Enhancers, silencers, termination. **RNA splicing and Processing**: mRNA capping, pre-mRNA splicing, lariat, snRNPs, spliceosome, autocatalytic splicing, alternative splicing, polyadenylation, tRNA splicing and maturation, production of rRNA, Catalytic RNAs-auto splicing, ribozymes, rinonuclease P,viroids and virusoids, RNA editing.	**15 Hrs**
UNIT 3:Translation Genetic code, t RNA structure, charging of tRNA, differences between initiator tRNA and elongator tRNA, ribosome structure. Accuracy of translation. Stages of translation. Role of IFsin initiation of bacterial translation, Formation of initiation complex. Initiation of eukaryotic translation - Scanning model of mRNA, IRES, Role of eIFs. Elongation of polypeptide - EF-Tu,EF-G, peptide bond formation, peptidyl transferase activity, translocation, eEFs. Termination. Regulation of translation. Post translational modifications of proteins. Protein maturation and secretion , protein splicing, molecular chaperones. Protein translocation and secretion in bacteria	**15 Hrs**
UNIT 4: Regulation of gene Expression **Control of gene expression in prokaryotes** Regulatory mechanisms in bacteria. Positive and negative transcriptional control in bacteria.	**15 Hrs**

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 & attenuator control. Arabinose operon -positive and negative transcriptional controlby AraC. Riboswitch control of *rib* operon of *Bacillus subtilis*. Control of translation by ribo switches and small RNAs. Global regulatory mechanisms - *mal* regulon, two-component signal transduction systems. Regulation of lytic &lysogenic life cycle in bacteriophage λ. Control of lytic cycle by regulatory proteins - *cro* gene, *N* gene, lambda repressor - structure, DNA binding mechanism. Events in switch from lytic to lysogenic cycle. Maintenance of lysogeny. **Control of gene expression in eukaryotes** Regulation through modification of gene structure- DNase I hypersensitivity, histone modifications, chromatin remodeling, DNA methylation. Regulation through transcriptional activators,Co-activators and repressors, enhancer sand insulators. Regulation through RNA Processing and degradation. Regulation through RNA interference	

Reference:

1. De Robertis E. D. P. and De Robertis E. M. F. (1987), Cellular and Molecular Biology Lea and Febiger, Philadelphia.
2. Nelson D. L. and Cox M. M. (2005) Lehninger's Principles of Biochemistry, Fourth edition, W. H. Freeman & Co. NewYork.
3. Molecular Biology of Gene. 5thEdn.The Benjamin / Cummings Pub. Co. Inc,2003.
4. Watson JD et al, 2004; Molecular biology of the Gene, Pearson EducationIndia.
5. Larry Snyder and Wendy Champness.Molecular Genetics of Bacteria. 3rd edition,ASM Press, Washington, D.C.2007
6. Baumberg. S. Prokaryotic gene expression. Oxford University Press.2002.
7. Daniel L. Hartl. Essential Genetics.A genomics perspective, 5th edition,2009.
8. Jeremy W. Dale and Simon F. Park. Molecular Genetics of Bacteria.2010.
9. Nancy Trun and Janine Trempy.Fundamental Bacterial Genetics.Wiley-Blackwell
10. Watson. J. D, Baker. T. A, Bell. S. P, Gann. A, Levine. M, Losick.R.
11. Molecular Biology of Gene. 5thEdn.The Benjamin / Cummings Pub. Co. Inc,2003.
12. William Hays, 1980; The genetics of bacteria and their viruses, CBS Publ. NewDelhi
13. Jenkins JB, 1995; Genetics, Houghton Mifflin Co.,Boston.
14. Strickberger MW, 1990; Genetics MacMillan Publ. Co. Inc. NewYork.
15. Stent GS & Calendar R, 1978; Molecular Genetics, Freeman & Co., SanFrancisco.
16. Benjamin Lewin, 2005, Genes - VIII, John Wiley & Sons, NewYork
17. Watson JD et al, 2004; Molecular biology of the Gene, Pearson EducationIndia
18. Hartwell LH et al, 2000; Genetics – from Genes to Genomes, McGraw HillPubl.,

Course Title	**MOLECULAR BIOLOGY(LAB)**	Practical Credits	**02**
Course Code	**21BSC5C5MBP**	Contact Hours	**4Hours/week**
Formative Assessment	**25Marks**	Summative Assessment	**25Marks**

Practical Content

1. Micro pipeting: Moving Very Small Volumes Very Accurately
2. Study of semi-conservative replication of DNA through micrographs/schematic representations
3. Extraction of crude DNA from bacteria and yeast by phenol/chloroform method.
4. Determination of purity and quantity of DNA
5. Determination of DNA melting point and GC content
6. Extraction and visualization of plasmids from bacterial cultures
7. Extraction and visualization of genomicDNA from bacterial cultures
8. Measurement of β-galactosidase activity in stimulated and control cells of *E.coli*
9. β-galactosidase activity assay in Yeast
10. DNA extraction from agarose gel
11. RNAextraction and visualization from yeast.
12. Analysis of RNAquality and integrity
13. Determining nucleotide composition of RNA
14. Restriction enzyme digestion of DNAmolecule -DNA fingerprinting
15. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE)

References

1. Karp's Cell and Molecular Biology by Gerald Karp, Janet Iwasa, Wallace Marshall. Ninth Edition. 2020
2. Lewin's Genes XII. Jocelyn E Krebs, Elliott S Goldstein, Stephen T Kilpatrick. Jones and Bartlett Learning.2017
3. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, RichardLosick. Molecular Biology of the Gene, 7th edition. 2017
4. Freifelder's Essentials of MOLECULAR BIOLOGY. George M Malacinski, 4th ed. 2015
5. Freifelder D (2012). Molecular Biology, 5th edition. Narosa Publishing House, India
6. Berg JM, Tymoczko JL, Gatto GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co., New York
7. Alberts Bruce, Johnson A, Lewis J, Raff M , Roberts K, Walter P (2014) Molecular Biology of the Cell. 5th Edition, Taylor and Francis. New York, USA.
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11. Bloch KD; Grossmann B (1995). Digestion of DNA with Restriction Endonucleases.
12. https://doi.org/10.1002/0471142727.mb0301s31
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14. Elkins K M (2013). DNA Extraction Forensic DNA Biology.
15. Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, J.G. Seidman, John A. Smith, Kevin Struhl (2003). Current Protocols in Molecular Biology. John Wiley & Sons, New York, United States.
16. Johnson M (2019). RNA extraction, Synatom Research, Princeton, New Jersey, United States. DOI//dx.doi.org/10.13070/mm.en.2.201.
17. Lewis M. Agarose gel electrophoresis (basic method). Department of Pathology, University of Liverpool. http://diyhpl.us/~bryan/irc/protocol-online/protocolcache/agarogel.html
18. Randall DR. (2009). Molecular Biology Laboratory manual.
19. Sambrook JF, Russell DW (2001). Molecular Cloning: a Laboratory Manual. 3rd edition. Cold Spring Harbor, N.Y. Cold Spring Harbor Laboratory Press
20. Struhl K, Seidman J G, Moore D D, Kingston RE, Brent R, Ausubel FM, Smith JA. (2002). Hort Protocols in Molecular Biology: A Compendium of Methods from Current Protocols in Molecular Biology. John Wiley & Sons Inc., New York, United States

Program Name	**B.Sc in MICROBIOLOGY**	Semester	**V**
Course Title	**FOOD MICROBIOLOGY(Theory)**		
Course Code:	**21BSC5C6MBL**	No. of Credits	**04**
Contact hours	**60Hours(4 Hours per week)**	Duration of SEA/Exam	**2hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Outcomes(COs): After the successful completion of the course,the student will be able to:
CO1.To understand the association of microbes in food and the quality testing of food
CO2.To understand the preservation and food safety protocols
CO3.To understand the methods of spoilage of food and the diseases associated with it
CO4.To learn the properties of milk and the types of preservation of milk.
CO5.To learn the types of fermented food and dairy products and its significance

CONTENTS	
Unit 1:Microbes and food: Food as a substrate for microorganisms- Intrinsic and extrinsic parameters affecting the growth of microbes. Microorganisms in food and their sources (molds, yeast and bacteria) **Food borne infections** and intoxication *Staphylococcus, Clostridium. Salmonella.*	15hrs
Unit 2:Spoilage of Food, Preservation and Food safety- Spoilage: Principles of food spoilage. Sources of food contamination, Types of spoilage. Spoilage of meat and poultry, Fish and sea foods. Spoilage cereals, fruits and vegetables. Spoilage of canned food. Preservation: Principles of food Preservation. Methods of Preservation-Physical (temperature, drying, irradiation), chemical (Class I and Class II). Bio preservation. Canning.	15hrs
Unit 3:a) Food Biotechnology: Single cell protein– *Spirulina, Fusarium, Saccharomyces*; fermented foods, mushroom technology; fungal foods; microbial production of flavours, natural food colourants from bacteria, fungi and algae, enzymes for food processing (protease, lipase, invertase,) sweeteners, food waste management, **b)Food and sanitation:** Good Hygiene practices, GLP, GMP(Waste treatment disposal methods),HACCP, Food control agencies and their regulation –FSSAI, FDA,FAO	15hrs
Unit 4: Dairy Microbiology: History. Properties of milk. Types of milk- dried, liquid, condensed. **Microorganisms in milk.** Starter culture and its types- (single, mixed) Sources of contamination of milk. Microbiological analysis of milk- Rapid platform tests (organoleptic, alcohol, COB, alcohol test, Phosphatase test, DMC, sedimentation test). Reductase tests, SPC. Preservation of milk- Pasteurization. Dehydration, sterilization. Packing of milk and dairy products. **Fermentation in milk**: Lactic acid, gassy fermentation, souring **Dairy products:** Cheese- Types and production (Cheddar), Tofu, Yoghurt, Acidophilus milk.Prebiotics, Probiotics.	15hrs

References:

1. Doyte MP, Loory RB & Thomas JM; Food Microbiology, ASM Pres, Washington DC.
2. Jay JM, Modern; Food Microbiology, Chapman & Hall, New York.
3. Joshi VK &Pandey Ashok; Biotechnology of Food Fermentation, Asia tech Publ. Delhi, India.
4. Frazier WC &Westhof DC; Food Microbiology, 3rd Ed., Tata McGraw Hill.
5. Doyle PM et al; Food Microbiology – Fundamentals & Frontiers, 2nd Ed., ASM Press.
6. Danwart GJ; Basic Food Microbiology, CBS Publ. Delhi.
7. Pitt J & Hocking. (1985); Fungi & Food spoilage, Academic Press.
8. Sandeep Sareeen; Food Preservation, Sarops & Soni, New Delhi.
9. Anantha krishnan CP. (1994); Dairy Microbiology, Sree lakshmi Publ. Chennai.

Course Title	**FOOD MICROBIOLOGY(Lab)**	Practical Credits	**02**
Course Code	**21BSC5C6MBP**	Contact Hours	**4HRS/WEEK**
Formative Assessment	**25Marks**	Summative Assessment	**25Marks**

Practical Content

Course outcome: After the successful completion of the course, the student will be able
CO1: To analyze the quality of food and milk.
CO2: Able to detect food borne pathogens.
CO3: Able to study probiotics.

1. Detection of Food Borne Pathogens from street and Restaurant food.
2. Isolation of bacteria and fungi from fermented food and stored/ preserved food.
3. Reductase tests-MBRT/Resazurin.
4. Estimation of Titrable acidity milk.
5. Fat estimation – Gerber's method.
6. Bacterial examination by SPC, DMC.
7. Estimation of Lactose in milk
8. Production of Yoghurt.
9. Study of food borne pathogens- *Staphylococcus, Salmonella, Aspergillus, Clostridium.*
10. Detection of Aflatoxin by TLC.
11. Significant microbes in Food and Dairy - *Lactobacillus, Streptococcus, Penicillium, Rhizopus.*

Pedagogy: Experiential learning, Problem solving, Project

References

1. Doyle M. P. and Beuchat L. R. (2007). Food Microbiology- Fundamentals. Frontiers, ASM Press.
2. Garbutt J. (1997). Essentials of Food Microbiology, Armold- International Students edition, London. 8. Marriott N. G. and Gravani R. B. (2006).
3. Principles of Food Sanitation, Food Science Text Series, Springer International, New York, USA.
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5. Deak T. and Beuchat L. R. (1996). Hand Book of Food Spoilage Yeasts, CRC Press, New York.
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