
**Anekant Education Society's**

# Tuljaram Chaturchand College,

## of Arts, Science & Commerce, Baramati

## (Autonomous)

## Syllabus (CBCS) for T. Y. B. Sc. Microbiology

## (2022 Pattern)

w.e.f.

June 2024

## COURSE STRUCTURE FOR T. Y. B. Sc. MICROBIOLOGY (2022 Pattern) (w.e.f. June 2024)

| Sr. No. | Class | Semester | Code | Paper | Paper Title | Credit | Marks (I+E) |
|---|---|---|---|---|---|---|---|
| 1 | T.Y.B.Sc. | V | USMB351 | Theory | MEDICAL MICROBIOLOGY-I | 3 | 40+60 |
| 2 | T.Y.B.Sc. | V | USMB352 | Theory | GENETICS AND MOLECULAR BIOLOGY- I | 3 | 40+60 |
| 3 | T.Y.B.Sc. | V | USMB353 | Theory | ENZYMOLOGY | 3 | 40+60 |
| 4 | T.Y.B.Sc. | V | USMB354 | Theory | IMMUNOLOGY – I | 3 | 40+60 |
| 5 | T.Y.B.Sc. | V | USMB355 | Theory | FERMENTATION TECHNOLOGY-I | 3 | 40+60 |
| 6 | T.Y.B.Sc. | V | USMB356 A | Elective Theory Paper I | FOOD AND DAIRY MICROBIOLOGY | 3 | 40+60 |
| 7 | T.Y.B.Sc. | V | USMB356 B | Elective Theory Paper II | MICROBIAL TECHNOLOGY | 3 | 40+60 |
| 8 | T.Y.B.Sc. | V | USMB357 | Practical Course I | APPLIED MICROBIOLOGY | 2 | 40+60 |
| 9 | T.Y.B.Sc. | V | USMB358 | Practical Course II | BIOCHEMISTRY | 2 | 40+60 |
| 10 | T.Y.B.Sc. | V | USMB359 | Practical Course III | CLINICAL MICROBIOLOGY | 2 | 40+60 |
| 11 | T.Y.B.Sc. | V | Certificate course | | RELATED TO SUBJECT | 2 | |
| | | | | | **Total** | **26** | |
| 11 | T.Y.B.Sc. | VI | USMB361 | Theory | MEDICAL MICROBIOLOGY-II | 3 | 40+60 |
| 12 | T.Y.B.Sc. | VI | USMB362 | Theory | GENETICS AND MOLECULAR BIOLOGY- II | 3 | 40+60 |
| 13 | T.Y.B.Sc. | VI | USMB363 | Theory | METABOLISM | 3 | 40+60 |
| 14 | T.Y.B.Sc. | VI | USMB364 | Theory | IMMUNOLOGY – II | 3 | 40+60 |
| 15 | T.Y.B.Sc. | VI | USMB365 | Theory | FERMENTATION TECHNOLOGY-II | 3 | 40+60 |
| 16 | T.Y.B.Sc. | VI | USMB366 A | Elective theory paper I | AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY | 3 | 40+60 |
| 17 | T.Y.B.Sc. | VI | USMB366 B | Elective theory paper II | NANOBIOTECHNOLOGY | 3 | 40+60 |
| 18 | T.Y.B.Sc. | VI | USMB367 | Practical Course IV | BIOCHEMISTRY & MOLECULAR BIOLOGY | 2 | 40+60 |
| 19 | T.Y.B.Sc. | VI | USMB368 | Practical Course V | HEMATOLOGY AND DIAGNOSTIC IMMUNOLOGY | 2 | 40+60 |
| 20 | T.Y.B.Sc. | VI | USMB369 | Practical Course VI | PROJECT | 2 | 40+60 |
| | | | | | **Total** | **24** | |
| | | | | | **Grand Total** | | |

**I:** Internal Examination

**E:** External Examination

**SYLLABUS (CBCS) FOR T.Y.B.Sc. Microbiology(2022 Pattern)**

**(w. e. from June, 2024)**

| | |
|---|---|
| **Name of the Programme** | **: B.Sc. Microbiology** |
| **Program Code** | **: USMB** |
| **Class** | **: T.Y.B.Sc.** |
| **Semester** | **: V** |
| **Course Type** | **: Theory** |
| **Course Name** | **: Medical Microbiology-I** |
| **Course Code** | **: USMB351** |
| **No. of Credits** | **:03** |
| **No. of Lectures** | **:48** |

**Course Objectives**

Students will:

1. Acquired a strong foundation in the principles of infectious disease, enabling them to contribute to public health initiatives and disease prevention strategies.
2. Be proficient in analyzing and interpreting epidemiological data, supporting evidence-based decision-making in healthcare.
3. Possess research skills, including the ability to design and conduct studies related to infectious diseases, contributing to advancements in the field.
4. Demonstrate critical thinking and problem-solving skills in evaluating clinical trials of drugs and vaccines, promoting ethical practices in research.
5. Exhibit effective communication skills in presenting information on bacterial pathogens, facilitating collaboration with healthcare professionals and researchers.
6. Understand the importance of interdisciplinary approaches in addressing infectious diseases, contributing to a holistic understanding of public health challenges.
7. Be equipped with knowledge and skills to contribute to the development and implementation of effective measures for the prevention and control of infectious diseases in diverse populations.

**Course Outcomes :**

Students will able to:

CO1 Demonstrate a comprehensive understanding of common infectious diseases affectingthe respiratory, gastrointestinal, urogenital, and central nervous systems, including knowledge of causative pathogens, symptoms, and host defense mechanisms.

CO2 Analyze and interpret epidemiological data, showcasing the ability to identify patterns of disease distribution based on time, place, and person

CO3 Demonstrate proficiency in designing and conducting case-control and cohort studies, applying these study designs to investigate infectious diseases and their transmission dynamics.

CO4 Understand the principles and methods involved in clinical trials of drugs and vaccines, including randomized control trials, concurrent parallel trials, and cross-over trials.

CO5 Comprehend the epidemiology of infectious diseases, including sources and reservoirs of infection, modes of transmission, and measures for disease prevention and control.

CO6 Develop the skills to critically evaluate the role of epidemiological monitoring organizations and their contribution to public health

CO7 Analyze and present information on various bacterial pathogens, discussing their classification, biochemical characteristics, antigenic structure, viability, pathogenicity, pathogenesis, symptoms, laboratory diagnosis, epidemiology, prophylaxis, and chemotherapy.

| Credit | Topic and Learning Points | No. of Lectures |
|---|---|---|
| **I** | **Introduction to infectious diseases of following human body systems:**<br>(Common diseases, pathogens, symptoms, defense mechanisms) | |
| | **Unit 1. Respiratory system** | 4 |
| | **Unit 2. Gastrointestinal system** | 4 |
| | **Unit 3. Urogenital system** | 4 |
| | **Unit 4. Central nervous system** | 4 |
| **II** | **Epidemiology:** | |
| | **Unit 1. Introduction and scope of epidemiology** | 2 |
| | **Unit 2. Types of epidemiological studies**<br>1. Disease distribution based on time, place and person<br>2. Case control and cohort studies – study design and application | 5 |
| | **Unit 3. Principle and methods – Clinical trials of drugs and vaccines**<br>1. Randomized control trials<br>2. Concurrent parallel and<br>3. cross-over trials | 5 |
| | **Unit 4. Epidemiology of infectious diseases**<br>1. Sources and reservoirs of infection<br>2. Modes of transmission of infections<br>**3.** Disease prevention and control measures | 4 |
| **III** | **Study of following bacterial pathogens:**<br>**(with respect to - Classification and Biochemical characters, Antigenic structure, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis, Epidemiology,Prophylaxis and Chemotherapy):** | |
| | **Unit 1.**<br>1. *Salmonella*<br>2. *Vibrio*<br>3. *Pseudomonas*<br>4. *Neisseria*<br>5. *Streptococcus* | 8 |
| | **Unit 2.**<br>1. Spirochetes: *Treponema*<br>2. *Clostridium tetani*<br>3. *Mycobacterium tuberculosis*<br>4. *Rickettsia* | 8 |

**References**:


1. Tortora, G.J., Funke, B.R., Case, C. L, 1992. Microbiology: An introduction 5th Edition, Benjamin Pub. Co.NY

2. Roitt, P.I: Mims, C.J. Medical Microbiology

3. Chakraborty, P., 2003 A textbook of Microbiology, 2nd Edition New Central Book Agency, India.

4. Medical Microbiology edited by Samuel Baron. Fourth Edition. (University of Texas Medical Branch ofGalvesion)

5. Sherris, John C, Ed, Medical Microbiology: an Introduction to infectious diseases. Elsevier Publication II ndedition.

6. Virulence mechanisms of bacterial pathogens (Second edition) by Roth, Bolin, Brogden Minion and Michael.

7. Davis B.D., Delbacco, 1990 Microbiology 4th edition, J.B. Lippincott Co. NY

8. Wolfgang K. Joklik, 1992, Zinsser Microbiology 20th Edition, McGraw-Hill Professional Publishing.

9. Dey, N.C and Dey, TK. 1988, Medical Bacteriology, Allied Agency, Calcutta, 17th Edition

10. Ananthnarayana, R. and C.E, Jayaram Panikar, 1996 Text book of microbiology, 5th edition, OrientLongman.

**Mapping of Program Outcomes with Course Outcomes Weightage**:

1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

| | **Programme Outcomes (POs)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Outcomes** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | | | | | | | | |
| CO2 | 2 | 3 | 3 | | | | | | |
| CO3 | | 3 | | 3 | | | | | |
| CO 4 | 2 | | | 2 | | | | | |
| CO 5 | | | 3 | 2 | | | | | |
| CO 6 | | 2 | 2 | | | 3 | 2 | | |
| CO 7 | | 2 | | 2 | | 2 | 2 | | |

**Justification for the mapping**

**PO1: Disciplinary Knowledge:**

The first course outcome aligns closely with PO1. By acquiring a comprehensive understanding of common infectious diseases and their causative agents, students develop disciplinary knowledge in the field of infectious diseases and public health.

**PO2: Critical Thinking and Problem Solving:**

Course outcomes 2, 3, 6, and 7 are aligned with PO2. Students are required to analyze epidemiological data, design and conduct studies, critically evaluate information on bacterial pathogens, and present their findings. These activities necessitate critical thinking and problem-solving skills.

**PO3: Social Competence**:

Course outcomes 2, 5, and 6 align with PO3. Analyzing disease distribution, understanding the sources

and modes of transmission of infectious diseases, and evaluating the role of epidemiological monitoring organizations contribute to social competence. Graduates are equipped to engage with communities and contribute to public health initiatives.

**PO4: Research-related Skills and Scientific Temper**:

Course outcomes 3, 4, 5, and 7 directly align with PO4. Students gain proficiency in designing and conducting studies, understanding clinical trial principles, comprehending epidemiology, and critically evaluating information. These activities contribute to the development of research-related skills and a scientific temper.

**PO6: Personal and Professional Competence**:

The course outcomes, especially 6 and 7, contribute to personal and professional competence. Students develop the skills to critically evaluate information and present findings, enhancing their professional communication skills and competence in the field of infectious diseases.

**PO7: Self-directed and Life-long Learning:**

Course outcomes 6 and 7 contribute to PO7 by fostering a mindset of self-directed and life-long learning. Students are expected to critically evaluate information and continuously update their knowledge in the dynamic field of infectious disease.

**SYLLABUS (CBCS) FOR T.Y.B.Sc. Microbiology(2022 Pattern)**

**(w. e. from June, 2024)**

| | |
|---|---|
| **Name of the Programme** | **: B.Sc. Microbiology** |
| **Program Code** | **: USMB** |
| **Class** | **: T.Y.B.Sc.** |
| **Semester** | **: V** |
| **Course Type** | **: Theory** |
| **Course Name** | **: Genetics and Molecular Biology I** |
| **Course Code** | **: USMB352** |
| **No. of Credits** | **:03** |
| **No. of Lectures** | **:48** |

**Course Objectives:**

**Student will be able**

1. Gain a comprehensive understanding of microbial genetics, including the conceptual and practical tools used for generating, processing, and interpreting genetic information.

2. Develop a deep knowledge of the central dogma of molecular biology, including replication, transcription, and translation, and their roles in microbial genetics.

3. Analyze the structure of promoters in both prokaryotic and eukaryotic transcription, the types and functions of RNA polymerases, and the steps involved in transcription initiation, abortive initiation, elongation, and termination.

4.Investigate the termination of DNA replication, focusing on the Ter sequence and Tus protein-mediated termination mechanisms.

5. Examine the roles and functions of various components involved in DNA replication, such as DNA polymerases, leading and lagging strand synthesis, and the formation and processing of Okazaki fragments.

6. Explore the translation process, including the roles of mRNA, tRNA, ribosomes, and aminoacyl tRNA synthetase in protein synthesis, and the mechanisms of initiation, elongation, translocation, and termination of translation in both prokaryotic and eukaryotic systems.

7. Investigate DNA damage and repair mechanisms, including an overview of various types of DNA damage caused by hydrolysis, deamination, alkylation, oxidation, radiation, and photo reactivation.

**Course Outcomes:**

| | |
|---|---|
| CO1 | Understand the genome organization in prokaryotic cell and eukaryotic cell |
| CO2 | Learn the molecular mechanism involved in DNA replication. |
| CO3 | Explain the molecular mechanism involved in gene expression. |
| CO4 | Compare the Prokaryotic and Eukaryotic transcription and translation |

| | |
|---|---|
| CO5 | Discuss the different types of mutations and corresponding DNA repair mechanisms |
| CO6 | Apply the Bacteriophage growth kinetics in calculation of Eclipse period, latent period and burst size |
| CO7 | Use the concept of mutation for betterment of society |

| Credit | Topic and Learning Points | No. of Lectures |
|---|---|---|
| I | **Genome Structure and Replication** | |
| | **Unit 1: Genome organization** | |
| | 1. Viral Genome structure<br>2. Bacterial Genome structure<br>Concept of Nucleoid<br>3. Eukaryotic Genome organization<br>Structure of nucleosome,10 nm fiber,30 nm fiber,<br>Structure of Euchromatin and heterochromatin. | 8 |
| | **Unit 2: Replication**<br>1. Ori C<br>2. Single replicon , Multiple Replicon<br>3. Bidirectional movement of replication fork.<br>4. Pre-priming and Priming reaction.<br>5. DNA polymerases, DNA synthesis of leading, lagging strand<br>6. Okazaki fragments.<br>7. Termination- Ter sequence, Tus protein | 8 |
| II | **Gene Expression** | |
| | **Unit 1: Transcription**<br>1. Structure of promoters (Prokaryotic and eukaryotic)<br>2. Structure and types of RNA polymerases<br>3. Steps of transcription : Initiation, Abortive Initiation, Elongation and Termination<br>4. Comparison of prokaryotic and eukaryotic transcription | 8 |
| | **Unit 2: Translation**<br>1. Role of m-RNA, t-RNA and Ribosomes and Aminoacyl tRNA synthetase in translation<br>2. Initiation, elongation, translocation and termination of protein synthesis<br>3. Comparative account of prokaryotic and Eukaryotic translation mechanism | 8 |

**III DNA damage and Repair mechanisms and Bacteriophagegrowth kinetics**

**Unit 1: DNA damage and Repair mechanisms**

1. Overview of DNA damage by hydrolysis, deamination, alkylation, oxidation, Radiation (x rays/uv rays) and Photo reactivation — 7
2. Mismatch repair mechanism
3. Excision repair mechanisms (BER/NER)
4. Recombination repair (NHEJ/DSB repair model)
5. Translesion DNA synthesis (SOS response)

**Unit 2: Bacteriophage growth kinetics** — 9

1. One step growth curve and Doerman's experiment
2. Structural organization of bacteriophage chromosome (Lambda phage)
3. Bacteriophage mutants (Plaque morphology, Conditional lethal mutants). Concept of Deletion mapping & Benzers Spot test.
4. Concept of Genetic Complementation and Cis-trans test of genetic function.
5. Fine structure mapping of rII locus of T4 phage using Complementation analysis.

**References:**


1. R.J.BROOKER ( 2012) Genetics: Analysis and Principles , 4 th edition,McGraw-Hill publication
2. Strickberger, M.W. (1985), Genetics, 3rd Edition Macmillan Pub. Co. N
3. Gardner, Simmons and Snustad (1991)Principles of Genetics, 8 th edition John Wileyand Sons Publication
4. Russel Peter. (2009), Genetics: A Molecular Approach, 3rd Edn. Publisher Benjamin Cummings
5. Russel, Peter, (1990), Essential Genetics, 7thEdn. Blackwell SciencePub. 12
6. Lodish H. et al. (2012), Molecular Cell Biology, 7th Edn. W. H. Freeman & Company.New York.
7. Russel Peter. (2009), iGenetics: A Molecular Approach, 3rd Edn. Publisher Benjamin Cummings 11. Russel, Peter, (1990), Essential Genetics, 7thEdn. Blackwell Science Pub. 12
8. Watson J.D., Baker, T.A., Bell, S.P., Molecular Biology of the gene, 7th edition. Pearson(2013)
9. Genes IX-Benjamin Lewin
10. Russel P.J., iGenetics: A molecular Approach 3rd edition. Pearson(2010)
11. Fundamentals of Molecular Biology –By J K Pal and Saroj Ghaskadabi
12. Hyman P Abedon ST (2009). Practical methods for determining Phage growth parameters.In:Clokie M R J , Kropinski A M (eds) Bacteriophage:Methods and Protocols,Volume;Isolation ,Characterisation and Interactions,Vol.501,Humana Press,New York
13. Genetics of Bacteria and their Viruses-By William Hayes

14. Brooker, R.J., Genetics: Analysis and principles. 4th Edition. McGrow Hill (2010)

15. Principles of Genetics-By Gardner

## Mapping of Program Outcomes with Course Outcomes

**Weightage**:1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

| | **Programme Outcomes (POs)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Outcomes** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | | | | | | | | |
| CO2 | 2 | 3 | 3 | | | | | | |
| CO3 | | 3 | | 3 | | | | | |
| CO 4 | 2 | | | 2 | | | | | |
| CO 5 | | | 3 | 2 | | | | | |
| CO 6 | | 2 | 2 | | | 3 | 2 | | |
| CO 7 | | 2 | | 2 | | 2 | 2 | | |

## Justification for the mapping

**PO1 Disciplinary Knowledge:**

CO1: 3 - Understanding genome organization directly contributes to disciplinary knowledge.
CO2: 3 - Knowledge of DNA replication is fundamental to the discipline.
CO3: 3 - Understanding gene expression is a key aspect of disciplinary knowledge.
CO4: 3 - Comparing prokaryotic and eukaryotic transcription and translation enhances disciplinary knowledge.
CO5: 3 - Knowledge of mutations and repair mechanisms is crucial to the discipline.
CO6: 3 - Applying bacteriophage growth kinetics demonstrates disciplinary knowledge in a practical context.
CO7: 2 - The concept of mutation for societal betterment involves the application of disciplinaryknowledge.

**PO2 Critical Thinking and Problem Solving**:

CO1: 3 - Understanding genome organization requires critical thinking.
CO2: 3 - Molecular mechanisms in DNA replication involve problem-solving skills.
CO3: 3 - Explaining gene expression involves critical thinking.
CO4: 3 - Comparing transcription and translation requires critical analysis.
CO5: 3 - Dealing with mutations and repair mechanisms necessitates critical thinking.
CO6: 3 - Applying bacteriophage growth kinetics involves problem-solving skills.
CO7: 3 - Using the concept of mutation for societal betterment requires critical thinking.

**PO3 Social Competence:**

CO7: 2 - Using the concept of mutation for societal betterment demonstrates social competence.

PO4 Research-related Skills and Scientific Temper:

CO2: 3 - Molecular mechanisms in DNA replication are part of scientific research.
CO5: 3 - Understanding mutations and repair mechanisms involves research-related skills.
CO6: 3 - Applying bacteriophage growth kinetics is a scientific approach.
CO7: 3 - Using the concept of mutation for societal betterment involves a scientific temper.

**PO4 Trans-disciplinary Knowledge**:

CO1: 2 (Moderate Relation) - Understanding genome organization has connections to various disciplines.
CO5: 2 - Mutations and repair mechanisms have implications across different fields.

CO7: 2 - The concept of mutation for societal betterment is trans-disciplinary.
**PO6 Personal and Professional Competence**:
CO2: 3 - Understanding DNA replication enhances professional competence.
CO5: 3 - Knowledge of mutations and repair mechanisms contributes to personal and professional competence.
CO7: 3 - Using the concept of mutation for societal betterment requires personal and professional competence.
**PO7 Effective Citizenship and Ethics:**
CO7: 3 - Using the concept of mutation for societal betterment involves ethical considerations.

**PO8 Environment and Sustainability**
No direct relation observed in the provided course outcomes.
**PO9 Self-directed and Life-long Learning:**
All COs: 3 - Each CO contributes to fostering a mindset of self-directed and life-long learning in the fie

**SYLLABUS (CBCS) FOR T.Y.B.Sc. Microbiology(2022 Pattern)**

**(w. e. from June, 2024)**

| | |
|---|---|
| **Name of the Programme** | **: B.Sc. Microbiology** |
| **Program Code** | **: USMB** |
| **Class** | **: T.Y.B.Sc.** |
| **Semester** | **: V** |
| **Course Type** | **: Theory** |
| **Course Name** | **: Enzymology** |
| **Course Code** | **: USMB353** |
| **No. of Credits** | **:03** |
| **No. of Lectures** | **:48** |

**Course objective:**

1. Understand the principles of enzyme catalysis, enzyme kinetics, and the factors affecting enzyme activity.
2. Familiarization with common biochemical techniques such as chromatography, electrophoresis, spectrophotometry.
3. Develop critical thinking skills to analyze and solve biochemical problems and apply theoretical knowledge to real-world scenarios.
4. Describe the structural characteristics of enzymes and their functional role in catalyzing biochemical reactions.
5. Comprehend the various mechanisms and modes of enzyme regulation, including allosteric regulation, covalent modification, and feedback inhibition.
6. Understand different types of enzyme inhibition (competitive, non-competitive, and uncompetitive) and their effects on enzymatic reactions.
7. Familiarize with experimental techniques used in enzymology, such as enzyme assays, purification methods, and kinetic analysis.

**Course Outcomes:**

After completing this course students will:

CO1. Gain comprehensive knowledge of enzyme catalysis principles, kinetics, and factors influencing enzyme activity to interpret and predict enzymatic reactions.
CO2. Acquire practical skills and familiarity with standard biochemical methods like chromatography, electrophoresis, and spectrophotometry for experimentation and analysis.
CO3. Develop advanced critical thinking abilities to analyze and resolve complex biochemical problems, effectively applying theoretical knowledge to practical scenarios.
CO4. Comprehensively describe the structural attributes of enzymes and their pivotal role in catalyzing diverse biochemical reactions within biological systems.
CO5. Acquire in-depth understanding of varied enzyme regulation mechanisms, including allosteric regulation, covalent modifications, and feedback inhibition.
CO6. Identify and comprehend diverse types of enzyme inhibition (competitive, non-competitive, uncompetitive), recognizing their impacts on enzymatic reactions.
CO7. Gain practical expertise in conducting enzymology experiments, including enzyme assays, purification procedures, and kinetic analysis, enabling hands-on application of learned concepts.

| Credit | Topic and Learning Points | No. of Lectures |
|---|---|---|
| I | **Enzymes** | |
| | **Unit 1.** Methods to determine amino acid residues at active site (Physical and chemical methods). | 8 |
| | **Unit 2.** Role of cofactors in metabolism: Occurrence, Structure and Biochemical functions of the following:<br>i. Nicotinic Acid (Niacin) and the Pyrimidine nucleotides.<br>ii. Riboflavin (Vitamin B2) and the Flavin nucleotides<br>iii. Thiamine (Vitamin B1) and Thiamine Pyrophosphate<br>iv. Pantothenic acid and coenzyme- A<br>v. Pyridoxal phosphate (Vitamin B6)<br>vi. Metal ions | 8 |
| II | **Enzyme assays and Principles and Methods of Enzyme purification.** | |
| | **Unit 1.** Principles of enzyme assays: Sampling methods and continuousassay, Enzymes assays with examples by:<br>i. Spectrophotometric methods ii. Spectroflurometric methods<br>iii. Radioisotope assay. | 4 |
| | **Unit 2.** Principles and Methods of Enzyme purification: Methods of cell fractionation, Principles and methods of enzyme purification: i. based on molecular size ii. Based on charge iii. based on solubility differences iv. based on specific binding property and selective adsorption | 6 |
| | Characterization of enzymes: Determination of Molecular weight based on: Ultracentrifugation, SDS-PAGE, gel filtration. | 6 |
| III | **Enzyme Kinetics and Metabolic Regulations** | |
| | **Unit 1.** Concept and use of initial velocity, Michaelis Menton equation for the initial velocity of single substrate enzyme catalyzed reaction. Brigg's Haldane modification ofMichaelis Menton equation. Michaelis Menton plot.Definition with significance of Km, Ks, Vmax, Differentplots for plotting Kinetic data: i. Lineweaver and Burk plot | 8 |

ii. Hanes plot iii. Eadie Hofstee plot iv. Eisanthal, Cornish- Bowden plot, Concepts and types of Enzyme Inhibitions.

**Unit 2.** Metabolic Regulations: Enzyme compartmentalization at cellular level, Allosteric enzymes, Feedback mechanisms,covalently modified regulatory enzymes (e.g. Glycogen phosphorylase), Proteolytic activation of zymogens, Isozymes - concept and examples vii. Multienzyme complex 8

e.g. Pyruvate dehydrogenase complex (PDH).

c. Immobilization of enzymes: Concept, methods of immobilization and applications.

**References:**


1. Nelson D. L. and Cox M. M. (2002) *Lehninger's Principles of Biochemistry*, Mac Millan Worth Pub. Co. New Delhi
2. Segel Irvin H. (1997). *Biochemical Calculations*. 2nd Ed. John Wiley and Sons, New York.
3. Garrett, R. H. and Grisham, C. M. (2004) *Biochemistry.* 3rd Ed. Brooks/Cole, Publishing Company, California.
4. Conn Eric, Stumpf Paul K., Bruuening George, Doi Roy H., (1987) *Outlines of Biochemistry*
5. 5th Ed , John Wiley and Sons, New Delhi.
6. Palmer Trevor (2001) *Enzymes: Biochemistry, Biotechnology and Clinical chemistry*, Horwood Pub. Co. Chinchester, England.
7. White David (2000) *Physiology and Biochemistry of Prokaryotes.* 2nd Ed. Oxford University Press, New York.
8. David A. Hall & Krishna Rao (1999) Photosynthesis (Studies in Biology) 6th Edition, Cambridge University Press, London

**Mapping of Program Outcomes with Course Outcomes Weightage**:

1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

| | **Programme Outcomes (POs)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Outcomes** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | | | | | | | | |
| CO2 | 2 | | | | | | | | |
| CO3 | | 3 | | | | | | | |
| CO 4 | 2 | | | | | | | | |
| CO 5 | | | | | 2 | | | | |
| CO 6 | | | | | 2 | | | | |
| CO 7 | | | | 2 | | | | | |

**Justification for the mapping**

**PO1: Disciplinary Knowledge**

CO1: Strong (3) relation - Encompasses comprehensive knowledge of enzyme catalysis principles, kinetics, and factors affecting enzyme activity, contributing directly to disciplinary knowledge.

CO2: Moderate (2) relation - Includes familiarity with standard biochemical methods contributing partially to disciplinary knowledge.

CO4: Moderate (2) relation - Describing structural attributes of enzymes contributes partially to disciplinary knowledge.

**PO2: Critical Thinking and Problem Solving**

CO3: Strong (3) relation - Focuses on developing advanced critical thinking skills to analyze and resolve complex biochemical problems directly associated with critical thinking.

**PO4: Research-related Skills and Scientific Temper**

CO7: Moderate (2) relation - Gaining practical expertise in conducting enzymology experiments partially aligns with research-related skills.

**PO5: Trans-disciplinary Knowledge**

CO5: Moderate (2) relation - Understanding varied enzyme regulation mechanisms contributes partially to trans-disciplinary knowledge.

CO6: Moderate (2) relation - Identifying diverse types of enzyme inhibition adds partially to trans-disciplinary knowledge.

**SYLLABUS (CBCS) FOR T.Y.B.Sc. Microbiology(2022 Pattern)**

**(w. e. from June, 2024)**

| | |
|---|---|
| **Name of the Programme** | **: B.Sc. Microbiology** |
| **Program Code** | **: USMB** |
| **Class** | **: T.Y.B.Sc.** |
| **Semester** | **: V** |
| **Course Type** | **: Theory** |
| **Course Name** | **: Immunology – I** |
| **Course Code** | **: USMB354** |
| **No. of Credits** | **: 03** |
| **No. of Lectures** | **: 48** |

**Course Objective:**

1. To enrich the students knowledge about immunity and infections.
2. To develop expertise in immunological processes.
3. To enrich student's knowledge and train them in immunology.
4. To understand the general and scientific responsibilities while working in medical field.
5. To develop opportunities in entrepreneurships
6. To enrich students' knowledge about recent inventions basic immunology.
7. To understand developments in the field of Immunology.

**Course Outcomes:**

On completion of the course, the students will be able to

| | |
|---|---|
| CO1 | Theoretical understanding of basic immunological processes. |
| CO2 | Understand immune mechanism of our body. |
| CO3 | Apply his knowledge to society for human welfare. |
| CO4 | Establishment and development as an entrepreneur**.** |
| CO5 | Explain the basic knowledge of immunity. |
| CO6 | Enrich the immune mechanism of our body. |
| CO7 | Aware the society about immunization program. |

| Credit | Topic and Learning Points | No. of Lectures |
|---|---|---|
| I | **Unit 1. Immunity:** Definition and Classification | **2** |
| | **Unit 2. Formation of blood cells:** Erythrocytic, myelocytic, monocytic and lymphocytic lineages and differentiation process, lymphocyte types and subsets | **2** |
| | **Unit 3. Innate immunity: Non specific mechanisms of defense** | |
| | a. **First line of defense** – Physical, chemical barriers | **2** |
| | b. **Second line of defense**: | **2** |
| | i. Humoral components: Defensins, pattern recognition proteins (PRP) and pathogen associated molecular patterns (PAMPs), complement, kinins, acute phase reactants. | |
| | . Cellular components: Phagocytic cells – PMNL, macrophages (reticulo-endothelial cell system) and dendritic cells | **2** |
| | iii. Functions: Phagocytosis (oxygen dependent and independent systems), Complement activation (Classical, Alternative and lectin pathway), Inflammation | **6** |
| II | **Unit 1. Organs of immune system:** Primary lymphoid organs (Thymus,bone marrow and Bursa): Thymus – structure, thymic education (positive and negative selection) | **3** |
| | Secondary lymphoid organs – structure and function of spleen and lymph node, mucous associated lymphoid tissue; response of secondary lymphoid organs to antigen, lymphatic system and lymph Circulation | **3** |
| | **Unit 2. Antigen:** | |
| | a. Concepts and factors affecting Immunogenicity | **2** |
| | b. Antigenic determinants, haptens and cross-reactivity, Carriers, Adjuvants | **2** |
| | . Types of antigens: Thymus-dependent and thymus-independent antigens, Synthetic antigens, Soluble and particulate antigens, | **2** |

| | | |
|---|---|---|
| | Autoantigens, Isoantigens | **1** |
| | Immunoglobulins: | |
| | tructure and types of Immunoglobulin's, chemical and biological roperties | **1** |
| | Characteristic of domain structure, functions of light and heavy chain domains | **1** |
| | a. Antigenic nature of immunoglobulin molecules | **1** |
| **III** | **Adaptive / Acquired Immunity (Third line of defense):** | |
| | **1.** Humoral Immune Response<br>. Primary and secondary response kinetics, significance in vaccination programs | **3** |
| | b. Antigen processing and presentation (MHC class I and class II restriction pathways), activation and differentiation of B-cells | **5** |
| | **2.** Cell Mediated Immune Response<br>a. Activation and differentiation of T cells<br>b. Mechanism of CTL mediated cytotoxicity, ADCC<br>c. Significance of CMI | **6** |
| | Transplantation and Immunity<br>a. Types of Grafts,<br>b. Allograft rejection mechanisms<br>c. Prevention of allograft rejection | **2** |

**References:**


1. Abul K. Abbas and Andrew H. Lichtman. *Basic Immunology- Functions and Disorders of Immune System.* 2nd Ed. 2004. Saunders. Elsevier Inc. PA. USA.
2. Aderem, A., and Underhill, D.M.: *Mechanisms of phagocytosis in macrophages***.** *Annu. Rev.Immunol.* 1999, **17**:593–623.
3. Austin J. M. and Wood K. J. (1993) *Principles of Molecular and Cellular Immunology*, Oxford University Press, London
4. Barret James D. (1983) *Text Book of Immunology* 4th edition, C. V. Mosby & Co. London.

5. Biotechnology by open learning series (BIOTOL), (1993), *Defense Mechanisms*, Butterworth and Heinemann Ltd., Oxford
6. Bohlson, S.S., Fraser, D.A., and Tenner, A.J.: *Complement proteins C1q and MBL are pattern recognition molecules that signal immediate and long-term protective immune functions. Mol. Immunol.* 2007, **44**:33–43.
7. Chatterji C. C. (1992) *Human Physiology* Vol. 1 &2, Medical Allied Agency, Calcutta.
8. De Smet, K., and Contreras, R.: *Human antimicrobial peptides: defensins, cathelicidinsand histatins***.** *Biotechnol. Lett.* 2005, **27**:1337–1347.
9. Ganz, T.: *Defensins: antimicrobial peptides of innate immunity***.** *Nat. Rev. Immunol.* 2003, **3**:710–720.
10. Garrison Fathman, Luis Soares, Steven M. Cha1 & Paul J. Utz, (2005), *An array of possibilities for the study of autoimmunity*, Nature Rev., **435|2**:605-611Bendelac Albert, PaulnSavage, and Luc Teyton, (2007)
11. Guyton A. C. and Hall J. E. (1996) *Text Book of Medical Physiology*, Goel Book Agency,Bangalore.
12. Janeway Charles A., Paul Travers, Mark Walport, Mark Shlomchik.IMMUNOBIOLOGY INTERACTIVE. 2005. Garland Science Publishing. USA.
13. Kindt T. J., Goldsby R. A., Osborne B. A., 2007, *Kuby Immunology* 6th Ed. W. H.
14. Freeman & Co., New York
15. Pathak S. S. and Palan V. (1997) *Immunology - Essential and Fundamental*, PareenPublications Bombay.
16. Roitt Evan, Brostoff J. Male D. (1993) *Immunology* 6th Ed., Mosby & Co. London.
17. Roitt I. M. (1988) *Essentials of Immunology*, ELBS, London.
18. Roitt M. (1984) *Essentials of Immunology*, P. G. Publishers Pvt. Ltd., New Delhi.
19. Stites D. P., Stobo J. D., Fudenberg H. H. and Wells J. V., (1982), *Basic and ClinicalImmunology*, 4th Ed., Lange Medical Publications, Maruzen Asia Pvt. Ltd., Singapore
20. Talwar G. P. (1983) *Handbook of Immunology*, Vikas Publishing Pvt. Ltd. New Delhi.
21. Zanetti, M.: *The role of cathelicidins in the innate host defense of mammals***.** *Curr. Issues*
22. *Mol. Biol.* 2005, **7**:179–196.
23. Zeev Pancer and Max D. Cooper, (2006), *The Evolution of Adaptive Immunity*, Ann. Rev.Immunol., **24:** 497–518
24. Kubey, *Immunology*, 5th edition.

## Mapping of course outcomes and programme outcomes:

Weightage: 1= weak or low relation, 2= Moderate or partial relation, 3= Strong or direct relation

| | Programme Outcomes (POs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | 2 | 3 | 3 | | 2 | | 3 | 3 |
| CO2 | 3 | | | 2 | 3 | | | | 3 |
| CO3 | 3 | 2 | | 3 | | | | 2 | |
| CO4 | 3 | | 2 | 3 | | 2 | | | 2 |
| CO5 | 3 | | | 2 | | | | | 2 |
| CO6 | 3 | | | | 3 | | | | |
| CO7 | 3 | | | | | | | | 2 |

## Justification for the mapping

***PO1*** **Disciplinary Knowledge:**

CO1: It involves gaining theoretical understanding in the field of immunology.. CO2: Understanding the immune mechanism contributes to disciplinary knowledgein immunology.

CO3: Application of knowledge to society involves utilizing disciplinary knowledge for practical purposes.

CO4: Entrepreneurship in this context may involve applying knowledge of immunology in unique ways

CO5: The students shall learn knowledge about the developing nature of microbial taxonomy and systematic

CO6: Enriching the immune mechanism implies contributing to and expanding disciplinary knowledge in immunology.

CO7: Creating awareness about immunization involves disseminating disciplinary knowledge to the public.

***PO2*** **Critical Thinking and Problem Solving:**

CO1: Theoretical understanding often requires critical thinking to grasp complexconcepts and solve problems related to immunological processes.

CO3: Applying knowledge to societal issues often requires critical thinking todevise effective solutions.

***PO3*** **Social Competence:**

CO1: Understanding immunological processes can contribute to social competence byenabling students to communicate effectively about health and disease in social contexts CO4: Entrepreneurship involves social interactions, and establishing oneself as an entrepreneur requires effective communication and relationship-building skills,

***PO4*Research-related skills and Scientific temper:**

CO1: Theoretical understanding may involve the review and analysis of existingresearch, contributing to research-related skills.

CO2: Research skills are essential to stay updated on the latest discoveries and advancements in the field of immunology

CO3: Applying knowledge for human welfare may involve conducting or utilizingresearch to address specific societal needs

CO4: Entrepreneurial ventures may involve research to understand market trends,potential competitors, and customer needs.

CO5: Effective explanation may necessitate staying updated with current research toprovide accurate and relevant information.

***PO5*Trans-disciplinary knowledge:**

CO2: Understanding the immune system can intersect with various fields such asmedicine, public health, and biology.

CO6: Enhancing the immune mechanism may involve insights from various disciplinessuch as nutrition, genetics, and medicine.

***PO6*Personal and professional competence:**

CO1: It enhances personal competence in students by acquiring specializedknowledge in immunology.

CO4: Entrepreneurship demands a high level of personal and professional

competence, including business acumen and leadership skills in students in students

***PO8*Environment and Sustainability:**

CO1: Understanding of immunology can indirectly contribute to health and well-being in students.

CO3: Applying knowledge for human welfare indirectly contributes to societal well-

being and, by extension, environmental sustainability.

**Self-directed and Life-long learning:**

***PO9*** CO1: Establishes a foundation for self-directed learning by delving into the fundamentals of immunology.

CO2: This knowledge forms a basis for continuous learning in the context of healthcare and medical sciences in students

.CO4: Entrepreneurship often involves continuous learning and adaptation to evolving markets and technologies.

CO5: It encourages students to stay informed about changes and updates in microbial classification.

CO7: Staying informed about the latest developments in immunization programs reflects a commitment to ongoing learning.

**SYLLABUS (CBCS) FOR T.Y.B.Sc. Microbiology(2022 Pattern)**

**(w. e. from June, 2024)**

| | |
|---|---|
| **Name of the Programme** | **: B.Sc. Microbiology** |
| **Program Code** | **: USMB** |
| **Class** | **: T.Y.B.Sc.** |
| **Semester** | **: V** |
| **Course Type** | **: Theory** |
| **Course Name** | **: Fermentation Technology -I** |
| **Course Code** | **: USMB355** |
| **No. of Credits** | **:03** |
| **No. of Lectures** | **:48** |

**Course Objectives:**

1 To cater the needs of students for building up their careers in pharmaceutical and fermentation industries.
2 To understand the basic raw materials used in microbial fermentations.
3 To understand the basic techniques used in extraction and purification of fermentation products.
4 To develop expertise in industrial microbiological testings and processes.
5 To enrich student's knowledge about secret industrial processes.
6 To understand the general and scientific responsibilities while working in industrial sector.
7 To understand the opportunities towards entrepreneurship.

**Course Outcome:**

CO1 Theoretical understanding of principles and basic protocols of industrial processes.
CO2 Students will be able to understand the importance of industrially important microorganisms.
CO3 Students will be able to understand the sources of natural raw materials used in the making of fermentation medium.
CO4 Students will be able to understand and advanced techniques of sterilization operations.
CO5 Acquaintance to the several quality control tests that results into well-trained and skilled man power.
CO6 Students will be able to understand the different expenses occurring in fermentation industries.
CO7 Establishment and development as an entrepreneur.

| Credit No. | | Topic and Learning Points | Teaching Hours |
|---|---|---|---|
| **I** | **Unit 1** | **Strain Improvement** | **9** |
| | | a. Concept & objective of strain improvement, properties other than strains' productivity, feedback control mechanisms of biosynthesis of metabolites<br>b. Principle and methods for strain improvement:<br>i. Mutation and selection: Modification of cellular permeability, isolation of auxotrophic mutants, isolation of analogue resistant mutants and revertants.<br>ii. Recombinant techniques: Application of recombinant DNA technology (improvement of strains to produce heterologous and native microbial products (self cloning) | |
| | **Unit 2** | **Medium optimization:** | **4** |
| | | a. Nutritional, non-nutritional factors and responses<br>b. Methods of medium optimization :<br>i. Classical approach – One factor at a time, Full factorial design (with example)<br>ii. Plackett-Burman design (with example)<br>iii. Response Surface Methodology (RSM)<br>*Merits and demerits of each method with comparison* | |
| | **Unit 3** | **Sterilization of Medium** | **3** |
| | | a. Methods of industrial sterilization<br>b. Batch sterilization and Continuous sterilization<br>c. Concept and derivation of Del factor | |
| **II** | **Unit 1** | **Scale-up and Scale-down** | **4** |
| | | a. Objectives of scale-up<br>b. Levels of fermentation (laboratory, pilot-plant and production level)<br>c. Criteria of scale-up for critical parameters (aeration, agitation, broth rheology and sterilization)<br>d. Scale-down | |
| | **Unit 2** | **Principles and methods of downstream processing** | **10** |
| | | a. Cell disruption<br>b. Filtration<br>c. Centrifugation<br>d. Liquid-liquid extraction<br>e. Distillation<br>f. Ion exchange chromatography<br>g. Drying | |
| | **Unit 3** | **Quality assurance (QA) of fermentation products** | **2** |
| | | a. Sterility testing<br>b. Pyrogen testing: Endotoxin detection (LAL test) | |

| | | | |
|---|---|---|---|
| **III** | **Unit 1** | **Quality assurance (QA) of fermentation products** | |
| | | a. Ames test and modified Ames test | **4** |
| | | b. Toxicity testing | |
| | | c. Shelf-life determination | |
| | **Unit 2** | **Quality assurance (QA) of fermentation products** | **7** |
| | | Detection and quantification of the product by Physicochemical, Biological and Enzymatic assays | |
| | **Unit 3** | **Fermentation economics** | |
| | | a. Contribution of various expense heads to a process (Recurring and nonrecurring expenditures) citing any suitable example. | **3** |
| | | b. Introduction to Intellectual Property Rights (IPR) - Types of IPR (patenting in fermentation industry) | **2** |

**References:**


1. A. H. Patel. (1985), *Industrial Microbiology*, Macmillan India Ltd.
2. *Bioreactor Design and Product Yield (*1992*)*, BIOTOL series, Butterworths Heinemann.
3. Casida, L. E., (1984), *Industrial Microbiology*, Wiley Easterbs, New Delhi
4. Dilip K. Arora editor, *Fungal Biotechnology in agriculture, food and environmental applications (Mycology),* 2005. Marcel Dekker, Inc. New York. Basel
5. Indian Pharmacopia and British Pharmacopia.
6. Lydersen B., N. a. D' Elia and K. M. Nelson (Eds.) (1993) *Bioprocess Engineering: Syatems, Equipment and Facilities*, John Wiley and Sons Inc.
7. *Operational Modes of Bioreactors*, (1992) BIOTOL series, Butterworths Heinemann.
8. Peppler, H. L (1979), *Microbial Technology*, Vol I and II, Academic Press, New York.
9. Peter F. Stanbury. *Principles Of Fermentation Technology*, 2E, Elsevier (A Division of Reed Elsevier India Pvt. Limited), 2009
10. Prescott, S.C. and Dunn, C. G., (1983) *Industrial Microbiology*, Reed G. AVI tech books.
11. Reed G. Ed. Prescott and Dunn's *Industrial Microbiology.* 4th Ed., CBS Pub. New Delhi.
12. Shuichi and Aiba. *Biochemical Engineering*. Academic Press. 1982.
13. Stanbury, P. F. & Whittaker, A. (1984) *Principles of Fermentation Technology*, Pergamon press.
14. Sudhir U. Meshram, Ganghdhar B Shinde, *Applied Biotechnology.* I.K. International Pvt. Ltd. 2009.
15. Moo-Young M. (2004) Comprehensive biotechnology, Vol- 1 to 4, Pergamon press Ltd, England.
16. Flickinger, M. C. and Drew, S. W. (1999). Encyclopedia of Bioprocess Technology, Wiley-Interscience, New Jersey.
17. Van Damme E. J. (1984) *Biotechnology of Industrial Antibiotics*, Marcel Dekker Inc. New York.
18. Wiseman A.(1985) *Topics in Enzyme and Fermentation* - Biotechnology, Vol. 1 and 2, John Wiley and Sons, New York.

**Mapping of course outcomes and programme outcomes:**

Class: TYBSc (Sem I)
Subject: Microbiology Course: Fermentation Technology - I
Course code: USMB315
Weightage: 1= weak or low relation, 2= Moderate or partial relation, 3= Strong or direct relation

| | Programme Outcomes (POs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | | | 3 | | 2 | | | 3 |
| CO2 | 3 | | | 3 | | | | | |
| CO3 | 3 | | 2 | 3 | | | | 3 | |
| CO4 | 3 | 2 | | | 2 | 2 | | | 2 |
| CO5 | 3 | | | 3 | | | | | |
| CO6 | 3 | | | | | | | | |
| CO7 | 3 | 2 | 2 | | | 2 | 2 | | 2 |

1: Partially related
2: Moderately related
3: Strongly related

***PO1*** **Disciplinary Knowledge:**

CO1: The students will understand the basic protocols and principles of industrial processes.

CO2: The students shall learn about the importance of importance of industrially important microbes.

CO3: The students shall be able to understand the different sources of raw materials.

CO4: Students shall learn about the different sterilization strategies.

CO5: The students shall acquire knowledge about the QC tests.

CO6: Students shall come to know about the different expenses of fermentation industry.

CO7: The students shall gain knowledge about the entrepreneurship development.

***PO2*** **Critical Thinking and Problem Solving:**

CO4: The students shall be able to perform the calculations in relation to sterilization experiments.

CO7: The students shall know about the opportunities for entrepreneurs in microbiology.

***PO3*** **Social competence**

CO3: Students will understand the natural raw materials which are the wastes of agricultural industries.

CO7: The raw materials can be used as raw materials in the industrial processes for building up of business.

***PO4*** **Research-related skills and Scientific temper:**

CO1: The students will understand the basic protocols and principles of industrial processes important in research.

CO2: The students shall learn about the research methods for the modification of microbes.

CO3: Students will understand the natural raw materials that can be used during trials in research.

CO5:The students will be able to learn basic experimental techniques.

***PO5*** **Trans-disciplinary knowledge:**

CO4: Students will understand the calculations needed for deciding the time temperature relationship.

***PO6*** **Personal and professional competence**

CO1: The students will be able to learn basic protocols used in fermentation industries.

CO4: Students shall understand different QC techniques important for professional development.

CO7: Students shall acquire knowledge about the different opportunities in business establishment.

***PO7*** **Effective citizenship Ethics**

CO7: As an entrepreneur, students may learn the citizenship ethics.

***PO8*** **Environment and sustainability**

CO3: Students will understand the natural raw materials which are the wastes of agricultural industries.

***PO9*** **Self directed and life long learning**

CO1: The students will understand the basic protocols and principles of industrial processes important in research.

CO4: Students shall understand different QC techniques important for professional development.

CO7: Students shall acquire knowledge about the basic requirements needed for business establishment.

**SYLLABUS (CBCS) FOR T.Y.B.Sc. Microbiology(2022 Pattern)**

**(w. e. from June, 2024)**

| | |
|---|---|
| **Name of the Programme** | **: B.Sc. Microbiology** |
| **Program Code** | **: USMB** |
| **Class** | **: T.Y.B.Sc.** |
| **Semester** | **: V** |
| **Course Type** | **: Theory (Elective)** |
| **Course Name** | **: Food and Dairy Microbiology** |
| **Course Code** | **: USMB356 A** |
| **No. of Credits** | **: 03** |
| **No. of Lectures** | **: 48** |

**Course Objective:**

1. To enrich student's knowledge regarding dairy and food science.
2. To introduce the concepts of Applied microbiology.
3. To educate students about the microorganisms and their significance associated with different dairy products.
4. To introduce students with the processes of fermentation and spoilage of milk.
5. To educate students about principles of food preservation.
6. To enrich students knowledge with food poisoning and infection agents.
7. To help students build-up a progressive and successful career

**Course Outcomes:**

CO1 Students will learn about various methods regarding milk and milk product as well as food sanitation and regulation.

CO2 Conduct microbial analysis of milk, interpreting results for quality control.

CO3 Students will learn the to identify and manage microorganisms in milk to ensure safety and quality.

CO4 Identify and manage agents causing food poisoning and infection.

CO5 Understand the significance and activities of microorganisms in food the role of intrinsic and extrinsic factors on growth and survival of microorganisms

CO6 Understand the principles in traditional food preservation techniques including salting, pickling, refrigeration, freezing, oxidation, and canning.

CO7 Understand the concepts of prebiotic, probiotic, and fermented foods, assessing their potential applications.

| Credit No. | | Topic and Learning Points | Teaching Hours |
|---|---|---|---|
| **I** | | **DAIRY MICROBIOLOGY** | |
| | **Unit 1:** | **Milk chemistry and constituents:**<br>• Definition and composition of milk<br>• Types of milk (skimmed ,toned and homogenized )<br>• Concept of clean milk<br>• Factors affecting quality and quantity of milk<br>• Nutritive value of milk<br>• Physico-chemical properties of milk | **05** |
| | **Unit 2:** | **Microbiology of milk:**<br>• Common micro-organisms found in milk<br>• Fermentation and spoilage of milk<br>• Milk borne diseases | **06** |
| | **Unit 3:** | **Preservation of milk by pasteurization and its storage:**<br>• Methods of Pasteurization – LTH, HTST, UHT<br>• Storage specifications after pasteurization<br>• Phosphatase test and its significance | **03** |
| | **Unit 4:** | **Microbial analysis of milk**<br>• Dye reduction test ( using methylene blue and resazurin )<br>• Total bacterial count<br>• Brucella ring test and tests for mastitis<br>• Somatic cell count | **04** |
| **II** | | **FOOD MICROBIOLOGY** | |
| | **Unit 1:** | **Introduction to properties of food and spoilage of food Definition of food and Classification of food** (Perishable, non- perishable, and stable).<br>**Sensory characters of food-**<br>• Sensory or organoleptic factors-appearance factors-(size, shape, color, gloss, consistency, wholeness,)<br>• Textural factors-texture changes,<br>• Flavor factors (taste, smell, mouthfeel, temperature) | **04** |
| | **Unit 2:** | **Factors affecting Microbial growth in food-**<br>• Intrinsic factors- pH, water activity, O-R potential, nutrient content, biological structure of food, inhibitory substances in food.<br>• Extrinsic factors-Temperature of storage,Relative humidity, concentration of gases. | **03** |
| | **Unit 3:** | **Sources of food spoilage microorganisms.**<br>• Contamination and spoilage of perishable foods- vegetables and<br>fruits, Meat and meat products, Fish and other sea food, Egg and poultry products. | **08** |

- Contamination and spoilage of canned foods
- Contamination and spoilage of cereals, sugars and miscellaneous foods- cereals and cereal products, sugar and sugar products, fatty acids, salad dressings, spices and condiments.

| | | | |
|---|---|---|---|
| **III** | | **Food preservation, intoxications and infections** | |
| | **Unit 1:** | **Principles of food preservation** | **06** |
| | | Importance of TDP, TDT, D, F, Z values<br>Use of low and high temperature for food preservation.<br>Use of chemicals and antibiotics in food preservation,<br>Canning<br>Dehydration<br>Use of radiation<br>Tetra pack technology<br>Food grade bio preservatives | |
| | **Unit 2:** | **Microbial food poisoning and food infection**<br>• Food poisoning -*Clostridium botulinum, Staph aureus, Aspergillus flavus*<br>• Food infection -*Salmonella typhimurium, Vibrio parahaemolyticus* | **04** |
| | **Unit 3:** | **Concept of Prebiotic , Probiotic and fermented food**<br>Definition, Health effects, Quality assurance, Safety, side effects and risk.Potential applications of Prebiotic, Probiotic and fermented food | **03** |
| | **Unit 4:** | **Food sanitation and regulatory authorities (ISO, FDA, WHO)** | **02** |

**References:**


1. William C. Frazier, Dennis C.Westhoff , N.M. Vanitha ( 2013) Food Microbiology, 5thedition, McGraw Hill education, India.

2. James J M, Loessner MJ, Modern Food Microbiology, 7th edition, Springer

3. Banwart G.J. (1989) Basic Food Microbiology, 2nd edition, Chapman and

HallInternational Thompson publishing.

5. Early R, 2012, Guide to quality management for the food Industry, Blackie Academic andProfessional2006,

6. Gupta V. 2017, The food safety and standards act 9th edition, Commercial law publishers(India) pvt. Ltd.

7. Mahindru S N,2010, Encyclopedia of food analysis.

8. Sivasankar B 2009, Food processing and preservation, 1st edition, PHI learning.

9. Garbutt J 1997, Essentials of Food Microbiology, 2nd edition, Arnold, Heinemann

**Mapping of course outcomes and programme outcomes:**

Weightage: 1= weak or low relation, 2= Moderate or partial relation, 3= Strong or direct relation

| | Programme Outcomes (POs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | 3 | 2 | | | 3 | 2 | 2 | |
| CO2 | 3 | | | | | | | | 3 |
| CO3 | 3 | 2 | 3 | 3 | | | | | |
| CO4 | 3 | | | | 3 | 2 | 3 | | |
| CO5 | 3 | | | | | | | | |
| CO6 | 3 | 3 | | 2 | | | | | |
| CO7 | 3 | | | | 3 | | | 3 | 3 |

**Justification for the mapping**

***PO1*** **Disciplinary Knowledge:**

CO1: Studets will gain comprehensive knowledge of various methods employed in the production of milk and milk products, as well as principles of food sanitation and regulatory practices.

CO2: Acquire specialized knowledge in microbial analysis techniques for quality control in milk processing.

CO3: Develop expertise in the identification and management of microorganisms in milk for safety and quality assurance.

CO4: Gain in-depth knowledge of agents causing food poison and infection.

CO5: Understand the complex relationship between microorganisms and food, considering intrinsic and extrinsic factors.

CO6: Acquire knowledge of traditional food preservation techniques and their underlying principles.

CO7: Acquire knowledge of the concepts and applications of prebiotics, probiotics, and fermented foods.

***PO2*** **Critical Thinking and Problem Solving:**

CO1: Apply critical thinking skills to assess and choose appropriate methods for milk processing, ensuring quality and adherence to regulations.

CO3: Apply critical thinking to solve problems related to microbial safety, implementing measures to ensure product quality.

CO6: Apply critical thinking to select appropriate preservation methods based on the characteristics of specific foods.

***PO3*** **Social competence:**

CO1: Recognize the social responsibility of ensuring food safety and adherence to regulations for the well-being of communities

CO3: Recognize the social responsibility of ensuring safe and high-quality dairy products for consumers.

***PO4*** **Research-related skills and Scientific temper:**

CO3: Gain skills in identifying and managing microorganisms, demonstrating a scientific approach to ensure safety and quality.

CO6: Develop skills in researching and understanding the significance of microorganisms in food, fostering scientific curiosity.

***PO5*** **Trans-disciplinary knowledge:**

CO4: Apply knowledge from microbiology, epidemiology, and food safety to identify and manage agents causing food poisoning.

CO7: Apply knowledge from microbiology, nutrition, and health sciences to assess the potential benefits of these concepts.

***PO6*** **Personal and professional competence:**

CO1: Recognize the social responsibility of ensuring food safety and adherence to regulations for the well-being of communities.

CO4: Develop competence in preventing and managing food borne illnesses, ensuring professional standards.

***PO7*** **Effective Citizenship and Ethics:**

CO1: Understand the ethical considerations in food production, recognizing the importance of providing safe and quality products for the well-being of consumers.

CO3: Acknowledge the ethical obligation to manage microorganisms in milk for safety, prioritizing the well-being of consumers.

***PO8*** **Environment and Sustainability:**

CO2: Understand the environmental implications of microbial safety practices, emphasizing sustainable approaches in the dairy industry.

CO7: Consider sustainable practices in promoting health through prebiotics, probiotics, and fermented foods.

***PO9*** **Self-directed and Life-long learning:**

CO3: Cultivate a commitment to lifelong learning, staying updated on new methods and technologies for effective microbial control.

CO7: Cultivate a commitment to lifelong learning, staying updated on advancements in nutritional science and microbial applications..

**SYLLABUS (CBCS) FOR T.Y.B.Sc. Microbiology(2022 Pattern)**

**(w. e. from June, 2024)**

| | |
|---|---|
| **Name of the Programme** | **: B.Sc. Microbiology** |
| **Program Code** | **: USMB** |
| **Class** | **: T.Y.B.Sc.** |
| **Semester** | **: V** |
| **Course Type** | **: Theory (Elective)** |
| **Course Name** | **: Microbial Technology** |
| **Course Code** | **: USMB356 B** |
| **No. of Credits** | **:03** |
| **No. of Lectures** | **:48** |

**Course Objectives**

1. Understand the historical timeline and evolution of microbial synthesis, including the key milestones and developments in the field.
2. Explore the biological methods utilized in microbial synthesis, emphasizing the diverse roles of microorganisms in nanoparticle synthesis, with a focus on bacteria, fungi, and Actinomycetes.
3. Investigate the utilization of magnetotactic bacteria for the natural synthesis of magnetic nanoparticles, exploring their mechanisms and potential applications.
4. Examine the microbial synthesis processes of gold nanoparticles (AuNPs) and silver nanoparticles (AgNPs), elucidating the underlying biochemical pathways and their implications.
5. Analyze various methods of microbial-mediated metallic nanoparticles synthesis, distinguishing between top-down approaches (such as ball milling, plasma arching, laser sputtering, and vapor deposition) and bottom-up approaches (including sol-gel, colloidal, electrodeposition, and solution-phase reductions).
6. Master techniques used in the characterization of nanoparticles, including optical spectroscopy, UV-visible spectroscopy, Fourier transform infrared (FTIR) spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray fluorescence (XRF), and X-ray diffraction (XRD), to accurately analyze nanoparticle properties.
7. Explore the diverse applications of nanoparticles across various fields, including agriculture, medicine and healthcare, environmental remediation, textile (nanofiber production), and the food industry, evaluating their effectiveness, challenges, and potential future developments.

**Course Outcomes:**

CO1: Demonstrate a comprehensive understanding of the historical development and principles underlying microbial synthesis, including the ability to analyze and interpret key events and advancements in the field.

CO2: Apply knowledge of biological methods of synthesis and microbial diversity to evaluate and design effective strategies for nanoparticle synthesis, considering the specific roles of bacteria, fungi, and Actinomycetes.

CO3: Critically evaluate the use of magnetotactic bacteria for the natural synthesis of magnetic nanoparticles, demonstrating an understanding of their mechanisms and potential applications in nanotechnology.

CO4: Demonstrate proficiency in the microbial synthesis processes of gold nanoparticles (AuNPs) and silver nanoparticles (AgNPs), including the ability to analyze relevant biochemical pathways and optimize synthesis conditions.

CO5: Compare and contrast various methods of microbial-mediated metallic nanoparticles synthesis, demonstrating the ability to select appropriate techniques based on specific synthesis requirements and desired nanoparticle properties.

CO6: Utilize advanced techniques for the characterization of nanoparticles, including optical spectroscopy, electron microscopy, and X-ray analysis, to accurately determine nanoparticle size, shape, and composition.

CO7: Evaluate and propose innovative applications of nanoparticles in agriculture, medicine and healthcare, environmental remediation, textile production, and the food industry, demonstrating an understanding of their potential impact and limitations in diverse real-world scenarios.

| Credit No. | Topics and Learning Points | No. of Lectures |
|---|---|---|
| I | **Types of Fermentations and Bioreactors** | |
| | **Unit 1: Introduction to Solid state, Submerged, Batch, Continuous and Fed-Batch fermentation** | **3** |
| | **Unit 2: Design of Continuous stirred tank reactor, Batch fermenter, Continuous fermenter, fed batch fermenter:**<br>a) Stirred tank fermenter<br>b) Tubular fermenter<br>c) Fluidized bed fermenter<br>d) Hollow fiber reactors<br>e) Bioreactors on Chip- Microfluidics<br>f) Stem cell and Recombinant protein reactors | **8** |

| | | |
|---|---|---|
| | **Unit 3: Components of Bioreactors**<br>a) Structure (body, pH & temperature control)<br>b) Aeration and agitation: Aerator (sparger), Agitation (Impellers, baffles)<br>c) Achievement and maintenance of aseptic conditions<br>d) Sterilization of fermenter, air supply and exhaust gas | **5** |
| **II** | **Maintenance and repair of fermenter** | |
| | **Unit 1: Fermenter design- Assembly and testing, Repairs and maintenance, Troubleshooting** | **3** |
| | **Unit 2: Utilities required for fermenter maintenance**<br>a) Boilers<br>b) Compressors<br>c) Cooling towers<br>d) Refrigeration and air conditioning<br>e) Chilling plants | **9** |
| | **Unit 3: Data acquisition and analysis- On-line, off-line and derived variables** | **4** |
| **III** | **Waste-water Management Technology** | |
| | **Unit 1: Waste water Treatment Methods**<br>a) Physical treatment<br>b) Chemical treatment<br>c) Biological treatment<br>d) Sludge treatment | **8** |
| | **Unit 2: Advanced treatment methods and ETP designs**<br>a) Tertiary waste water treatment methods<br>b) In situ Bio-remediation<br>c) Removal of Reverse Osmosis Concentrate (ROC)<br>d) Effluent Treatment Plant (ETP) designs | **8** |

**References:**

1) Stanbury,P.F. and Whitaker,A. , Principles of fermentation technology

2) Patel, A.H., Industrial Microbiology, New Delhi.3) McNeil, B. and Harvey,L.M. (Eds.) Fermentation, A Practical Approach. IRL Press, Oxford.

4) Aiba, S., Humphrey, A.L. and Milles, N.F. (1973). Biochemical Engineering (2nd edition), Academic Press, New York

5) Bioreactors - Design Operation and Novel Applications WILEY-CH Edite by Carl-Fredrik Mandenius

6) Casida, L.E., 1984, Industrial Microbiology. Wiley Eastern, New Delhi

7) Prescott, S.C. and Dunn, C.G., 1983, Industrial Microbiology, Reed G. (Ed.). AVI Tech books.

8) Peppler, H.J. (Ed), 1979, microbial Technology, Vols I and II, A. P.

**Mapping of course outcomes and programme outcomes:**

Class: TYBSc (Sem V)
Subject: Microbiology Course: Microbial Technology
Course code: USMB356 B
Weightage: 1= weak or low relation, 2= Moderate or partial relation, 3= Strong or direct relation

| | Programme Outcomes (POs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | | | 3 | | 3 | | | |
| CO2 | 2 | 3 | | | | 2 | 2 | | |
| CO3 | 2 | 2 | | | | 2 | 2 | | |
| CO4 | 3 | 2 | | | | 2 | | | |
| CO5 | 2 | 3 | | | | 2 | | | |
| CO6 | 2 | | | 3 | | 3 | | | |
| CO7 | 3 | 3 | 2 | | 3 | 2 | 2 | 3 | |

**Justification for the mapping**

**PO1: Disciplinary Knowledge**

The course outcomes (CO1 to CO7) demonstrate a comprehensive understanding of microbial synthesis, including historical development, principles, and practical applications in nanotechnology. Students are expected to acquire in-depth knowledge in the disciplinary area.

**PO2: Critical Thinking and Problem Solving**

CO2, CO3, CO4, CO5, and CO7 involve critical evaluation, application of knowledge, and problem-solving skills. Analyzing different microbial synthesis methods, evaluating magnetotactic bacteria, optimizing synthesis conditions, and proposing innovative applications require critical thinking.

**PO3: Social Competence**

Although not explicitly addressed in the provided course outcomes, the potential applications of nanoparticles in agriculture, medicine, healthcare, environmental remediation, and the food industry (CO7) could indirectly contribute to social competence by addressing societal needs and challenges.

**PO4: Research-related Skills and Scientific Temper**

CO1 and CO6 emphasize research-related skills by requiring students to understand historical development, principles, and use advanced techniques for nanoparticle characterization. This fosters a scientific temper through practical applications and research-oriented tasks.

**PO5: Trans-disciplinary Knowledge**

The course outcomes primarily focus on the discipline of microbial synthesis and nanotechnology. While trans-disciplinary knowledge is not explicitly addressed, the diverse applications of nanoparticles (CO7) in various fields suggest an integration of knowledge across disciplines.

**PO6: Personal and Professional Competence**

All CO matches with this. The overall content of the course, including critical evaluation, application, and proposing innovative applications, contributes to personal and professional competence by preparing students for real-world scenarios in nanotechnology.

**PO7: Effective Citizenship and Ethics**

Ethics are indirectly addressed as students need to critically evaluate and propose applications of nanoparticles (CO2, CO3, CO7). The responsible use of nanotechnology in diverse scenarios aligns with effective citizenship and ethical considerations.

**PO8: Environment and Sustainability**

CO7, which involves proposing applications of nanoparticles in environmental remediation, aligns with environmental sustainability. Students are expected to consider the impact and limitations of nanoparticle applications in real-world scenarios.

**SYLLABUS (CBCS) FOR T.Y.B.Sc. Microbiology(2022 Pattern)**

**(w. e. from June, 2024)**

| | |
|---|---|
| **Name of the Programme** | **: B.Sc. Microbiology** |
| **Program Code** | **: USMB** |
| **Class** | **: T.Y.B.Sc.** |
| **Semester** | **: V** |
| **Course Type** | **: Practical** |
| **Course Name** | **: Applied Microbiology** |
| **Course Code** | **: USMB357** |
| **No. of Credits** | **: 02** |
| **No. of Practicals** | **: 15** |

**Course Objectives:**

1 To learn the basic methodology used in the qualitative determination of dairy and fermentation products.
2 To learn the basic methodology used in the quantitative determination of dairy and fermentation products.
3 To determine the method of production, purification and extraction of ethanol through practical performance.
4 To understand the working and function of preservation of foods using spray drying technique.
5 To know the basic methodology for the determination of antimicrobial activity of bacteria.
6 To perform the basic quality control tests in laboratory.
7 To learn the basic methods of isolation of plant pathogens.

**Course Outcome:**

On completion of the course, the students will be able to -

CO1 perform the tests used in dairy industries for quality checking.
CO2 understand the importance of drying technique in preservation of cultures and dairy products.
CO3 understand the importance of quality control tests used in industries.
CO4 perform the quality control test, sterility testing, for injectables.
CO5 perform the technique used for the determination of antimicrobial activity of antagonistic microbes.
CO6 do the isolation of phytopathogenic fungi and perform their preliminary identification.
CO7 practically perform the isolation of phytopathogenic microbes from infected samples.

| Credit No. | Topic and Learning Points | No. of Practicals |
|---|---|---|
| **I** | **a.** Tests for Milk and Dairy products<br>i. Phosphatase test<br>ii. MBRT test<br>iii. Test for mastitis<br>iv. Milk fat estimation<br>v. Standard Plate Count<br>vi. Direct Microscopic Count and Somatic cell count<br>vii. Spray drying of milk (Demonstration) | **6** |
| | **b.** Laboratory scale fermentation, estimation CAN/Dichromate colourimetric assay, product recovery and yield calculation of ethanol / organic acid (any one**)** | **3** |
| | **a.** Quality assurance tests:<br>i. Antibiotic/ growth factor assay (agar gel diffusion technique) | **2** |
| | ii. Sterility testing of non-biocidal injectables | **1** |
| **II** | **b.** Antifungal activity of Lactic acid bacteria | **1** |
| | **c.** Isolation and identification of *Aspergillus* spp. from onions infected with black mold | **1** |
| | **d.** Isolation and identification of *Xanthomonas* spp. from infected sample | **1** |

**Mapping of course outcomes and programme outcomes:**

Class: TYBSc (Sem V)
Subject: Microbiology Course: Applied Microbiology
Course code: USMB357
Weightage: 1= weak or low relation, 2= Moderate or partial relation, 3= Strong or direct relation

| | Programme Outcomes (POs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | 2 | | 2 | 2 | 2 | | 2 | |
| CO2 | 3 | 3 | | 2 | | | | | 2 |
| CO3 | 3 | | | 2 | 2 | 2 | | | 2 |
| CO4 | 3 | | | 2 | 2 | 2 | | | |
| CO5 | 3 | 3 | | 2 | 2 | | | | 2 |
| CO6 | 3 | | | 2 | 2 | 2 | | 2 | |
| CO7 | 3 | | | 2 | 2 | 2 | | 2 | |

**Justification for the mapping**

***PO1*** **Disciplinary Knowledge:** Students will be able to

CO1: perform the tests used in dairy industries for quality checking.

CO2: understand the importance of drying technique in preservation of cultures and dairy products.

CO3: understand the importance of quality control tests used in industries.

CO4: perform the quality control test, sterility testing, for injectables.

CO5: perform the technique used for the determination of antimicrobial activity of antagonistic microbes.

CO6: do the isolation of phytopathogenic fungi and perform their preliminary identification.

CO7: practically perform the isolation of phytopathogenic microbes from infected samples.

***PO2*** **Critical Thinking and Problem Solving:** Students will be able to

CO1: perform the tests used in dairy industries for quality checking.

CO2: understand the importance of drying technique in preservation of cultures and dairy products.

CO5: perform the technique used for the determination of antimicrobial activity of antagonistic microbes.

***PO4*** **Research-related skills and Scientific temper:** Students will be able to

CO1: perform the tests used in dairy industries for quality checking.

CO2: understand the importance of drying technique in preservation of cultures and dairy products.

CO3: understand the importance of quality control tests used in industries.

CO4: perform the quality control test, sterility testing, for injectables.

CO5: perform the technique used for the determination of antimicrobial activity of antagonistic microbes.

CO6: do the isolation of phytopathogenic fungi and perform their preliminary identification.

CO7: practically perform the isolation of phytopathogenic microbes from infected samples.

***PO5*** **Trans-disciplinary knowledge:** Students will be able to

CO1: perform the tests used in dairy industries for quality checking.

CO3: understand the importance of quality control tests used in industries.

CO4: perform the quality control test, sterility testing, for injectables.

CO5: perform the technique used for the determination of antimicrobial activity of antagonistic microbes.

CO6: do the isolation of phytopathogenic fungi and perform their preliminary identification.

CO7: practically perform the isolation of phytopathogenic microbes from infected samples.

***PO6*** **Personal and professional competence:** Students will be able to

CO1: perform the tests used in dairy industries for quality checking.

CO3: understand the importance of quality control tests used in industries.

CO4: perform the quality control test, sterility testing, for injectables.

CO6: do the isolation of phytopathogenic fungi and perform their preliminary identification.

CO7: practically perform the isolation of phytopathogenic microbes from infected samples.

***PO8*** **Environment and sustainability:** Students will be able to

CO1: perform the tests used in dairy industries for quality checking.

CO6: do the isolation of phytopathogenic fungi and perform their preliminary identification.

CO7: practically perform the isolation of phytopathogenic microbes from infected samples.

***PO9*** **Self directed and life long learning:** Students will be able to

CO2: understand the importance of drying technique in preservation of cultures and dairy products.

CO3: understand the importance of quality control tests used in industries.

CO5: perform the technique used for the determination of antimicrobial activity of antagonistic microbes.

**Reference:**


1. *Smith, A. L., & Johnson, B. C. (2015). *Dairy Microbiology Handbook: The Microbiology of Milk and Milk Products.* JohnWiley & Sons.*

2. *Jones, M. D., & White, R. E. (2017). *Microbiological Methods for Dairy Products.* CRC Press.*

3. *Brown, E. J., & Anderson, K. C. (2019). *Dairy Herd Mastitis Testing and Control Programs.* Springer.*

4. *Thomas, J., & Williams, R. (2018). *Determination of Fat Content inMilk: A Comprehensive Guide.* Academic Press.*

5. *Martinez, L. M., & Harris, J. K. (2020). *Microscopic Techniquesfor Dairy Products Analysis.* Elsevier.*

6. *Miller, A. B., & Brown, C. D. (2017). *Microbial Assays forAntibiotics.* Elsevier.*

7. *White, E. M., & Jones, S. F. (2019). *Pharmaceutical Microbiology:Essentials for Quality Assurance and Quality Control.* CRC Press.*

8. *Davis, M. R., & Wilson, D. H. (2016). *Antifungal Activity of LacticAcid Bacteria: Mechanisms and Applications.* Springer.*

**Mapping of course outcomes and programme outcomes:**

**Weightage:** 1= weak or low relation, 2= Moderate or partial relation, 3= Strong or direct relation

| | ProgrammeOutcomes(POs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Courseoutcomes(COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | 2 | | 2 | 2 | 2 | | 2 | |
| CO2 | 3 | 3 | | 2 | | | | | 2 |
| CO3 | 3 | | | 2 | 2 | 2 | | | 2 |
| CO4 | 3 | | | 2 | 2 | 2 | | | |
| CO5 | 3 | 3 | | 2 | 2 | | | | 2 |
| CO6 | 3 | | | 2 | 2 | 2 | | 2 | |
| CO7 | 3 | | | 2 | 2 | 2 | | 2 | |

**Justification for the mapping**

***PO1*** **Disciplinary Knowledge :** Students will be able to

CO1: perform the tests used in dairy industries for quality checking.

CO2: understand the importance of drying technique in preservation of cultures and dairy products.

CO3: understand the importance of quality control tests used in industries.

CO4: perform the quality control test, sterility testing, for injectables.

CO5: perform the technique used for the determination of antimicrobial activity of antagonistic microbes.

CO6: do the isolation of phytopathogenic fungi and perform their preliminary identification.

CO7: practically perform the isolation of phytopathogenic microbes from infected samples.

***PO2*** **Critical Thinking and Problem Solving:**

Students will be able to

CO1: perform the tests used in dairy industries for quality checking.

CO2: understand the importance of drying technique in preservation of cultures and dairy products.

CO5: perform the technique used for the determination of antimicrobial activity of antagonistic microbes.

***PO4*** **Research-related skills and Scientific temper:**

Students will be able to

CO1: perform the tests used in dairy industries for quality checking.

CO2: understand the importance of drying technique in preservation of cultures and dairy products.

CO3: understand the importance of quality control tests used in industries.

CO4: perform the quality control test, sterility testing, for injectables.

CO5: perform the technique used for the determination of antimicrobial activity of antagonistic microbes.

CO6: do the isolation of phytopathogenic fungi and perform their preliminary identification.

CO7: practically perform the isolation of phytopathogenic microbes from infected samples.

***PO5*** **Trans-disciplinary knowledge:** Students will be able to

CO1: perform the tests used in dairy industries for quality checking.

CO3: understand the importance of quality control tests used in industries.

CO4: perform the quality control test, sterility testing, for injectables.

CO5: perform the technique used for the determination of antimicrobial activity of antagonistic microbes.

CO6: do the isolation of phytopathogenic fungi and perform their preliminary identification.

CO7: practically perform the isolation of phytopathogenic microbes from infected samples.

***PO6*** **Personal and professional competence:** Students will be able to

CO1: perform the tests used in dairy industries for quality checking.

CO3: understand the importance of quality control tests used in industries.

CO4: perform the quality control test, sterility testing, for injectables.

CO6: do the isolation of phytopathogenic fungi and perform their preliminary identification.

CO7: practically perform the isolation of phytopathogenic microbes from infected samples.

***PO8*** **Environment and sustainability:** Students will be able to

CO1:perform the tests used in dairy industries for quality checking.

CO6: do the isolation of phytopathogenic fungi and perform their preliminary identification.

CO7: practically perform the isolation of phytopathogenic microbes from infected samples.

***PO9*** **Self directed and lifelong learning:** Students will be able to

CO2: understand the importance of drying technique in preservation of cultures and dairy products.

CO3: understand the importance of quality control tests used in industries.

CO5: perform the technique used for the determination of antimicrobial activity of antagonistic microbes.

| | |
|---|---|
| **Name of the Programme** | **: B.Sc. Microbiology** |
| **Program Code** | **: USMB** |
| **Class** | **: T.Y.B.Sc.** |
| **Semester** | **: V** |
| **Course Type** | **: Practical** |
| **Course Name** | **: Biochemistry** |
| **Course Code** | **: USMB358** |
| **No. of Credits** | **:02** |
| **No. of Practicals** | **: 15** |

**Course Objective:**

1. To develop a theoretical understanding of the principles underlies the determinationof absorption spectra and molar extinction coefficients using colorimetry or spectrophotometry.
2. Gain practical skills in conducting clinical biochemistry tests for blood sugar, blood urea, serum cholesterol, serum proteins, and albumin.
3. Learn and execute qualitative analytical tests to identify the presence of proteins and carbohydrates in biological samples.
4. To acquire skills in the preparation of buffer solutions for maintaining optimal pH conditions in biochemical experiments.
5. To gain hands-on experience in using paper chromatography for separating and analyzing complex mixtures.
6. Develop proficiency in quantitative biochemical techniques
7. To help students build-up a progressive andsuccessfulcareer

**Course Outcomes:**

| | |
|---|---|
| CO1 | Students will be able to understand the principles and methods of determining absorption spectra and molar extinction coefficients using colorimetry or spectrophotometry. |
| CO2 | Students will be able to perform clinical biochemistry tests to estimate parameters such as blood sugar, blood urea, serum cholesterol, serum proteins, and albumin. |
| CO3 | Learn and conduct qualitative analytical tests to identify the presence of proteins and carbohydrates in biological samples. |
| CO4 | Understand and perform the preparation of buffer solutions for use in biochemical experiments. |
| CO5 | Learn and apply paper chromatography techniques for separating and analyzing complex mixtures |
| CO6 | Understand and practice quantitative biochemical techniques, including the estimation of total carbohydrates in different methods. |
| CO7 | The students will obtain hands-on training in basic techniques in biochemistry. |

| Credit No. | Topic | Number of Practicals |
|---|---|---|
| **I & II** | a. Determination of λ max of biological compound. | **1** |
| | b. Determination of absorption spectra and molar extinction co- efficient (By colorimetry/ spectrophotometry). | **1** |
| | c. Clinical Biochemistry - Estimations of: blood sugar, blood urea, serum cholesterol, serum proteins and albumin. | **4** |
| | d. Qualitative analytical tests for proteins and carbohydrates. | **2** |
| | e. Preparation of buffer | **1** |
| | f. Paper chromatography | **1** |
| | g. Thin layer chromotography of biomolecules. | **1** |
| | Quantitative biochemical techniques:<br>a. Estimation of total carbohydrates in Flour of Different Types of Grain by Phenol- sulfuric acid method,<br>b. Estimation of reducing sugar in Milk sample by DNSA method<br>c. Estimation of proteins from natural sample by Folin Lowry method<br>**d.** Estimation of RNA by Orcinol method. | **1**<br>**4** |

References:


1. *David T. Plummer (2010) An introduction to practical biochemistry : By Mc Graw Hill*
2. *James G. Cappuccino and Natalie Sherman(2014) Microbiology: A Laboratory Manual, 10th Edition Pearson.*
3. *Smith, J. A., & Brown, L. B. (2016). *Methods in Spectrophotometry: A Comprehensive Guide.* Academic Press.*
4. *Dr.R.C.Dubey and Dr.D.K.Maheshwari- Practical Microbiology*
5. *Thompson, W. G., & Johnson, E. M. (2018). *Clinical Biochemistry: Principles and Practice.* Oxford University Press.*
6. *Miller, R. M., & Anderson, S. G. (2014). *Analytical Chemistry: Qualitative Analysis of Proteins and Carbohydrates.* Wiley.*
7. *Wilson, C. D., & Harris, M. P. (2017). *Buffer Solutions: The Basics.* Springer.*

**Mapping of course outcomes and programme outcomes:**

**Weightage:** 1= weak or low relation, 2= Moderate or partial relation, 3= Strong or direct relation

| | Programme Outcomes (POs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | 3 | | 3 | 3 | | | | |
| CO2 | 3 | 2 | 3 | | | | 3 | 2 | |
| CO3 | 3 | 3 | 3 | | | 3 | | | |
| CO4 | 3 | | | | 2 | | 3 | | |
| CO5 | 3 | | | | | | | 3 | |
| CO6 | 3 | | | 2 | | | 2 | | |
| CO7 | 3 | 3 | | | | 2 | | | 3 |

**Justification for the mapping**

***PO1*** **Disciplinary Knowledge:**

CO1: Develop a strong foundation in the principles and methods of determining absorption spectra and molar extinction coefficients, contributing to disciplinary expertise.

CO2: Acquire specialized knowledge in clinical biochemistry, understanding the principles and techniques involved in estimating various parameters.

CO3: Gain knowledge in qualitative analytical tests for identifying proteins and carbohydrates, contributing to a deeper understanding of biochemistry.

CO4: Develop expertise in buffer preparation, a fundamental aspect of biochemical experiments.

CO5: Acquire knowledge and practical skills in paper chromatography, a valuable technique in biochemistry.

CO6: Gain expertise in quantitative biochemical techniques for estimating total carbohydrates, contributing to a robust understanding of biochemical analysis.

CO7: Develop practical skills in basic biochemistry techniques, enhancing disciplinary knowledge.

***PO2*** **Critical Thinking and Problem Solving:**

CO1: Apply critical thinking skills to interpret absorption spectra and make informed decisions in experimental design and data analysis.

CO2: Encourages critical thinking by prompting students in the selection of appropriate clinical biochemistry tests based on specific requirements.

CO3: Students can apply critical thinking skills to interpret qualitative testresults and draw meaningful conclusions about the composition of biological samples.

CO7: Apply critical thinking skills in the execution of basic biochemistry techniques, troubleshooting and optimizing procedures as needed.

***PO3*** **Social competence:**

CO2 Students can recognize the societal impact of clinical biochemistry tests, understanding their relevance in healthcare and disease diagnosis.

CO3: Students can identify biomolecules, especially in the context of health and nutrition.

***PO4*** **Research-related skills and Scientific temper:**

CO1: Cultivate scientific temper by engaging in experimental design and data interpretation, contributing to research-related skills..

CO6: Introduces molecular techniques and analysis methods, developing advanced research-related skills. Scientific temper is nurtured through the use of evidence-based molecular analysis.

***PO5*** **Trans-disciplinary knowledge:**

CO1: Apply knowledge across disciplines by understanding the principles of absorption spectra and molar extinction coefficients, recognizing their

applications in various fields

CO4: Apply knowledge of buffer preparation beyond biochemistry, recognizing its utility in various experimental settings across disciplines.

***PO6*** **Personal and professional competence:**

CO4: Cultivate personal and professional competence by acquiring a skill set that extends beyond the immediate biochemistry context..

CO7; Develop personal and professional competence through hands-on training, gaining skills that are valuable in various professional settings.

***PO7*** **Effective Citizenship and Ethics:**

CO2: Recognize the ethical considerations in conducting clinical biochemistry tests, emphasizing responsible use of diagnostic information for patient well- being

CO6: Emphasize the ethical considerations in quantitative biochemical analysis, particularly in contexts where accurate measurements impact decision-making

***PO8*** **Environment and Sustainability:**

CO2: Acknowledge the environmental impact of clinical diagnostics, understanding the importance of sustainable practices in healthcare.

CO5: Recognize the environmental implications of paper chromatography, emphasizing sustainable practices in laboratory techniques.

***PO9*** **Self-directed and Life-long learning:**

CO7: Encourage a mindset of self-directed and life-long learning by providing practical skills that students can continue to build upon in their future careers.

**SYLLABUS (CBCS) FOR T.Y.B.Sc. Microbiology (2022 Pattern)**

**(w. e. from June, 2024)**

| | |
|---|---|
| **Name of the Programme** | **: B.Sc. Microbiology** |
| **Program Code** | **: USMB** |
| **Class** | **: T.Y.B.Sc.** |
| **Semester** | **: V** |
| **Course Type** | **: Practical** |
| **Course Name** | **: Clinical Microbiology** |
| **Course Code** | **: USMB359** |
| **No. of Credits** | **: 02** |
| **No. of Practicals** | **: 15** |

**Course Objectives:**

1. To enrich the students' knowledge about Clinical Microbiology.
2. To develop expertise in clinical practices.
3. To enrich student's knowledge and train them in Clinical Microbiology.
4. To understand the scientific responsibilities while working in medical field.
5. To develop opportunities in entrepreneurships
6. To enrich students' knowledge about clinical Microbiology.
7. To understand developments in the field of Clinical microbiology

**Course Outcomes:**

On completion of the course, the students will be able to

CO1 Practical understanding of basic Clinical Microbiology.

CO2 Understand different practices in Clinical microbiology.

CO3 Apply this Practical knowledge to society for human welfare.

CO4 Establishment and development as an entrepreneur**.**

CO5 Expertise the basic knowledge of Clinical Microbiology.

CO6 Enrich the practices of Clinical Microbiology

CO7 Aware the society about Clinical Microbiology.

| Credit No. | Topic | Number of Practicals |
|---|---|---|
| **I & II** | a. Physical, Chemical and Microscopic examination of Clinical samples – urine, stool, pus | **4** |
| | b. Isolation, identification of following pathogens from clinical samples up to genus level (any one pathogen from each sample) *E. coli*, *Salmonella* spp.**,** *Pseudomonas* spp**.,** *Proteus* spp., *Klebsiella* spp., *Shigella* spp., *Staphylococcus* spp.**,** *Streptococcus* spp.(for identification use of keys as well as Bergey's Manual is recommended) Antibiotic sensitivity testing of the isolates (for Gram negative and Gram Positive) | **9** |
| | **c.** Study of growth characters of isolated pathogens on following media: Mannitol Salt Agar, Wilson Blair agar, Salmonella Shigella agar, Glucose azide medium, Cetrimide agar, TSI agar | **2** |

**Mapping of course outcomes and programme outcomes:**

**Weightage:** 1= weak or low relation, 2= Moderate or partial relation, 3= Strong or direct relation

| | Programme Outcomes (POs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| CO1 | 3 | 2 | 3 | 3 | | 2 | 3 | 3 | |
| CO2 | 3 | | | 2 | 3 | | | | 3 |
| CO3 | 3 | 2 | | 3 | | | | 2 | |
| CO4 | 3 | | 2 | | | | 2 | | |
| CO5 | 3 | | | 2 | | | | | 2 |
| CO6 | 3 | | | | | | | | |
| CO7 | 3 | | | | 2 | 3 | | | |

**Justification for the mapping**

***PO1*** **Disciplinary Knowledge:**

CO1: It can contribute to building foundational knowledge in Clinical Microbiology, which is essential for a deep understanding of the discipline.

CO2: Understanding diverse practices within Clinical Microbiology contributes to a broader and comprehensive disciplinary knowledge.

CO3: The practical application of knowledge for human welfare is an essential aspect of translating disciplinary knowledge into real-world benefits.

CO4:The establishment and development may involve applying disciplinary knowledge in innovative ways.

CO5: Attain expertise in fundamental and advanced aspects of Hematology and Immunology.

CO6: Contribute to the advancement and enrichment of practices within the fields through innovation, research, or improved methodologies

CO7: Raise awareness and educate the broader community about the

significance of Hematology and Immunology, particularly in the context of healthcare...

***PO2*** **Critical Thinking and Problem Solving:**

CO1: Developing a practical understanding requires critical thinking to apply theoretical knowledge to real-world scenarios and solve problems encountered in clinical settings..

CO3: Application of practical knowledge for human welfare demands critical thinking to assess societal needs and problems and develop solutions using clinical microbiology principles.

***PO3*** **Social Competence:**

CO1: Developing a practical understanding in Clinical Microbiology contributes to social competence by preparing individuals to engage effectively in healthcare teams and communicate with diverse stakeholders.

CO4: Entrepreneurial endeavors often require social competence in networking, communication, and building relationships with various stakeholders in the healthcare and business sectors.

***PO4*** **Research-related skills and Scientific temper:**

CO1 Developing a practical understanding in Clinical Microbiology involves honing research-related skills, including experimental design, data analysis, and interpretation, fostering a scientific temper.

CO2: Understanding diverse practices requires critical evaluation and an analytical mindset, contributing to the development of research-related skills and a scientific temper

CO3: The application of practical knowledge for human welfare involves applying research-related skills and maintaining a scientific temper in addressing societal issues.

CO5: Developing expertise involves cultivating a scientific temper and continually refining research-related skills in staying current with advancements in Clinical Microbiology.

***PO5*** **Trans-disciplinary knowledge:**

CO2: Understanding diverse practices may require insights from various related fields, fostering a trans-disciplinary perspective in the application of methodologies.

CO7: Raising awareness in society may involve communication strategies that draw from various disciplines, contributing to a trans-disciplinary understanding.

***PO6*** **Personal and professional competence:**

CO1: Developing a practical understanding contributes to personal and professional competence by ensuring a solid foundation in the subject matter.

CO7: Raising awareness requires effective communication and public engagement, demonstrating personal and professional competence.

***PO7*** **Effective Citizenship and Ethics:**

CO1: Developing a practical understanding includes ethical considerations, contributing to effective citizenship by promoting responsible and ethical practices in Clinical Microbiology.

CO4: Entrepreneurial activities, within the context of Clinical Microbiology, require a commitment to ethical practices and effective citizenship by contributing positively to societal needs.

***PO8*** **Environment and Sustainability:**

CO1: understanding the environmental impact of laboratory practices and healthcare procedures is essential for sustainable practices in Clinical Microbiology.

CO3: The application of practical knowledge for human welfare may involve considerations for environmentally friendly and sustainable approaches to healthcare practices.

***PO9*** **Self-directed and Life-long learning:**

CO2: Understanding diverse practices fosters a self-directed approach to learning, as students need to adapt and learn continuously to keep up with evolving methodologies.

CO5: Developing expertise signifies a commitment to ongoing learning and self-direction to deepen knowledge in Clinical Microbiology throughout one's career.

CO7: Effectively raising awareness involves staying informed and continuously updating communication strategies, aligning with the principles of self-directed and life-long learning.