



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

SR. NO.	COURSE CODE	COURSE NAME
1	23SBMB51MM	Immunology - I
2	23SBMB52MM	Enzymology
3	23SBMB53MM	Bacterial Genetics
4	23SBMB54MM	Practical course: Enzymology and Genetics
5	23SBMB55MM	Practical course: Industrial and Agricultural Microbiology
6	23SBMB51MEA	Fermentation Technology - I
7	23SBMB51MEB	Marine Microbiology
8	23SBMB52MEA	Agricultural Microbiology
9	23SBMB52MEB	Dairy Microbiology
10	23SBMB51VS	Practical course: Immunology



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology

(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Immunology I
Course Code	23SBMB51MM
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand a comprehensive understanding of the types of immunity
2.	To understand the importance of structure and function of primary and secondary lymphoid organs
3.	To understand the components and mechanisms involved in innate immunity and non-specific defense, which are crucial for the body's initial response to pathogens
4.	To gain practical skills and knowledge about various antigen-antibody interaction techniques in clinical settings and enhancing their ability to diagnose and monitor diseases effectively.
5.	To understands the concepts of immunohematology and their applications in clinical diagnostics

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the concepts of immunity and organs involved in it.
2.	Students will become aware about the role of immune cells in different diseases
3.	Students will understand the clinical tests and their applications in disease diagnosis.

Syllabus

Unit No.	Title with Contents	No. of Lectures
Credit I	Immune System: Structure and Function	15
1.	a. Immunity – Definition & Classification of Immunity- Innate & Acquired Immunity, Active and passive immunity, Humoral & cell mediated Immunity b. Three lines of defence mechanisms c. Cells of Immune system: Hematopoiesis, Structure, classification, properties and function of Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell. d. Lymphoid Organs (primary and secondary)– location, classification & functions of -Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT	2 1 2 2
2.	Antigen - Definition, concept of immunogen, epitopes, types of antigens- soluble and particulate antigens, autoantigens, Isoantigens, factors affecting immunogenicity. Concepts of haptens, carriers and adjuvants	1
3.	Antibodies/Immunoglobulin - Definition, structure of typical immunoglobulin, classes and biological functions of immunoglobulin, light and heavy chain domains	2
4.	Principles of antigen and antibody interactions- lattice hypothesis and zone phenomenon Antigen-antibody Reactions – i. Precipitation ii. Agglutination iii. IF iv. ELISA v. RIA vi. FACS	1 4
Credit II	Antigen- Antibody Interactions, Major Histocompatibility Complex, Transplantation and Immunity and Immunohematology	15

1.	Immune response: Cellular and Humoral a. Cellular components: Phagocytic cells – PMNL, macrophages (reticulo- endothelial cell system) and dendritic cells b. Humoral components: complement, cytokinins, inflammatory mediators c. Non-specific mechanisms of defense d. Phagocytosis - oxygen dependent and independent systems e. Complement activation - Classical, Alternative and lectin pathway f. Inflammation - cardinal signs, mediators, vascular and cellular changes	1 1 2
2.	Major Histocompatibility Complex: Structure of MHC in man and mouse Structure and functions of MHC class–I and class–II molecules MHC antigen typing (microcytotoxicity, mixed lymphocyte reaction and molecular typing)	1 1 2
3.	Transplantation and Immunity: Types of Grafts, Allograft rejection mechanisms Prevention of allograft rejection Shelf-life determination	1 1
4.	Immunohematology a. ABO and Rh blood group systems b. Bombay blood group c. Biochemistry of blood group substances d. Inheritance of ABH antigens e. Medico- legal applications of blood groups	3
5.	Immunomodulatory Approaches in Fungal and Cancer Diseases a. Concept b. Significance in treating infection and cancer	2

References: Immunology- I

1. Abbas A. K. and Lichtman A. H. (2004). Basic Immunology- Functions and Disorders of Immune System. 2 nd Ed. Saunders. Elsevier Inc. PA. USA.
2. Aderem A., and Underhill D. M. (1999). Mechanisms of phagocytosis in macrophages. Annu. Rev. Immunol. 17: 593-623.
3. Austin J. M. and Wood K. J. (1993). Principles of Molecular and Cellular Immunology.

Oxford University Press, London

4. Barret J. D. (1983). Text Book of Immunology. 4th edition, C. V. Mosby and Co. London.
5. Bendelac A. Savage P. B. and Teyton L. (2007). The biology of NKT cells. *Annu Rev Immunol.* 25: 297-336.
6. BIOTOL Series. (1993). Biotechnology by open learning series. Defense Mechanisms. Butterworth and Heinemann Ltd., Oxford
7. Bohlsón S. S., Fraser D. A. and Tenner A. J. (2007). Complement proteins C1q and MBL are pattern recognition molecules that signal immediate and long-term protective immune functions. *Mol. Immunol.* 44: 33–43.
8. Chatterji C. C. (2002). Human Physiology. Vol. 1. Special reprint edition. Medical Allied Agency, Calcutta.
9. Chatterji C. C. (2004). Human Physiology. Vol. 2. Eleventh edition. Medical Allied Agency, Calcutta.
10. De Smet K. and Contreras R. (2005). Human antimicrobial peptides: defensins, cathelicidins and histatins. *Biotechnol. Lett.* 27:1337–1347.
11. Fathman G., Soares L., Cha S. M. and Utz P. J. (2005). An array of possibilities for the study of autoimmunity. *Nature Rev.* 435(2):605-611
12. Ganz T. (2003). Defensins: antimicrobial peptides of innate immunity. *Nat. Rev. Immunol.*, 3:710–720.
13. Guyton A. C. and Hall J. E. (1996) Text Book of Medical Physiology, Goel Book Agency, Bangalore.

14. Janeway C. A., Travers P. Jr., Walport M. and Shlomchik M. J. (2005). Immunobiology Interactive. Garland Science Publishing. USA.
15. Kindt T. J., Goldsby R. A. and Osborne B. A. (2007). Kuby Immunology. 6th Ed. W. H. Freeman and Co., New York
16. Kuby J. (1996) Immunology. 7th Ed. W. H. Freeman and Co, New York
17. Pancer Z. and Cooper M. D. (2006). The Evolution of Adaptive Immunity, Ann. Rev. Immunol., 24: 497–518
18. Pathak S. S. and Palan V. (1997) Immunology - Essential and Fundamental. Pareen Publications Bombay.
19. Roitt E., Brostoff J. and Male D. (1993) Immunology. 6th Ed. Mosby and Co. London.
20. Roitt I. M. (1988). Essentials of Immunology. ELBS, London.
21. Roitt M. (1984). Essentials of Immunology. P. G. Publishers Pvt. Ltd., New Delhi.
22. Stites D. P., Stobo J. D., Fudenberg H. H. and Wells J. V. (1982). Basic and Clinical Immunology. 14th Ed. Lange Medical Publications. Maruzen Asia Pvt. Ltd., Singapore
23. Talwar G. P. (1983) Handbook of Immunology, Vikas Publishing Pvt. Ltd. New Delhi.
24. Zanetti M. (2005). The role of cathelicidins in the innate host defense of mammals. Curr. Issues Mol. Biol. 7:179–196.



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology
(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Enzymology
Course Code	23SBMB52MM
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand methods of active site determination, role of enzymes and its cofactors in microbial physiology.
2.	To learn to perform enzyme assay, purification and quantification of enzymes activity, enzyme kinetics in terms of initial, final velocity, mathematical expression of enzyme kinetic parameters.
3.	To correlate regulation of metabolism at enzymatic levels and apply methodology for commercial applications of enzymes.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the methods of active site determination, role of enzymes and its cofactors in microbial physiology.
2.	Students will become aware about the concept enzyme assay, purification and quantification of enzymes activity, enzyme kinetics in terms of initial, final velocity and mathematical expression of enzyme kinetic parameters.
3.	Students will understand the significance of regulation of metabolism at enzymatic levels and apply methodology for commercial applications of enzymes.

Syllabus

Unit No	Title with Contents	No. of Lectures
Credit I	Enzymes:	15
1	Structure of enzymes: a. Methods to determine amino acid residues at active site (Physical method e.g. x-ray crystallography and chemical methods such as trapping of ES complex and use of pseudo- substrate) b. Role of vitamins in metabolism: Occurrence, Structure and Biochemical functions of the following: i) Nicotinic Acid (Niacin) and the Pyrimidine nucleotides. ii) Riboflavin (Vitamin B2) and the Flavin nucleotides	03 02
2	Enzyme assays: a. Principles of enzyme assays and calculation of enzyme unit, specific activity b. Enzymes assays with examples by: i. Spectrophotometric methods ii. Radioisotope assay	01 02
3	3. Principles and Methods of Enzyme purification: a. Methods of cell fractionation b. 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 c. Construction of enzyme purification chart	01 02 01 01 01 01
Credit II	Enzyme Kinetics, metabolic regulation and Immobilized Enzymes:	15
1	Enzyme Kinetics: a. Concept of initial velocity b. Michaelis Menton equation for the initial velocity of single substrate enzyme catalyzed reaction. Brigg's Haldane modification of Michaelis Menton equation. Michaelis Menton plot, Lineweaver and Burk plot. Definition with significance of Km, Ks, Vmax.	01 05
2	Metabolic Regulations: a. Enzyme compartmentalization at cellular level b. Allosteric enzymes c. Feedback mechanisms d. Covalently modified regulatory enzymes (Glycogen phosphorylase) e. Proteolytic activation of zymogens f. Isozymes - concept and examples g. Multienzyme complex e.g. Pyruvate dehydrogenase complex (PDH)	01 01 01 01 01 01 01
3	Immobilization of enzymes: Concept, methods of immobilization and applications	02

References

1. Berg J. M., Stryer L., Tymoczko J. and Gatto G. (2019). Biochemistry.9th Edition. Palgrave Macmillan. ISBN-978-1319114657.
 2. Conn E. E., Stumpf P. K., Bruening G. and Doi R. H. (1987). Outlines of Biochemistry.5th Edition.John Wiley and Sons. ISBN-13: 9780471052883
 3. Hall D. A. and Krishna Rao K. (1994). Photosynthesis (Studies in Biology). 6thEdition. Cambridge University Press, London. ISBN-13: 978-1-133-10629-6
 4. Garrett R. H. and Grisham C. M. (2013). Biochemistry.5th Edition. Brooks/Cole, Publishing Company, California. ISBN-13: 978-1-133-10629-6
 5. Katoch R. (2011). Analytical Techniques in Biochemistry and Molecular Biology.Springer New York.ISBN 978-1-4419-9785-2.
 6. Nelson D. L. and Cox M. M. (2021). Lehninger's Principles of Biochemistry.8th Edition. Mac Millan Worth Pub.Co. New Delhi. ISBN:9781319228002
 7. Palmer T. (2001) Enzymes: Biochemistry, Biotechnology and Clinical chemistry. Horwood Pub. Co. Chinchester, England.ISBN-9781898563785.
 8. Segel I. H. (2010).Biochemical Calculations.2nd Ed. Wiley India Pvt. Limited. ISBN: 9788126526437
 9. Stanier R. Y., Adelberg E. A. and Ingraham J. L. (1985). General Microbiology. 4th Edition. London: Macmillan.
 10. Wilson K. and Walker J. (Editors) (2010). Principles and Techniques of Biochemistry and Molecular Biology.7th edition. Cambridge University Press, New York. ISBN-13: 978-0521731676
-



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology

(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Bacterial Genetics
Course Code	23SBMB53MM
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand the central dogma of molecular biology.
2.	To know basic biological life processes like replication, transcription and translation.
3.	To learn basic gene transfer and mapping techniques.
4.	To know basic recombination mechanisms at the molecular level.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	To exhibit a knowledge base in Bacterial Genetics.
2.	To understand the central dogma of Molecular Biology.
3.	To construct genetic map of bacteria.
4.	To get introduced to the concept of recombination.

Syllabus

Unit No	Title with Contents	No. of Lectures
Credit I	DNA REPLICATION, CENTRAL DOGMA AND GENE EXPRESSION	15
	1. Process of prokaryotic DNA replication a. Concept of Single replicon. b. Bidirectional movement of replication fork , Ori C gene c. Pre-priming and Priming reactions. d. DNA polymerases, DNA synthesis of leading & lagging strand synthesis. Okazaki fragments. e. Termination-Ter sequences, Tus protein	05
	2. Transcription a. Concept of central dogma b. Structure of promoter sequences. c. Structure and function of RNA polymerase. d. Steps of transcription: Initiation, Elongation and termination. e. Gene Regulation and Operon Concept (Eg-Lac Operon)	05
	3. Translation a. Structure and roles of m-RNA, t-RNA, rRNA and ribosome in translation. b. Role of Aminoacyl t-RNA synthetase in tRNA charging. c. Steps in translation: Initiation, elongation, translocation and termination of protein synthesis.	05
Credit II	Gene transfer in bacteria and mapping techniques.	15
	1. Gene transfer by Transformation a. Discovery of Transformation b. Natural transformation Systems- <i>Streptococcus pneumonia</i> and <i>Haemophilus influenzae</i> . c. Factors affecting transformation process (Competence development , Size of DNA, Concentration of DNA) d. Mapping of genes by co-transformation	4

	2. Gene transfer by Conjugation a. Discovery of Conjugation b. Properties of F plasmid, F ⁺ , F ⁻ , Hfr and F' strains c. Process of conjugation between F ⁺ and F ⁻ , Hfr and F' d. Mapping by interrupted mating experiment	4
	3. Gene transfer by Transduction a. Discovery of Transduction b. Generalized transduction mediated by phage P22 c. Specialized transduction mediated by lambda phage. d. Mapping of genes by co-transduction	4
	4. An introduction to Recombination a. Concept of genetic recombination and its types. b. Concept of recombination mapping: Map unit, recombination frequency, recombination frequency percentage. c. Concept of Holliday model of recombination, Role of Rec and Ruv proteins in homologous recombination.	3

References

1. Birge E. A. (2013). Bacterial and Bacteriophage Genetics. Springer, New York. ISBN: 9781475732580
2. Brooker R. J. (2012). Genetics: Analysis and Principles. 4th edition. McGraw- Hill Publication.
3. Brown T. A. (2006). Gene Cloning and DNA Analysis. Blackwell Publication. 5th Edition. ISBN: 1405111216
4. Brown T.A. (2016). Gene Cloning and DNA Analysis: An Introduction. 7th Ed. Wiley Blackwell Publication, U.S.A. ISBN: 978-1-119-07254-6
5. Clokie M. R. J. and Kropinski A. M. (editors): Bacteriophage: Methods and Protocols.
6. Clutterbuck A. J. (1996). Parasexual recombination in fungi. J. Genet. 75(3): 281-286, @ Indian Academy of Sciences
7. Dubey R. C. (2014). Advanced Biotechnology. S. Chand Publishing. ISBN: 9788121942904
8. Freifelder D. (2005). Molecular Biology. 2nd Edition. Narosa Publishing House Pvt. Limited, India.
9. Gardner E. J., Simmons M. J. and Snustad D. P. (2006). Principles of Genetics. 8th edition. John Wiley and Sons Publication. ISBN-13: 9788126510436
10. Goodenough U. (2016). Genetics. Publisher: Holt, Rinehart and Winston. ISBN-13: 978-0030197161

11. Gupta P. K. (2020). Elements of biotechnology. 4th Reprint (2nd Edition). Product Code: BC-22.Rastogi Publications. Meerut, India. ISBN: 978-81-7133-937
12. Hartwell L., Goldberg M., Fischer J. and Hood L. (2018). Genetics: from genes to genomes. McGraw-Hill. ISBN13: 9781259700903
13. Hayes W. (1968). Genetics of Bacteria and their Viruses. 2nd Edition. Oxford-Edinburgh: Blackwell Scientific Publications.
14. Hyman P. and Abedon S.T. (2009). Practical methods for determining Phage growth parameters. Methods Mol Biol. 501:175-202. doi: 10.1007/978-1-60327-164-6_18. PMID: 19066822.
15. Kemp W. (2011). Organic Spectroscopy.3rd edition. Publisher: Red Globe Press. Macmillan
16. Klug W. S., Cummings M. R., Spencer C. A., Michael A. and Palladino M. (2019). Genetics.Pearson Publisher. ISBN 13: 978-0-134-60471-8
17. Kohli D. V. and Vyas S. P. (2009).Pharmaceutical Biochemistry. Published by CBS Publishers andDistributors CBS. ISBN 13: 9788123916903
18. Lewin's GENES X (2011). Krebs J., Kilpatrick S. T., Goldstein E. S. (Editors). 10th Edition.Sudbury, Mass.: Jones and Bartlett, c2011.
19. Lodish H., Berk A., Kaiser C. A., Krieger M., Bretscher A., Ploegh H., Martin K. C., Yaffe M. and Amon A. (2021). Molecular Cell Biology, 9th Edn. Macmillan Learning. ISBN: 9781319208523
20. Pal J. K. and Ghaskadabi S. (2009). Fundamentals of Molecular Biology. Oxford UniversityPress. ISBN: 9780195697810
21. Primrose S. B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics, 7thEd. Blackwell Publishing: U.S.A.
22. Russel P. J. (2000). Fundamentals of Genetics. Publisher: Benjamin/Cummings. ISBN: 9780321036261
23. Russel P. J. (2010). iGenetics: A Molecular Approach. 3rd Edition. Benjamin Cummings. ISBN: 9780321569769
24. Sambrook J. F. and Russel D. W. (Editors). (2001). Molecular cloning, A laboratory manual (3rd Edition.).Volumes 1, 2, and 3.Cold Spring Harbor Laboratory Press. ISBN- 978-0-87969-577-4
25. Sharma. B. K. (2011). Instrumental Methods of Chemical Analysis.27th Edition.Goel PublishingHouse, Meerut. India
26. Singh B. D. (2007). Biotechnology Expanding Horizon.Kalyani Publishers, India
27. Singh B. D. (2016). Biotechnology.5th Edition.Reprint.Kalyani Publishers, India.
28. Stanier R. Y. (1999). General Microbiology. 5th Edition. Palgrave Macmillan
29. Strickberger M.W. (2012). Genetics.3rd Edition. New Delhi: PHI Learning Gardner.

30. Tamarin R. H. (2002). Principles of Genetics. Publisher: McGraw-Hill Education (India) Pvt Limited. ISBN:9780070486676

31. van Sinderen D. and McGrath S.(Editors). (2007). Bacteriophage: Genetics and Molecular Biology. Caister Academic Press

32. Watson J.D., Baker, T.A., Bell, S.P., Gann A., Levine M. and Losick R. (2014). Molecular Biology of the gene. 7th edition. Pearson. ISBN:

9780321762436 **Reference-Links:**

1. Potential biohazards of recombinant DNA molecules:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC388511/?page=1>

2. National Academies Press: Introduction of Recombinant DNA-Engineered Organisms Into the Environment: Key Issues:

<https://www.nap.edu/download/18907#>

3. Guidelines and Handbook for Institutional Biosafety Committees (DBT, Govt. of India and BCIL): <https://thsti.res.in/pdf/IBG.pdf>

4. University of North Carolina's Biosafety Guidelines (Principles, Risk assessment, Biosafety levels, Guidelines):

<https://ehs.unca.edu/laboratory-safety/biological-safety/>

<http://www.informatics.jax.org/silver/chapters/7-1.shtml>



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

**T.Y.B.Sc. Microbiology
2025-26 (NEP-2023)**

Course/ Paper Title	Practical course: Enzymology and Genetics
Course Code	23SBMB54MM
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To make students aware about the principle and working of colorimeter and spectrophotometer along with estimation of biological molecules.
2.	To make students aware about basics of Enzymology along with production, assay and precipitation of Amylase.
3.	To make them understand basic chromatography techniques with an example of Paper Chromatography.
4.	To introduce basic techniques in Molecular Biology like plasmid DNA isolation, estimation and purity determination

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will learn the principle and working of colorimeter and spectrophotometer along with estimation of biological molecules.
2.	Students will learn basics of Enzymology along with production, assay and precipitation of Amylase.
3.	Students will be acquainted with concept, principle and basic chromatography techniques with an example of Paper Chromatography
4.	Students will understand principle and methodology of plasmid DNA isolation, estimation and purity determination

Syllabus

Expt. No.	Topics	No. of Practicals
1	Determination of absorption spectra and molar extinction co-efficient of two different dyes (by colorimetry /spectrophotometry)	2
2	Estimation of reducing sugar from natural sources by DNSA method	1
3	Estimation of proteins from natural sources by Folin Lowry method	1
4	Lab scale production of amylase using isolates	1
5	Assay of Amylase Enzyme	1
6	Precipitation of amylase from fermentation broth by salt & Determination of specific activity of crude and purified amylase	2
7	Separation and Identification of amino acids from the mixture by paper chromatography.	1
8	Isolation of Plasmid DNA from Bacteria	1
9	Estimation of DNA by Diphenylamine method.	1
10	Determination of purity of DNA preparation and its quantification. Estimation of DNA by UV spectrophotometric methods at 260 nms. Purity checks of DNA by 260 / 280 ratio.	1
11	Bacterial Artificial transformation & Competence development in <i>E coli</i> using Calcium Chloride method.	2
12	Bacterial Conjugation(Demonstration)	1
	TOTAL	15



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology
(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Practical course: Industrial and Agricultural Microbiology
Course Code	23SBMB55MM
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr.No.	Objectives
1.	To make students aware about operation of laboratory scale fermenter
2.	To make them understand importance of sterility checking of injectables
3.	To introduce concept of bioassay by different methods
4.	To make them understand importance of microorganisms in plant pathology and agriculture

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will learn about the use of laboratory scale fermenter
2.	Students will learn to check sterility of injectables and get acquainted with different types of methods used for bioassay
3.	Students will learn isolation and identification of plant pathogens
4.	Students will understand importance of microorganisms with respect to soil fertility and plant growth

Syllabus

Expt. No.	Topics	No. of Practicals
1	Media preparation and sterilization of laboratory scale fermenter	2
2	Sterility Testing of pharmaceuticals (non-biocidal injectables)	1
3	Minimum inhibitory concentration and minimum bactericidal concentration of antibacterial compounds (MIC and MBC)	2
4	Antibiotic and growth factor assay (agar gel diffusion technique)	2
5	Isolation and identification of <i>Xanthomonas</i> spp. from citrus canker	1
6	Isolation of <i>Aspergillus niger</i> from black rot of onion	1
7	Collection of plant disease specimens and study of symptoms/ Project based on digital record of plant diseases (Group Activity)	2
8	Isolation of PGPR with phosphate solubilization potential	1
9	Validation of commercial formulations of bioinoculants based on BIS standards,	1
10	Pot studies to check effect of bioinoculants on plant growth	2
	TOTAL	15

References:

1. Indian Pharmacopeia. (2018 Addendum 2021). <https://www.indianpharmacopoeia.in/index.php>
2. USA Clinical Laboratory Standards Institute (CLSI) Guidelines 2021 on <https://clsi.org/>
3. Sterility Testing:
https://www.who.int/medicines/publications/pharmacopoeia/TestForSterility-RevGenMethod_QAS11-413FINALMarch2012.pdf.
4. Microbiological assay of antibiotics:
<https://apps.who.int/phint/pdf/b/7.3.1.3.1-Microbiological-assay-of-antibiotics.pdf>
http://www.uspbpep.com/usp29/v29240/usp29nf24s0_c81.html.
5. Microbiological assay of vitamins:
<https://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=14117andcontext=rtd>.
<https://www.pharmaguideline.com/2011/09/microbiological-assay-of-cyanocobalamin.html>.



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology

(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Fermentation technology I
Course Code	23SBMB51MEA
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To apply classical, advanced strain improvement and isolation techniques for fermentation processes.
2.	To optimize and sterilize media used in fermentation industry for commercially economical and efficient fermentations.
3.	To recover the product using suitable methods and ensuring quality of the finished product by quality assurance tests.
4.	To acquaint fermentation economics, process patentability, process validation.
5.	To understand the concepts and skills essential for industrial biotechnology, pharmaceuticals and bioengineering applications.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the concepts of strain improvement, Sterilization & optimization of Media and Scale-up & Scale-down of fermentation
2.	Students will understand the Significance Downstream processing and Quality assurance of fermentation products
3.	Students will become aware about the Fermentation economics, IPR and SOPs

Syllabus
Fermentation Technology– I

Unit No.	Title with Contents	No. of Lectures
Credit I	Upstream processes of fermentations	15
1.	a. Concept of Fermentation Technology b. Types of fermentations: Concept of Batch, continuous and dual fermentation c. Design of a Fermenter (typical CSTR Continuous stirred tank Reactor): Different parts and their working	2
2.	Media optimization a. Objectives of media optimization b. Methods of media optimization c. Classical approach – One factor at a time, Full factorial design Plackett and Burman Design (with example) d. Response Surface Methodology (RSM)	2 1
3.	Strain Improvement: a. Objectives of strain improvement b. Methods for strain improvement c. Types of mutants used in strain improvement (altered cell permeability mutants, auxotrophs, analogue resistant mutants, revertants, genetic engineering approaches) d. Selection of different types of mutants (replica plate method, filtration enrichment, penicillin enrichment method, gradient plate technique)	2 1
4.	Sterilization of Media: a. Methods of sterilization b. Batch sterilization and Continuous sterilization (direct and indirect methods) c. Concept and derivation of Del factor d. Filter sterilization of liquid media	1 1 1 1
5.	Scale-up and Scale-down: a. Objectives of scale-up b. Levels of fermentation (laboratory, pilot-plant and production level-flow sheet to explain scale up) c. Criteria of scale-up for critical parameters: Scale-up window Scale-down	1 1 1
Credit II	Downstream processing and Quality assurance of fermentation products	15

1.	Downstream processing of fermentation products: (method, principle, types, examples of fermentations, factors affecting, merits and demerits at large scale operation) a. Solid-Liquid Separation b. Cell Disruption c. Concentration d. Purification e. Formulation f. Product Recovery	1 1 1 1 1 1
2.	Quality assurance of fermentation products (as per IP, USP) Methods of detection and Quantification of the fermentation product: physicochemical, biological and enzymatic methods Bioburden test Microbial limit test Sterility testing (direct inoculation method, membrane filtration method) Pyrogen testing: Endotoxin detection (LAL test) Ames test and modified Ames test Toxicity testing (Acute toxicity)	1 1 1 1 1 1
3.	Fermentation economics, IPR and SOPs Contribution of various expense heads to a process (Recurring and nonrecurring expenditures) citing any suitable example. Introduction to Intellectual Property Rights – Types of IPR (Patenting in fermentation industry) Concept of validation (significance of SOPs)	1 1 1

References: Fermentation Technology- I

1. Aiba S., Humphrey A. E. and Millis N.F. (1977). Biochemical Engineering. Academic Press, New York,
2. Bailey J. A., Bailey J. E., Bailey J., Simpson R. J. and Ollis D. F. (1986). Biochemical Engineering Fundamentals. 2nd Edition. McGraw-Hill. Chemical Engineering Series. McGraw-Hill Publisher. ISBN: 0070032122, 9780070032125
3. BIOTOL series. (1992). Bioreactor Design and Product Yield. Butterworths- Heinemann (Publisher). ISBN-13: 978-0750615082
4. BIOTOL series. (1992). Operational Modes of Bioreactors. Butterworths-Heinemann. ISBN- 13: 978-0750615082
5. British Pharmacopeia. (2021). The Stationery Office Ltd (TSO), PO Box 29, Norwich, NR3 1PD. <https://www.pharmacopoeia.com/Catalogue/Products>
6. Casida L. E. J. R. (2016). Industrial Microbiology. New Age International Private Limited. ISBN- 9788122438024
7. Flickinger M. C. (2010). Encyclopedia of Bioprocess Technology. Seven Volume Set. Wiley- Interscience, New Jersey. ISBN: 978-0-471-79930-6
8. Indian Pharmacopeia. (2018- Addendum 2021):<https://www.indianpharmacopoeia.in/index.php>
9. Lydersen B. K., D' Elia N. A. and Nelson K. L. (Eds.). (1994). Bioprocess Engineering: Systems, Equipment and Facilities. Wiley. ISBN: 978-0-471-03544-2
10. Meshram S. U. and Shinde. G. B. (2009). Applied Biotechnology. I K International Publishing House. ISBN-13: 978-93-80026-56-5, ISBN: 93-80026-56-0
11. Moo-Young M. (2019). Comprehensive biotechnology. Third edition. Volume 1: Scientific Fundamentals of Biotechnology. Volume 2: Engineering Perspectives in Biotechnology. Volume 3: Industrial Biotechnology and Commodity Products. Volume 4: Agricultural and Related Biotechnologies. Volume 5: Medical Biotechnology and Healthcare. Volume 6: Environmental and Related Biotechnologies. Pergamon Press Limited, England. ISBN: 978- 0-444-64047-5
12. Peppler H. L. and Perlman D. (1979). Microbial Technology. Volume 1: Microbial Processes. Academic Press, New York. ISBN: 978-0-12-551501-6
13. Peppler H. L. and Perlman D. (1979). Microbial Technology. Volume II: Fermentation Technology (2nd Edition). Academic Press. ISBN: 9781483268279

14. Stanbury P. F., Whitaker A. and Hall S. J. (2016). Principles of Fermentation Technology. 3rd Edition. Butterworth-Heinemann. ISBN: 9780080999531
15. Reference links: USA Clinical Laboratory Standards Institute (CLSI) Guidelines 2021:
<https://clsi.org/>



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology

(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Marine Microbiology
Course Code	23SBMB51MEB
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To train students in the field of Marine Microbiology
2.	To acquire advances in the knowledge of marine microbes and marine Ecology
3.	To comprehend the role of marine microbes in bioremediation
4.	To comprehend the role of marine microbes in bioprospecting.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	The awareness of unseen and unexplored niche of marine ecosystem of microbes will be created in students
2.	Students will acquire advances in the knowledge of marine microbes and marine ecology.
3.	This course will help students to get new career opportunities in Marine Microbiology field.

Syllabus

Unit No	Title with Contents	No. of Lectures
Credit I		15
A	Marine ecology and sampling	
	a. Marine Habitats – estuaries, mangroves, coral reefs, salt marshes, coastal ecosystems, deep sea, hydrothermal vents, Polar habitat – Arctic, Antarctica, Southern Ocean	3
	b. Physiology of marine microorganisms – metabolic diversity, marine loop, marine snow(Composition and formation), Role of marine microorganisms in biogeochemical cycles	4
	c. Sampling methods– water sampling (Niskin sampler) and sediment sampling (Types of Grab sampler and core), Culturing methods of marine microorganisms – VBNC, biofilm, mats from vents and estuarine sample.	4
B	Applications of Marine Microbial Biotechnology	
	a. Production and applications of marine microbial products – Biosurfactants, Pigments, Enzymes, Organic acids, Antibiotics and Toxins,	2
	b. Molecular markers and their applications in fisheries and aquaculture	2
Credit II		15
A	Marine microbes, role in bioremediation and bioprospecting	
	a. Extremophilic microorganisms – econiches, different types with examples and significance	2
	b. Archaea –biodiversity, stress response, adaptation and Significance	3
	c. Marine mycology – econiche, types of marine fungi and Significance	2
	d. Bioremediation – Role of marine microorganisms in bioremediation of heavy metals, hydrocarbon pollutants – tar ball and oil spills	3
	e. Bioleaching and biodeterioration of natural and synthetic materials	2
B	Marine Microbial Diseases	
	a. Aqua culture pathogens & Water borne pathogens - Aeromonas, Vibrio, Salmonella, Pseudomonas, Leptospira, Corynebacteria.	3
	b. Viral diseases of marine ecosystem- Effect of viruses on ecology of the marine ecosystem, movement of viruses between biomes, viral pathogens of fish, viruses in shell-fish and health hazards: Norwalk virus and Hepatitis virus A	

References

1. Alexopoulos C. J., Mims C. W. and Blackwell M. (1996). *Introductory Mycology*. Wiley ISBN: 978-0-471-52229-4.
2. Bathmann U. (2005). Ecological and biogeochemical response of Antarctic ecosystems to iron fertilization and implications on global carbon cycle, *Ocean and Polar Research*. 27(2): 231-235.
3. Bej A. K., Aislabie J. and Atlas R. M. (2009). *Polar Microbiology. The ecology, biodiversity and bioremediation potential of microorganisms in extremely cold environments*. Taylor and Francis. eBook. ISBN-9780429150913.
4. Belkin S. and Colwell R. R. (2005). *Oceans and Health: Pathogens in the Marine Environment*. Springer. ISBN 978-0-387-23709-1.
5. Boone D. R. Castenholz R. W. and Garrity G. M. (2001). *Bergey's Manual of Systematic Bacteriology: The archaea and the deeply branching and phototrophic bacteria*. Springer. ISBN- 978-0-387-98771-2.
6. Borse B. D., Bhat J. D., Borse K. N., Tuwar N. S. and Pawar N. S. (2012). *Marine Fungi of India (Monograph)*. 1st edition. Broadway Publishing House. Broadway Publishing. ISBN-13: 978-9380837383.
7. Bull A. T. (2004) *Microbial Diversity and Bioprospecting*. ASM Press. ISBN 1- 55581- 267- 268.
8. Caspers H. (1980). *Phytoplankton Manual*. Sournia A. Editors. *Monographs on Oceanographic Methodology* 6. Paris: Unesco. ISBN 92-3-101572-9.
9. Clark R. B. And Clark R. L. (2001). *Marine Pollution*. Oxford University Press.
10. Gasol G. M. and Kirchman D. L. (2018). *Microbial Ecology of the Oceans*. 3rd Edition. Wiley-Blackwell. ISBN: 978-1-119-10718-7.
11. Grasshoff K., Ehrhardt M. and Kremling K. (1985) *Methods of Seawater Analysis*. Second, Revised and Extended Edition. Weinheim/Deerfield Beach, Florida: Verlag Chemie 1983. ISBN 3–527-2599-8 (Weinheim) 0–89573-7 (Deerfield Beach).
12. Grasshoff K., Ehrhardt M. and Kremling K. (1999). *Methods of Seawater Analysis*, WILEY- VCH Verlag GmbH. ISBN: 9783527295890.
13. Hopkins D.W. (2012). *Polar Microbiology: Life in a Deep Freeze*. Miller R. V. and Whyte L. G. Editors. Cambridge University Press. Doi: 10.1017/S095410201300059X.
14. Horikoshi K. and Grant W. D. (1998). *Extremophiles – Microbial Life in Extreme Environments*: 20. Wiley-Liss. ISBN-13: 978-0471026181.
15. Hunter-Cevera J., Karl D. and Buckley M. (2005). *Marine Microbial Diversity: the Key to Earth's Habitability*. Washington (DC): American Society for Microbiology. ISBN-0198792921, 9780198792925.
16. Meller C. B. and Wheeler P. A. (2012). *Biological Oceanography*. Wiley-Blackwell Publishers. ISBN: 978-1-444-33301-5.
17. Mitchell R. and Kirchman D. L. (2000). *Microbial Ecology of the Oceans*. Wiley- Blackwell.

18. Munn C. B. (2020). *Marine Microbiology: Ecology and Applications*. CRC Press. ISBN 9780367183561.
19. Prince R.C. and Atlas R.M. (2016). Bioremediation of Marine Oil Spills. In: Steffan R. (Editor). *Consequences of Microbial Interactions with Hydrocarbons, Oils, and Lipids: Biodegradation and Bioremediation. Handbook of Hydrocarbon and Lipid Microbiology*. Springer, Cham. https://doi.org/10.1007/978-3-319-44535-9_13-1.
20. Rainey F. A. And Oren A. (2006). Extremophile microorganisms and the methods to handle them. *Methods in Microbiology*. 35:1-25
21. Satyanarayana T., Johri B. and Prakash A. (2012). *Microorganisms in Environmental Management*. Springer. ISBN 978-94-007-2229-3.
22. Satyanarayana T., Raghukumar C. and Shivaji S. (2005) Extremophilic microbes: diversity and perspectives. *Current Science*. 89(1): 78-90.
23. Seshagiri R. (2017). *Fungi in Coastal and Oceanic Marine Ecosystems: Marine Fungi*. Springer. ISBN 978-3-319-54304-8.
24. Stricklan J. D. H. and Parsons T. R. (1972). *A Manual of Seawater Analysis*. Bulletinno. 167. 2nd Edition. Ottawa: Fisheries Research Board of Canada.
25. Thomas T. R., Kavlekar, D. P., Lokabharathi, P. A. (2010) Marine drugs from spongemicrobe association: a review. *Marine Drugs*. 8: 1417-1468.
26. Chauhan, T. and Rajiv, K. (2010) Molecular markers and their applications in fisheries and aquaculture. *Advances in Bioscience and Biotechnology*, **1**, 281-291. doi: [10.4236/abb.2010.14037](https://doi.org/10.4236/abb.2010.14037).
27. Lo LSH, Liu X, Liu H, Shao M, Qian PY, Cheng J. Aquaculture bacterial pathogen database: Pathogen monitoring and screening in coastal waters using environmental DNA. *Water Res X*. 2023 Aug 7;20:100194. doi: 10.1016/j.wroa.2023.100194. PMID: 37637860; PMCID: PMC10448209.
28. Floris R, Rizzo C, Lo Giudice A. Biosurfactants from Marine Microorganisms [Internet]. *Metabolomics - New Insights into Biology and Medicine*. IntechOpen; 2020. Available from: <http://dx.doi.org/10.5772/intechopen.80493>
29. Bhatnagar, I.; Kim, S.-K. Immense Essence of Excellence: Marine Microbial Bioactive Compounds. *Mar. Drugs* **2010**, *8*, 2673-2701. <https://doi.org/10.3390/md8102673>
30. Kim, SK. (2019). Genetic Diversity and DNA Markers in Fish. In: *Essentials of Marine Biotechnology*. Springer, Cham. https://doi.org/10.1007/978-3-030-20944-5_5
31. Movement of Viruses between Biomes (2004). E. Sano, S. Carlson, L.Wegley and F. Rohwer. *Appl Environ Microbiol* 70: 5842–5846.
32. Exploring the Vast Diversity of Marine Viruses (2007). M. Breitbart, L. R . Thompson, C.A. Suttle and M.B. Sullivan. *Oceanography* 20:135-139.
33. Viruses manipulate the marine environment (2009) F. Rohwer and R.V. Thurber. *Nature* 459, 207-212.
34. Marine viruses and global climate change (2011). R. Danovaro, C. Corinaldesi, A. Dell’Anno, J.A. Fuhrman, J.J. Middelburg, R.T. Noble and C.A. Suttle. *FEMS Microbiol Rev* 35: 993–1034
35. Viruses of Fish: An Overview of Significant Pathogens (2011) M. Crane and A. Hyatt *Viruses* 3: 2025–2046.



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology

(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Agricultural Microbiology
Course Code	23SBMB52MEA
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand plant growth improvement with respect to disease resistance, environment tolerance.
2.	To correlate stages of plant disease development, epidemiology, symptoms based classification, control methods.
3.	To understand the importance of microorganisms in sustainable agriculture, biotechnological application of bio films, edible vaccines
4.	To correlate Soil Micro biome and Role of microorganisms in soil health
5.	To determine the use of Microorganisms as tools in plant genetic engineering

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the concepts of plant disease resistance
2.	Students will become aware about the role of Microbiologist in Epidemiology of plant diseases
3.	Students will understand the Significance of biotechnological applications of microorganisms in the field of agriculture.

Syllabus

Unit No	Title with Contents	No. of Lectures
Credit I	Plant Pathology	15
A	Stages in development of a disease Infection, invasion, colonization, dissemination of pathogens	3
B	Classification of disease based on symptoms (with one example of the following): i. Canker ii. Downy mildew iii. Mosaic	4
C	Plant disease epidemiology : i. Concepts of monocyclic, polycyclic and polyetic diseases with one example of each ii. Disease triangle iii. Forecasting of plant diseases	3
D	Methods of plant disease control i. Eradication ii. Chemical control iii. Biological control (employing bacterial and fungal cultures) iv. Integrated pest management	5
Credit II	Microorganisms in sustainable Agriculture and tools in plant genetic engineering	15
A	Microorganisms in sustainable Agriculture Soil Micro biome (plant Micro biome): Concept, Composition, functioning and methods to study plant Micro biome Conservation of soil health: Role of microorganisms in soil health	5
B	Phytonutrient availability by soil microorganisms Mechanism of diazotrophy, Phosphate solubilization, Potassium mobilization, micronutrient availability	2
C	Biofilm in plant surfaces, Biofilm formation; Biofilm in Phyllosphere and rhizosphere, Examples of plant- microbe interactions in biofilms, Biotechnological applications of plant biofilms	3
D	Microorganisms in plant genetic engineering: a. Concept of GM crops (Transgenic crops) w.r.t. to edible vaccines, insecticide resistance, herbicide resistance, improved varieties, new variants, disease resistance	2
E	Tools and techniques: i. Technology of BT resistant crops ii. Concept of edible vaccines iii. Technique of use of plant viruses in genetic engineering iv. RNAi Technology and antisense RNA technology in disease resistant plant varieties	3

References:

1. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
2. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hall of India Pvt. Ltd., New Delhi.
3. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
4. Dube. H.C. and Bilgrami. K.S.1976 Text book of modern pathology. Vikas publishing house. New Delhi.



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology
(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Dairy Microbiology
Course Code	23SBMB52MEB
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand prospects of dairying at commercial marketing.
2.	To acquire skills of processing of milk and dairy products
3.	To assess quality control in dairy industry.
4.	To comprehend production of dairy products of commercial significance with emphasis to local and global market demand.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will understand prospects of dairying at commercial marketing.
2.	Students will acquire skills of processing of milk and dairy products.
3.	Students will be able to assess quality control in dairy industry.
4.	Students will be able to comprehend production of dairy products of commercial significance with emphasis to local and global market demand.

Syllabus

Dairy Microbiology

Unit No	Title with Contents	No. of Lectures
Credit I	1. Definition, types, microflora and pathogens • Definition of milk • Composition of milk • Physico-chemical properties of Milk of different animals • Difference between colostrum and milk. • Types of milk: whole, toned, double toned, homogenized, and skimmed milk, dehydrated milk • Microflora associated with milk and its importance. • Sources of contamination of raw milk and relative importance in influencing quality of milk during production, collection, transportation, and storage • Milk borne diseases.	10
	2. Processing Techniques and naturally occurring preservatives • Bacteriological aspects of processing techniques like bacto-fugation, thermisation, pasteurization (in detail process is expected), sterilization and boiling. • Naturally occurring preservative systems in milk like LP system, immunoglobulins, Lysozyme, Lactoferrin etc.	5
Credit II	1. Spoilage of Milk • Succession of microorganisms in milk leading to spoilage • Stormy fermentation • Ropiness • Sweet curdling • Colour and flavour defects • Preservation of Milk and Milk products by physical (irradiation) and Chemical agents • Food grade bio preservatives (GRAS) • Bacteriocins of LAB	8



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune-1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T. Y. B. Sc. (Under NEP 2023)

Course Title: Practical course : Immunology		Semester: V
Course Code: 23SBMB51VS		No. of Credits: 02
Nature of Course: Major		Total Teaching Hours: 60

Course Objectives	
1.	To make the students understand immunohematology techniques like crossmatching
2.	To train the students in performing WBC differential count from peripheral blood smear
3.	To train the students in immunological techniques like Immunoprecipitation
4.	To make the students understand the applications of recent techniques like electrophoresis and ELISA (Antigen/ Antibody detection)

Course Outcome	
1.	Students will learn principles of immunohematology techniques like cross matching
2.	Students will comprehend the significance of CBC with special reference to WBC differential count from peripheral blood smear
3.	Students will study immunological techniques like Immunoprecipitation
4.	Students will appreciate the applications of recent immunological techniques in diagnosis of diseases

SYLLABUS

Expt. No.	Topics	No. of Practicals
1.	Blood grouping: ABO and Rh system.	1
2.	Agglutination tests: Widal test (Slide test and Tube Test)	1
3.	Rapid Plasma Reagin (RPR) test	1
4.	Agglutination Inhibition (Pregnancy test)	1
5.	White blood cell differential count from peripheral blood	2
6.	Immunochemistry: Cross-matching (Major and Minor)	2
7.	Coomb's test (Direct and Indirect)	1
8.	Immunochromatography tests: a) Qualitative differential detection of IgM and IgG antibodies to Dengue virus in human serum / plasma b) Qualitative detection of Rheumatoid factor (RA factor)	2
9.	Immunoprecipitation: Double diffusion (Ouchterlony) technique	1
10.	Demonstrations of: a) Serum protein separation by electrophoresis b) ELISA (Antigen/ Antibody detection)	2
11.	Visit to Immunological and immune-haematological Laboratory and preparation of visit report	1
	TOTAL	15

References:

1. Godkar P.B. (2020). Textbook of Medical Laboratory Technology Volume 1 and 2. 3rd edition Bhalani Publishing House. ASIN: 9381496196. ISBN-13: 978- 9381496190
2. Maheshwari N. (2017). Clinical Pathology Hematology and Blood Banking (For DMLT Students). 3rd edition. Jaypee Brothers Medical Publishers. ISBN-13: 978- 9386261182
3. Mukherjee K. L. and Ghosh S. (2010). Medical Laboratory Technology, Volume I: Procedure Manual for Routine Diagnostic Tests. 2nd edition. McGraw Hill Education (India) Private Limited. ISBN-13: 978- 1259061233
4. Mukherjee K.L. and Ghosh S. (2010). Medical Laboratory Technology, Volume II: Procedure Manual for Routine Diagnostic Tests. 2nd edition. McGraw Hill Education (India) Private Limited. ISBN-13:978-1259061240
5. Mukherjee K. L. and Ghosh S. (2010). Medical Laboratory Technology, Volume III: Procedure Manual for Routine Diagnostic Tests. 2nd edition. McGraw Hill Education (India) Private Limited. ISBN-13:978-1259061257
6. Talib V. H. (2019). Hand book Medical Laboratory Technology. 2nd edition. CBS Publishers and Distributors Pvt. Ltd. ISBN-13: 978- 81239067



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

SR. NO.	COURSE CODE	COURSE NAME
1	23SBMB61MM	Immunology - II
2	23SBMB62MM	Metabolism
3	23SBMB63MM	Genetics and Molecular Biology
4	23SBMB64MM	Practical course: Metabolism and Molecular Biology
5	23SBMB65MM	Practical course: Industrial and Food Microbiology
6	23SBMB61MEA	Fermentation Technology - II
7	23SBMB61MEB	Nanobiotechnology
8	23SBMB62MEA	Food Microbiology
9	23SBMB62MEB	Waste Management



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology (Autonomy NEP 2023 Pattern)

Course/ Paper Title	Immunology II
Course Code	23SBMB61MM
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To get a comprehensive understanding of Adaptive / Acquired Immunity
2.	To understand the importance of Cytokines
3.	To understand the components and mechanisms involved in Humoral Immune Response, Cell Mediated Immune Response
4.	To gain knowledge about Hypersensitivity
5.	To understands the concepts of Autoimmunity, Autoimmune diseases

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the concepts of Adaptive / Acquired Immunity
2.	Students will become aware about Hypersensitivity
3.	Students will understand Autoimmunity and Autoimmune diseases

Syllabus SEM VI

Unit No.	Title with Contents	No. of Lectures
Credit I	Cytokines, Adaptive / Acquired Immunity	15
1.	Cytokines: Concept-Cytokines, lymphokines, monokines, interleukins, chemokines, interferons and tumor necrosis factor Properties, Attributes and biological functions of cytokines	1 1
2.	2. Adaptive / Acquired Immunity (Third line of defense): A. Humoral Immune Response i. Primary and secondary response kinetics, significance in vaccination programs ii. Role of cytokines in activation and differentiation of B-cells B. Cell Mediated Immune Response Activation and differentiation of T cells, role of cytokines in activation Antigen processing and presentation (Major Histocompatibility class I and class II restriction pathways), cell-cell interactions and adhesion molecules, response to super-antigens Mechanism of Cytotoxic T lymphocytes (CTL) mediated cytotoxicity, Antibody- dependent cellular cytotoxicity (ADCC) Significance of Cell Mediated Immune Response (CMI)	2 1 2 5 3
Credit II	Hypersensitivity, Autoimmunity, Autoimmune diseases	15
1.	Hypersensitivity General principles of different types of hypersensitivity reactions Gell and Coomb's classification of hypersensitivity – mechanism with examples for type I (Immediate), II, III and IV (delayed)	4
2.	Autoimmunity and Autoimmune diseases: Immunological tolerance – Central and peripheral tolerance Types of autoimmune diseases	1 1

	Factors contributing development of autoimmune diseases	1
	Immunopathological mechanisms, Diagnosis and treatment of autoimmune diseases: Myasthenia gravis and Rheumatoid arthritis	4
	Therapeutic immunosuppression for autoimmunity	1
3	Active and Passive Immunization 1.Active Immunization -Whole organism vaccines i. Attenuated vaccines ii. Inactivated vaccines iii. Recombinant vaccines iv. Conjugate vaccines v. Subunit vaccine vi. Toxoids 2.Passive Immunization Transfer of preformed antibodies 3.Latest Immunization schedule in India	2
4	Hybridoma Technology and Monoclonal Antibodies: Preparation, HAT selection and propagation of hybridomas secreting monoclonal antibodies Applications of monoclonal antibodies	1

References:

1. Abbas A. K. and Lichtman A. H. (2004). Basic Immunology- Functions and Disorders of Immune System. 2 nd Ed. Saunders. Elsevier Inc. PA. USA.
2. Aderem A., and Underhill D. M. (1999). Mechanisms of phagocytosis in macrophages. Annu.Rev. Immunol. 17: 593-623.
3. Austin J. M. and Wood K. J. (1993). Principles of Molecular and Cellular Immunology. Oxford University Press, London
4. Barret J. D. (1983). Text Book of Immunology. 4th edition, C. V. Mosby and Co. London.
5. Bendelac A. Savage P. B. and Teyton L. (2007). The biology of NKT cells. Annu RevImmunol. 25: 297-336.
6. BIOTOL Series. (1993). Biotechnology by open learning series. Defense Mechanisms. Butterworth and Heinemann Ltd., Oxford
7. Bohlson S. S., Fraser D. A. and Tenner A. J. (2007). Complement proteins C1q and MBL are pattern recognition molecules that signal immediate and long-term protective immunefunctions. Mol. Immunol. 44: 33-43.
8. Chatterji C. C. (2002). Human Physiology. Vol. 1. Special reprint edition. Medical

Allied Agency, Calcutta.

9. Chatterji C. C. (2004). Human Physiology. Vol. 2. Eleventh edition. Medical Allied Agency, Calcutta.
10. De Smet K. and Contreras R. (2005). Human antimicrobial peptides: defensins, cathelicidins and histatins. Biotechnol. Lett. 27:1337–1347.
11. Fathman G., Soares L., Cha S. M. and Utz P. J. (2005). An array of possibilities for the study of autoimmunity. Nature Rev. 435(2):605-611
12. Ganz T. (2003). Defensins: antimicrobial peptides of innate immunity. Nat. Rev. Immunol., 3:710–720.
13. Guyton A. C. and Hall J. E. (1996) Text Book of Medical Physiology, Goel Book Agency, Bangalore.
14. Janeway C. A., Travers P. Jr., Walport M. and Shlomchik M. J. (2005). Immunobiology Interactive. Garland Science Publishing, USA.
15. Kindt T. J., Goldsby R. A. and Osborne B. A. (2007). Kuby Immunology. 6th Ed. W. H. Freeman and Co., New York
16. Kuby J. (1996) Immunology. 7th Ed. W. H. Freeman and Co, New York
17. Pancer Z. and Cooper M. D. (2006). The Evolution of Adaptive Immunity, Ann. Rev. Immunol., 24: 497–518
18. Pathak S. S. and Palan V. (1997) Immunology - Essential and Fundamental. Preen Publications Bombay.
19. Roitt E., Brostoff J. and Male D. (1993) Immunology. 6th Ed. Mosby and Co. London.
20. Roitt I. M. (1988). Essentials of Immunology. ELBS, London.
21. Roitt M. (1984). Essentials of Immunology. P. G. Publishers Pvt. Ltd., New Delhi.
22. Stites D. P., Stobo J. D., Fudenberg H. H. and Wells J. V. (1982). Basic and Clinical Immunology. 14th Ed. Lange Medical Publications. Maruzen Asia Pvt. Ltd., Singapore
23. Talwar G. P. (1983) Handbook of Immunology, Vikas Publishing Pvt. Ltd. New Delhi.
24. Zanetti M. (2005). The role of cathelicidins in the innate host defense of mammals. Curr. Issues Mol. Biol. 7:179–196.



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology
(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Metabolism
Course Code	23SBMB62MM
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To learn mechanisms of transport of solutes across the membrane.
2.	To study the concept of Bioenergetics
3.	To get acquainted with mechanism of biosynthesis and degradation of Biomolecules.
4.	To comprehend basic concept of Bacterial photosynthesis

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the different mechanisms of transport of solutes across the membrane.
2.	Students will study the concept of Bioenergetics
3.	Students will learn mechanism of biosynthesis and degradation of biomolecules.
4.	Students will understand basic concept of Bacterial photosynthesis.

Syllabus

Unit No	Title with Contents	No. of lectures
Credit I	Membrane transport and Bioenergetics	15
1	Membrane transport mechanisms: i. Passive transport - Diffusion, Osmosis, Facilitated transport ii. Active transport - Active transport systems in bacteria iii. Group translocation of sugars in bacteria iv. Ionophores: Mechanism and examples	05
2	Bioenergetics: i. Laws of thermodynamics- first and second law ii. Concepts of free energy, entropy, high energy compounds: Pyrophosphate, enolic phosphates, acyl phosphates, thioester compounds, and guanidinium compounds iii. Mitochondrial electron transport chain: components, arrangement of different components in the inner membrane, structure and function of ATP synthetase, inhibitors and uncouplers of ETC and oxidative phosphorylation, energetics of mitochondrial electron transport chain	01 04 05
Credit II	Metabolic pathways and Bacterial Photosynthesis	15
1	Biosynthesis and Degradation: a. Chemistry, concept of polymerization of macromolecules: Polysaccharides. (Starch, and peptidoglycan) and Lipids (Fatty acids, triglycerides and phospholipids) b. Degradation of macromolecules – Polysaccharides (starch), Lipids (fatty acids oxidation e.g. β oxidation), Proteins (urea cycle)	05 05
2	Bacterial Photosynthesis: i. Examples of photosynthetic bacteria ii. Photosynthetic apparatus iii. Oxygenic and Anoxygenic mechanisms iv. Calvin cycle and its regulation	05

References

1. Berg J. M., Stryer L., Tymoczko J. and Gatto G. (2019). Biochemistry.9th Edition. Palgrave Macmillan. ISBN-978-1319114657.
2. Conn E. E., Stumpf P. K., Bruening G. and Doi R. H. (1987). Outlines of Biochemistry.5th Edition. John Wiley and Sons. ISBN-13: 9780471052883
3. Hall D. A. and Krishna Rao K. (1994). Photosynthesis (Studies in Biology). 6th Edition. Cambridge University Press, London. ISBN-13: 978-1-133-10629-6
4. Garrett R. H. and Grisham C. M. (2013). Biochemistry.5th Edition. Brooks/Cole, Publishing Company, California. ISBN-13: 978-1-133-10629-6
5. Katoch R. (2011). Analytical Techniques in Biochemistry and Molecular Biology. Springer New York. ISBN 978-1-4419-9785-2.
6. Nelson D. L. and Cox M. M. (2021). Lehninger's Principles of Biochemistry.8th Edition. Mac Millan Worth Pub.Co. New Delhi. ISBN:9781319228002
7. Palmer T. (2001) Enzymes: Biochemistry, Biotechnology and Clinical chemistry. Horwood Pub. Co. Chinchester, England. ISBN-9781898563785.
8. Segel I. H. (2010). Biochemical Calculations. 2nd Ed. Wiley India Pvt. Limited. ISBN: 9788126526437
9. Stanier R. Y., Adelberg E. A. and Ingraham J. L. (1985). General Microbiology. 4th Edition. London: Macmillan.
10. Wilson K. and Walker J. (Editors) (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th edition. Cambridge University Press, New York. ISBN-13: 978-0521731676.



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B. Sc Microbiology
(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Genetics and Molecular Biology
Course Code	23SBMB63MM
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To get introduced to concept of recombination and bacteriophage Genetics
2.	To demonstrate the knowledge of common and advanced laboratory practices in Molecular Biology
3.	To exhibit a knowledge base in Genetics and Molecular Biology.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	To exhibit a knowledge base in Genetics and Molecular Biology
2.	To understand the concept of cloning in bacteria
3.	To construct genetic map of bacteria and fungi by mapping techniques
4.	To get introduced to concept of recombination and bacteriophage Genetics
5.	To demonstrate the knowledge of common and advanced laboratory practices in Molecular Biology

Syllabus

Unit No	Title with Contents	No. of Lectures
Credit I	Fungal and Bacteriophage Genetics	15
	1. Fungal Genetics. a. Mendel's laws b. Eukaryotic Cell cycle, Mitosis, Meiosis c. Life cycle and gene mapping by Tetrad analysis in <i>N.crassa</i> d. Life cycle and gene mapping by Parasexual cycle in <i>A. nidulans</i>	05
	2. Bacteriophage Genetics. a. Lytic and lysogenic cycles in Virulent and temperate phages. (Eg s - T-series / Lamda phage) b. Concept of a plaque, Phage enumeration by plaque assay. c. Bacteriophage mutants : Plaque morphology (r t ype), Host range and Conditional lethal mutants (Ts and Am) d. Concept of Genetic Complementation , Cis-Trans test e. Latest applications of Bacteriophages. f. Concept of CRISPER-CAS system.	10
Credit II	DNA repair mechanisms and RDT	15
	3.DNA damage and Repair mechanisms a. Concept and types of DNA damages (hydrolysis, deamination, alkylation, oxidation and Radiation) b. DNA repair by Photo reactivation c. DNA repair by Mismatch repair mechanism d. DNA repair by Excision repair mechanisms (BER/NER)	03
	4.Recombinant DNA Technology-Tool sand basics of recombinant DNA technology a. Introduction to recombinant DNA technology b. Restriction enzymes: Nomenclature, properties and types with specific examples (Eco R1, SmaI, PstI).	09

	c. Vectors: Features of an ideal vector i. Plasmids: pBR322 ii. Bacteriophage vectors: Lambda iii. Cosmids d. Joining of DNA molecules by DNA Ligases (<i>E. coli</i> and T4 phage), linkers, adaptors and homopolymer tailing. e. Methods to transfer recombinant DNA into bacterial host cells (Physical – Electroporation, Gene gun, Chemical – CaCl ₂ mediated, liposome mediated) f. Methods of screening recombinants using selectable markers and Blue-White screening	
	5. Molecular techniques used in RDT- Principle, applications and methodology of- a. Southern blot b. Northern blot c. Western blot d. PCR	03

References:

1. Birge E. A. (2013). Bacterial and Bacteriophage Genetics. Springer, New York. ISBN: 9781475732580
2. Brooker R. J. (2012). Genetics: Analysis and Principles. 4th edition. McGraw- Hill Publication.
3. Brown T. A. (2006). Gene Cloning and DNA Analysis. Blackwell Publication. 5th Edition. ISBN: 1405111216
4. Brown T.A. (2016). Gene Cloning and DNA Analysis: An Introduction. 7th Ed. Wiley Blackwell Publication, U.S.A. ISBN: 978-1-119-07254-6
5. Clokie M. R. J. and Kropinski A. M. (editors): Bacteriophage: Methods and Protocols.
6. Clutterbuck A. J. (1996). Parasexual recombination in fungi. J. Genet. 75(3): 281-286, @ Indian Academy of Sciences
7. Dubey R. C. (2014). Advanced Biotechnology. S. Chand Publishing. ISBN: 9788121942904
8. Freifelder D. (2005). Molecular Biology. 2nd Edition. Narosa Publishing House Pvt. Limited, India.
9. Gardner E. J., Simmons M. J. and Snustad D. P. (2006). Principles of Genetics. 8th edition. John Wiley and Sons Publication. ISBN-13: 9788126510436
10. Goodenough U. (2016). Genetics. Publisher: Holt, Rinehart and Winston. ISBN- 13: 978-0030197161



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology

(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Practical course: Metabolism and Molecular Biology
Course Code	23SBMB64MM
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To make students aware about the clinical aspects of biochemistry.
2.	To make students aware about concept and preparation of buffers, qualitative and quantitative biochemical techniques.
3.	To make them understand basic concept of genomic DNA isolation and its detection.
4.	To introduce basic techniques in phage biology.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will learn the estimation of anlysts from clinical samples by biochemical techniques.
2.	Students will learn basic concept, calculations and preparation of buffers along with qualitative and quantitative biochemical techniques.
3.	Students will be acquainted with concept, principle and methodology of genomic DNA isolation and its detection using agarose gel electrophoresis.
4.	Students will understand isolation and enumeration of bacteriophages from natural sources.

Syllabus

Expt. No.	Topics	No. of Practicals
1	Clinical Biochemistry - Estimations of i) Blood sugar ii) Blood urea iii) Serum cholesterol iv) Serum proteins	4
2	Preparation of buffers	2
3	Estimation of total carbohydrates from natural sources by Phenol Sulphuric acid method.	2
4	Spot tests for Proteins	1
5	Spot tests for Carbohydrates	1
6	Isolation and Enumeration of Bacteriophages (Principle , Methodology and Calculations of phage titer in PFU's/ml)	3
7	Isolation of Genomic DNA from bacteria (Demonstration)	1
8	Agarose Gel Electrophoresis for DNA detection. (Demonstration)	1
	TOTAL	15



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology

(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Practical course: Industrial and Food Microbiology
Course Code	23SBMB65MM
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr.No.	Objectives
1.	To make students aware about laboratory scale production of ethanol
2.	To make them understand about alcohol and sugar tolerance for yeast
3.	To introduce concept of probiotic micro flora
4.	To make them learn importance of microorganisms in food spoilage and use of heat in controlling microbial growth

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will learn about production of ethanol at laboratory scale
2.	Students will learn to isolate probiotic micro flora and food spoilage causing organisms
3.	Students will be acquainted with significance of high temperature in controlling food spoilage
4.	Students will understand HACCP guidelines and importance of sanitary status of eatery

Syllabus

Expt. No.	Topics	No. of Practicals
1	Laboratory Scale production of the fermentation products: a. Ethanol (fermentation, recovery by simple distillation, estimation of end product by CAN method and fermentation efficiency)	3
2	Study of alcohol and sugar tolerance for yeast	1
3	Production and detection of amylase by shake flask or solid substrate cultivation / Bread making	2
4	Isolation and identification of probiotic micro flora from natural sources or any commercial formulation.	2
5	Isolation of microorganisms causing spoilage of vegetables/fruits/bread/sweets	1
6	Determination of TDP value	1
7	Determination of TDT value	1
8	Determination of D value	1
9	HACCP guidelines for food industry (activity based)	1
10	Evaluation and validation of sanitary status of an eatery i. Examination of micro flora from table surface ii. Utensils	2
	TOTAL	15

References:

1. Casida L. E., Jr. (2019). Industrial Microbiology, New Age International Publishers, New Delhi. ISBN- 9788122438024
2. Patel A. H. (2016). Industrial Microbiology. Trinity Press (Publisher). ISBN-13- 9789385750267
3. Meshram S. U. and Shinde G. B. (2009). Applied Biotechnology. I.K. International Publishing House Pvt. Ltd., New Delhi.
4. <https://www.hindawi.com/journals/ijmicro/2020/8865456/>.
5. Frazier W. C., Westhoff D. C. and Vanitha N. M. (2013). Food Microbiology. 5th edition. McGraw Hill education, India.

6. Jay J. M. and Loessner M. J. (2005). Modern Food Microbiology. 7th edition. Springer. ISBN 978-0- 387-23413-7.
-



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B.Sc. Microbiology

(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Fermentation Technology II
Course Code	23SBMB61MEA
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand Solid state and Submerged state fermentations
2.	To study the parameters of large scale fermentations.
3.	To acquaint with large scale fermentations of Primary Metabolites and Secondary metabolites
4.	To learn about biomass-based products in large scale fermentations
5.	To understands the concepts and skills essential for industrial biotechnology, pharmaceuticals and bioengineering applications.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the concepts of Solid state and Submerged state fermentations
2.	Students will understand the Significance of large scale fermentations of Primary Metabolites and Secondary metabolites
3.	Students will become aware about the biomass-based products in large scale fermentations

Fermentation Technology– II
Syllabus

Unit No.	Title with Contents	No. of Lectures
Credit I	Solid state and Submerged state fermentations and large scale fermentations	15
1.	Introduction to Solid State Fermentation and Submerged Fermentation: Process, production strains, media, fermenter design, fermentation conditions, applications, merits and demerits	1
2.	Large scale production of (process with flow sheet, nature of the product, production pathway, applications, production strains, media, fermentation process, parameters, product recovery) a. Primary Metabolites: i. Vitamins (B12 and B2) ii. Amino acids - Glutamic acid, Lysine iii. Organic acids (Citric acid, Vinegar) b. Secondary metabolites: i. Bioethanol Alcoholic Beverages - Beer (Lagering, Maturation, Types of beer) Wine (Aging, Malo-lactic acid fermentation, types of wine, wine defects, comparison of white and red wine) Antibiotics [Penicillin (natural and semi synthetic) and Streptomycin]	3 3 2 1 2 3
Credit II	Large scale production of enzymes, steroids, biomass-based products, milk products, vaccines, immune sera and Modern trends in microbial production	15
1.	Enzymes Amylase Esterases Proteases	2 2 2

2.	Microbial transformation of steroids	2
3.	Biomass based products: i. Yeast: Baker's and Distiller's yeast ii Probiotics: Lactobacillus sporogenes	2 2
4.	Milk products: Cheese (Processed, soft, semi-hard, hard ripened types- bacterial and mold)	1
5.	Vaccines: Tetanus – Tetanus toxoid (TT) Rabies – HDCC, Chick embryo cell line, Vero cell line as per Serum Institute	1 1
6.	Immune sera: Anti-tetanus serum (ATS) Anti-rabies serum (ARS)	1 1

References: MB 365 Fermentation Technology- II

1. Arora D.K. (Editor). (2003). Fungal Biotechnology in Agriculture, Food and Environmental Applications (Mycology). CRC Press. ISBN 9780824747701.
2. Casida L. E. J. R. (2016). Industrial Microbiology. New Age International Private Limited. ISBN- 9788122438024
3. Patel. A. H. (2016). Industrial Microbiology. Trinity Press (Publisher). ISBN-13-9789385750267
4. Peppler H. L. and Perlman D. (1979). Microbial Technology. Volume 1: Microbial Processes. Academic Press, New York. ISBN: 978-0-12-551501-6
5. Peppler H. L. and Perlman D. (1979). Microbial Technology. Volume II: Fermentation Technology (2nd Edition). Academic Press. ISBN: 9781483268279
6. Reed G. (Editor). (1982). Prescott and Dunn's Industrial Microbiology. Westport, CT, AVI Publishing Co Inc.
7. Van Damme E. J. (1984) Biotechnology of Industrial Antibiotics. Marcel Dekker Inc. New York. ISBN-13: 978-0824770563

8. Wiseman A. (1983) Topics in Enzyme and Fermentation – Biotechnology. Volume 7. EllisHorwood Limited, Publishers: Chichester. John Wiley and sons, New York.

9. Reference links:

Guidelines for Tetanus Vaccine production:

https://www.who.int/biologicals/vaccines/Tetanus_Recommendations_TRS_980_Annex_5

<https://academic.oup.com/jimb/article-pdf/18/5/340/34773995/jimb0340.pdf>.

Large scale production of rabies vaccine:

Large scale production of tetanus vaccine:

[http://nopr.niscair.res.in/bitstream/123456789/26533/1/JSIR%2060%2810%29%20773-](http://nopr.niscair.res.in/bitstream/123456789/26533/1/JSIR%2060%2810%29%20773-778.pdf)

778.pdf.10.USA Clinical Laboratory Standards Institute (CLSI) Guidelines 2021:

<https://clsi.org/>



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

**T.Y.B.Sc. Microbiology
(Autonomy NEP 2023 Pattern)**

Course/ Paper Title	Nanobiotechnology
Course Code	23SBMB61MEB
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To study fundamentals of nanobiotechnology
2.	To train students in biogenic synthesis and characterization of Nanoparticles.
3.	To obtain understanding of various biomedical applications of nanoparticles and nanomaterials.
4.	To understand design, development and application of Nanomaterials

**Expected Course Specific Learning
Outcome**

Sr. No.	Learning Outcome
1.	Students will get complete understanding of basic concepts in Nanobiotechnology
2.	Students will get theoretical knowledge about design, development and application of Nanoparticles and Nanomaterials.
3.	Students will get practical training in biogenic synthesis and characterization of Nanoparticles. These skills will help them to apply for job opportunities in Nanobiotechnology field

Syllabus

Unit No	Topic	No. of Lectures
Credit I	1. Introduction to Nano-biotechnology:	15
	a. Introduction to nanoscale, nanomaterials, nanoscience and nanotechnology b. Nanoscale bioassemblies - Liposomes, viruses, DNA, polysaccharides and proteins (Protein nanotubes, nanofibers, peptide nanoparticles). c. Biomedical applications of bioassemblies - Cell targeting, drug delivery, bioimaging and vaccine development. Microbial mediated metallic nanoparticles synthesis: a. Gold nanoparticles (AuNPs) b. Silver nanoparticles (AgNPs) c. Au-Ag alloy nanoparticles d. Oxide nanoparticles e. Magnetic nanoparticles f. Non-magnetic oxide nanoparticles g. Sulfide nanoparticles etc. Characterization techniques for nanomaterials: UV-visual spectroscopy, Fourier transform infrared (FTIR), X-ray diffraction	6 5 4
Credit II	Applications of nanoparticles:	15
1	Antibacterial agent, drug delivery, biosensor, animal industry and nanotechnology in wastewater treatment	6
2	Microbial synthesis of metallic nanoparticle synthesis (any two)	3
3	Detection and Characterization of metallic nanoparticles in colloidal solutions by: a. UV-Spectrophotometer b. FTIR analysis	3

4	Application of nanoparticles- checking antimicrobial activities against the microbial synthesized metallic nanoparticles (any two)	3
---	--	---

References:

1. Bujold K. E., Lacroix A., and Sleiman H. F. (2018). DNA Nanostructures at the Interface with Biology. Chem. 4: 495–521. Elsevier Inc.
2. Chokriwal A., Sharma M. M. and Singh A. (2014). Biological synthesis of nanoparticles using bacteria and their applications. American Journal of PharmTechResearch. 4(6):38-61.
3. Das R. K., Pachapur V. L., Lonappan L., Naghdi M., Pulicharla R., Maiti S. and Brar S. K. (2017). Biological synthesis of metallic nanoparticles: plants, animals and microbial aspects. Nanotechnology for Environmental Engineering. 2(1): 1-21.
4. Doll T. A. P. F., Raman S., Dey R. and Burkhard P. (2013). Nanoscale assemblies and their biomedical applications. JR Soc Interfac <http://dx.doi.org/10.1098/rsif.2012.0740>
5. Gurunathan S., Kalishwaralal K., Vaidyanathan R., Venkataraman D., Pandian S. R. K., Muniyandi J., Hariharan N. and Soo Hyun Eom. (2009). Biosynthesis, purification and characterization of silver nanoparticles using *Escherichia coli*. Colloids and Surfaces B. 74(1): 328–335.
6. Fariq A., Khan T. and Yasmin, A. (2017). Microbial synthesis of nanoparticles and their potential applications in biomedicine. J. Appl. Biomed. 15: 241–248
7. Li X., Xu H., Chen Z. S. and Chen G. (2011). Biosynthesis of nanoparticles by microorganisms and their applications. Journal of Nanomaterials. 2011.

8. Madkour L. H. (2019) Introduction to Nanotechnology (NT) and Nanomaterials (NMs). In: Nanoelectronic Materials. Advanced Structured Materials, vol 116. Springer, Cham. https://doi.org/10.1007/978-3-030-21621-4_1
9. MohdYusof H., Mohamad R., Zaidan U. H. and Rahman N. A. A. (2019). Microbial synthesis of zinc oxide nanoparticles and their potential application as an antimicrobial agent and a feed supplement in animal industry: a review. *J Animal SciBiotechnol.* 10(57): <https://doi.org/10.1186/s40104-019-0368-z>
10. Rajput N. and Bankar A. (2017). Bio-inspired gold nanoparticles synthesis and their antibiofilm efficacy. *J. Pharm. Investig.* 47: 521–530.
11. Rattan R., Shukla S., Sharma B. and Bhat M. (2021). A mini review on lichen-based nanoparticles and their applications as antimicrobial agents. *Front. Microbiol.* <https://doi.org/10.3389/fmicb.2021.633090>
12. Salame P. H., Pawade V. B. and Bhanvase B. A. (2018). Characterization tools and techniques for nanomaterials. *Nanomaterials for Green Energy*: 83–111. doi:10.1016/b978-0-12-813731-4.00003-5
13. Shukla M. and Shukla P. (2020) Microbial nanotechnology for bioremediation of industrial wastewater. *Front. Microbiol.* 590631. <https://doi.org/10.3389/fmicb.2020>.
14. Tiquia-Arashiro S. and Rodrigues D. (2016). Nanoparticles Synthesized by Microorganisms. In *Extremophiles: Applications in Nanotechnology*. 1-51. Springer, Cham.
15. Xiangqian Li, Huizhong Xu, Zhe-Sheng Chen, and Guofang Chen. (2011). Biosynthesis of nanoparticles by microorganisms and their applications nanostructures for medicine and pharmaceuticals Volume 2011 |Article ID 270974 | <https://doi.org/10.1155/2011/270974>



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

T.Y.B. Sc Microbiology

(Autonomy NEP 2023 Pattern)

Course/ Paper Title	Food Microbiology
Course Code	23SBMB62MEA
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To Identify and classify types of microorganisms in food processing and compare their Characteristics and behavior
2.	To learn food classification based on their perishability, intrinsic and extrinsic factors affecting the growth of microbes in foods, role of microorganisms in food fermentation.
3.	To acquire knowledge about food spoilage, food borne diseases, predisposition and preventive and control measures

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the different types of microorganisms in food processing with respect to their classification and role.
2.	Students will learn classification of foods and different parameters affecting food spoilage.

3.	Students will understand the importance of food borne diseases and their control measures.
-----------	--

Syllabus

Sr.No.	Topic	No. of Lectures
Credit I	Introduction to properties of food and spoilage of food	15
1	Classification of food- Perishable, non-perishable, and stable	1
	i. Definition of food	1
	ii. Sensory or organoleptic factors- appearance factors- size, shape, color, gloss, consistency, wholeness	1
	iii. Textural factors- texture changes	1
	iv. Flavor factors (taste, smell, mouthfeel, temperature)	1
2	Factors affecting Microbial growth in food	
	i. Intrinsic factors- pH, water activity, O-R potential, nutrient content, biological structure of food, inhibitory substances in food. ii. Extrinsic factors- Temperature of storage, Relative humidity, concentration of gases	6
	i. Sources of food spoilage microorganisms ii. Contamination and spoilage of perishable foods- a. Vegetables and fruits b. Meat and meat products c. spoilage of canned foods	1 3
Credit II	Food Preservation and food in relation to disease	15
1	Principles of food preservation a. Importance of TDP, TDT, D, F, Z values b. Use of low and high temperature for food preservation. c. Use of chemicals and antibiotics in food preservation, d. Canning e. Dehydration f. Use of radiation g. Tetra pack technology h. Food grade bio preservatives	10

2	Microbial food poisoning and food infection a. Food poisoning - <i>Clostridium botulinum</i> , <i>Aspergillus flavus</i> b. Food infection- <i>Salmonella typhimurium</i> , <i>Vibrio parahaemolyticus</i>	4
3	Concept of Prebiotic and Probiotic and fermented food-	1

References:

1. Banwart G. J. (1989). Basic Food Microbiology. 2nd edition. Chapman and Hall. International Thompson Publishing.
 2. Frazier W. C., Westhoff D. C. and Vanitha N. M. (2013). Food Microbiology. 5th edition. McGraw Hill education, India.
 3. Garbutt J. (1997). Essentials of Food Microbiology. Taylor and Francis. ISBN: 9780340677018
 4. Jay J. M. (2012). Modern Food Microbiology. Netherlands: Springer Netherlands. ISBN: 9789401164818
 1. Jay J. M. and Loessner M. J. (2005). Modern Food Microbiology. 7th edition. Springer. ISBN 978-0-387- 23413-7
 6. Makun H. A. (2016). Significance, Prevention and Control of Food Related Diseases. Croatia: IntechOpen. ISBN: 9789535122777
 7. Peñas. E., Frias J. and Villaluenga C. M. (2016). Fermented Foods in Health and Disease Prevention. Netherlands: Elsevier Science. 9780128025499
 8. Preedy V. R. (2015). Probiotics, Prebiotics, and Synbiotics: Bioactive Foods in Health Promotion. Netherlands: Elsevier Science. ISBN: 9780128023716
 9. Ray B. (2019). Food Biopreservatives of Microbial Origin. United States: CRC Press. ISBN: 9781351080514
 10. Sivasankar B. (2009). Food processing and preservation. PHI Learning Pvt. Li
-



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune- 1

(Autonomous) Affiliated to Savitribai Phule Pune University

NAAC accredited 'A' Grade

**T.Y.B.Sc. Microbiology
(Autonomy NEP
2023 Pattern)**

Course/ Paper Title	Waste Management
Course Code	23SBMB62MEB
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand waste management and its practicable applicability.
2.	To assess the magnitude and influence of hazardous content of waste, pollution of water and waste water treatment technologies
3.	To impart the understanding of kinetics of biological systems used in waste treatment
4.	To learn the standards of waste management and competent authorities involved at National and international level.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	The awareness of waste management and its practicable applicability will be created in students
2.	Students will acquire knowledge of magnitude and influence of hazardous content of waste, pollution of water and waste water treatment technologies
3.	This course will help students to understand kinetics of biological systems used in waste treatment
4.	Students will learn the standards of waste management and competent authorities involved at National and international level.

Syllabus

Unit No.	Title with Contents	No. of Lectures
Credit I	A. Liquid Waste Management	15
	1. Principles of Wastewater Treatment i. The need for treatment of wastewater ii. General characteristics of liquid waste - pH, Colour Turbidity, Odor, Electrical conductivity, COD, BOD, Total Solids, Total Dissolved Solids, Total Suspended Solids, Total Volatile Solids, Chlorides, Sulphates, Oil and Grease.	5
	2. Microbiology of Wastewater Role of microorganisms in wastewater treatment i. Aerobic and Anaerobic digestion models; attached / anchored and suspended growth. ii. Removal of pathogenic microbes, indicator microbes, enumeration of different types of microbes	5
	3. Unit operations in wastewater treatment plant i. Collection system - Methods of collection, conservancy systems, water carriage system, sewerage system. ii. Screen chamber, Grit chamber, Oil and grease removal iii. Stabilization pond, Aerated lagoon iv. Activated sludge process, Trickling filter v. Rotating biological contactors, anaerobic digestion processes, fluidized bed reactor.	5

Credit II	B. Solid Waste Management and hazardous waste	15
	1. Characterization of solid wastes: Dairy and e-waste 2. Biomedical waste: Definition, Types, Processing 3. Solid biodegradable waste processing: Composting, Vermicomposting, Biogas production 4. Post-processing by-products of municipal solid waste treatment: leachate refused-derived fuel (RDF)	2 2 2 3
2	Determination of Solids in wastewater: Total Solids, Suspended Solids, Dissolved Solids, Volatile Solids, Fixed Solids, Settleable Solids	2
3	Determination of Dissolved Oxygen, BOD and COD of waste water (before and after treatment) (MPCB Standards)	2
4	Preparation of Project report based on a case study (Hotel/ Industry-Dairy, Food processing). Study of the source, generation rates and characteristics of hazardous wastes and their regulation, handling, treatment, and disposal. Special emphasis is placed on process design of waste handling, treatment and disposal systems.	2

References

1. Chandrappa R. and Das D. B. (2012). Solid Waste Management-Principles and Practice. In Environmental Science and Engineering. Springer (Firm).
2. Dutta S., Neela Priya D., Chakradhar B. and Sasi Jyothsna T.S. (2019) Value Added Byproducts Recovery from Municipal Solid Waste in Waste Valorisation and Recycling. Springer, Singapore.
3. Masters G. M. (1994). Introduction to Environmental Engineering and Science. Prentice Hall of India (Private) Ltd., New Delhi.
4. Metcalf and Eddy (Eds.) 2003. Wastewater Engineering – Treatment and Reuse. 4th Edition. Tata Mac Graw Hill Publishing Co. Ltd. New Delhi.

5. Pichtel J. (2014). Waste Management Practices- Municipal, Hazardous and Industrial. 2nd edition. CRC Press.
6. Prakash S. (2009). Biotechnology for Water and Wastewater Treatment. Navyug Publishers and Distributors, New Delhi.
7. Rajaram V., Siddiqui F. Z., Agrawal S. and Khan M. E. (2016). Solid and liquid waste management- Waste to wealth. PHI Learning Private Limited, New Delhi, India
8. Ramachandran T. V. (2009). Management of Municipal Solid Waste. Centre for Ecological Sciences, IISc Karnataka Research Foundation. India
9. Rangwala S. C. (2005). Water supply and sanitary engineering. Charotar Publishing House, India
10. Standard Methods for the Examination of Water and Wastewater. (2017). 23rd Edition. American Public Health Association, American Water Works Association, and Water Environment Federation
11. Tchobanoglous G. and Kreith F. (2002). Handbook of solid waste management. 2nd edition. McGraw-Hills Professional.
12. Tchobanoglous G., Burton F. L. and Stensel H. D. (2003). Wastewater Engineering, Treatment, Disposal and Reuse. 4th Ed., Metcalf and Eddy (Editors). Mc Graw Hill Companies. Inc.
13. Wesley Eckenfelder W. Jr. (2000). Industrial Water Pollution Control. 3rd Edition. McGraw Hill.