

GUJARAT VIDYAPITH: AHMEDABAD
Faculty of Science and Applied Science, Sadra,
Department of Biogas Research and Microbiology
Course Structure For M.Sc Microbiology (Semester I to IV)
Effective from June 2023

Availability of time for direct teaching in each semester = 15weeks = 517.5 hours (15weeks × 34.5 hours)

Monday to Friday (excluding prayer and recess)= 30 hours (6 hours × 5 days)

Saturday (excluding prayer and recess) = 4.5 hours

Therefore 1week = 34.5 hours

M.Sc. Semester-1							
Sr. no	Broad Category of Course	Subject Name	Semester	Hours		Credits	
				Theory	Practical	Theory	Practical
1	Major (Core)	Microbiology (Microbial Diversity)	First	45	60	3	2
2	Major (Core)	Microbiology (Microbial Physiology)	First	45	60	3	2
3	Major (Core)	Microbiology Bio-instrumentation	First	45	60	3	2
4	Major (Core)	Microbiology (Immunology)	First	45	60	3	2
5	Community Life	Community Life	First	-	-	-	-
Total				180	240	12	8

Available Total Credits= 20 Total required hours per semester=420

Total available hours per semester=517.5 hours

Available hours per week= 34.5 hours

Calculation of required hours per week

12 credits for theory=**12 hours**

8 credits for practicals=**16 hours**

Total required hours per week=28 hours

Extra hours =6.5 hours (we can arrange tutorial class, remedial class, library class and other co-curricular activities during these hours).

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MIC 101-Microbial Diversity (Theory)

Credits-3

Teaching Hours- 45

Learning outcomes:-

1. Student will understand the evolution of life.
2. Student will understand the distribution of microorganisms in different ecosystems.
3. Student will understand the role of microorganisms in extreme environment and their importance.

Unit I	Microbial Evolution and Taxonomy		11 h
	1	Origin of earth and life	
	2	Microbial evolution and biogeochemical cycles	
	3	Impact of oxygen, Endosymbiotic evolution, Origin of ozone layer, Evolutionary chronometers	
	4	Sequence of Major events during biological evolution	
	5	Taxonomy of Eubacteria and Archaea- Nomenclature, classification, Identification	
	6	Nomenclature, Bergey's Manual- The nature of bacterial identification schemes, prokaryote or eukaryote, the four major categories of bacteria, groups within the four major categories of bacteria	
Unit II	Basics of Microbial Diversity		11 h
	1	Prokaryotic diversity: Bacteria- Purple and Green bacteria, Cyanobacteria, Prochlorophytes, Spirilla, Pseudomonads, Free-living aerobic nitrogen fixing bacteria, and Filamentous Actinomycetes Eukarya- Algae, Protozoa	
	2	Microbial metabolism of Hydrogen	
	3	Aerobic metabolism of Glucose	
	4	Aerobic metabolism of Methane and Methanol	
	5	Microbial metabolism of carbon dioxide	
Unit III	Extremophiles		11 h
	1	Extremes of environmental conditions allowing bacterial growth and survival	
	2	Extremophilic microbes- acidophiles, alkaliphiles, psychrophiles, halophiles, thermophiles, Taxonomy and physiology of Extremely Halophilic Archaea	
	3	Microbial diversity of rumen	
	4	Microbial diversity of desert ecosystem	
Unit IV	Conservation strategies and Application of Microbial Diversity		12 h
	1	The challenges of studying microbial diversity	
	2	Microbial diversity loss- causes and restoration	
	3	National Biodiversity Strategy and Action Plan	
	4	Biotechnology of artificial cells including application to artificial organs	
	5	Biotechnology applied to Raw Mineral Processing, Microbially Enhanced Oil Recovery	
	6	Microbial diversity and biodegradation of xenobiotics	
	7	Exploitation of fungal and cyanobacterial diversity	
	8	Societal issues of biotechnology	

MIC 101-Microbial Diversity (Practical)

Credits-2

Teaching Hours- 60

Sr. No.	Practical
1	Study of Physiological diversity of microorganisms
2	Study of Metabolic diversity of microorganisms
3	Study of fungal diversity
4	Diversity study of various habitats

References

1	Brock Biology of Microorganisms” Eighth Edition By- Madigan, T.M.; Martinko, J.M. and Parker, J. Prentice Hall Publication, U.K.
2	Microbiology: Dynamics & Diversity, - Perry JJ and Staley JT, Saunders College Publishing, US
3	Microbiology: Diversity, Disease and the Environment, by Abigail A Salyers and Dixie D Whitt, Fitzgerald Science Press, Maryland
4	Bergey’s Manual of Determinative Bacteriology, by John G Holt, Noel R Krieg, Peter HA Sneath, James T Staley and Stanley T Williams, Lippincott Williams & Wilkins, Maryland
5	Biology Life on Earth, by Audesirk & Audesirk, Macmillan Publishing Company, New York
6	Manual of Industrial Microbiology and Biotechnology, Second Edition Editor-in Chief- Arnold, L.; Demain and Julian, E. Davies Editors- Ronald, M. Atlas; Gerald Cohen; Charles, L. Hershberger; Wei-Shou Hu; David, H. Sherman; Richard, C. Willson and David Wu, J.H. ASM Press, Washington
7	Global Biodiversity Status of The Earth’s Living Resources, Editor-Groombridge, B. Chapman and Hall Publication, London.
8	Global Biodiversity Assessment, Editor-Heywood, V.H. and Watson, R.T. Cambridge University, Press.
9	Biodiversity of Microbial Life, Editor-Staley, JT and Reysenbach, A.L, Wiley-Liss Publication, NY.
10	Molecular Biotechnology: Principles and Applications of Recombinant DNA, by Bernard R. Glick, Jack J Pasternak, Cheryl L Patten.
11	The Prokaryotes-A Handbook on The Biology of Bacteria: Ecophysiology, Isolation, Identification, Application, Second Edition, Volume-I Editors-Balows, A.; Truper, H.G.; Dworkin, M.; Harder, W. and Schleiffer, K.H. Springer-Verlag Publication, New York.

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MIC 102- Microbial Physiology (Theory)

Credits-3

Teaching Hours- 45

Learning Outcomes:-

1. Student will understand the different metabolic activity.
2. Student will understand the effect of radiation, inorganic and organic components on microbes.

Unit I	Microbial Growth	11 h
	1 Bacterial growth and its kinetics: Definition, trophophase and idiophase, Diauxic growth, Maximum growth rate, Specific growth rate, Yield co-efficient	
	2 Continuous growth and its kinetics: Continuous culture, Dilution rate, Residual substrate concentration	
	3 Factors affecting growth: Temperature, pH, Oxygen, Salt concentration, Pressure, Water activity, Radiation	
	4 Growth measurement: Direct methods and indirect methods	
	5 Control of microbial growth: Physical agents and chemical agents	
Unit-II	Membrane Trasport, Physiological Adptations and Intercellular Signaling	11 h
	1 Cytoplasmic Membrane and Transport- Membrane Structure, The Functions of cytoplasmic membrane, Nutrient Transport	
	2 Physiological Adaptation and Intercellular signaling- Overview of Regulation of gene expression, Bioluminescence, Signal Transduction and its Molecular mechanisms, Mechanism of drug resistance, Quorum Sensing, Cellular Differentiation, Microbial Stress Responses	
Unit- III	Physiological and Metabolism Diversity of Fungi	12 h
	1 Introduction to fungal physiology	
	2 Morphology of yeasts and fungi- Filamentous fungi, Yeasts	
	3 Ultrastructure and function of fungal cells- The fungal cell surface, Subcellular architecture and organelle function	
	4 Fungal nutrition and cellular biosynthesis- Chemical requirements for growth, Fungal cultivation media, Nutrient uptake and assimilation, Overview of fungal biosynthetic pathways, Fungal cell wall growth	
	5 Fungal metabolism- Carbon catabolism, Nitrogen metabolism	
	6 Fungal growth and reproduction- Physical requirements for growth, Cellular reproduction, Population growth, Fungal cell death	
Unit-IV	Diversity of Heterotrophic and Autotrophic Metabolism	11 h
	1 Metabolic Strategies for Generating Cellular Energy	
	2 Respiration- Oxydative Phosphorylation, Aerobic Chemoorganotrophic Process, Anaerobic Respiration	
	3 Autotrophy (The Calvin Cycle, Other Autotrophic pathways, Nitrogen Metabolism)	

MIC 102- Microbial Physiology (Practical)

Credits-2

Teaching Hours- 60

Sr. No.	Practical
1	Growth Kinetics: Calculation of Generation time, Growth rate , μ_{Max} Substrate utilization (Glucose -Coles method)
2	Growth Measurement by Biomass (Fungal culture), Gravimetric Method
3	Factors affecting growth: pH, Temperature, Aeration, Agitation, Carbon source, Nitrogen source
4	Measurement of Water Activity (A_w)
5	Measurement of Death Rate of Bacteria
6	Whole cell mass determination of yeast and fungi under different conditions

References

1	Walker, G.M. and White, N.A. 2017. Introduction to fungal physiology. In: K. Kavangh, ed. Fungi: biology and applications. John Wiley & Sons
2	Microbial Physiology (4 th Ed.) 2002, Albert G. Moat, John W. Foster, Micheal P. Spector Willey-Liss, A John Willey and Sons, Inc
3	The Cell, A Molecular Approach (4 th Ed.) 2007, Geoffrey M. Cooper, Robert E. Hausman, ASM Press, Washington D.C.
4	Brock Biology of Microorganisms” E(14 th Ed.) 2015, Madigan, Martinko, Bender Burckley, stahl, Person International Education
5	Lehninger, Principles of Biochemistry (4 th Ed.) 2005, David L. Nelson, Micheal M. Cox, W. H. Freeman and company, New york
6	Microbs (2006) Schaechter, M, Ingraham, J.L. and Neidhardt, F.C. ASM Press, Washington DC
7	Microbiology: An Introduction (2004), Tortora, G.J., Funke B.R. and Case C.L., Benjamin Cummings, San Francisco
8	Prescott. Harley and Kleings, Microbiology (7 th Ed.) Willey Sherwood Woolverton, McGraw Hill International Edition
9	Principles of Microbiology (2 nd Ed.) Ronals M. Atlas

GUJARAT VIDYAPITH, AHMEDABAD
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MIC 103- Bioinstrumentation (Theory)

Credits-3

Teaching Hours- 45

Learning Outcomes:-

1. Student will learn principles, working and applications of various instruments.
2. Student will understand the application of various instruments for analysis.

Unit I	Principle, Instrumentation and Applications		11 h
	1	Principle and application of scanning and transmission electron microscopy, scanning tunneling microscopy, confocal microscopy	
	2	PCR and Sequencing Techniques	
Unit II	Specialized Spectroscopy: (Principle, Instrumentation and Applications)		12 h
	1	Infrared Spectroscopy, Flame emission Spectroscopy and Atomic absorption spectroscopy	
	2	Nuclear Magnetic Resonance Spectroscopy, Electron Spin Resonance Spectroscopy, Mass Spectroscopy- MALDI-TOF and X- Ray Spectroscopy.	
Unit III	Separation Techniques :1: (Principle, Instrumentation and Applications)		11 h
	1	Chromatography: Paper; TLC; Conventional Column Chromatography- Ion- Exchange; Affinity; Adsorption	
	2	Specialized Technique-I: GLC- Column; Detectors. HPLC: Pumps; Columns; Instrumentation	
	3	Specialized Technique-II: HPTLC, FPLC	
Unit IV	Separation Techniques: 2: (Principle, Instrumentation and Applications)		11 h
	1	Centrifugation Techniques: Types of centrifugation; Rate Zone; Isopycnic; High speed; Ultra; preparative; Gradient	
	2	Electrophoretic Techniques: Native, SDS, Agarose and 2D; Zone EP; Isoelectric; Slab Gel; DISC EP; Immuno EP; Pulsed Field; Cellular Gel EP.	

MIC 103- Bioinstrumentation (Practical)

Credits-2

Teaching Hours- 60

Sr. No.	Practical
1	Estimation of Carbohydrates by Anthrone's Method.
2	Estimation of Reducing Sugars by DNSA Method.
3	Estimation of Carbohydrate by Nelson Somogyi's Method
4	Estimation of Protein by Folin Lowry's Method.
5	Determination of Compounds by Chromatography: Paper, TLC Separation of bacterial lipids/amino acids/sugars/organic acids by TLC or Paper Chromatography.
6	Analysis of Elements by Flame Photometer
7	Separation of serum protein by horizontal submerged gel electrophoresis.
8	Quantitative estimation of hydrocarbons/pesticides/organic
9	Demonstration of HPLC, HPTLC and AAS.
10	Demonstration of Fermenters
11	Separation of biomolecules by gel filtration

References

1	Instrumental methods of chemical analysis. <i>Sharma B.K.</i>
2	Instrumental methods of analysis. <i>Skoog D.A.</i>
3	An introduction to practical Biochemistry. <i>Plummer.</i>
4	Instrumentation: Spectroscopy. <i>Chatwal and Anand.</i>
5	Modern experimental Biology. <i>Boyer.</i>
6	Biochemistry. 6th Edition. <i>Freeman, New York. . Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006)</i>
7	Biophysics: An Introduction. John Wiley & Sons, England. <i>Cotterill, R. M. J. (2002)</i>
8	Principles of protein X-ray crystallography. 3rd Ed. Springer, Germany. . <i>Drenth, J. (2007)</i>
9	Biochemistry. 3rd Ed. Brooks/Cole, Publishing Company, California. <i>Garrett, R. H. and Grisham, C. M. (2004)</i>
10	Understanding NMR Spectroscopy. John Wiley & Sons, England. <i>Keeler, J. (2002)</i>
11	Methods in modern biophysics. Second Edition. Springer, Germany. <i>Nölting, B. (2006)</i>
12	Biophysics. Kluwer Academic Publishers, New York and Narosa Publishing House, Delhi. <i>Pattabhi, V. and Gautham, N. (2002)</i>
13	Principles and Techniques of Biochemistry and Molecular Biology, 6th Ed. Cambridge University Press, New York. <i>Wilson Keith and Walker John (2005).</i>
14	Biosensors: An Introduction, Brain Eggins, Wiley Teuinee

GUJARAT VIDYAPITH, AHMEDABAD
BIOGAS RESEARCH AND DEPARTMENT OF MICROBIOLOGY, AHMEDABAD
MIC-104: Immunology (Theory)

Credits-3

Teaching Hours- 45

Learning outcomes:-

1. Student will learn about basic concepts of immunology.
2. Students will learn in detail about Antigens and Antibodies.
3. Students will understand the application of immunology.

Unit I	General principles of immunology:		10 h
	1	Structure, composition and function of cells and organs involved in immune system. Immune response (humoral and cell mediated) innate immunity, acquired immunity	
	2	Antigens – antibodies: Antigens-structure and properties; types-iso and allo; haptens adjuvants, antigen specificity. Membrane receptors for antigens; immunoglobulins; structure-heterogeneity-types and subtypes-properties; theories of antibody production	
Unit II	Antigen and antibody interactions:		10 h
	1	<i>In vitro</i> methods-agglutination, precipitation, complement fixation, immunofluorescence, ELISA, radio immunoassay; <i>in vivo</i> methods; phagocytosis, opsonization, neutralization	
	2	Complement system; complement components. complement activation - pathways,regulation of complement system, biological consequences of complement activation, complement deficiencies	
Unit III	Histocompatibility and Tumor immunology:		15 h
	1	Immunogenetics: Structure, distribution and functions of histocompatibility antigens. Major histocompatibility gene complex (MHC) and the HLI-A system; gene regulation and immune response (IR) genes; HL-A and tissue transplantation- tissue typing methods for organ and tissue transplantations in humans; graft versus host reaction and rejection.	
	2	Tumor immunology: Tumor immunology - tumor antigens, Host immune response to tumors, antibody dependent cell cytotoxicity (ADCC), tumor escape mechanisms Immuno diagnosis and therapy	
Unit IV	Dysfunctional immunity and applied immunology:		10 h
	1	Immunopathology: Classification of immunopathological disorders. General account of immune deficiency disorders. Primary and secondary, phagocytic cell disorder. Gammopathies. Complement deficiencies. Hypersensitivity reactions: type I, II, III and IV the respective diseases, immunological methods of their diagnosis. Autoimmunity mechanism and diseases	
	2	Immuno biotechnology: Isolation of spleen cells, Myeloma cell lines used as fusion partner, fusion method, detection and application of monoclonal antibodies, types of vaccines, whole - organism vaccines, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccines, subunit vaccines, immunization procedures, adverse reactions to vaccines	

MIC-104: Immunology (Practical)

Credits-2

Teaching Hours- 60

Sr. No.	Practical
1	Ouchterlony double diffusion (Ab titration)
2	Ouchterlony double diffusion (Antigen – Antibody titration)
3	DOT ELISA
4	Single radial Immuno diffusion
5	Rocket immune electrophoresis
6	RA test
7	Immuno electrophoresis
8	Quantitative precipitin assay
9	Antibody labelling

References

1	Essentials of Immunology by Riott I .M. 1998. ELBS, Blackwell Scientific Publishers, London
2	Immunology 2 nd Edition by Kuby J. 1994. W.H. Freeman and Co. New York
3	Immunology - Understanding of Immune System by Claus D. Elgert. 1996. Wiley - Liss, New York
4	Fundamentals of Immunology by William Paul
5	Cellular and Molecular Immunology. 3rd Edition by Abbas
6	Immunobiology: The Immune System in Health and Disease. 3rd Edition by Travers
7	Immunology- A short Course. 2 nd Edition by Benjamin
8	Manual of Clinical Laboratory and Immunology 6th Edition. 2002 by Noel R. Rose, Chief Editor: Robert G. Hamilton and Barbara Detrick (Eds.) , ASM Publications
9	Pocket Guide to Clinical Microbiology. 2 nd Edition. 1998 by Patrick R. Murray, ASM Publications