VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM&SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN MICROBIOLOGY

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

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VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS) MAJOR IN MICROBIOLOGY
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons.)	1st	I	**SEMESTER-I**							
			Major-1	**MCBHMJ101**	**T: Introduction to Microbiology & Microbial Diversity** **P: Introduction to microbiology and Microbial Diversity - Lab**	**4**	**3-0-1**	**15**	**60**	**75**
			SEC	**MCBSEC01**	**P: Biosafety and instrumentation**	**3**	**0-0-3**	**10**	**40**	**50**
			AEC	**AEC01**	Communicative English -1 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			MDC	**MDC01**	Multidisciplinary Course -1 (***to be chosen from the list***)	**3**	**3-0-0**	**10**	**40**	**50**
			VAC	**VAC01**	ENVS (***common for all programmes***)	**4**	**2-0-2**	**50**	**50**	**100**
			Minor-1 (Disc.-I)	**MCBMI01**	**T: Introduction and Scope of Microbiology; P: Practical** ***(To be taken from other Discipline)***	**4**	**3-0-1**	**15**	**60**	**75**
			Semester-I Total			**20**				**400**
		II	**SEMESTER-II**							
			Major-2	**MCBHMJ102**	**T: Bacteriology** **P: Bacteriology - Lab**	**4**	**3-0-1**	**15**	**60**	**75**
			SEC	**MCBSEC02**	**P: Microbial Analysis of Air and Water**	**3**	**0-0-3**	**10**	**40**	**50**
			AEC	**AEC02**	MIL-1 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			MDC	**MDC02**	Multi Disciplinary Course-02 (***to be chosen from the list***)	**3**	**3-0-0**	**10**	**40**	**50**
			VAC	**VAC02**	Value Added Course-02 (***to be chosen from the list***)	**4**	**4-0-0**	**10**	**40**	**50**
			Minor-2 (Disc.-II)	**MCBMI02**	**T: Prokaryotic microbes : Bacteria and Virus; P: Practical** ***(To be taken from other Discipline)***	**4**	**3-0-1**	**15**	**60**	**75**
			Summer Intern.	**CS**	Community Service	**4**	**0-0-4**	**-**	**-**	**50**
			Semester-II Total			**24**				**400**
			TOTAL of YEAR-1			**44**				**800**

MJ = Major, MI = Minor Course, SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, VAC = Value Added Course; CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language, ENVS = Environmental Studies

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MAJOR (MJ)

MJ-1: Introduction to Microbiology & Microbial Diversity **Credits 04**
(Full Marks: 75)

MJ-1T: Introduction to Microbiology & Microbial Diversity **Credits 03**

Course contents:

UNIT 1: Historical Developments and Scope
An overview of Scope of Microbiology for human welfare. Theory of biogenesis and abiogenesis, Development of microbiology as a discipline: Contribution of Anton von Leeuwenhoek, Louis Pasteur, Joseph Lister, Alexander Fleming, Robert Koch; Germ theory of disease, Development of the field of soil microbiology: Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky work of Paul Ehrlich and Elie Metchnikoff,

UNIT 2: Microbial Classification
Systems of classification Binomial Nomenclature, Whittaker's five kingdom: Protista and Monera, Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms, General characteristics of different groups: Acellular microorganisms and Cellular microorganisms with emphasis on distribution, economic importance.

UNIT 3: Bacteria and virus
General Characteristics, structure, shape, size, genome and organization of bacteria and viruses. Classification of bacteria and viruses, Pattern of reproduction of bacteria, life cycle of viruses.

UNIT 3: Algae and fungi
General characteristics, Classification, ultra-structure: thalllus organization, Pigments reproduction, life cycles in micro algae with suitable examples: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles, General characteristics and Classification, nutritional types, fungal cell ultra-structure: thallus organization, reproduction, heterokaryosis, heterothallism and parasexual mechanism.

UNIT 4: Protozoa
Classification, General characteristics and significance with special reference to *Amoeba, Paramecium, Plasmodium and Giardia.*

Suggested Readings:

1. Microbiology: An Introduction. 9th edition. Pearson Education. Tortora GJ, Funke BR and Case CL. (2008).
2. Brock Biology of Microorganisms.14th edition. Pearson International Edition. Madigan MT, Martinko J.M, Dunlap P.V and Clark D.P. (2014).
3. Prescott's Microbiology. 9th Edition. McGraw Hill International.
4. Principles of Microbiology. 2nd edition. WM.T.Brown Publishers. Atlas RM. (1997).
5. Microbiology. 5th edition. McGraw Hill Book Company. Pelczar MJ, Chan ECS and Krieg NR. (1993).
6. General Microbiology. 5th edition, McMillan. Stanier R.Y, Ingraham J.L, Wheelis M.L, and Painter P.R. (2005).

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MJ-1P: Introduction to microbiology and Microbial Diversity - Lab **Credits 01**

General Experiments:

1. To study the principle and applications of important instruments used in the microbiology laboratory.
2. Preparation of culture media for bacterial cultivation.
3. Sterilization of medium using Autoclave and assessment for sterility
4. Sterilization of glassware using Hot Air Oven and assessment for sterility
5. Demonstration of the presence of microbes by exposing nutrient agar plates to air.
6. Isolation of fungus from different natural samples.
7. Study of *Penicillium* and *Aspergillus* using temporary mounts
8. Study of *Chlamydomonas and Volvox* using permanent Mounts/Photographs.
9. Study of the following protozoans (atleast any two) using permanent mounts/photographs: *Amoeba*, *Entamoeba*, *Paramecium* and *Plasmodium*

Suggested Readings:

1. Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited. Cappucino. J and Sherman N. (2010).
2. Practical Microbiology, 1st edition, S. Chand. R. C. Dubey and D. K. Maheswari (2010)

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MJ-2: Bacteriology **Credits 04 (Full Marks: 75)**

MJ-2T: Bacteriology **Credits 03**

Course contents:

UNIT 1: Cell organization
Cell size, shape and arrangement, capsule, cilia, flagella and motility, fimbriae and pili, Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids Endospore: Structure, formation, stages of sporulation Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative bacteria, Achaea: Archaebacterial cell wall, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms.

UNIT 2: Bacteriological techniques
Pure culture isolation: Streaking, serial dilution and plating methods (spread plate and pour plate); maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, Microscopy: Bright Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Scanning and Transmission Electron Microscope, Bacterial staining: Gram and acid fast staining, Negative-staining.

UNIT 3: Bacterial growth, reproduction and control
Nutritional requirements in bacteria and nutritional types; Culture media: natural media, synthetic media, complex media, selective and differential media, enriched and enrichment media, phases of growth, logarithmic representation of bacterial populations, calculation of generation time and specific growth rate. Reproduction in bacteria: Asexual methods of reproduction, Parasexual reproduction (conjugation and transduction), Physical methods of microbial control: high and low temperature, filtration, desiccation, osmotic pressure, radiation Chemical methods of microbial control: disinfectants, types and mode of action.

UNIT 4: Bacterial Systematics
Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches for bacterial taxonomy, Phylogenetic classification, rRNA oligonucleotide sequencing and protein sequences. Differences between eubacteria and archaebacteria; Important archaeal and eubacterial groups and their characteristics and significance: Thermophiles, Methanogens, Halophiles, Chemoautotrophic bacteria, Photosynthetic bacteria (Cyanobacteria), Mycoplasma.

Suggested Readings:

1. Principles of Microbiology. 2nd edition. WM.T.Brown Publishers. Atlas RM. (1997).
2. Microbiology: Principles and Explorations. 7th edition. Prentice Hall Black JG. (2008).
3. Understanding Bacteria. Kluwer Academic Srivastava S and Srivastava PS. (2003), Publishers, Dordrecht
4. General Microbiology. 5th edition McMillan. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005).
5. Microbiology: An Introduction. 9th edition Pearson Education. Tortora GJ, Funke, BR, and Case CL. (2008).
6. Prescott's Microbiology. 9th edition. McGraw Hill Higher Education. Willey JM, Sherwood LM, and Woolverton CJ. (2013).

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MJ-1P: Introduction to microbiology and Microbial Diversity - Lab **Credits 01**

General Experiments:

1. Demonstration of Negative staining
2. Demonstration of Gram's staining
3. Demonstration of Acid fast staining-permanent slide only.
4. Demonstration of fungal staining.
5. Demonstration of algal staining.
6. Enumeration of bacterial population by spread plate method from water/soil sample.
7. Isolation of pure cultures of bacteria from water/soil sample.
8. Study of the culture characteristic of bacteria on nutrient agar surface.
9. Preservation of bacterial cultures by application of low temperature.

Suggested Readings:

1. Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited. Cappucino. J and Sherman N. (2010).
2. Practical Microbiology, 1st edition, S. Chand. R. C. Dubey and D. K. Maheswari (2010)

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MINOR (MI)

MI – 1: Introduction and Scope of Microbiology **Credits 04 (Full Marks: 75)**

MI – 1T: Introduction and Scope of Microbiology **Credits 03**

Course contents:

Unit I: History and Development of Microbiology

Scope of Microbiology, Contributions of Anton von Leeuwenhoek, Louis Pasteur, Alexander Fleming, Robert Koch, Germ theory of disease, Theory of biogenesis and abiogenesis.

Unit II: Diversity of Microorganisms

Microorganism's position in Whittaker's five kingdom and Carl Woese's three kingdom classification systems, General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Prokarya: Archaea and Bacteria, Eukarya : Algae, Fungi and Protozoa), Definitions and citing examples of Protozoa ; Methods of nutrition, locomotion & reproduction - Amoeba, and *Plasmodium*.

Unit –III: Instrumentation

Bright Field Microscope, Principles and application Electron Microscope (TEM and SEM), Phase contrast microscope, Flouroscence microscope, Sterilization process: Autoclave, Tyndallization, Hot Air Oven, Filteration.

Unit-IV: Microbiological techniques

Culture media: natural media, synthetic media, complex media, selective and differential media, enriched and enrichment media, Pure culture isolation: Streaking, serial dilution and plating methods (spread plate and pour plate); maintenance and preservation/stocking of pure cultures; Bacterial staining: Gram and acid fast staining, Negative-staining, Physical methods of microbial control: high and low temperature, filtration, desiccation, osmotic pressure, radiation Chemical methods of microbial control: disinfectants, types and mode of action.

Suggested Readings:

1. Microbiology: An Introduction. 9th edition. Pearson Education. Tortora GJ, Funke BR and Case CL. (2008).
2. Brock Biology of Microorganisms. 14th edition. Pearson International Edition. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014)
3. Principles of Microbiology. 2nd edition. WM.T.Brown Publishers, Atlas RM. (1997).
4. Microbiology. 5th edition. McGraw Hill Book Company. Pelczar MJ, Chan ECS and Krieg NR. (1993).
5. General Microbiology. 5th edition. McMillan. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005).

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MI-1P: Introduction and Scope of Microbiology (Practical) **Credits 01**

General Experiments

1. To study the principle and applications of important instruments used in the microbiology laboratory
2. Preparation of culture media for bacterial cultivation
3. Sterilization of medium using Autoclave and assessment for sterility
4. Sterilization of glassware using Hot Air Oven and assessment for sterility
5. Demonstration of presence of micro flora in the environment by exposing nutrient agar plates to air.
6. Demonstration of Gram's staining procedure.
7. Demonstration of sub culturing techniques.
8. Preservation of bacterial culture at low temperature.

Suggested Readings:

1. Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited. Cappucino J and Sherman N. (2010).
2. Practical Microbiology, Dubey and Maheshwari ,S.Chand Publication, First edition 2002

MI-2: Prokaryotic microbes: Bacteria and Virus **Credits 04 (Full Marks: 75)**

MI-2T: Prokaryotic microbes: Bacteria and Virus **Credits 03**

Course contents:

Unit 1: Cell organization of bacteria
Cell size, shape and arrangements, capsule, flagella and pili, Composition and detailed structure of gram-positive and gram-negative cell wall and archaeal cell wall, Structure, chemical composition and functions of bacterial and archaeal cell membranes, Ribosomes, inclusions, nucleoid, plasmids, structure, formation and stages of sporulation

Unit 2: Bacterial growth and control
Culture media: Components of media, Synthetic or defined media, Complex media, enriched media, selective media, differential media, enrichment culture media
Pure culture isolation: Streaking, serial dilution and plating methods, cultivation, maintenance and stocking of pure cultures, cultivation of anaerobic bacteria
Growth: Binary fission, phases of growth

Unit 3: Bacterial Systematics and Taxonomy
Taxonomy, nomenclature, systematics, types of classifications Morphology, ecological significance and economic importance of different group of bacteria.

Unit 4: Introduction to Viruses
Properties of viruses; general nature and important features Subviral particles; viroids, prions and their importance Isolation and cultivation of viruses

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Unit 5: Structure and multiplication of viruses

Morphological characters: Capsid symmetry and different shapes of viruses with examples Viral multiplication in the Cell: Lytic and lysogenic cycle.

Description of important viruses: salient features of the viruses infecting different hosts - Bacteriophages (T4 & Lambda); Plant (TMV & Cauliflower Mosaic Virus), Human (HIV & Hepatitis viruses).

MI-2P: Prokaryotic microbes: Bacteria and Virus (Practical) Credits 01

Course Outline:

1. Preparation of different media: Nutrient agar, Nutrient broth
2. To perform simple staining and Gram's staining of the bacterial smear
3. To perform spore staining
4. Isolation of pure cultures of bacteria by streaking method
5. Enumeration of colony forming units (CFU) count by spread plate method/pour plate
6. Study the morphological structures of viruses (DNA and RNA) and their important characters using electron micrographs
7. Study of the methods of isolation and propagation of plant viruses
8. Study of cytopathic effects of viruses using photographs

Suggested Readings:

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP (2014). Brock Biology of Micro- organisms. 14th edition. Pearson Education, Inc.
3. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition. McMillan
4. Carter J and Saunders V(2007). Virology; principles and Applications. John Wiley and Sons
5. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR Skalka, AM (2004) Principles of Virology, Molecular Biology, Pathogenesis and Control.2nd edition.ASM Press
6. Shors Teri (2013) Understanding Viruses 2nd edition Jones and Bartlett Learning Burlington USA
7. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
8. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education.
9. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
10. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
11. Cann AJ (2012) Principles of Molecular Virology, Academic Press Oxford UK

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SKILL ENHANCEMENT COURSE (SEC)

SEC 1: Biosafety and instrumentation **Credits 03**

SEC1P: Biosafety and instrumentation **Full Marks: 50**

Course Outline:

Unit-1: Biosafety
Basic rules and regulations related to Microbiological work, personal hygiene, sterility maintenance, Microbiological Good Laboratory Practices and Biosafety. Level of Biosafety (BSL1-BSL4).

Unit-2: Basic instrumentation in microbiology
Principle and applications of biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, water bath, shaker, light microscope, and pH meter used in the microbiology laboratory.

Unit-3: Qualitative and quantitative analysis of biomolecules
Principle and applications of quantitative analysis through colorimeter and spectrophotometer. Principle and practical applications of different chromatographic approach (TLC, paper, column).

Unit-4: Separation of biomolecules
Agarose and polyacrylamide gel electrophoresis: principle, process and applications. Principle of centrifugation and its practical applications. Concept of RCF, rpm and sedimentation coefficient, density gradient centrifugation and ultracentrifugation.

Suggested Readings:

1. Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited. Cappucino J and Sherman N. (2010).
2. Practical Microbiology, Dubey and Maheshwari ,S.Chand Publication, First edition 2002
3. Introductory Practical Biochemistry, S.K. Sawhney and Randhir Singh, Narosa publisher (2016)
4. An Introduction to Practical Biochemistry, D.T. Plummer (2001)

SEC 2: Microbial Analysis of Air and Water **Credits 03**

SEC2P: Microbial Analysis of Air and Water **Full Marks: 50**

Course Outline:

Unit-1: Aeromicrobiology
Introduction, Definition of Bioaerosol, Layers of atmosphere, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens. Factors effecting air microflora. Aeroallergens, droplet nuclei and aerosol. Air borne diseases and their management.

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Unit-2: Air Sample Collection and Analysis

Bioaerosol sampling, air samplers, methods of quantitative analysis (CFU count), culture media for bacteria and fungi. Enumeration of micro-organisms in air: Impingement in liquid, Impaction in solids, Filtration, Sedimentation, Centrifugation and Electrostatic Precipitation. Identifying characteristics of air microorganism.

Unit-3: Water Microbiology

Natural waters, atmospheric waters, surface water and ground water. Aquatic Microorganisms: lakes, ponds, streams, estuaries and marine planktons. Lotic, Lenthic and Benthic population. Hydrologic cycle, factors affecting kinds of microorganisms found in aquatic environments and nutrient cycles in aquatic environments, Zonations, Eutrophication. Water borne diseases (Giardiasis, Cholera, Viral jaundice) and their management.

Unit-4: Microbial analysis of Water

Microorganisms as indicators of water quality. Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for fecal coliforms (b) Membrane filter technique and (c) Presence/absence tests. Estimation of Biological oxygen demand (BOD). Water purification in municipal water supply. IMViC test.

Suggested Readings:

1. Microbiology: An Introduction. 9th edition. Pearson Education. Tortora GJ, Funke BR and Case CL. (2008).
2. Brock Biology of Microorganisms.14th edition. Pearson International Edition. Madigan MT, Martinko J.M, Dunlap P.V and Clark D.P. (2014).
3. Prescott's Microbiology. 9th Edition. McGraw Hill International.
4. Microbiology. 5th edition. McGraw Hill Book Company. Pelczar MJ, Chan ECS and Krieg NR. (1993).
5. Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited. Cappucino J and Sherman N. (2010).
6. Practical Microbiology, Dubey and Maheshwari ,S.Chand Publication, First edition 2002

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