B.Sc. in Microbiology Syllabus for 5th Semester
(Semester V)
(FYUGP Regulation 2022)
University of North Bengal

B.Sc. Syllabus in Microbiology according to the new curriculum and credit framework 2022

University of North Bengal

UG Syllabus scheme in microbiology for 5th Semester

Course Component	No. of Course	Credit distribution of each paper		Total credit
		Theory	Practical	
Major Course (MAJ)	4	3	1	4x4=16
Minor Course (MIN)	1	3	1	1x4=4
Internship (IARD)*	1	0	2	1x2=2
				22

*As decided centrally by University of North Bengal.

Question Pattern for MAJ, MIN (Theoretical) for 40 marks

Sl. No	Question to be answered	Out of	Marks of each question	Total Marks
1	5	8	1	5X1=5
2	3	5	5	3X5=15
3	2	4	10	2X10=20

Question carries 5 marks each may be bifurcated as 3+2 or as 5
Question carries 10 marks each may be bifurcated as 6+4 or 7+3

Major and Minor Syllabus outline for 5th Semester:

Sl. No	Paper Type	Paper Code	Paper Title	Theory Credit	Practical Credit
1.	MAJOR	UMICMAJ35009	CELL BIOLOGY	3	1
2.	MAJOR	UMICMAJ35010	ENVIRONMENTAL MICROBIOLOGY	3	1
3.	MAJOR	UMICMAJ35011	IMMUNOLOGY	3	1
4.	MAJOR	UMICMAJ35012	MEDICAL MICROBIOLOGY	3	1
5.	MINOR	UMICMIN30003	MEDICAL MICROBIOLOGY AND IMMUNOLOGY	3	1

MAJOR

Paper: MAJOR Paper Code: UMICMAJ35009 Paper Level: 300

CELL BIOLOGY

(Paper Type: Theory)
Semester –V
Lecture Hours : 45 h Marks: 40 Credits: 3

Unit 1: Structure and organization of Cell **No. of Hours: 12**

Cell Organization – Eukaryotic (Plant and animal cells) and prokaryotic, Plasma membrane: Structure and transport of small molecules; Cell Wall: Eukaryotic cell wall; Mitochondria, chloroplasts and peroxisomes; Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules

Unit 2: Nucleus **No. of Hours: 4**

Nuclear envelope, nuclear pore complex and nuclear lamina Chromatin – Molecular organization Nucleolus

Unit 3: Protein Sorting and Transport **No. of Hours: 12**

Ribosomes, Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus Lysosomes

Unit 4: Cell Signalling **No. of Hours: 5**

Signalling molecules and their receptors Function of cell surface receptors Pathways of intra-cellular receptors – Cyclic AMP pathway

Unit 5 Cell Cycle, Cell Death and Cell Renewal **No. of Hours: 12**

Eukaryotic cell cycle and its regulation, Mitosis and Meiosis, Development of cancer, causes and types, Programmed cell death

Paper: MAJOR Paper Code: UMICMAJ35009 Paper Level: 300

CELL BIOLOGY

(Paper Type: Practical)
Semester –V
Lecture Hours : 30 h Marks: 20 Credits: 1

1. Perform microscopy with a representative plant and animal cell.
2. Study of the structure of cell organelles through electron micrographs
3. Cytochemical staining of DNA – Feulgen
4. Study of polyploidy in Onion root tip by colchicine treatment.
5. Identification and study of cancer cells by photomicrographs.
6. Study of different stages of Mitosis.
7. Study of different stages of Meiosis.
8. Staining of mitochondria by Janus Green stain.

SUGGESTED READING :

1. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell.8th edition. Pearson.

2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons.Inc.

3. De Robertis, EDP and De Robertis EMF.(2006). Cell and Molecular Biology.8th edition. Lipincott Williams and Wilkins, Philadelphia.

4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition.ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA

Paper: MAJOR Paper Code: UMICMAJ35010 Paper Level: 300

ENVIRONMENTAL MICROBIOLOGY

(Paper Type: Theory)
Semester –V
Lecture Hours : 45 h Marks: 40 Credits: 3

Unit 1: Microorganisms and their Habitats — No. of Hours: 11

Structure and function of ecosystems Terrestrial Environment: Soil profile and soil microflora Aquatic Environment: Microflora of fresh water and marine habitats Atmosphere: Aeromicroflora and dispersal of microbes ,Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.

Unit 2: Microbial Interactions — No. of Hours: 8

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, Predation Microbe-Plant interaction: Symbiotic and non symbiotic interactions Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent Bacteria

Unit 3: Biogeochemical Cycling — No. of Hours: 8

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin; Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction; Phosphorus cycle: Phosphate immobilization and solubilisation; Sulphur cycle: Microbes involved in sulphur cycle

Unit 4: Waste Management — No. of Hours: 8

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill) Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment

Unit 5: Microbial Bioremediation — No. of Hours: 5

Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inroganic (metals) matter, biosurfactants

Unit 6: Water Potability **No. of Hours: 5**

Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecalcoliforms (b) Membrane filter technique and (c) Presence/absence tests

Paper: MAJOR Paper Code: UMICMAJ35010 Paper Level: 300
ENVIRONMENTAL MICROBIOLOGY
(Paper Type: Practical)
Semester –V
Lecture Hours : 30 h Marks: 20 Credits: 1

1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.

2. Isolation and enumeration of microbes (bacteria & fungi) from soil.

3. Assessment of microbiological quality of water.

4. Determination of BOD of waste water sample.

5. Study the presence of microbial activity by detecting (qualitatively) enzymes (amylase) in soil.

6. Isolation of *Rhizobium* from root nodules.

SUGGESTED READINGS

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA

2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms.14th edition. Pearson/ Benjamin Cummings

3. Maier RM, Pepper IL and Gerba CP. (2009).Environmental Microbiology. 2nd edition, Academic Press

4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York

5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg

6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA Campbell RE.(1983). Microbial Ecology.Blackwell Scientific Publication, Oxford, England.

7. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.

8. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.

9. Martin A. (1977). An Introduction to Soil Microbiology.2nd edition.John Wiley & Sons Inc. New York & London.

10. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.

11. Subba Rao NS.(1999). Soil Microbiology.4th edition. Oxford & IBH Publishing Co. New Delhi.

12. Willey JM, Sherwood LM, and Woolverton CJ.(2013). Prescott's Microbiology.9th edition. McGraw Hill Higher Education.

Paper: MAJOR Paper Code: UMICMAJ35011 Paper Level: 300

IMMUNOLOGY

(Paper Type: Theory)
Semester –V
Lecture Hours : 45 h Marks: 40 Credits: 3

Unit 1: Immune Cells and Organs **No. of Hours: 5**

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT

Unit 2: Antigens **No. of Hours: 4**

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants

Unit 3: Antibodies **No. of Hours: 6**

Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Monoclonal and Chimeric antibodies

Unit 4: Major Histocompatibility Complex **No. of Hours: 5**

Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways)

Unit 6: Generation of Immune Response **No. of Hours: 8**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance

Unit 7: Auto immunity, hypersensitivity and Immunological Disorders **No. of Hours: 9**

Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumors, tumor Antigens, causes and therapy for cancers.

Unit 8: Immunological Techniques **No. of Hours: 8**

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluoresence, Flow cytometry, Immunoelectron microscopy.

Paper: MAJOR Paper Code: UMICMAJ35011 Paper Level: 300

IMMUNOLOGY

(Paper Type: Practical)

Semester –V

Lecture Hours :30 h Marks: 20 Credits: 1

1. Identification of human blood groups.

2. Perform Total and Differential Leukocyte Count of the given blood sample.

3. VDRL test.

4. Separate serum from the blood sample (demonstration).

5. Perform immunodiffusion by Ouchterlony method.

6. Perform DOT ELISA.

7. Perform immunoelectrophoresis.

SUGGESTED READINGS

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition

Saunders Publication, Philadelphia.

2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley- Blackwell Scientific Publication, Oxford.

3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.

5. Peakman M, and Vergani D. (2009).Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.

6. Richard C and Geiffrey S. (2009). Immunology.6th edition.Wiley Blackwell Publication.

Paper: MAJOR Paper Code: UMICMAJ35012 Paper Level: 300

MEDICAL MICROBIOLOGY

(Paper Type: Theory)

Semester –V

Lecture Hours : 45 h Marks: 40 Credits: 3

Unit1 Normal microflora of the human body and host pathogen interaction No. of Hrs: 6

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS

Unit 2: Sample collection, transport and diagnosis No. of Hours: 4

Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, PCR, DNA probes).

Unit 3: Bacterial diseases **No. of Hours: 10**

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Respiratory Diseases: Mycobacterium tuberculosis Gastrointestinal Diseases: *Salmonella typhi, Vibrio cholerae*, *Escherichia coli*; Others: *Bacillus anthracis, Clostridium tetani*

Unit 4: Viral diseases **No. of Hours: 10**

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Polio, Hepatitis, AIDS, Influenza with brief description of Ebola, Japanese Encephalitis

Unit 5: Protozoan diseases **No. of Hours: 5**

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Malaria, Kala-azar

Unit 6: Fungal diseases **No. of Hours: 5**

Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention Cutaneous mycoses: Tinea pedis (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis

Unit 7: Antimicrobial agents: General characteristics and mode of action **No. of Hrs: 5**

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin Antiviral agents: Mechanism of action of Amantadine, Azidothymidine Antibiotic resistance, MDR, XDR, MRSA.

Paper: MAJOR Paper Code: UMICMAJ35012 Paper Level: 300

MEDICAL MICROBIOLOGY

(Paper Type: Practical)

Semester –V

Lecture Hours :30 h Marks: 20 Credits: 1

1. Identify bacteria (*E. coli, Salmonella, Staphylococcus, Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests

2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS.

3. Isolation and enumeration bacterial flora of skin by swab method.

4. Perform antibacterial sensitivity by Kirby-Bauer method.

5. Determination of minimal inhibitory concentration (MIC) of an antibiotic.

6. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms)

7. Study of various stages of malarial parasite in RBCs using permanent mounts.

SUGGESTED READING

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication

2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication

3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier

4. Willey JM, Sherwood LM, and Woolverton CJ.(2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education

5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms.14th edition. Pearson International Edition.

MINOR

Paper: MINOR Paper Code: UMICMIN30003 Paper Level: 200
MEDICAL MICROBIOLOGY AND IMMUNOLOGY
(Paper Type: Theory)
Semester –V
Lecture Hours : 45 h Marks: 40 Credits: 3

Unit 1 Normal microflora of the human body and host pathogen interaction No. of Hrs: 6

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection,

Unit 2: Sample collection, transport and diagnosis No. of Hours: 4

Collection, transport and culturing of clinical samples and their identification characteristics.

Unit 3: Microbial diseases No. of Hours: 8

Study the diseases and their symptoms caused by following microorganisms: Bacteria: *Escherichia coli, Salmonella typhi, Staphylococcus aureus, and Bacillus cereus*. Fungi: *Candida albicans*, *Aspergillus flavus, Histoplasma capsulatum*, Viruses: Polio, Hepatitis, Influenza, Protozoa: *Entamoeba histolytica, Plasmodium vivax, Leshmania donovani.*

Unit 4: Antimicrobial agents: General characteristics and mode of action No. of Hrs: 5

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine

Unit 5: Immune Cells and Organs No. of Hours: 4

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen

Unit 6: Antigens and Antibodies **No. of Hours: 4**

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes), Adjuvants, Structure, Types and Functions of antibodies.

Unit 7: Generation of Immune Response **No. of Hours: 5**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response

Unit 8: Autoimmunity, hypersensitivity and immunological disorder **No. of Hours: 4**

Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice).

Unit 9: Immunological Techniques **No. of Hours: 5**

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT

Paper: MINOR Paper Code: UMICMIN30003 Paper Level: 200

MEDICAL MICROBIOLOGY AND IMMUNOLOGY

(Paper Type: Practical)
Semester –V
Lecture Hours : 30 h Marks: 20 Credits: 1

1. Identify bacteria (*E. coli, Salmonella, Staphylococcus, Bacillus*) on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar
4. Perform antibacterial sensitivity by Kirby-Bauer method
5. Identification of human blood groups.
6. VDRL test.
8. To separate serum from the blood sample (demonstration).
9. To perform immunodiffusion by Ouchterlony method.

SUGGESTED READING

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication

3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ.(2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
6. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley- Blackwell Scientific Publication, Oxford.
7. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
8. Richard C and Geiffrey S. (2009). Immunology.6th edition.Wiley Blackwell Publication.