

**B.Sc. in Microbiology Syllabus for 6th Semester
(Semester VI)
(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 6th Semester

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 6th Semester:

Sl. No	Paper Type	Paper Code	Paper Title	Theory Credit	Practical Credit
1.	MAJOR	UMICMAJ36013	GENETICS	3	1
2.	MAJOR	UMICMAJ36014	RECOMBINANT DNA TECHNOLOGY	3	1
3.	MAJOR	UMICMAJ35015	PLANT PATHOLOGY	3	1
4.	MAJOR	UMICMAJ35016	ADVANCES IN MICROBIOLOGY	3	1
5.	MINOR	UMICMIN30003	MEDICAL MICROBIOLOGY AND IMMUNOLOGY	3	1

MAJOR

Paper: MAJOR Paper Code: UMICMAJ36013

GENETICS

(Paper Type: Theory)

Semester –VI

Lecture Hours : 45 h Marks: 40 Credits: 3

Unit 1 Genome Organization and Mutation

No. of Hours: 10

Genome organization: *E. coli*, *Saccharomyces*, Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of Mutations Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes

Unit 2 Mechanisms of Genetic Exchange , Plasmids

No. of Hours: 14

Transformation - Discovery, mechanism of natural competence Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted mating technique Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, Plasmid replication and partitioning, Regulation of copy number, curing of plasmids

Unit 3 Phage Genetics

No. of Hours: 4

Genetic basis of lytic *versus* lysogenic switch of phage lambda

Unit 4 Transposable elements

No. of Hours: 5

Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Drosophila (P elements), Maize (Ac/Ds) Uses of transposons and transposition

Unit 5 Mendelian Principles, Linkage and Crossing over

No. of Hours: 12

Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Epistasis, Incomplete dominance and co-dominance. Linkage and recombination of genes, Cytological basis of crossing over, Crossing over at four-strand stage, Molecular mechanism of crossing over, mapping

Paper: MAJOR Paper Code: UMICMAJ36013

GENETICS

(Paper Type: Practical)

Semester –VI

Lecture Hours : 30 h Marks: 20 Credits: 1

1. Preparation of Master and Replica Plates
2. Study the effect of chemical (HNO₂) and physical (UV) mutagens on bacterial cells
3. Study survival curve of bacteria after exposure to ultraviolet (UV) light
4. Isolation of Plasmid DNA from *E. coli*
5. Study different conformations of plasmid DNA through Agarose gel electrophoresis.
6. Demonstration of Bacterial Conjugation
7. Demonstration of bacterial transformation and transduction
8. Demonstration of AMES test

SUGGESTED READING

1. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
2. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
3. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
4. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings
5. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
6. Russell PJ. (2009). *i* Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
7. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
8. Maloy SR, Cronan JE and Friefelder D(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers

Paper: MAJOR Paper Code: UMICMAJ36014
RECOMBINANT DNA TECHNOLOGY
(Paper Type: Theory)
Semester –VI
Lecture Hours : 45 h Marks: 40 Credits: 3

Unit 1 Introduction to Genetic Engineering

No. of Hours: 2

Milestones in genetic engineering and biotechnology

Unit 2 Molecular Cloning- Tools and Strategies

No. of Hours: 15

Cloning Tools; Restriction modification systems: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases Cloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series Bacteriophage lambda and M13 based vectors Cosmids, BACs, YACs Use of linkers and adaptors Expression vectors: *E.coli* lac and T7 promoter-based vectors, mammalian ,SV40-based expression vectors

Unit 3 Methods in Molecular Cloning

No. of Hours: 10

Transformation of DNA: Chemical method, Electroporation, Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viralmediated delivery, *Agrobacterium* - mediated delivery DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern - blotting techniques, dot blot, DNA microarray analysis, SDS-PAGE and Western blotting.

Unit 4 DNA Amplification and DNA sequencing

No. of Hours: 6

PCR: Basics of PCR, RT-PCR, Real-Time PCR Sanger's method of DNA Sequencing: traditional Primer walking and shotgun sequencing

Unit 5 Construction and Screening of Genomic and cDNA libraries

No. of Hours: 6

Genomic and cDNA libraries: Preparation and uses, Screening of libraries: Colony hybridization and colony PCR, Chromosome walking and chromosome jumping

Unit 6 Applications of Recombinant DNA Technology

No. of Hours: 6

Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines, protein engineering and site directed mutagenesis

Paper: MAJOR Paper Code: UMICMAJ36014

RECOMBINANT DNA TECHNOLOGY

(Paper Type: Practical)

Semester –VI

Lecture Hours : 30 h Marks: 20 Credits: 1

1. Preparation of competent cells for transformation
2. Bacterial Transformation and calculation of transformation efficiency.
3. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis
4. Interpretation of sequencing gel electropherograms
5. Designing of primers for DNA amplification
6. Demonstration of Southern blotting

SUGGESTED READING

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
4. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. ColdSpring Harbor Laboratory Press
5. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
6. Brown TA. (2007). Genomes-3. Garland Science Publishers
7. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.

Paper: MAJOR Paper Code: UMICMAJ36015

PLANT PATHOLOGY

(Paper Type: Theory)

Semester –VI

Lecture Hours : 45 h Marks: 40 Credits: 3

Unit 1 Introduction and History of plant pathology

No. of Hours: 5

Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant landmarks in the field of plant pathology- Contributions of Anton DeBary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank, molecular Koch's postulates. Contributions of eminent Indian plant pathologists.

Unit 2 Stages in development of a disease

No. of Hours: 2

Infection, invasion, colonization, dissemination of pathogens and perennation.

Unit 3 Plant disease epidemiology

No. of Hours: 5

Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of plant diseases and its relevance in Indian context.

Unit 4 Host Pathogen Interaction

No. of Hours: 15

A. Microbial Pathogenicity

Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction).

B. Genetics of Plant Diseases

Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance: true resistance– horizontal & vertical, apparent resistance.

C. Defense Mechanisms in Plants

Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histological cork layer, abscission layer, tyloses, gums), inducible biochemical defenses [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].

Unit 5 Control of Plant Diseases

No. of Hours: 10

Principles & practices involved in the management of plant diseases by different methods, viz. regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material

Unit 6 Specific Plant diseases

No. of Hours: 8

Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control

Important diseases caused by fungi: Downy mildew of onion – *Peronospora destructor* Late blight of potato - *Phytophthora infestans* Black stem rust of wheat - *Puccinia graminis* Wilt of tomato - *Fusarium oxysporum* , Important diseases caused by phytopathogenic bacteria: Bacterial leafblight of rice, crown galls, Important diseases caused by viruses: tomato yellow leaf curl

Paper: MAJOR Paper Code: UMICMAJ36015

PLANT PATHOLOGY

(Paper Type: Practical)

Semester –VI

Lecture Hours : 30 h Marks: 20 Credits: 1

1. Investigating Plant Disease (fungal, bacterial and viral plant pathogens) Causation Using Koch's Postulates
2. Microscopic observation (size, shape, morphology) and colony morphology of the following fungal plant pathogens: - *Fusarium*, *Puccinia*.
3. Microscopic observation (size, shape, gram nature, morphology) and colony morphology of the following bacterial plant pathogens: - *Xanthomonas*, *Agrobacterium*

SUGGESTED READINGS

1. Agrios GN. (2006). Plant Pathology.5th edition. Academic press, San Diego,
2. Lucas JA. (1998). Plant Pathology and Plant Pathogens.3rd edition. Blackwell Science, Oxford.
3. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
4. Rangaswami G. (2005). Diseases of Crop Plants in India.4th edition.Prentice Hall of India Pvt.Ltd., New Delhi.
5. Singh RS. (1998). Plant Diseases Management.7th edition.Oxford & IBH, New Delhi.

Paper: MAJOR Paper Code: UMICMAJ36016

ADVANCES IN MICROBIOLOGY

(Paper Type: Theory)

Semester –VI

Lecture Hours :45 h Marks: 40 Credits: 3

Unit 1 Evolution of Microbial Genomes

No. of Hours: 15

Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pangenome, Evolution of bacterial virulence – Genomic islands, Pathogenicity islands (PAI) and their characteristics

Unit 2 Metagenomics

No. of Hours: 10

Brief history and development of metagenomics, Understanding bacterial diversity using metagenomics approach, Basic knowledge of viral metagenome, metatranscriptomics, metaproteomics and metabolomics.

Unit 3 Molecular Basis of Host-Microbe Interactions

No. of Hours: 10

Epiphytic fitness and its mechanism in plant pathogens, Type three secretion systems (TTSS) of plant and animal pathogens, Biofilms: types of microorganisms, Quorum sensing (Gram positive and gram negative)

Unit 4 Systems and Synthetic Biology

No. of Hours: 10

Networking in biological systems, Co-ordinated regulation of bacterial virulence factors, Future implications of synthetic biology with respect to bacteria and viruses

Paper: MAJOR Paper Code: UMICMAJ36016

ADVANCES IN MICROBIOLOGY

(Paper Type: Practical)

Semester –VI

Lecture Hours :30 h Marks: 20 Credits: 1

1. Extraction of metagenomic DNA from soil
2. Extraction of metagenomic DNA from water
3. PCR amplification of metagenomic DNA using universal 16s ribosomal gene primers
4. Determination of the size of PCR amplified product after agarose gel electrophoresis
5. Case study to understand how networking of metabolic pathways in bacteria takes place using softwares.
6. Estimation of biofilm formation by bacteria using crystal violet

SUGGESTED READING

1. Fraser CM, Read TD and Nelson KE. Microbial Genomes, 2004, Humana Press
2. Miller RV and Day MJ. Microbial Evolution- Gene establishment, survival and exchange, 2004, ASM Press
3. Bull AT. Microbial Diversity and Bioprospecting, 2004, ASM Press
4. Sangdun C. Introduction to Systems Biology, 2007, Humana Press
5. Klipp E, Liebermeister W. Systems Biology – A Textbook, 2009, Wiley –VCH Verlag
6. Caetano-Anolles G. Evolutionary Genomics and Systems Biology, 2010, John Wiley and Sons
7. Madigan MT, Martink JM, Dunlap PV and Clark DP (2014) Brook's Biology of Microorganisms, 14th edition, Pearson-Benjamin Cummings
8. Wilson BA, Salyers AA Whitt DD and Winkler ME (2011) Bacterial Pathogenesis- A molecular Approach, 3rd edition, ASM Press,
9. Bouarab K, Brisson and Daayf F (2009) Molecular Plant-Microbe interaction CAB International
10. Voit EO (2012) A First Course in Systems Biology, 1st edition, Garland Science

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

MEDICAL MICROBIOLOGY AND IMMUNOLOGY

(Paper Type: Practical)

Semester –VI

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.