



ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Syllabus for 4-Year UG Honours in B.Sc. (Microbiology) as Major in consonance with Curriculum framework w.e.f. AY 2025-26

Prepared by Acharya Nagarjuna University, Guntur

COURSE STRUCTURE (for Semester I to VI)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Introduction to Microbiology and Microbial Diversity	3	3
			Introduction to Microbiology and Microbial Diversity-Practical	2	1
		2	Principles of Bacteriology and Microbial Techniques	3	3
			Principles of Bacteriology and Microbial Techniques-Practical	2	1
	II	3	Fundamentals of Biochemistry and Analytical techniques	3	3
			Fundamentals of Biochemistry and Analytical techniques-Practical	2	1
		4	Microbial Physiology	3	3
			Microbial Physiology-Practical	2	1
II	III	5	Cell biology and Genetics	3	3
			Cell biology and Genetics-Practical	2	1
		6	Molecular biology and bacterial Genetics	3	3
			Molecular biology and bacterial Genetics-Practical	2	1
		7	r DNA Technology, Bioinformatics and Biostatistics	3	3
			r DNA Technology, Bioinformatics and Biostatistics-Practical	2	1
	IV	8	Basics of Immunology	3	3
			Basics of Immunology-Practical	2	1
		9	Medical Microbiology	3	3
			Medical Microbiology-Practical	2	1
		10	Agricultural Microbiology	3	3
			Agricultural Microbiology-Practical	2	1
III	V	11	Food Microbiology	3	3
			Food Microbiology-Practical	2	1

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
		12 A	Industrial Microbiology	3	3
			Industrial Microbiology-Practical	2	1
		OR			
		12 B	Fermentation Technology	3	3
			Fermentation Technology-Practical	2	1
		13 A	Environmental microbiology	3	3
			Environmental microbiology-Practical	2	1
		OR			
		13 B	Mushroom Cultivation	3	3
			Mushroom Cultivation-Practical	2	1
	VI	14 A	Clinical microbiology	3	3
			Clinical microbiology-Practical	2	1
		OR			
		14 B	Veterinary microbiology	3	3
			Veterinary microbiology-Practical	2	1
		15 A	Microbial Quality Control in Food and Pharmaceutical Industry	3	3
			Microbial Quality Control in Food and Pharmaceutical Industry-Practical	2	1
		OR			
		15 B	Microbial Biotechnology	3	3
			Microbial Biotechnology-Practical	2	1
IV	VII	16	Microbial Biochemistry and Analytical Techniques	3	3
			Microbial Biochemistry and Analytical Techniques-Practical	2	1
		17	Virology	3	3
			Virology-Practical	2	1
		18	Biology of Eukaryotic Microorganisms	3	3
			Biology of Eukaryotic Microorganisms-Practical	2	1
		19 A	Marine Microbiology	3	3
			Marine Microbiology-Practical	2	1
		OR			
		19 B	Organic Farming	3	3
			Organic Farming-Practical	2	1
	VIII	20	Microbial Metabolism	3	3
			Microbial Metabolism-Practical	2	1
		21	Molecular genetics of microorganisms	3	3
			Molecular genetics of microorganisms-Practical	2	1

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
		22	Immunology	3	3
			Immunology-Practical	2	1
		23 A	Biofertilization Technology	3	3
			Biofertilization Technology-Practical	2	1
		OR			
		23 B	Cellular microbiology	3	3
			Cellular microbiology-Practical	2	1

Note: In the III Year (during the V and VI Semesters), students are required to select a pair of electives from one of the Two specified domains. For example: if set 'A' is chosen, courses 12 to 15 to be chosen as 12 A, 13 A, 14 A and 15 A. To ensure in-depth understanding and skill development in the chosen domain, students must continue with the same domain electives in both the V and VI Semesters.

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SEMESTER-III

COURSE 5: CELL BIOLOGY AND GENETICS

Theory

Credits: 3

3 hrs/week

I. Learning Objectives:

1. Explain cell theory, organelles, the cell cycle, and cytoskeleton functions.
2. Describe cell membrane, nuclear envelope, nucleolus, and basics of cancer development.
3. Illustrate protein sorting, signal transduction, apoptosis, and specialized chromosomes.
4. Apply Mendelian genetics, including crosses, inheritance patterns, and allele frequencies.
5. Understand linkage, crossing over, Hardy-Weinberg law, natural selection, genetic drift, and sex determination.

II. Course Outcomes: On completion of this course students will be able to:

1. Distinguish prokaryotic and eukaryotic cell structures, describe major cell organelles and cytoskeletal elements, and explain the regulation of the cell cycle and mitosis.
2. Understand membrane structure and transport, nuclear organization, and basic concepts of cancer.
3. Learn about cell signaling mechanisms, protein transport pathways, and the regulation of apoptosis.
4. Gain knowledge of Mendelian inheritance and its extensions, including specialized chromosomes, pedigree analysis, multiple alleles, and epistasis.
5. Describe linkage and crossing over, apply population genetics principles, and differentiate modes of sex-linked and extranuclear inheritance.

III. Syllabus of Theory:

Unit 1

09 Hrs

- 1.1 Cell theory and cell organelles (Mitochondria, Chloroplasts, Lysosomes, Glyoxysomes and Peroxisomes, Golgi apparatus and ER).
- 1.2 Prokaryotic cell, eukaryotic cell(plant cell and Animal cell)
- 1.3 Cell cycle and its check points. Mitosis.
- 1.4 Cytoskeleton: Structure and organization. Role of actin, myosin and intermediate filaments, microtubules.

Unit 2

09 Hrs

- 2.1 Structure and functions Cell membrane, proton pumps ($\text{Na}^+ - \text{K}^+$ pump, Ca^{2+} -calmodulin, etc.) and their distribution.
- 2.2 Endocytosis: Phagocytosis, Pinocytosis, Exocytosis.
- 2.3 Nuclear envelope: Structure of nuclear pore complex, nuclear lamina, Nucleolus; Transport across nuclear membrane.
- 2.4 Elementary knowledge of cancer development and causes; Oncogenes and suppressor genes,

Unit 3

09 Hrs

- 3.1 Basic structure of cell signalling systems; first messengers and intracellular secondary messengers.
- 3.2 Cell-to-cell signalling: Eukaryotes-endocrine hormone signalling, cytokine signalling; prokaryotes-quorum sensing, bacterial pheromones.
- 3.3 Protein sorting and Transport; Intracellular signal transduction pathways (GPCR, ERK Pathway)
- 3.4 Apoptosis: Programmed Cell Death; Brief note on Stem cells



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UNIT 4**09 Hrs**

- 4.1 Mendelian Genetics: Mendel's Laws (Laws of dominance, segregation and Independent assortment).
- 4.2 Deviations from Mendel's laws: Incomplete dominance, co-dominance, epistasis.
- 4.3 Chromosome theory of inheritance: Multiple alleles, lethal alleles

Unit – 5**09 Hrs**

- 5.1 Linkage and Crossing over; Theories of linkage; Significance of Linkage.
Crossing over; Types of crossing over and mechanism of crossing over. Difference between linkage and crossing over.
- 5.2 Sex determination; Sex linked inheritance;
- 5.3 Theory of Evolution: Natural selection; Genetic drift.

IV. Co-curricular activities:

- 1. Create 3D models of cell organelles and demonstrate their functions.
- 2. Observe mitosis, cell structures, and apoptosis using prepared slides.
- 3. Solve monohybrid, dihybrid, problems.
- 4. Use interactive software or games to explore linkage, crossing over, and sex-linked inheritance.

V. Reference Books:

- 1. A.J.F Griffiths, S. R Wessler, S. B Carroll & J. Doebley, An Introduction to Genetic Analysis, 10th Ed., W.H. Freeman & Company (New York) 2010
- 2. Geoffrey M. Cooper and Robert E. Hausman - The cell a molecular approach.
- 3. Bruce Alberts, Rebecca Heald, et al. Molecular Biology Of The Cell
- 4. Arnold Berk (Author), Chris A. Kaiser (Author), Harvey Lodish (Author), Angelika Amon (Author), Molecular Cell Biology.
- 5. Benjamin Lewin Genes
- 6. Eldon John Gardner, Michael J. Simmons, D. Peter Snustad Principles of Genetics
- 7. Karp G, John Wiley Cell Biology
- 8. Jane B. Reece (Author), Martha R. Taylor (Author), Eric J. Simon (Author), Jean L. Dickey, Campbell Biology: Concepts and Connections
- 9. Veer Bala Rastogi, Genetics B D Singh, Genetics



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SEMESTER-III

COURSE 5: CELL BIOLOGY AND GENETICS

Practical

Credits: 1

2 hrs/week

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Observe and analyze cell structure, organelles, and cell viability.
2. Examine mitosis, meiosis, and identify cancer cells using microscopy.
3. Apply genetic principles to study linkage, recombination, and gene mapping.

II. Laboratory/Field exercises:

1. Yeast cell counting and Viability
2. Study a representative plant (Chlorella) and animal cell (Amoeba) by microscopy.
3. Study of ultrastructure of cell (Plasma membrane, Nucleus, Nuclear Pore Complex, Chloroplast, Mitochondrion, Golgi bodies, Lysosomes, SER and RER)
4. Demonstration of the presence of mitochondria in striated muscle cells/ cheek epithelial cell using vital stain Janus Green B
5. Mitosis from onion root tips.
6. Meiosis of flower buds.
7. Identification and study of cancer cells by photomicrographs
8. Study of Linkage, recombination using marker-based data from Drosophila.



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SEMESTER-III

COURSE 6: MOLECULAR BIOLOGY AND BACTERIAL GENETICS

Theory

Credits: 3

3 hrs/week

I. Learning Objectives:

1. Explore experiments demonstrating DNA/RNA as genetic material, prokaryotic replication, and plasmids/transposons.
2. Examine gene concepts, structure, and transcription in prokaryotes and eukaryotes.
3. Illustrate translation, genetic code, and bacterial gene regulation.
4. Analyze mutations, their molecular basis, and DNA repair mechanisms.
5. Investigate bacterial recombination through conjugation, transformation, and transduction.

II. Course Outcomes: On completion of this course students will be able to:

1. Explain the experiments demonstrating DNA/RNA as genetic material, DNA replication, and plasmids/transposons.
2. Describe gene concepts, structure, and transcription.
3. Illustrate translation and bacterial gene regulation.
4. Classify mutations and summarize DNA repair.
5. Explain bacterial recombination and its applications.

III. Syllabus of Theory:

Unit - 1: DNA/RNA as genetic material, Replication of DNA 9 Hrs.

- 1.1 DNA and RNA as genetic material (Griffith, Avery-MacLeod-McCarty Experiment, Hershey & Chase) Genome organization in prokaryotes.
- 1.2 Replication of DNA in prokaryotes. Bidirectional and unidirectional replication, Semiconservative Replication: Proof Mechanism.
- 1.3 Extrachromosomal genetic elements: General characters, types and applications of Plasmids and transposons.

Unit - 2: Concept of gene, Transcription 9 Hrs

- 2.1 Classical Concept of gene: Muton, Recon and Cistron; One gene-one enzyme, one gene-one polypeptide.
- 2.2 Modern concept of gene: Definition of gene; Open reading frame; Types of genes (structural, Constitutive and regulatory genes; Gene Slicing – concept of introns and exons
- 2.3 Transcription-Definition, mechanism of transcription.

Unit - 3: Translation and regulation of gene expression 9 Hrs.

- 3.1 Genetic code: Salient features, Wobble hypothesis.
- 3.2 Translation- Mechanisms of initiation, elongation and termination of polypeptides. Inhibitors of protein synthesis.
- 3.3 Regulation of gene expression in bacteria – lac operon.

Unit - 4: Mutations and DNA repair**9 Hrs**

- 4.1 Mutations: Definition and types of Mutations (Spontaneous and induced, Somatic and germline); Physical and chemical mutagens;
- 4.2 Molecular basis of mutations (base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions); Functional mutants (loss and gain of function mutants); Uses of mutations.
- 4.3 Outlines of DNA repair mechanisms: Direct, Excision, Mismatch, Recombination Repair, SOS Repair.

Unit - 5: Genetic recombination in bacteria**9 Hrs**

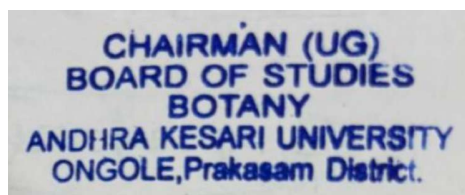
- 5.1 Conjugation- Definition, F-factor, F⁺ & Hfr, mechanism of conjugation, applications of conjugation;
- 5.2 Transformation- Discovery, mechanism of transformation, factors affecting transformation and application of transformation.
- 5.3 Transduction- discovery, mechanism and types of transduction.

IV. Co-curricular activities:

1. Prepare and present a poster or model illustrating DNA replication, plasmids, and transposons.
2. Perform a simulation or virtual lab on transcription, translation, and bacterial gene regulation.
3. Conduct a case study or discussion on mutations, DNA repair, and bacterial recombination, highlighting real-world applications.

V. Reference Books:

1. James D. Watson Tania A. Baker, Stephen P. Bell Alexander Gann, Michael Levine, Richard Losick, 2013, Molecular Biology of the Gene, 5th Edition, Pearson Edu Publishers.
2. Roger Y. Stanier, Edward A. Adelberg, John L. Ingraham, 1977, General Microbiology 5th edition, London Macmillan.
3. David Freifelder 1986 Molecular Biology 3rd edition, Jones & Bartlett Publishers
4. T.A. Brown, Gene cloning and DNA analysis- An Introduction, 4th edition
5. Bernard R. Glick and Jack. J. Pasternak, Molecular Biotechnology. 3rd edition
6. David Freifelder. Essentials of molecular biology. Jones and Bartlett Publishers, 1998



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SEMESTER-III

COURSE 6: MOLECULAR BIOLOGY AND BACTERIAL GENETICS

Practical

Credits: 1

2 hrs/week

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Isolate and visualize DNA/RNA and plasmids using electrophoresis micrographs and schematic representations.
2. Solve DNA/RNA, transcription, translation problems and study bacterial mutations.
3. Demonstrate molecular biology equipment like transformation, PCR, and ultracentrifugation.

II. Laboratory/Field exercises:

1. Isolation of genomic DNA from E. coli
2. Study of different types of DNA and RNA using micrographs and model / schematic representations
3. Study of semi-conservative replication of DNA through micrographs / schematic Representations
4. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
5. Study of different conformations of plasmid DNA through agarose gel electrophoresis.
6. Problems related to DNA and RNA characteristics, Transcription and Translation.
7. Induction of mutations in bacteria by UV light.
8. Demonstration of bacterial transformation
9. Instrumentation in molecular biology – Ultra centrifuge, Transilluminator, PCR



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SEMESTER-III

COURSE 7: r-DNA TECHNOLOGY, BIOINFORMATICS AND BIOSTATISTICS

Theory	Credits: 3	3 hrs/week
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I. Learning Objectives:

1. To learn principles, tools, and vectors used in gene cloning.
2. To understand blotting, DNA sequencing, PCR, and RFLP techniques.
3. To impart knowledge about gene libraries, recombinant DNA applications, and intellectual property rights.
4. To explore bioinformatic databases, tools, sequence alignment, and ChIP.
5. To understand measures of central tendency, dispersion, and data presentation.

II. Course Outcomes: On completion of this course students will be able to:

1. Explain the fundamental principles and tools of genetic engineering, including gene cloning steps, vectors, and DNA transformation methods.
2. Outline genomic techniques and explain major applications of recombinant DNA technology in various fields.
3. Describe key genetic engineering techniques and recognize the importance of intellectual property rights in biotechnology.
4. Utilize major bioinformatics databases and tools for sequence retrieval, alignment, and analysis.
5. Apply basic biostatistical methods for data analysis and effectively use statistical software for biological data interpretation.

III. Syllabus of Theory:

UNIT- 1: Gene cloning- Tools and techniques 9 Hrs.

- 1.1 Steps in gene cloning.
- 1.2 Cloning tools: Restriction endonucleases Type II, DNA polymerases, ligases, Exonucleases, DNase, polynucleotide kinase, Alkaline phosphatase; Use of linkers and adaptors.
- 1.3 Cloning Vectors: Plasmid (PBR 322), Bacteriophages, Cosmid, BAC, YAC, Expression vector- *E.coli* lac promoter-based vector.
- 1.4 Brief account on transformation of DNA (Chemical method, Electroporation).

UNIT- 2: Techniques in genetic engineering 9 Hrs.

- 2.1 Blotting Techniques: Southern, Northern and Western blotting techniques
- 2.2 DNA Sequencing-Sanger's method
- 2.3 Basics of Polymerase chain Reaction; RFLP.

UNIT- 3: Gene libraries, Applications of r-DNA technology and IPR 9 Hrs.

- 3.1 Genomic and c-DNA Libraries: Preparation and uses
- 3.2 Application of genetic engineering in industry, agriculture and medicine, Hybridoma Technology.
- 3.3 Outlines of Intellectual property Rights: Patents, Trademark, Copyright.

UNIT- 4: Bioinformatics**9 Hrs**

- 4.1. Bioinformatic resources: NCBI, EMBL, DDBJ, PUBMED, BIOMED.
- 4.2 Sequence Databases – GENBANK, BLAST, FASTA, ExPasy, PDB, NDB, UNIPROT – SWISS PROT.
- 4.3 Sequence alignment – Sequence homology, pairwise sequence alignment, automated DNA sequencing, ChIP.

UNIT- 5: Biostatistics**9 Hrs**

- 5.1 Measurement of central tendency: Mean, Median, Mode.
- 5.2 Measurement of dispersion: Standard Deviation, Standard error, t-test and Chi square test
- 5.3 Sample and population: Types of Data, methods of Data presentation.
- 5.4 Use of Biostatistics software: IBM- SPSS or Minitab

IV. Co-curricular activities:

- 1. Create a model or poster showing cloning steps and vectors.
- 2. Demonstrate PCR or virtual blotting techniques in a workshop.
- 3. Prepare a chart/poster on r-DNA applications and IPR concepts.
- 4. Hands-on session using BLAST or GenBank for sequence analysis.

V. Reference Books:

- 1. Brown, T. A. (2010). *Gene Cloning and DNA Analysis* (6th ed.). Blackwell Publishing, Oxford, UK.
- 2. Campbell, A. M., & Heyer, L. J. (2006). *Discovering Genomics, Proteomics and Bioinformatics* (2nd ed.). Benjamin Cummings.
- 3. Clark, D. P., & Pazdernik, N. J. (2009). *Biotechnology: Applying the Genetic Revolution*. Elsevier Academic Press, USA.
- 4. Ghosh, Z., & Bibekanand, M. (2008). *Bioinformatics: Principles and Applications*. Oxford University Press.
- 5. Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). *Molecular Biotechnology* (4th ed.). ASM Press.
- 6. Gupta, P. K. (2009). *Elements of Biotechnology* (2nd ed.). Rastogi Publications.
- 7. Pevsner, J. (2009). *Bioinformatics and Functional Genomics* (2nd ed.). Wiley-Blackwell.
- 8. Primrose, S. B., & Twyman, R. M. (2008). *Genomics: Applications in Human Biology*. Blackwell Publishing, Oxford, UK.
- 9. Ratledge, C., & Kristiansen, B. (2001). *Basic Biotechnology* (2nd ed.). Cambridge University Press.
- 10. Sambrook, J., & Russell, D. (2001). *Molecular Cloning: A Laboratory Manual* (3rd ed.). Cold Spring Harbor Laboratory Press.
- 11. Swartz, J. R. (2001). Advances in *Escherichia coli* production of therapeutic proteins. *Current Opinion in Biotechnology*, 12, 195–201.

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SEMESTER-III

COURSE 7: r-DNA TECHNOLOGY, BIOINFORMATICS AND BIostatISTICS

Practical

Credits: 1

2 hrs/week

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Isolate, digest, ligate, and amplify DNA using standard molecular biology techniques.
2. Analyse DNA fragments, interpret sequencing data, and perform RFLP analysis.
3. Retrieve and align sequences using bioinformatics tools like BLAST and Clustal W.

II. Laboratory/Field exercises:

1. Isolation of plasmid DNA by Agarose gel Electrophoresis.
2. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis.
3. Ligation of DNA fragments by using T4 DNA Ligase.
4. Amplification of DNA by PCR
5. Demonstrate RFLP
6. Interpretation of sequencing gel electropherograms.
7. Introduction to bioinformatics databases: NCBI, EMBL
8. Sequence retrieval using BLAST.
9. Sequence alignment using clustal W.



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SEMESTER-IV

COURSE 8: BASICS OF IMMUNOLOGY

Theory

Credits: 3

3 hrs/week

I. Learning Objectives:

1. Outline the basics of immunity, immune cells, and organs.
2. Describe properties, types, and interactions of antigens and antibodies.
3. Illustrate primary and secondary immune responses through cell-mediated and humoral pathways.
4. Classify hypersensitivity, autoimmune, and immunodeficiency disorders.
5. Evaluate vaccination principles, immunological diagnostic techniques, and monoclonal antibody production.

II. Course Outcomes: On completion of this course students will be able to:

1. Differentiate innate and adaptive immunity, major immune cells, and lymphoid organs.
2. Describe antigens, antibody classes and structures, and antigen-antibody interactions.
3. Illustrate MHC function, T and B cell activation, and effector mechanisms of CTLs, NK cells, antibodies, and complement.
4. Categorize hypersensitivity reactions and summarize autoimmune and immunodeficiency diseases.
5. Distinguish types of vaccines, implement immunological techniques, and assess applications of monoclonal antibodies.

III. Syllabus of Theory:

Unit 1: Introduction to Immunology:

9 Hrs

1.1. Definition, Contributions of the scientists – Edward Jenner, Karl Landsteiner, Elie Metchnikoff, MacFarlane Burnet, Neils K Jerne and Susumu Tonegawa.

Types of Immunity: Innate and acquired Immunity.

1.2 Cells of the Immune System: Structure and functions of Macrophages, Neutrophils, Basophils

and Eosinophils, Lymphocytes (B cells, T cells, NK cells), Dendritic Cells.

1.3 Organs of the Immune System: Primary (Bone marrow, Thymus, bursa fabricius) and Secondary (Lymph nodes, Spleen and lymphoid tissues) Lymphoid organs.

Unit 2: Antigens and Antibodies

9Hrs

2.1 Antigens: Definition, Types (Exogenous, Endogenous, Autoantigens), Characteristics (Foreignness, Molecular size, Heterogeneity and solubility); Haptens, Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants

2.2 Antibodies (Immunoglobulins): Basic structure (Heavy and Light Chains, Fab and Fc regions); Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); Classes of

Immunoglobulins (IgG, IgM, IgA, IgE, IgD)

2.3 Antigen-Antibody Interaction: Specificity, Avidity, Affinity; Functions of Antibodies: Immune complex formation and elimination -Agglutination, Precipitation, Neutralisation; Complement fixation, Phagocytosis



Unit 3: Generation of Immune Response**9 Hrs**

- 3.1 Primary and Secondary Immune Response; concept on Major Histocompatibility Complex.
- 3.2 Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co-stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance
- 3.2 Humoral Immunity: Generation of Humoral Immune Response (Plasma and Memory cells)
Complement System in brief: Components and functions of complement (lysis, opsonization, and inflammation)

Unit 4: Hypersensitivity and Immunological Disorders**9 Hrs**

- 4.1 Hypersensitivity Reactions (Gell and Coombs Classification):
- 4.2 Autoimmune Disorders: Rheumatoid Arthritis, Systemic Lupus Erythematosus
- 4.3 Immunodeficiency Disorders: Primary (e.g., SCID) and Secondary (e.g., AIDS) immunodeficiencies

Unit 5: Vaccines and Immunotechnology**9 Hrs**

- 5.1 Principles of Vaccination: Active vs Passive Immunization; Types of Vaccines (Live Attenuated, Inactivated, Subunit, mRNA-based); Adjuvants in Vaccines
- 5.2 Diagnostic Immunological Techniques: Principles of Precipitation, Agglutination, Immunodiffusion, ELISA, Immunofluorescence.
- 5.3 Monoclonal Antibodies: Production (Hybridoma technology); Applications in diagnostics and Therapy.

IV. Co-curricular activities:

- 1. Participate in quizzes or debates on vaccines, autoimmune diseases, or emerging immunology topics.
- 2. Create 3D models or posters of immune cells, antigen-antibody interactions, or hypersensitivity mechanisms.
- 3. Visit a diagnostic lab or vaccine research center, or attend a guest lecture by an immunologist.

V. Reference Books:

- 1. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2007). *Cellular and Molecular Immunology* (6th ed.). Saunders Publication, Philadelphia.
- 2. Delves, P., Martin, S., Burton, D., & Roitt, I. M. (2006). *Roitt's Essential Immunology* (11th ed.). Wiley-Blackwell Scientific Publication, Oxford.
- 3. Goldsby, R. A., Kindt, T. J., & Osborne, B. A. (2007). *Kuby's Immunology* (6th ed.). W.H. Freeman and Company, New York.
- 4. Murphy, K., Travers, P., & Walport, M. (2008). *Janeway's Immunobiology* (7th ed.). Garland Science Publishers, New York.
- 5. Peakman, M., & Vergani, D. (2009). *Basic and Clinical Immunology* (2nd ed.). Churchill Livingstone Publishers, Edinburgh.
- 6. Richard, C., & Geoffrey, S. (2009). *Immunology* (6th ed.). Wiley-Blackwell Publication.



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SEMESTER-IV

COURSE 8: BASICS OF IMMUNOLOGY

Practical

Credits: 1

2 hrs/week

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Identify human blood groups and perform serum separation.
2. Conduct total and differential leukocyte counts.
3. Apply immunological techniques such as immunodiffusion and DOT-ELISA.

II. Laboratory/Field exercises:

1. Identification of human blood groups.
2. Perform Total Leukocyte Count of the given blood sample.
3. Perform Differential Leukocyte Count of the given blood sample.
4. Separate serum from the blood sample (demonstration).
5. Perform immunodiffusion by RID/ Ouchterlony method.
6. Perform Dot ELISA.



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SEMESTER-IV

COURSE 9: MEDICAL MICROBIOLOGY

Theory

Credits: 3

3 hrs/week

I. Learning Objectives:

1. To summarize the role of normal microflora and host–pathogen interactions.
2. To demonstrate methods for collecting, transporting, and diagnosing microbial pathogens.
3. To describe key bacterial and viral diseases, their transmission, and control measures.
4. To classify protozoan and fungal diseases and outline their transmission and control.
5. To compare antimicrobial agents, their actions, and resistance mechanisms.

II. Course Outcomes: On completion of this course students will be able to:

1. Identify normal microflora, define infection-related terms, and differentiate opportunistic and nosocomial infections.
2. Demonstrate sample collection, apply pathogen identification techniques, and interpret diagnostic results.
3. Summarize symptoms, transmission, and prevention of tuberculosis, COVID-19, typhoid, and hepatitis A.
4. Outline symptoms, transmission, and control of malaria, amoebiasis, candidiasis, and aspergillosis.
5. Classify antimicrobial agents, describe resistance mechanisms, and perform susceptibility testing.

III. Syllabus of Theory:

Unit 1 Normal microflora of the human body and host pathogen interaction 9 Hrs

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

Unit - 2: Bacterial and Viral diseases 9 Hrs

Detailed study of the following diseases covering Symptoms, mode of transmission, pathogenesis, diagnosis, prophylaxis and control

- 2.1 Respiratory Diseases: Tuberculosis (*Mycobacterium tuberculosis*) and COVID-19 (*SARS-CoV-2*)
- 2.2 Gastrointestinal Diseases: Typhoid (*Salmonella typhi*) and Hepatitis (Hepatitis A)
- 2.3 Sexually transmitted diseases: Gonorrhea (*Neisseria gonorrhoeae*) and AIDS (*Human Immunodeficiency Virus – HIV*)

Unit - 3: Fungal diseases & Protozoa 9 Hrs

Detailed study of the following diseases covering Symptoms, mode of transmission, pathogenesis, diagnosis, prophylaxis and control

- 3.1 Candidiasis
- 3.2 Aspergillosis
- 3.3 Amoebiasis (*Entamoeba histolytica*)

3.4 Malaria (*Plasmodium* spp.)

Unit 4 Sample collection, transport and diagnosis

9 Hrs

- 4.1 Collection and transport of clinical samples,
- 4.2 Culturing, isolation, and identification of pathogens based on cultural characteristics, microscopy and biochemical/physiological properties
- 4.3 principles of diagnostic tests ELISA, Immunofluorescence, Agglutination, Complement fixation, molecular assays (PCR, DNA probes).

Unit - 5: Antimicrobial agents

9 Hrs

- 5.1 Antimicrobial agents- General modes of action of antibacterial agents (Penicillin, Streptomycin), antifungal agents (Amphotericin and Griseofulvin), Antiviral agents (Amantadine, Acyclovir) agents, Interferons.
- 5.2. Antibiotic resistance: Definition, causes, brief mechanisms (Enzymatic degradation, Target site alteration, Efflux pumps, Reduced permeability), examples (MRSA, Multidrug-resistant TB), consequences, and prevention strategies.
- 5.3 MIC Tests for antimicrobial susceptibility (Disc diffusion).

IV. Suggested extracurricular activities:

- 1. Visit a hospital or diagnostic lab to observe infection identification and discuss case studies.
- 2. Practice mock collection, labeling, and transport of clinical samples and discuss contamination prevention.
- 3. Create posters or digital presentations on diseases, highlighting symptoms, transmission, and prevention.
- 4. Design posters or digital content on proper antibiotic use, resistance, and prevention strategies.

V. Reference Books:

- 1. **Ananthanarayan R. & Paniker C.K.J.** (2009). *Textbook of Microbiology* (8th ed.). University Press.
- 2. **Brooks G.F., Carroll K.C., Butel J.S., Morse S.A., & Mietzner, T.A.** (2013). *Jawetz, Melnick, and Adelberg's Medical Microbiology* (26th ed.). McGraw Hill.
- 3. **Goering R., Dockrell H., Zuckerman M., & Wakelin D.** (2007). *Mims' Medical Microbiology* (4th ed.). Elsevier.
- 4. **Willey J.M., Sherwood L.M., & Woolverton C.J.** (2013). *Prescott, Harley and Klein's Microbiology* (9th ed.). McGraw Hill.
- 5. **Madigan M.T., Martinko J.M., Dunlap P.V., & Clark D.P.** (2014). *Brock Biology of Microorganisms* (14th ed.). Pearson.
- 6. **Patrick R. Murray** (2023). *Murray's Basic Medical Microbiology: Foundations and Clinical Cases* (2nd ed.). Elsevier. ISBN: 978-0323878104.
- 7. **Patrick R. Murray** (2023). *Medical Microbiology* (10th ed.). Elsevier. ISBN: 978-0443261336.



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SEMESTER-IV

COURSE 9: MEDICAL MICROBIOLOGY

Practical

Credits: 1

2 hrs/week

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

II. Laboratory/Field exercises:

1. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
2. Isolation of Normal flora of human body (Hands, Feet, Nostrils, Teeth Surface) by swab method.
3. Identify bacteria (any three of *E. coli*, *Salmonella*, *Pseudomonas*, *Staphylococcus*, *Bacillus*)
4. Using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC,
5. TSI, nitrate reduction, urease production and catalase tests
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
8. Antibacterial sensitivity by Kirby-Bauer method
9. Determination of minimal inhibitory concentration of an antibiotic (Streptomycin).



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SEMESTER-IV

COURSE 10: AGRICULTURAL MICROBIOLOGY

Theory

Credits: 3

3 hrs/week

I. Learning Objectives:

1. Explore soil as a microbial habitat and summarize microbial diversity and interactions.
2. Classify microbial and viral virulence factors and illustrate plant defense mechanisms.
3. Compare strategies for controlling plant diseases, including chemical, biological, and genetic methods.
4. Identify plant diseases caused by fungi, bacteria, viruses, and viroids, and outline their symptoms and spread.
5. Evaluate the role of beneficial microbes in promoting plant growth and managing pests.

II. Course Outcomes: On completion of this course students will be able to:

1. Summarize soil properties, explore microbial diversity, and outline microbe interactions.
2. Categorize virulence factors and depict plant defense mechanisms.
3. Compare disease management strategies and demonstrate GM crop applications.
4. Recognize major plant diseases and examine their symptoms and spread.
5. Differentiate biofertilizers and bioinsecticides and appraise their use in agriculture.

III. Syllabus of Theory:

Unit 1: Soil Microbiology

9 Hrs

1. Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil.
2. Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus.
3. Microbial interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non-symbiotic interactions.

Unit 2: Host Pathogen Interaction

9 Hrs

- 2.1. **Microbial Pathogenicity: Bacterial** virulence factors- enzymes, toxins (host-specific and non-specific), growth regulators; **Viral** virulence factors: replicase, coat protein, silencing suppressors
- 2.2. Effects on Host Physiology: Impact on photosynthesis, respiration, cell membrane permeability, nutrient and water translocation, growth, and reproduction.
- 2.3. Defence Mechanisms in Plants: Concepts of constitutive defences; Inducible structural defenses: cork layer, abscission layer, tyloses, gums; Inducible biochemical defenses: hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins; pathogenesis related (PR) proteins.

Unit 3: Plant Diseases control

9 Hrs

- 3.1. Principles and Practices of Disease Management: **Regulatory methods**- quarantine, avoidance of pathogens, use of pathogen-free propagative material; **Cultural methods**: host eradication, crop rotation, sanitation.
Chemical methods: systemic fungicides, antibiotics; development of pathogen resistance.
- 3.2. Biological Control: Antagonistic microbes (bacteria and fungi).
- 3.3. Genetic Engineering of Disease-Resistant Plants: Use of plant-derived and pathogen-derived genes; Development of genetically modified (GM) crops (BT)

Unit: 4: Study of Plant diseases**9 Hrs**

Study of selected plant diseases with emphasis on **etiological agent, symptoms, epidemiology, and control:**

4.1 Diseases Caused by Fungi:

- a) Black stem rust of wheat – *Puccinia graminis tritici*
- b) Wilt of tomato – *Fusarium oxysporum* f. sp. *Lycopersici*
- c) Early blight of potato – *Alternaria solani*

4.2 Diseases Caused by Phytopathogenic Bacteria: bacterial blight of rice, crown galls, bacterial cankers of citrus

4.3. Diseases caused by viruses and viroids: Papaya ring spot, tomato yellow leaf curl. diseases caused by viroids: Potato spindle tuber, coconut cadang- cadang

Unit 5: Biofertilization, Phytostimulation, Bioinsecticides No of Hrs: 9

- 5.1. Plant growth promoting bacteria and biofertilizers – symbiotic (Bradyrhizobium, Rhizobium), Non Symbiotic (Azospirillum, Phosphate solubilizers)
- 5.2. Mycorrhizal Inoculum: Types of mycorrhizae, associated plants, Mass production of VAM (Vesicular-Arbuscular Mycorrhiza), field applications of Ectomycorrhizae and VAM.
- 5.3. Bioinsecticides: Advantages over synthetic pesticides, *Bacillus thuringiensis*-production and field applications; Viruses-**Baculoviruses**cultivation and field applications.

III. Co-curricular activities:

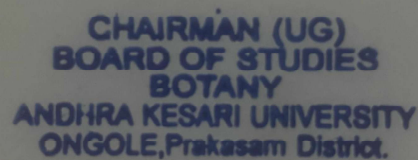
- 1. Collect soil samples, observe microbial diversity, and present findings.
- 2. Create posters or models of disease control strategies and present them.
- 3. Prepare charts of plant diseases or visit a farm to observe and discuss them.

V. Reference Books:

- 1. Agarwal, S. K. (2005). *Advanced Environmental Biotechnology*. APH Publishing.
- 2. Agrios, G. N. (2006). *Plant Pathology* (5th ed.). Academic Press, San Diego.
- 3. Bagyaraj, D. J., & Rangaswami, G. (2005). *Agricultural Microbiology*. Prentice Hall of India Pvt. Ltd.
- 4. James, A. (2021). *Soil and Agricultural Microbiology*. Ed-Tech Press.
- 5. Lacomme, C. (Ed.). (2025). *Plant Pathology: Techniques and Protocols* (2nd ed.). Springer.
- 6. Lucas, J. A. (1998). *Plant Pathology and Plant Pathogens* (3rd ed.). Blackwell Science, Oxford.
- 7. Mahindra, K. Rai. (2005). *Handbook of Microbial Biofertilizers*. The Haworth Press, New York.
- 8. Mehrotra, R. S. (1994). *Plant Pathology*. Tata McGraw-Hill Limited.
- 9. Reddy, S. M., et al. (2002). *Bioinoculants for Sustainable Agriculture and Forestry*. Scientific Publishers.
- 10. Rangaswami, G. (2005). *Diseases of Crop Plants in India* (4th ed.). Prentice Hall India Pvt. Ltd., New Delhi.
- 11. Salem, F., & Shakoori, A. R. (2012). *Development of Bioinsecticide*. Lap Lambert Academic Publishing GmbH KG.
- 12. Singh, K. P., Jahagirdar, S., & Sarma, B. K. (Eds.). (2020). *Emerging Trends in Plant Pathology*. Springer.
- 13. Singh, R. S. (1998). *Plant Diseases Management* (7th ed.). Oxford & IBH, New Delhi.



14. Subba Rao, N. S. (1995). *Soil Microorganisms and Plant Growth*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
15. Subba Rao, N. S. (2009). *Soil Microbiology*. Oxford and IBH Publishing Company.
16. Kannaiyan, S. (2003). *Biotechnology of Biofertilizers*. CHIPS, Texas.
17. Academic Press. (2025). *Textbook of Agricultural Microbiology & Phytoremediation*. Academic Press.



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SEMESTER-IV

COURSE 10: AGRICULTURAL MICROBIOLOGY

Practical

Credits: 1

2 hrs/week

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Observe and analyse soil properties and microbial diversity.
2. Apply techniques for isolating and characterizing beneficial soil microbes.
3. Identify plant pathogens and examine disease symptoms through microscopic observations and Koch's postulates.

II. Laboratory/Field exercises:

1. Study of soil profile, water activity, pH.
2. Study microflora of different types of soils.
3. Rhizobium as soil inoculant, characteristics and field application.
4. Azotobacter as soil inoculant, characteristics and field application.
5. Isolation of cellulose degrading organisms
6. Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.

Study of important diseases of crop plants by cutting sections of infected plant material (microscopic observations)- Albugo, Puccinia, Ustilago, Fusarium, Colletotrichum.



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