



BON SECOURS COLLEGE FOR WOMEN (AUTONOMOUS)

Nationally Accredited with 'A++' Grade by NAAC in Cycle II

Affiliated to Bharathidasan University, Tiruchirappalli

UGC Recognized 2(f) and 12(B) Institution

Vilar Bypass, Thanjavur – 613006, Tamil Nadu

SEMESTER I

24ULS401 : CELL AND MOLECULAR BIOLOGY

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Understand the basic structure and function of the cells.	K1 – K3
Unit II	CO II	Understand the significance of Mitosis and Meiosis Cell division.	K1 – K3
Unit III	CO III	Interpret the Structure and functions of Nucleic acids	K1 - K4
Unit IV	CO IV	Gain Knowledge on the central dogma of cells.	K1 – K4
Unit V	CO V	Apply the knowledge of gene regulation and its Significance.	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I The Cell

Historical background, Cell theory, Cell size and Structure, Comparative account of prokaryotic and eukaryotic cell. Structures and Functions of Cell Organelles: Nucleus, Ribosomes, Nucleoplasm, Mitochondria and Chloroplast, Types of plastids, Golgi complex, Endoplasmic Reticulum, Lysosomes, Peroxisomes

Unit-II Chromosomes

History, types and functions of chromosomes. Giant chromosomes, Polytene chromosome and Lamp brush chromosome. Chromosomal Aberrations. Cell cycle Cell Division: Mitosis (cell cycle stages, cytokinesis) Meiosis (reproductive cycle stages, synaptonemal complex, recombination nodules). Comparison between Mitosis and Meiosis and their significance

Unit-III Structure and Type of DNA and RNA

Structure, functions and type of DNA, Watson and Crick's structural model of DNA, chemical composition of DNA, replication of DNA. DNA as genetic material. Structure of RNA(primary, secondary and tertiary structure) and types of RNA (transfer RNA, messenger RNA, ribosomal RNA).Function and importance of RNA

Unit-IV Central Dogma

Transcription and Translation in prokaryotes and Eukaryotes. DNA Repair mechanism.Genetic Code: Properties of genetic code, codon and anti codon, The Wobble Hypothesis, Mutation and the triplet code

Unit-V Gene regulation:

Operon hypothesis: regulator gene, promoter gene, operator gene, structural gene, repressor gene, co repressor gene and inducer gene. Regulation at transcription, regulation by gene arrangement and reversible phosphorylation, types of control mechanisms, regulation of gene activity in eukaryotes

Text Books:

- 1 Unit- I – Verma P.S, Agarwal V.K (2009).Cell Biology, Genetics, Molecular Biology, Evolution & Ecology, S Chand And Company Ltd.
- 2 Unit -II - Bates A.D & white M.R.H.Turner P.C, Mc Lennan A.G ,(2009), Molecular biology,M R H White ; Publisher,
- 3 Unit –III - Sunil Patel, Rukum ,Tomar S, Harsukin Gazera, Golakiya & Manoj Parakhia G.A .(2010). Hand Book of Life Science , New India publishing agency.
- 4 Unit – IV - Lehninger , David L. Nelson, Michael M.Cox.(2005). Principles of Biochemistry.Garland Publishing, Inc
- 5 Unit –V- Watson, J. D.etal (2017). 7th edition. Pearson Molecular Biology of Gene, Library of Congress Cataloging-in-Publication.

SEMESTER I
24ULS451 - PRACTICAL IN CELL AND MOLECULAR BIOLOGY

Credits: 2

Internal Marks: 40

Contact Hours: 4

External Marks: 60

Course Outcomes:

CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO I	Understand of laboratory safety rules and protocols.	K1 - K2
CO II	Identify and describe the structures of various cell types using microscopy techniques	K1 - K2
CO III	Analyze the Mitosis and Meiosis Cell Division	K1 - K4
CO IV	Demonstrate Nucleic acid Isolation and Estimation	K1 - K5
CO V	Familiarize DNA transformation techniques	K1 - K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

1. Preparation of different stock solutions used in molecular biology (Solutions used in electrophoresis, DNA isolation, RNA isolation and Protein isolation)
2. Microscope
3. Micrometry
4. Cell division- Mitotic stages-Preparation of Onion Root Tip
5. Meiotic study in flower buds and cockroach or grasshopper
6. Giant chromosome studies in Chironomous larvae.
7. Cell counting and cell viability
8. Isolation of DNA from bacteria
9. Isolation of DNA from plants
10. Isolation of DNA from animal tissue
11. Quantification of DNA and RNA through spectrophotometer
12. Separation of different sized DNA fragments on agarose gel
13. Transformation of Bacteria-Chemical Method.

Text Books:

- 1 Dr. David A Thompson, (2009). Cell and Molecular Biology Lab Manual, 1st Edition, Create Space publishers.
- 2 Quincy Quick.(2009). Cell and Molecular Biology Laboratory Manual. Quincy Quick Publishing,
- 3 Julio E. Celis. (2006).Cellbiology: A laboratory handbook, Elsevier Academic publishing.

SEMESTER I

24UMB301 - BASIC MICROBIOLOGY

Credits: 3

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Understand the structure and classification of microorganisms	K1 – K3
Unit II	CO II	Knowledge of sterilization techniques used in microbiology.	K1 – K3
Unit III	CO III	Familiarize the culture techniques	K1 - K4
Unit IV	CO IV	Analyze the Microbial Metabolism	K1 – K4
Unit V	CO V	Apply the Microbial Control Methods	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I Introduction to Microbiology:

History and Scope of Microbiology, Microscopy, The golden age Microbiology with contribution of Scientist. Microbial Diversity: Classification of Microorganisms

Unit-II Structure of Microorganisms:

Morphology and cell structure of major groups of microorganisms e.g. Bacteria, Algae, Fungi, Protozoa, Archea (Halophyles, Methanogens, Thermophyles), Virus (structure of viruses, Bacterial, plant, animal and tumor viruses, DNA- and RNA- viruses.

Unit-III Cultivation and Maintenance of Microorganisms:

Structure, functions and type of DNA, Watson and Crick's structural model of DNA, chemical composition of DNA, replication of DNA. DNA as genetic material. Structure of RNA(primary, secondary and tertiary structure) and types of RNA (transfer RNA, messenger RNA, ribosomal RNA).Function and importance of RNA

Unit-IV Microbial Metabolism:

Metabolic pathways, amphi- catabolic and biosynthetic pathways. Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

Unit-V Control of Microorganisms:

By physical, chemical and chemotherapeutic Agents, Water Microbiology: Bacterial pollutants of water, coliforms and noncoliforms. Sewage composition and its disposal. Food Microbiology: Important microorganism in food: molds, Yeasts, bacteria.

Text Books:

- 1 Unit -1 - Pelczar MJ, Chan ECS And Krein NR, Tata McGraw,(2015) Microbiology, Hill Edition, New Delhi, India.
- 2 Unit-2 - Prasad B.N., (2003). *"A Text Book of Biotechnology"*, Budha Academic Enterprises, G.P.O., Box 20195, Kathmandu, Nepal.
- 3 Unit-3 - Michael T. Madigan, John Martinko.M, Kelly S. Bender, Daniel H. Buckley, David A. Stahl and Thomas Brock. (2014). *Brock- Biology of Microorganisms*, Pearson Education publication.
- 4 Unit- 4 -,Gerard J. Tortora, BerdellR. Funke and Christine L.. 13th Edition (2019). *Microbiology: An Introduction*, Addison-Wesley publication
- 5 Unit-5 - Mark Gladwin, Bill Trattler and Scott Mahan C, 6th Edition, (2014). *Clinical Microbiology Made Ridiculously Simple*, Medmaster publication.

SEMESTER I

24UMB351 - PRACTICAL IN MICROBIOLOGY

Credits: 2

Internal Marks: 40

Contact Hours: 4

External Marks: 60

Course Outcomes:

CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO I	Understand technical expertise in handling and culturing microorganism	K1 – K3
CO II	Acquire training on the Media formulation	K1 – K3
CO III	Deliver hands-on experience on various Microscopic and Biochemical methods	K1 - K4
CO IV	Perceive the microbial growth kinetics.	K1 – K4
CO V	Identify and characterize the unknown microorganisms	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

1. Safety measures in Laboratory.
2. Study of student microscope and research microscope -Construction, working principle, care to be taken while using the microscope. Use of oil immersion objective
3. Study of instruments - Autoclave, hot air oven, laminar air flow bench, Inoculation chamber, inoculation loop and needle, Incubator, centrifuge, pH meter, Seitz filter, colony counter, membrane filter and colorimeter /spectrophotometer.
4. Aseptic techniques
5. Isolation of Bacteria and Fungi from various sources.
6. Plating Techniques–Pour, Spread and Streak Plates
7. Staining of bacteria-Simple staining; Gram staining. Endospore
8. Fungal Staining–Lacto Phenol Cotton Blue
9. Identify bacteria (*Bacillus*, *Staphylococcus*, *E.coli*, *Pseudomonas*,) on the basis of cultural, morphological and biochemical characteristics
10. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, TCBS.
11. Measurement of Microbial Growth–CFN and Turbidity Assay
12. Determination of minimal inhibitory concentration (MIC) of an antibiotic (Tetracycline/ Kanamycin)

Text Books:

- 1 Emanuel Goldman, Lorrence H. Green(2009), Practical Hand Book of Microbiology, *CRC Press*.
- 2 K.R.Aneja , (2014)-Laboratory manual of Microbiology and Biotechnology,*Scientific International, New Delhi*.
- 3 Bharti Arora, D.R., Arora, (2007) - Practical Microbiology, *CBS Publishers & Distributors*.
- 4 S. Rajan, (2019)- Experimental procedure in Life Sciences, *CBS Publisher*.

SEMESTER I

PART-IV

VALUE EDUCATION

(Theory)

Credits: 2

Contact Hours: 2

Internal Marks: 25

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Apply the values in thirukural to be peaceful, dutiful and responsible in family and society	K1 – K3
Unit II	CO II	Develop character formation and sense of citizenship	K1 – K3
Unit III	CO III	Be secular, self-control, sincere, respectful and moral.	K1 - K4
Unit IV	CO IV	Master yoga, asana and meditation to promote mental health	K1 – K4
Unit V	CO V	Be attitudinal to follow the constitutional rights	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I PHILOSOPHY OF LIFE AND SOCIAL VALUES:

Human Life on Earth (Kural 629) -Purpose of Life (Kural 46) -Meaning and Philosophy of Life (Kural 131, 226) -Family (Kural 45), Peace in Family (Kural 1025) Society (Kural 446), The Law of Life (Kural 952), Brotherhood (Kural 807) Five responsibilities / duties of Man (a) to himself (b) to his family (c) to his environment (d) to his society, (e) to the Universe in his lives (Kural 43, 981).

Unit-II HUMAN VALUES AND CITIZENSHIP

Aim of education and value education: Evolution of value oriented education, Concept of Human values: types of Values- Character Formation – Components of Value education- A P J Kalam's ten points for enlightened citizenship- The role of media in value building

Unit-III VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT:

Constitutional or national values: Democracy, socialism, secularism, equality, Justice, liberty, freedom and fraternity - Social Values: Pity and probity, self-control, universal brotherhood - Professional Values - Knowledge thirst, sincerity in profession, regularity, punctuality and faith -Religious Values: Tolerance, wisdom, character - Aesthetic Values- Love and appreciation of literature and fine arts and respect for the same- National Integration and International Understanding.

Unit-IV YOGA AND HEALTH:

Definition, Meaning, Scope of Yoga - Aims and objectives of Yoga - Yoga Education with modern context - Different traditions and schools of Yoga - Yoga practices: Asanas, Pranayama and Meditation.

Unit-V HUMAN RIGHTS:

Concept of Human Rights: Indian and international perspectives- Evolution of Human Rights- definitions under Indian and International documents -Broad classification of Human Rights and Relevant Constitutional Provisions: Right to Life, liberty and Dignity- Right to equality- Right against exploitation- Cultural and Educational Right- Economic Rights- Political Rights- Social Rights - Human Rights of Women and Children – Peace and harmony.

UNIT - VI: CURRENT CONTOURS: (for continuous internal assessment only):

Text Books:

- 1 Thirukkural with English Translation of Rev. Dr. G.U. Pope, Uma Publication, 156, Serfoji Nagar, Medical College Road, Thanjavur 613 004
- 2 Leah Levin, Human Rights, NBT, 1998
- 3 V.R. Krishna Iyer, Dialectics and Dynamics of Human Rights in India, Tagore Law Lectures.
- 4 Yogic Therapy - Swami Kuvalayananda and Dr.S.L.Vinekar, Government of India, Ministry of Health, New Delhi.
- 5 SOUND HEALTH THROUGH YOGA -Dr.K.Chandrasekaran, Prem Kalyan Publications, Sedapatti, 1999
- 6 Grose. D. N – “A text book of Value Education’ New Delhi (2005)
- 7 Gawande . EN – “Value Oriented Education” – Vision for better living. New Delhi (2002) Saruptsons
- 8 Brain Trust Aliyar- “Value Education for Health, Happiness and Harmony” Erode (2004) Vethathiri publications

SEMESTER II

24UBT501 - IMMUNOLOGY AND IMMUNOTECHNOLOGY

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Acquire knowledge about fundamentals and Anatomy of the immune system	K1 – K3
Unit II	CO II	Describe about cells of immune system in non-specific immunity	K1 – K3
Unit III	CO III	Enhance the skill of specific immunity	K1 - K4
Unit IV	CO IV	Analyze about the antibody and cell mediated Immune response	K1 – K4
Unit V	CO V	Assess the Immuno diffusion and Immuno electrophoresis	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I

Fundamental Concepts and Anatomy of the Immune System: Terminology –Antigen, immunogen, hapten, allergen, tolerogen, superantigens, antibody, immunoglobulin, antigenicity, immunogenicity. Self & non-self, innate& acquired immunity. Haematopoiesis. Primary lymphoid organs, secondary lymphoid tissues, lymphocytes, and mediators, Immunoglobulins- basic structure, classes & subclasses of immunoglobulins, Antigenic determinants. Antigen Recognition and Immune Receptors.

Unit-II

Non-specific Immunity: Natural barriers – skin, semen, saliva, tears, enzymes. Mediators of the immune system, lymphocytes, cytokines, interferon, Tumor necrosis factor. Complement components, Complement activation and regulation. Cells of the Immune System Cytokines-structure and functions, Interferon and interleukins. Natural killer cells, NK Cells in Viral Defense, Macrophages, phagocytosis, pinocytosis. Inflammatory response. Mucosal and Gut associated lymphoid tissue (MALT&GALT) and mucosal immunity.

Unit-III

Specific Immunity: Major Histocompatibility Complex - MHC genes, MHC in immune responsiveness and disease susceptibility. CMI response - T cell development, maturation, activation and differentiation. TCR complex, Antigen processing and presentation. HLA - HI response - B cell: B cell development, maturation, activation and differentiation. B-cell receptor and determinants. B-cell subsets. Regulation of the Adaptive Immune Response

Unit-IV

Humoral and Cell Mediated Immunity: Hybridoma technology -monoclonal & polyclonal antibody production, purification, and application. Purification of antibody-ammonium sulphate precipitation, PEG Precipitation, affinity and column chromatography. New Generation Antibodies (Tumour Immunology) and Therapeutic Agents: Vaccines, Growth factors, interferon, Tumour necrosis factor, cytokines, lymphokines & chemokines

Unit-V

Antigen Antibody Reaction: Single, Double Applications. Principle and Applications of RIA, ELISA, Fluorescent Antibody techniques (2 Techniques). Mitogen and antigen induced lymphoproliferation assay; cell mediated lympholysis and mixed lymphocyte reaction. Assessment of delayed type hypersensitivity reactions. In-situ and In - vivo characterization of cells from tissues, generation of T cell clones, Transplantation

Text Books:

- 1 Kuby, Immunology, 8th Edition, W.H. Freeman (2018). (Unit1)
- 2 Gupta P.K, Essentials of Immunology, 5th Edition, Rastogi Publications (2010). (Unit2).
- 3 Annadurai B. A, Textbook of Immunology and Immuno technology, 4th Edition S Chand & Company (2010) (Unit 3)
- 4 Roitt, Essential Immunology, 13th Edition. Wiley and Blackwell Publication (2016) (Unit 4&5).

Reference Books:

- 1 Delves P.J, Jartin I.S. and Burton I.D.R, Essential Immunotechnology. 12th Edition (2006).
- 2 Goldsby R.A. Kindt T.I and Osborne B.A Kuby Immunology 4th Edition. WH Freeman & Co, NY. (2000).
- 3 Rott. E. Essential Immunology, 12th Edition. Wiley & Blackwell. (2011).
- 4 Timothy Hybridoma technology in the Biosciences and Medicine–Springer Plenum Press (1985)
- 5 Robert M. Chanock, Fred Brown, Richard A. Lerner. Vaccines: New approach to immunization. Cold Spring Press (1986).

E-references:

- 1 <https://www.wpunj.edu/sec/vsec/science/courses/bio/BIOMmuIM.html>
- 2 <https://www.cell.com/immunity/home>

SEMESTER II

24UBT551 - IMMUNOLOGY AND IMMUNOTECHNOLOGY LAB

Credits: 2

Internal Marks: 40

Contact Hours: 4

External Marks: 60

Course Outcomes:

CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO I	Understanding the separation techniques for blood	K1 – K3
CO II	Identify and describe precipitation and agglutination of blood	K1 – K3
CO III	Analyze the blood cells	K1 - K4
CO IV	Demonstrate tissue typing	K1 – K4
CO V	Evaluate Antigen and Antibody reaction	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

1. Preparation of serum & plasma from blood samples
2. Estimation of Haemoglobin
3. Blood Cell Count – Total & Differential
4. Precipitation reaction – AGID, SRID, Ouchterlony double immunodiffusion, and Rocket Immunoelectrophoresis
5. Agglutination - Blood grouping, Latex agglutination, WIDAL, HBsAg, CRP
6. Labelled assays – IF, RIA (Theory), ELISA (Demo)
7. Western Blotting (Demo)
8. Tissue typing – Microcytotoxicity Assay, Mixed Lymphocyte Reaction and Primed Lymphocyte Typing (Demo).
9. Isolation of and quantification of immunoglobulin from serum.
10. Separation of lymphocytes from peripheral blood by density gradient centrifugation
11. Isolation of Spleen and Thymus (Demo)

Text Books:

- 1 Practical Immunology - Frank C. Hay, Olwyn M.R. Westwood
- 2 Text of Practical Immunodermatology - Xing Hua Gao and Hong Duochen.
- 3 Practical immunology - Mohamed Mohsin Ahmed.
- 4 Immunology: A Laboratory Manual, Richard L. Myers, 1989
- 5 Diagnostic Immunology Laboratory Manual, Ronald J. Harbeck, 1991
- 6 Richard A. Goldsby, Thomas J. Kindt. Barbara, A. Osborne, Janis Kuby. 2003. Immunology. 5th Edition, W. H. Freeman & Company
- 7 J. Sambrook and D.W. Russel, CSHL. 2001. Molecular Cloning: A Laboratory Manual, Vols 1-3. Cold spring Harbor Laboratory press
- 8 Topley and Wilson. G. Wilson, A.Miles, M.T.Paker. Arnold, Heineman, 1984. Principles of Bacteriology, Virology and immunology. Willy – Blackwell.
- 9 <https://www.cabdirect.org/cabdirect/abstract/19432701768>.

SEMESTER II

24UMB302 - MEDICAL MICROBIOLOGY

Credits: 3

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Know the microbes of medical interest.	K1 – K3
Unit II	CO II	Acquire knowledge of medical microbiology and the importance of microorganisms in diagnosis, monitoring and treatment of infectious diseases	K1 – K3
Unit III	CO III	Understand the viral diseases and its treatment.	K1 - K4
Unit IV	CO IV	Learn the Fungal and protozoan diseases and its treatment	K1 – K4
Unit V	CO V	Understand the significance of antimicrobial agents	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I Normal microflora of the human body and host pathogen interaction:

History of Medical Microbiology, classification of medically important microbes. Normal microflora, Host pathogen interaction, Epidemic, Endemic, and Pandemic.

Unit-II Bacterial diseases:

Symptoms, mode of transmission, prophylaxis and control of following diseases: Respiratory Diseases: tuberculosis; Gastrointestinal Diseases: typhoid, cholera; Wound infections: tetanus; Venereal disease: Syphilis

Unit-III Viral diseases:

Symptoms, mode of transmission, prophylaxis and control of following diseases: AIDS, Dengue, Chikungunya, Japanese Encephalitis, COVID-19

Unit-IV Protozoan diseases:

Symptoms, mode of transmission, prophylaxis and control of following diseases: Malaria, Kala-azar. Fungal diseases- General account on transmission, symptoms and prevention of cutaneous mycoses, Systemic mycoses, Opportunistic mycoses (Candidiasis)

Unit-V Antimicrobial agents:

General characteristics and mode of action- Naturally produced drugs. Antibiotics produced by bacteria, actinomycetes and fungi used in chemotherapy. Classification of antibiotics on the basis of structure and mode of action.

Text Books:

- 1 Ananthanarayan R. and Paniker C.K.J.(2009). Textbook of Microbiology. 8th edition, University Press Publication
- 2 Murray Rosenthal, Pfaller (2012). Medical Microbiology- - Seventh Edition Saunders.
- 3 Prescott (2019). Microbiology - 11th Edition. McGraw Hill

REFERENCE BOOKS:

- 1 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
- 2 Goering R., Dockrell H., Zuckerman M. And Wakelin D. (2007). Mims' Medical Microbiology. 4th Edition. Elsevier
- 3 Willey JM, Sherwood LM and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
- 4 Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
- 5

E-Resources

- 1 Introduction to Medical Microbiology- <https://www.ncbi.nlm.nih.gov/books/NBK7627/>
- 2 Medical Microbiology- <https://learninglink.oup.com/access/ford-fbms3e>
- 2 <https://www.pathselective.com/micro-resources>

SEMESTER II
ENVIRONMENTAL STUDIES - 24UFC902

Credits: 2
Internal Marks: 25

Contact Hours: 2
External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Understand the fundamentals of environmental studies and natural resources for sustainable ecosystem.	K1 – K3
Unit II	CO II	Analyse the conservation of Biodiversity, Environmental issues and its health	K1 – K3
Unit III	CO III	Explain the concepts of Legislation, ethics and Management for Environment	K1 - K4

K1- Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 - Create

SYLLABUS

Unit-I Fundamentals of Environment and Ecosystems: 12 Hrs.

- **Environmental Studies:** Definition, scope, importance; need for awareness.
- **Humans and Environment:** Historical interactions, environmentalism, sustainable development, global efforts (Rio Summit, UNFCCC).
- **Ecosystems:** Definition, structure, function, energy flow, succession, food chains/webs, ecological pyramids.
- **Natural Resources:** Renewable/non-renewable, biotic, abiotic; issues like deforestation, mining, water scarcity, soil degradation, energy exploitation.

Unit-II Biodiversity, Conservation, and Environmental Issues: 12 Hrs.

- **Biodiversity and Threats:** Genetic, species, ecosystem diversity; biogeographical classification; hotspots; Habitat loss, invasive species, climate change.
- **Conservation:** In-situ/ex-situ methods, traditional knowledge, gender roles.
- **Ecosystem Services:** Forests, wetlands, grasslands, agriculture, coastal/marine systems.
- **Environmental Issues:** Climate change, global warming, acid rain, ozone depletion, disaster management.
- **Pollution and Environmental Health:** Types; causes, effects, control measures, solid waste management; health impacts of Pollution and prevention

Unit-III Sustainability, Policies, and Environmental Management: 12 Hrs.

- **Sustainable Development:** Principles, challenges, strategies; SDGs; individual roles in conservation and resource use.
- **Environmental Legislation:** Key Indian/global acts (Wildlife Protection Act, Paris Agreement).
- **Environmental Management, Social Issues and Ethics:** Life cycle analysis, waste management (3Rs), ecolabeling; Urban energy challenges, environmental ethics, and public awareness.

Text Books:

- 1 <https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf>
- 2 https://books.google.co.in/books?id=w1G0oAEACAAJ&source=gbs_slider_cls_metadata_9_mylibrary

SEMESTER III

24ULS402 – INTRODUCTORY TO BIOINFORMATICS & BIOSTATISTICS

Credits: 4

Contact Hours: 4

Internal Marks: 25

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Demonstrate different nucleic acid data base and tools	K1 – K3
Unit II	CO II	Apply online software and tools for predict protein macromolecules	K1 – K3
Unit III	CO III	Categorize the sequence alignment methods	K1 - K4
Unit IV	CO IV	Know the various statistical method to solve different types of problem	K1 – K4
Unit V	CO V	Enhance knowledge of Analysis of central tendency	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I

Introduction to Bioinformatics – Genome, Transcriptome and Proteome, Gene prediction rules and software. Types of Nucleotide Sequence: Genomic DNA, Complementary DNA (cDNA), Recombinant DNA (rDNA), Expressed sequence tags (ESTs), Primer DNA and Design. Nucleic acid Databases – Primary and Secondary Databases – Structure Database – NCBI, CATH, SCOP – Data base Searching – BLAST and FASTA, BLOSSUM.

Unit-II

Protein sequence databases: SWISS-PROT, TrEMBL, PIRPSD, GenBank, EMBL, DDBJ Protein Database: Comparison of Protein sequences and Database searching Uniprot and protein DataBank (PDB), BLAST and FASTA- methods for protein structure prediction- Homology modeling of proteins, visualization tools (RASMOL).

Unit-III

Multiple Sequences alignment – method of multiple sequences alignment- Evolutionary analysis, clustering methods Phylogenetic trees - Methods to generate phylogenetic tree- Tools for multiple sequences alignment and phylogenetic analysis (MEGA4 or 6) - Drug Discovery, Steps in Drug design- Chemical libraries- Role of molecular docking in drug design, ADME properties.

Unit-IV

Statistics – Definition – Statistical methods- Basic principles – Variables – Measurements, functions, limitations and uses of statistics. Collection of Data: Primary and Secondary – Types and methods of data collection, Procedure, Merits and Demerits. Classification and tabulation of data – Diagrams and graphs.

Unit-V

Measures of Central tendency – Mean, Median, Mode, Geometric Mean – Merits and Demerits – Dispersion and measure of dispersion – Range, Standard deviation, quartile deviation – Merits and Demerits – Co-efficient of variations, ANOVA- One and Two way

Text Books:

- 1 Bioinformatics: Methods and Applications, S. C. Rastogi, Namita Mendiratta, 2013, PHI Learning Pvt Ltd, (Unit I, Unit III).
- 2 Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Andreas D. Baxevanis, B.F. Francis Ouellette, 2005 (3rd Edition), Wiley-Interscience (Unit II)
- 3 Basics of Biostatistics, A.P. Kulkarni, 2019, CBS Publishers & Distributors Pvt. Ltd., India (Unit IV, Unit V)

Reference Books:

- 1 Fundamentals of Bioinformatics, D. E. Krane and M. L. Raymer, 2003, Pearson Education
- 2 Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Andreas D. Baxevanis, B.F. Francis Ouellette, 2005 (3rd Edition), Wiley-Interscience
- 3 Essential Bioinformatics, Jin Xiong, 2006, Cambridge University Press.

Web References:

- 1 <https://www.ncbi.nlm.nih.gov>
- 2 <https://www.rcsb.org>
- 3 <https://www.megasoftware.net>
- 4 <https://statistics.laerd.com>
- 5 <https://www.medcalc.org>

SEMESTER III
24UBT502 - r-DNATechnology

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Explain the Core Concepts of Recombinant DNA Technology.	K1 – K3
Unit II	CO II	Demonstrate Laboratory Skills in DNA isolation, restriction digestion, ligation, transformation, and screening of recombinant clones.	K1 – K3
Unit III	CO III	Analyze the molecular techniques such as PCR, gel electrophoresis, blotting, and sequencing.	K1 - K4
Unit IV	CO IV	Evaluate Genetic Constructs for expression in prokaryotic and eukaryotic systems.	K1 – K4
Unit V	CO V	Assess the implications of medicine, agriculture, and environmental science.	K1 – K5

K1- Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 - Create

SYLLABUS

Unit-I

Introduction - recombinant DNA technology. Isolation and analysis of genes. Enzymes involved in rDNA technology –Nuclease - Restriction endonucleases, exonuclease, DNA modifying enzymes - Polymerase, Transferase, Kinase and DNA Ligase.

Unit-II

Plasmids vector – pBR322, PUC 18 / 19, Phage vectors, Cosmids, Phagemids, Virus vectors, Plant Vector, Animal vector, Shuttle vectors and expression vectors- YAC, BAC, MAC.S. cerevisiae system as a model.

Unit-III

Steps involved in construction of rDNA – Desire Gene, Vector, Ligation. Gene Transfer techniques – Natural and Artificial, Construction of genomic libraries and cDNA Libraries. Probe construction and screening and Gateway Cloning. DNA amplification using polymerase chain reaction (PCR), types and applications of PCR: Ligase chain reaction. RFLP, RAPD and DNA Finger printing.

Unit-IV

Analysis of recombinant DNA - Selection methods – antibiotics, GUS expression. Principles of Southern, Northern and Western blotting techniques. Sequencing - chemical degradation; chain termination and automated sequence. Site-directed mutagenesis. ZFN, TALENS and CRISPR Cas 9.

Unit-V

Transgenic plants- virus, fungi, bacteria and pest resistance, herbicide tolerance and stress tolerance (cold, heat and salt); cytoplasmic male sterility; delay of fruit ripening. Transgenic animals – Fish, Mice, Dolly. Pharmaceutical products – insulin, growth hormones and interferons.

Text Books:

- 1 Glick, B. R., & Pasternak, J. J. (2021).Molecular Biotechnology: Principles and ApplicationsofRecombinantDNA(6thEdition).ASMPress,Washington,D.C.(Unit- I to V)

Reference Books:

- 1 Brown,T.A.(2020).Genomes(4thEdition). Garland Science, New York.
- 2 Alberts,B.,Johnson,A.,Lewis,J.,Raff,M.,Roberts,K.,&Walter,P.(2022).Molecular Biology of the Cell(7thEdition).Garland Science, New York.

SEMESTER III

24ULS452 - r-DNA Technology Lab

Credits: 2

Internal Marks: 40

Contact Hours: 4

External Marks: 60

Course Outcomes:

CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO I	Understanding the separation techniques for blood	K1 – K3
CO II	Identify and describe precipitation and agglutination of blood	K1 – K3
CO III	Analyze the blood cells	K1 - K4
CO IV	Demonstrate tissue typing	K1 – K4
CO V	Evaluate Antigen and Antibody reaction	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

1. Isolation and separation of genomic DNA from Bacteria, Plant and animal
2. Isolation and separation of plasmid DNA from E.coli by Alkaline lysis method
3. Gene Cloning
4. PCR Amplification
5. Restriction Digestion
6. Ligation
7. Competent cell preparation
8. Transformation
9. Screening of recombinant DNA – Antibiotic and Blue white
10. RFLP
11. Separation of proteins by SDS PAGE

DBT STAR Programme Additional Practical

1. Western blotting
2. Zymography

Textbooks

- 1 Molecular Biotechnology: Principles and Applications of Recombinant DNA by Sambrook and Russell, 2018.
- 2 Molecular Cloning: A Laboratory Manual by Ausubel, Brent, Kingston, Smith, Rushton, and Gibbs, 2016.

SEMESTER III
24UBC303 - BIOCHEMISTRY

Credits: 3

Internal Marks: 25

Contact Hours: 3

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Acquire knowledge about Acids, Bases, and Buffers.	K1 – K3
Unit II	CO II	Describe about Carbohydrates.	K1 – K3
Unit III	CO III	Enhance the knowledge of Amino Acids and Proteins.	K1 - K4
Unit IV	CO IV	Analyze about the Fatty Acids and Lipids.	K1 – K4
Unit V	CO V	Analyze about the Nucleic Acids and Vitamins.	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I

Acids and Bases: Concepts, properties, and their role in biological systems; ways of expressing concentrations of solutions. pH of solution, pH scale, measurement of pH. Buffer solutions, properties of buffers, and the mechanism of buffer action of acidic buffers and basic buffers.

Unit-II

Classification and properties of carbohydrates. Ring structure of sugars and conformations of sugars. Hexose derivatives. Disaccharides and glycosidic bonds. Polysaccharides - Starch, Bacterial Peptidoglycan and Extracellular matrix (Glycosaminoglycans). Glycoconjugates. Metabolism of Carbohydrates – Glycogenesis, Glycogenolysis, Cori's cycle, Glycolysis, TCA cycle, bioenergetics of carbohydrate metabolism.

Unit-III

Structural conformation of protein Classification of proteins. Classification and structure of amino acids. Properties and biological importance of amino acids: amphoteric nature, Zwitter ion, isoelectric point and pKa Value, Ramachandran plot for amino acids and proteins. Degradation of Amino acids and Urea Cycle.

Unit-IV

Classification of Lipids. Characteristics, Properties and Biological importance of lipids: Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. Classification of fatty acids, physical and chemical properties of fatty acids - saponification number, acid number and iodine number, hydrolysis, acetyl number, Reichert- Meissel number. Metabolism of Fatty acids, triglycerides, phospholipids, cholesterol. Oxidation of fatty acids.

Unit-V

Vitamins - Source, structure, biological role, daily requirement and deficiency manifestation of vitamin A, B, C, D, E and K. Classification of nucleic acids. Purine and Pyrimidine bases. DNA: Watson and Crick model and forms of DNA. Properties of DNA. RNA- Structure and types of RNA: t-RNA, r-RNA and m-RNA Metabolism of purine and pyrimidine, Salvage pathway.

Text Books

- 1 Fundamentals of Biochemistry by J. L. Jain, 7th Edition, 2004 (Units I–IV).
- 2 Biochemistry by U. Satyanarayana and U. Chakrapani, 6th Edition, 2021 (Unit V).

Reference Books

- 1 Harper's Illustrated Biochemistry by Peter J. Kennelly et al., 32nd Edition, 2023.
- 2 Integrated Textbook of Biochemistry, 2nd Edition, 2023.
- 3 Lippincott Illustrated Reviews: Biochemistry, 2nd South Asian Edition, 2024.
- 4 Integrated Textbook of Biochemistry, 2nd Edition, 2023, by Indumati V. and Sowbhagya Lakshmi, Paras Medical Publisher

E-References

- 1 <http://aulanni.lecture.ub.ac.id/files/2012/01/15616949-Lehninger-Principles-of-Biochemistry-1-copy.pdf>
- 2 https://resource.odmu.edu.ua/chair/do4w3nload/116511/NIzyhkq4wD_gmgHLzZw80g/biochemistry_by_satynarayan_4e.pdf

SEMESTER IV

24ULS403 - DEVELOPMENTAL BIOLOGY AND GENETICS

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Understand the Key Developmental Stages such as fertilization, cleavage, gastrulation, and organogenesis across various model organisms.	K1 – K3
Unit II	CO II	Explain the Molecular Mechanisms involved in cell differentiation, gene expression regulation, and morphogen gradients during development.	K1 – K3
Unit III	CO III	Interpret Experimental Techniques used in developmental biology, including fate mapping, gene knockout, and live imaging.	K1 - K4
Unit IV	CO IV	Analyze the Role of Signaling Pathways (e.g., Wnt, Notch, Hedgehog) in controlling developmental processes.	K1 – K4
Unit V	CO V	Evaluate the Developmental Disorders and assess how errors in development can lead to congenital abnormalities and disease.	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I

12 Hrs.

Introduction to Developmental Biology & Model Organisms. Potency, commitment, specification, induction, competence, determination & differentiation; morphogenetic gradients; cell fate & cell lineages; genomic Equivalence and cytoplasmic determinants; imprinting. Cell-to-Cell Communication: Mechanisms of morphogenesis, Stem Cells: their potential and their niches.

Unit-II

12 Hrs.

Gametogenesis and fertilization in animals, ultra structure of sperm and ovum, egg types, egg membrane. Fertilization, cleavage, Morula, Implantation, blastulation, gastrulation, formation of germ layers, axis formation - anterior and posterior. Sex determination - chromosomes and environment. Establishment of symmetry in plants, Seed formation and germination.

Unit-III

12 Hrs.

Cleavage patterns and types. Axis Formation - Anterior-posterior axis formation, Dorsal-ventral and right-left axis formation, Control of blastomere identity in *C. elegans*. Organogenesis – vulva formation in *C. elegans*; eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development-larval formation, metamorphosis; sex determination

Unit-IV

12 Hrs.

Life cycle of an angiosperm plant, Plant growth and development, Embryonic and post-embryonic development, Characteristics of plant development. Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*.

Unit-V

12 Hrs.

Mendel's experiments; Law of segregation, monohybrid cross, reciprocal cross, back cross, test cross; ABO blood groups in human; Rh Blood group incompatibility; Human chromosomes and chromosomal Inheritance Pattern-Human Chromosomes, study of Normal Human Karyotype and abnormal karyotypes. Pattern of inheritance: Autosomal dominant –Adult polycystic kidney disease. Autosomal recessive – Sickle cell anaemia, X-linked dominant – Fragile X syndrome, X linked recessive – Duchennemus

Text Books

- 1 Developmental Biology (12th Edition) by Gilbert, S. F, 2023, Sinauer Associates, Sunderland, MA.
- 2 Genetics: Analysis of Genes and Genomes (9th Edition) by Hartl, D. L., & Ruvolo, M. 2021, Burlington, MA.

Reference Books

- 1 Carlson, B. M. Human Embryology and Developmental Biology (5th Edition),2020, Elsevier, Philadelphia, PA.
- 2 Lewis, R. Developmental Genetics (1st Edition), (2022). Oxford University Press, Oxford, UK.

E-References

- 1 <https://www.ncbi.nlm.nih.gov/gene/>
- 2 <http://www.informatics.jax.org/>
- 3 <http://www.informatics.jax.org/>

SEMESTER IV

24ULS452 - DEVELOPMENTAL BIOLOGY AND GENETICS LAB

Credits: 2

Internal Marks: 40

Contact Hours: 4

External Marks: 60

Course Outcomes:

CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO I	Demonstrate the preparation and identification of polytene chromosomes	K1 – K3
CO II	Observe and identify frog embryonic stages (blastula, gastrula, cleavage)	K1 – K3
CO III	Examine different developmental stages of chick embryos through incubation periods	K1 - K4
CO IV	Solve genetics problems involving Mendelian inheritance, linkage, and sex-linked traits	K1 – K4
CO V	Identify histological features of endocrine glands and gonads in transverse section	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

1. Giant Chromosome (Demonstration of polytene chromosome preparation).
2. Blastula of Frog.
3. Gastrula of Frog.
4. Study of different stages of cleavage (2-cell, 4-cell, 8-cell, 16-cell stages); morula, blastula.
5. Study of chick embryos at 18 hours, 24 hours, 33 hours, and 48 hours of incubation.
6. Problems on Genetics: Mendelian inheritance, linkage and crossing over, sex-linked inheritance.
7. T.S. of pituitary, thyroid, adrenal, ovary, and testis.
8. Kymograph (Demonstration of muscle twitch with PowerPoint).

DBT STAR Programme Additional Practicals

1. Observation of Mitotic Stages in Onion Root Tip (Squash Preparation)
2. Study of Meiosis in Grasshopper Testes/ Flower Buds
3. Preparation of Karyotype from Human Chromosome Images
4. Blood Grouping and Rh Typing (Demonstration or Chart-based)

Text books:

1. Wolpert, L., Tickle, C., & Arias, A. M. (2022). Principles of Development (6th Edition). Oxford University Press, Oxford, UK.
2. Slack, J. M. W. (2020). Essential Developmental Biology (4th Edition). Wiley-Blackwell, Hoboken, NJ.
3. Lynn, A., & Gerhart, J. (2021). *Developmental Biology: A Practical Approach* (2nd Edition). Garland Science, New York.

E-References

- 1 <https://www.carolina.com/teacher-resources/Interactive/onion-root-tip-squash-preparation/tr11013.tr>
- 2 <https://ib.bioninja.com.au/standard-level/topic-5-genetics/meiosis/meiosis.html>
- 3 <https://learn.genetics.utah.edu/content/labs/karyotype/>
- 4 <https://www.redcrossblood.org/donate-blood/blood-types.html>

SEMESTER IV

24UBC304 - ANALYTICAL TECHNIQUES IN BIOLOGY

Credits: 3

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Understand the principles of colorimetry and Beer-Lambert's law.	K1 – K3
Unit II	CO II	Apply microscopy techniques to visualize cellular structures and macromolecular assemblies.	K1 – K3
Unit III	CO III	Apply the Henderson-Hasselbalch equation to biological buffer systems.	K1 - K4
Unit IV	CO IV	Understand the basis of separation in gel exclusion, ion exchange, adsorption, and affinity chromatography.	K1 – K4
Unit V	CO V	Understand the principles and protocols of agarose gel electrophoresis for nucleic acid separation.	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create
SYLLABUS

Unit-I Solutions:

Water- Structure and interaction, water as solvent, pH, Bronsted- Lowry concept of acid and bases, ionization, Buffer: Henderson-Hasselbalch equation, Biological buffer system (bicarbonate, phosphate buffers and Tris buffers), Determination of molecular weight- molarity, molality, normality, equivalent weight.

Unit-II Microscopy:

Principle, and application of Light, Dark-field, Phase contrast, Fluorescence, Confocal microscopy, Atomic force microscopy, Electron Microscope - Transmission and Scanning electron microscopy (TEM and SEM). Sample preparation.

Unit-III Centrifugation

Principle & types, sedimentation co-efficient, sedimentation velocity, ultra centrifugation, separation of macromolecules, subcellular fractionation. Colorimetry, Basic principles, Beer-Lamberts law, instrumentation and application of UV-Vis, IR spectroscopy, AAS, ICP-OES, MS. Fluorescence spectroscopy, IR/Raman spectroscopy, NMR Spectroscopy and Mass spectroscopy.

Unit-IV Chromatography:

Paper chromatography, thin layer chromatography, column chromatography: gel exclusion, adsorption, ion exchange, affinity. Application of chromatographic technique – separation of biomolecules. Liquid Chromatography and HPLC, Gas Chromatography, GC-MS /MS and LC-MS/ MS.

Unit-V Electrophoresis:

Electrophoresis – Principles and application of Agarose gel electrophoresis, PAGE - SDS PAGE, Native-PAGE, 2D-electrophoresis, isoelectric focusing, capillary electrophoresis and Zymogram.

Text book:

- 1 Asokan, P. (2022). *Analytical Biochemistry: Methods in the Biological Sciences* (1st Edition). Springer, Cham, Switzerland.
- 2 Asokan, P. (2021). *Analytical Techniques in Biochemistry* (1st Edition). Elsevier, Amsterdam, Netherlands.
- 3 Nelson, D. L., Cox, M. M. (2021). *Lehninger Principles of Biochemistry* (8th Edition). W.H. Freeman and Company, New York
- 4 Berg, J. M., Tymoczko, J. L., Gatto, G. J., & Stryer, L. (2022). *Harper's Illustrated Biochemistry* (32nd Edition). McGraw-Hill Education, New York

Reference Books:

- 1 I. D. Campbell, Biological spectroscopy (Benjamin/Cummings Pub. Co, Menlo Park, Calif, 1984), Biophysical techniques series.
- 2 K. Wilson, J. M. Walker, Eds., Principles and techniques of biochemistry and molecular biology (Cambridge University Press, Cambridge, UK : New York, 7th ed., 2009).
- 3 R. F. Boyer, Biochemistry laboratory: modern theory and techniques (Prentice Hall, Boston, 2nd ed., 2012).
- 4 R. Katoch, Analytical techniques in biochemistry and molecular biology (Springer, New York, 2011).

e-Sources:

- 1 Syllabus_Affiliated_ArtsScience_B.Sc-Biotechnology-2021-22.pdf
- 2 Biological Science syllabus corrected 22032021.pdf
- 3 BBP111_pbt.pdf

SEMESTER IV

24UB352 - Biochemistry Lab

Credits: 2

Internal Marks: 40

Contact Hours: 4

External Marks: 60

Course Outcomes:

CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO I	To provide practical experience in preparing solutions of different molarity and normality.	K1 – K3
CO II	To train students in qualitative and quantitative biochemical analysis methods	K1 – K3
CO III	To familiarize students with modern techniques like chromatography, spectrophotometry, and enzyme activity assays.	K1 - K4
CO IV	To develop proficiency in the estimation of biomolecules such as proteins, amino acids, sugars, and nucleic acids.	K1 – K4
CO V	To enhance understanding of biochemical principles through hands-on experiments related to enzyme behavior, pH effects, and biomolecular identification.	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

1. Preparation of solutions of different molarity and normality.
2. Preparation of buffers.
3. Standardization of acids and base
4. Estimation of protein by Biuret method.
5. Estimation of protein by Folin Lowry's method
6. Estimation of reducing sugars by DNS method.
7. To study the effect of pH on the activity of salivary amylase enzyme.
8. Qualitative tests for Carbohydrates.
9. Qualitative tests for lipids.
10. Qualitative tests for proteins.
11. Separation of sugar, amino acids by paper chromatography
12. Separation of aminoacids by TLC method
13. Separation of plant pigments using column chromatography
14. Estimation of aminoacids by Ninhydrin method
15. Estimation of ascorbic acid content in foods
16. Analysis of nucleic acid by spectrophotometer

Text books:

- 1 D.M. Vasudevan and Subir Kumar Das (2016). Practical Textbook of Biochemistry for Medical Students
- 2 Prem Prakash (2018). Essentials of Practical Biochemistry

SEMESTER V
24UBT503 - PLANT BIOTECHNOLOGY

Credits: 4

Internal Marks: 25

Contact Hours: 5

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Acquire knowledge of plant physiology and biochemical processes.	K1 – K3
Unit II	CO II	Understand plant tissue culture techniques and their applications.	K1 – K3
Unit III	CO III	Explain somatic hybridization and haploid plant production.	K1 - K4
Unit IV	CO IV	Analyze industrial applications of plant biotechnology.	K1 – K4
Unit V	CO V	Understand molecular markers and their role in plant disease diagnosis and breeding.	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I Plant Physiology and Biochemistry:

Hormones – Auxin, gibberellins, cytokinins, ethylene (K1). Growth regulation in plants (K2), application of hormones in agriculture (K3). Photosynthesis – C3, C4 and CAM pathways (K2). Glycolysis (K2) – Krebs cycle (K2) – Oxidation – Reduction potential (K4) – ATP synthesis (K2). Nitrogen metabolism: Role of nitrogen and sources (K1), conversion of nitrate to ammonia – assimilation of ammonia (K4).

Unit-II Plant Tissue Culture:

Plant tissue culture techniques – Origin, history and importance (K1, K2). Laboratory organization (K2). Nutrient medium – composition and its types (K2). Sterilization techniques (K3). Types of culture – seed (K2), callus, embryo and organ culture (K2). Micropropagation (K3) and its applications (K4).

Unit-III Somatic Hybridization:

Protoplast isolation (K2) – enzymatic and mechanical methods (K3). Somatic hybridization (K2)– protoplast fusion (K3), types (K2), mechanism of fusion (K4), identification and selection of somatic hybrid cells (K4), verification (K5). Production of haploid plants (K3).

Unit-IV Industry and Plant Biotechnology:

Biosynthesis of plant compounds (K2)– Selection of cell lines for high yields of secondary metabolites (K4)– Enzymes from plants (K2) – Food and food additives from plants (K3) – Breeding strategies for enhancing active principles in plants (K5).

Unit-V Molecular Markers:

Nutrient film culture techniques (K3) – Plant diseases (K1) – Physiology of infection in plants (K4)– Disease resistance in plants (K2) – Phytodiagnostics based on immunological and molecular techniques: RFLP, RAPD, AFLP, SSR, STM and fingerprinting (K4). Marker assisted selection (K5).

Textbooks

- 1 Slater, A., Scott, N. W., & Fowler, M. R. (2008). *Plant Biotechnology: The Genetic Manipulation of Plants*. Oxford University Press, Oxford.
- 2 Noggle, R. F., & Fritz, G. J. (2013). *Introductory Plant Physiology*. Prentice Hall, New Delhi.
- 3 Chawla, H. S. (2009). *Introduction to Plant Biotechnology*. CRC Press, Boca Raton.
- 4 Umesha, S. (2016). *Plant Biotechnology*. I K International Publishing House, New Delhi.

Reference Books

- 1 *Plant Biotechnology and Genetics: Principles, Techniques and Applications* — Wiley.
- 2 *Plant Biotechnology: Principles and Applications* — Malik Z. Abdin et al., Springer.

e.Resources

- 1 <https://www.classcentral.com/course/swayam-plant-biochemistry-and-biotechnology-2927322>. <https://www.medicalnewstoday.com/articles/320101.php>
- 2 <https://archive.nptel.ac.in/courses/102/103/102103016/>

SEMESTER V
24UBT504 - ANIMAL BIOTECHNOLOGY

Credits: 4

Internal Marks: 25

Contact Hours: 5

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Acquire knowledge of animal cell structure, function, and fundamentals of animal biotechnology.	K1 – K3
Unit II	CO II	Understand animal cell and tissue culture techniques and their applications in research and medicine.	K1 – K3
Unit III	CO III	Explain molecular and genetic engineering approaches in animals, including Transgenesis and cloning.	K1 - K4
Unit IV	CO IV	Analyze applications of biotechnology in animal health, reproduction, and production of biopharmaceuticals.	K1 – K4
Unit V	CO V	Understand ethical, biosafety, and regulatory aspects of animal biotechnology, including emerging trends.	K1 – K5

K1- Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 - Create
SYLLABUS

Unit-I Fundamentals of Animal Biotechnology:

Scope and significance of animal biotechnology, Structure and function of animal cells, Introduction to animal cell culture techniques, Growth media composition, sterilization, and aseptic handling, Primary culture, sub-culturing, cryopreservation, and cell line maintenance, Types of cell lines: finite, continuous and hybridoma cells

Unit-II Animal Cell and Tissue Culture Techniques:

Animal cell growth kinetics and viability assays, Large-scale culture systems: roller bottles, bioreactors, Serum-free and suspension cultures, Hybridoma technology and monoclonal antibody production, Applications of tissue culture in medicine and diagnostics. Staining techniques.

Unit-III Molecular and Genetic Engineering in Animals:

Gene transfer methods: Natural and Artificial methods. Transgenic and knockout animals (mice, sheep, fish, goats), Cloning of animals (Somatic Cell Nuclear Transfer – SCNT), Genome editing using CRISPR/Cas9 and TALENs, Applications of transgenic animals in research, medicine and agriculture

Unit-IV Animal Health, Reproduction, and Biopharmaceuticals:

Assisted Reproductive Technologies (ART): Artificial Insemination (AI), *In Vitro* Fertilization (IVF), Embryo Transfer, Stem Cells and Regenerative Medicine, Animal Disease Diagnostics: PCR, ELISA, and Biosensors. Production of Recombinant Vaccines (Hepatitis vaccine, HPV Vaccine) and Hormones (Insulin, Growth Hormone), Biopharming: Transgenic Animals as Bioreactors for Therapeutic Proteins.

Unit-V Ethics, Biosafety, and Regulatory Frameworks:

Animal welfare, ethics in experimentation, Institutional Animal Ethics Committees (IAEC), Biosafety levels, containment facilities, and good laboratory practices (GLP), International guidelines: OECD, CPCSEA, USDA, NIH, Intellectual property rights and patenting in animal biotechnology, Emerging trends: 3D bioprinting, lab-grown meat, organoids.

Text books

- 1 Animal Biotechnology - R. Sasidhara
- 2 Animal Biotechnology – A.K.Srivastava

Reference Books

- 1 Animal Biotechnology: Principles and Applications — *M. Kishor Kumar & A. Lakra*
- 2 Animal Cell Culture: Essential Methods — *John R. W. Masters*
- 3 Animal Biotechnology: Models in Discovery and Translation — *William M. Muir & Allan E. Schinckel*

e. Resources

- 1 Animal Biotechnology (CEC / SWAYAM)
- 2 Animal Biotechnology overview (BioLibreTexts)

SEMESTER V
24UBT505 - GENOMICS AND PROTEOMICS

Credits: 4

Internal Marks: 25

Contact Hours: 5

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Explain genome organization and sequencing technologies.	K1 – K3
Unit II	CO II	Interpret gene expression and functional genomics data.	K1 – K3
Unit III	CO III	Demonstrate protein analysis and proteomic techniques.	K1 - K4
Unit IV	CO IV	Utilize bioinformatics tools for omics data integration.	K1 – K4
Unit V	CO V	Evaluate applications of genomics and proteomics ethically.	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create
SYLLABUS

Unit-I Introduction to Genomics:

Concept and scope of genomics, Genome organization in prokaryotes and eukaryotes, Structural vs. functional genomics, DNA sequencing technologies: Sanger, Next Generation Sequencing (NGS), third-generation sequencing, Genome annotation and gene prediction, Comparative genomics and synteny

Unit-II Functional Genomics and Transcriptomics:

Gene expression analysis: microarrays, RNA-Seq, Quantitative PCR (qPCR) and expression profiling, Gene knockout and RNA interference techniques, Genome mapping, Gene regulatory networks and systems biology concepts, Functional annotation using Gene Ontology (GO)

Unit-III Proteomics: Principles and Techniques:

Introduction to proteomics and protein structure–functional relationship, Protein - Extraction & purification techniques, Protein sequencing methods- Mass spectrometry, MALDI-TOF, LC-MS/MS , 2D gel electrophoresis and peptide mapping, Protein–protein interactions (yeast two-hybrid, co-immunoprecipitation).

Unit-IV Bioinformatics in Genomics and Proteomics:

Biological databases: GenBank, EMBL, DDBJ, UniProt, PDB, KEGG, Sequence alignment: BLAST, FASTA, CLUSTALW, Phylogenetic analysis and molecular evolution, Protein domain and motif analysis (Pfam, InterPro), Integration of omics data (genomics, transcriptomics, proteomics).

Unit-V Applications of Genomics and Proteomics:

Genomics and proteomics in personalized medicine and pharmacogenomics, Microbial genomics in biotechnology and bioremediation, Agricultural genomics: crop improvement and livestock genomics, Proteomics in biomarker discovery and drug development, Ethical, legal, and social implications (ELSI) of genomics research.

Text Books

- 1 Bioinformatics: Genomics and Proteomics — Ruchi Singh, *Vikas Publishing*; 2014.
- 2 Genomics and Proteomics: Principles, Technologies, and Applications — Devarajan Thangadurai & Jeyabalan Sangeetha, *Apple Academic Press*; 2015.
- 3 Principles of Genomics and Proteomics — Rakeeb Ahmad Mir, Sheikh Mansoor & Sajad Majeed Zargar, *Elsevier*; 2023.

References Book

- 1 Encyclopedia of Genetics, Genomics, Proteomics, and Informatics — George P. Rédei, *Springer Dordrecht*; 2008.
- 2 Genomics and Proteomics for Clinical Discovery and Development — György Marko-Varga (Ed.), *Springer Dordrecht*; 2014.
- 3 Concepts and Techniques in Genomics and Proteomics — N. Saraswathy & P. Ramalingam, *Elsevier*; 2016.
- 4 Encyclopedic Reference of Genomics and Proteomics in Molecular Medicine — Editors, *Springer Berlin/Heidelberg*; 2006.
- 5 Genomic, Proteomics, and Biotechnology — RC Sobti, Manishi Mukesh, Aastha Sobti (Eds.), *CRC Press*; 2023.
- 6 Discovering Genomics, Proteomics and Bioinformatics — Irving Bashirian, *White Press Academics*; 2020.

e. Resources

- 1 <https://genomemedicine.biomedcentral.com/>
- 2 <https://www.nature.com/subjects/genomics-and-proteomics>
- 3 <https://www.ncbi.nlm.nih.gov/books/>

SEMESTER V

24UBT555 - PLANT, ANIMAL BIOTECHNOLOGY, GENOMICS AND PROTEOMICS LAB

Credits: 2

Contact Hours: 4

Internal Marks: 40

External Marks: 60

Course Outcomes:

CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO I	Demonstrate aseptic techniques in tissue culture.	K1 – K3
CO II	Perform molecular biology experiments accurately.	K1 – K3
CO III	Analyze DNA, protein, and sequence data.	K1 - K4
CO IV	Interpret bioinformatics and proteomics results.	K1 – K4
CO V	Integrate wet-lab and in-silico approaches.	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

1. Introduction to Tissue Culture Laboratory – safety, sterilization, and aseptic techniques.
2. Preparation of MS Medium – with/without plant growth regulators.
3. Surface Sterilization and Inoculation of Explants – leaf, stem, or nodal segments.
4. Callus Induction from Explants – observation of growth patterns.
5. Shoot Multiplication and Root Induction – organogenesis study.
6. Laboratory Safety and Sterile Handling Techniques in animal cell culture.
7. Preparation of Culture Media (DMEM) and Sterilization.
8. Isolation of Genomic DNA from Animal Tissue.
9. PCR-based Detection of a Gene/Marker (Wet Lab).
10. Agarose Gel Electrophoresis for DNA Separation.
11. Restriction Digestion of Genomic DNA.
12. In-silico Sequence Analysis using NCBI BLAST.
13. Multiple Sequence Alignment using CLUSTAL Omega.
14. Gene Annotation and ORF Prediction using Expasy/Ensembl.
15. Protein Structure Prediction using SWISS-MODEL.
16. Protein–Protein Interaction Network Analysis using STRING Database.
17. SDS-PAGE for Protein Separation (Hands-on).
18. 2D Gel Electrophoresis / Virtual Proteomics Tool Analysis

Lab Manuals & References

- 1 R.I. Freshney – Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications(Wiley-Blackwell)
- 2 Roberta H. Smith – Plant Tissue Culture: Techniques and Experiments (Academic Press)
- 3 Sambrook & Russell – Molecular Cloning: A Laboratory Manual (Cold Spring Harbor Press)
- 4 Brown, T.A. – Genomes 4 (Garland Science)
- 5 Twyman, R.M. – Principles of Proteomics (Garland Science)
- 6 Online Tools: NCBI, UniProt, PDB, Expasy, KEGG, STRING, MEGA

SEMESTER V
24UBT701 - ADVANCES IN BIOTECHNOLOGY

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Understand recent trends, omics technologies, and emerging fields in modern biotechnology	K1 – K3
Unit II	CO II	Apply advanced molecular diagnostics, gene therapy, and vaccine technologies in healthcare contexts	K1 – K3
Unit III	CO III	Analyze next-generation crop improvement strategies, genome editing, and molecular farming applications	K1 - K4
Unit IV	CO IV	Evaluate industrial bioprocess innovations, bioremediation, and sustainable bioeconomy concepts	K1 – K4
Unit V	CO V	Create integrated solutions using computational tools, AI, and frontier technologies for future biotech challenges	K1 – K5

K1- Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 - Create

SYLLABUS

Unit-I Recent Trends and Emerging Fields in Biotechnology:

Overview of modern biotechnology and its evolution, Recent developments in molecular biology and genetic engineering. Nanobiotechnology – applications in diagnostics and therapeutics, Ethical, legal, and social implications of emerging biotechnologies

Unit-II Advances in Medical and Pharmaceutical Biotechnology:

Molecular diagnostics – PCR-based diagnostics, microarrays, biosensors, and CRISPR diagnostics. Gene therapy – advanced delivery systems and genome editing tools, Stem cell research and regenerative medicine, Vaccine innovations – recombinant, subunit, mRNA, and DNA vaccines, Monoclonal antibody production and therapeutic applications

Unit-III Agricultural and Plant Biotechnology Innovations:

Genetically modified (GM) crops – next-generation transgenic approaches (Eg), CRISPR/Cas-mediated genome editing in plants, Plant tissue culture and somatic hybridization, Biofertilizers, biopesticides, and bioherbicides – modern formulations, Molecular farming – production of biopharmaceuticals and edible vaccines in plants, Applications of AI and data analytics in crop improvement

Unit-IV Industrial and Environmental Biotechnology Developments:

Advanced fermentation and bioprocess technology, Bioreactor design – sensors, automation, and scaling-up strategies, Industrial enzymes – directed evolution and immobilization technology, Bioplastics and biodegradable materials, Waste valorization, bioremediation, and bioenergy (bioethanol, biodiesel, biohydrogen), Green and sustainable biotechnology – circular bioeconomy concepts

Unit-V Computational and Frontier Technologies in Biotechnology:

Bioinformatics and computational biology – next-generation sequencing data analysis, Artificial intelligence (AI) and machine learning in biotechnology research, Big data and cloud computing in biological systems, Biosensors, lab-on-a-chip, and point-of-care diagnostics, Robotics and automation in biotechnology laboratories, Future perspectives: space biotechnology, neurobiotechnology, and ethical challenges.

Textbooks / References

- 1 Jogdand, S.N. Gene Biotechnology. Himalaya Publishing House.
- 2 Singh, B.D. Biotechnology: Expanding Horizons. Kalyani Publishers.
- 3 Dubey, R.C. A Textbook of Biotechnology. S. Chand & Company.
- 4 Glick, B.R. & Pasternak, J.J. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press.
- 5 Primrose, S.B., Twyman, R.M., & Old, R.W. Principles of Gene Manipulation and Genomics. Blackwell Publishing.
- 6 Satyanarayana, U. Biotechnology. Books and Allied Pvt. Ltd.

SEMESTER V

24UBT751 - TOOLS AND TECHNIQUES IN BIOTECHNOLOGY

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Acquire knowledge of basic laboratory and analytical techniques.	K1 – K3
Unit II	CO II	Understand chromatographic and electrophoretic techniques for protein and nucleic acid analysis.	K1 – K3
Unit III	CO III	Explain molecular biology techniques including DNA/RNA isolation, PCR, and bacterial transformation.	K1 - K4
Unit IV	CO IV	Apply immunological and animal cell culture techniques in biotechnology research.	K1 – K4
Unit V	CO V	Utilize bioinformatics tools and advanced instrumentation for sequence analysis, protein visualization, and experimental applications.	K1 – K5

K1 - Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create
SYLLABUS

Unit-I Basic and Analytical Techniques:

Good Laboratory Practices (GLP) – laboratory safety, documentation, and calibration., Preparation of buffers and solutions – pH, molarity, and normality calculations., Operation and principles of instruments: pH meter, spectrophotometer, colorimeter, centrifuge, and laminar air flow, Estimation of protein concentration using Lowry / Bradford method. Estimation of DNA/RNA concentration using UV spectrophotometer.

Unit-II Chromatographic and Electrophoretic Techniques:

Paper and Thin Layer Chromatography – separation of amino acids or pigments., Gel Filtration and Ion Exchange Chromatography – demonstration or practical separation of proteins. SDS-PAGE – separation of proteins by electrophoresis. Agarose Gel Electrophoresis – separation and visualization of nucleic acids. DNA quantification and purity check using Nanodrop (demo).

Unit-III Molecular Biology Techniques:

Isolation of genomic DNA from plant, animal, or microbial samples, Isolation of plasmid DNA from E. coli., Restriction digestion and analysis of DNA fragments., Polymerase Chain Reaction (PCR) – amplification and visualization of DNA., Competent cell preparation and bacterial transformation.

Unit-IV Immunological and Cell Culture Techniques:

Principles and applications of immunotechniques – demonstration of ELISA., Immunodiffusion and immunoelectrophoresis (demonstration). Introduction to animal cell culture – aseptic techniques and media preparation. Trypan Blue exclusion test for cell viability. Observation of cells under inverted microscope (demonstration).

Unit-V Bioinformatics and Advanced Instrumentation:

Introduction to biological databases – NCBI, EMBL, UniProt., Sequence alignment using BLAST, Primer design and restriction map analysis using online tools., Protein structure visualization using RCSB PDB. Demonstration of advanced instruments: HPLC, GC-MS, and RT-PCR.

Text books

- 1 Practical Biotechnology: Laboratory Manual — *Jayaraj S. & Devi R.*, Laxmi Publications
- 2 Laboratory Manual in Biochemistry — *J. Jayaraman*, New Age International
- 3 Molecular Cloning: A Laboratory Manual — *Sambrook, J. & Russell, D.W.*, Cold Spring Harbor Laboratory Press
- 4 Principles and Techniques of Biochemistry and Molecular Biology — *Wilson, K. & Walker, J.*, Cambridge University Press

Reference Books

- 1 Plummer, D.T. An Introduction to Practical Biochemistry. Tata McGraw Hill.
- 2 Jayaraman, J. Laboratory Manual in Biochemistry. New Age International.
- 3 Sambrook, J. & Russell, D.W. Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press.
- 4 Wilson, K. & Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
- 5 Jayaraj, S. & Devi, R. Practical Biotechnology. Laxmi Publications.
- 6 Ninfa, A.J., Ballou, D.P., & Benore, M. Fundamental Laboratory Approaches for Biochemistry and Biotechnology. Wiley.

e.Resources

- 1 Practical Biotechnology – Free Online Course (CEC / SWAYAM)
Techniques in Biotechnology (NPTEL)

SEMESTER V

24UBT702 - APPLICATIONS IN BIOTECHNOLOGY

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Acquire knowledge of the fundamental concepts and scope of biotechnology.	K1 – K3
Unit II	CO II	Describe the applications of biotechnology in agriculture and plant biotechnology.	K1 – K3
Unit III	CO III	Understand the role of biotechnology in medical and animal biotechnology.	K1 - K4
Unit IV	CO IV	Analyse the applications in industrial and environmental biotechnology.	K1 – K4
Unit V	CO V	Understand emerging biotechnology fields and ethical issues in biotechnology.	K1 – K5

K1 - Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create
SYLLABUS

Unit-I Introduction and Scope of Biotechnology:

Definition, scope, and interdisciplinary nature of biotechnology, Historical development and milestones in biotechnology, Tools and techniques in biotechnology – overview of genetic engineering, cell culture, and bioinformatics, Role of biotechnology in society and economy, Global and national biotechnology policies and industries

Unit-II Agricultural and Plant Biotechnology Applications:

Genetically modified (GM) crops – pest resistance (Bt cotton), herbicide tolerance, and stress resistance, Biofertilizers, biopesticides, and bioherbicides – production and applications, Plant tissue culture – micropropagation and soma clonal variation, Transgenic plants for nutritional enhancement (e.g., Golden Rice), Edible vaccines and molecular farming, Role of biotechnology in sustainable agriculture

Unit-III Animal and Medical Biotechnology Applications:

Transgenic animals – production and applications in research and industry, Stem cell technology and regenerative medicine, Gene therapy – concept, types, and ethical issues, Production of biopharmaceuticals – insulin, interferons, growth hormones, Vaccine development – recombinant and mRNA vaccines, Molecular diagnostics – PCR, ELISA, and biosensors in disease detection

Unit-IV Industrial and Environmental Biotechnology Applications:

Industrial production of enzymes, antibiotics, vitamins, and organic acids, Fermentation technology – types, processes, and downstream processing, Biofuels – biogas, bioethanol, biodiesel, and hydrogen production, Bioremediation – use of microbes for degradation of pollutants and heavy metals, Biosensors and bioindicators for environmental monitoring, Waste management and conversion of biomass to value-added products

Unit-V Emerging and Societal Applications:

Bioinformatics and computational biology applications, Nanobiotechnology – drug delivery and diagnostics, Forensic biotechnology – DNA fingerprinting and crime investigation, Space biotechnology and bioprinting – future perspectives, IPR, bioethics, and biosafety in biotechnology research and applications, Contribution of biotechnology to food security, health, and environment

Text Books

- 1 Dubey, R.C. (2014). *A Textbook of Biotechnology*. S. Chand & Company Ltd., New Delhi.
- 2 Singh, B.D. (2018). *Biotechnology: Expanding Horizons*. Kalyani Publishers, New Delhi.
- 3 Sathyanarayana, U. (2017). *Biotechnology*. Books and Allied (P) Ltd., Kolkata.

References

- 1 Jogdand, S.N. (2017). *Gene Biotechnology*. Himalaya Publishing House, Mumbai.
- 2 Old, R.W. & Primrose, S.B. (2006). *Principles of Gene Manipulation and Genomics*. Blackwell Publishing, Oxford.
- 3 Purohit, S.S. & Mathur, S.K. (2015). *Biotechnology: Fundamentals and Applications*. Agrobios (India), Jodhpur.
- 4 Brown, T.A. (2016). *Gene Cloning and DNA Analysis: An Introduction*. Wiley-Blackwell, UK.
- 5 Glick, B.R., Pasternak, J.J., & Patten, C.L. (2018). *Molecular Biotechnology: Principles and Applications of Recombinant DNA*. ASM Press, USA.
- 6 Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., & Losick, R. (2014). *Recombinant DNA: Genes and Genomes – A Short Course*. W.H. Freeman & Company, New York.
- 7 Campbell, N.A. & Reece, J.B. (2017). *Biology*. Pearson Education, USA.
- 8 Krebs, J.E., Goldstein, E.S., & Kilpatrick, S.T. (2017). *Lewin's Genes XII*. Jones & Bartlett Learning, USA.

e-RESOURCES

- 1 <http://www.ncbi.nlm.nih.gov>
- 2 <http://www.fao.org/biotechnology>
- 3 <http://www.bio.org>

SEMESTER V

24UBT703 - INTRODUCTION TO ANATOMY, PHYSIOLOGY & HUMAN DISEASES

Credits: 4

Contact Hours: 4

Internal Marks: 25

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Explain the structural organization of the human body from cellular to system levels and functions.	K1 – K3
Unit II	CO II	Analyze the structure-function relationships of the skeletal, muscular, and nervous systems	K1 – K3
Unit III	CO III	Evaluate the integrated functioning of the circulatory, respiratory, and excretory systems	K1 - K4
Unit IV	CO IV	Correlate the roles of digestive, endocrine, and reproductive systems in nutrient processing, hormonal regulation	K1 – K4
Unit V	CO V	Assess the etiology, prevention, and public health implications of infectious, non-communicable, and genetic diseases, and propose evidence-based strategies for health promotion and disease management.	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I Introduction to Human Anatomy and Physiology:

Organization of the human body – cell, tissue, organ, and system levels. Anatomical terminology and body planes. Overview of homeostasis and feedback mechanisms. Structural organization of tissues: epithelial, connective, muscular, and nervous tissues. Microscopic and gross anatomy basics.

Unit-II Skeletal, Muscular, and Nervous Systems:

Skeletal system: structure, types of bones, bone formation, axial and appendicular skeleton. Muscular system: types of muscles, muscle contraction physiology, neuromuscular junction. Nervous system: organization (CNS, PNS, ANS), structure of neuron, synapse, transmission of nerve impulses, reflex arc, brain and spinal cord functions.

Unit-III Circulatory, Respiratory, and Excretory Systems:

Circulatory system: composition of blood, blood groups, coagulation, heart structure and function, cardiac cycle, blood pressure, lymphatic system. Respiratory system: structure and function of respiratory organs, mechanism of breathing, transport of gases, control of respiration. Excretory system: structure of nephron, urine formation, regulation of water and electrolyte balance.

Unit-IV Digestive, Endocrine, and Reproductive Systems:

Digestive system: structure and function of digestive organs, digestion and absorption of nutrients. Endocrine system: major glands (pituitary, thyroid, adrenal, pancreas, gonads), hormones and their physiological roles. Reproductive system: structure and function of male and female reproductive organs, menstrual cycle, fertilization, and embryonic development

Unit-V Human Diseases and Disorders:

Infectious diseases: bacterial (tuberculosis, typhoid), viral (hepatitis, HIV/AIDS), fungal and parasitic diseases (malaria, amoebiasis). Non-communicable diseases: diabetes mellitus, hypertension, cancer, cardiovascular diseases, renal failure. Genetic disorders: Down's syndrome, sickle cell anemia, cystic fibrosis. Basic principles of prevention, diagnosis, and treatment of diseases. Concept of vaccination and public health.

Text Books:

- 1 Welsh, Shier, Butler / McGraw-Hill (2026) Hole's Essentials of Human Anatomy and Physiology
- 2 Ross, M.H. & Pawlina, W. (2021). Histology: A Text and Atlas. 8th Ed., Wolters Kluwer.

References:

- 1 Tortora, G.J. & Derrickson, B. (2019). Principles of Anatomy and Physiology. 16th Ed., Wiley.
- 2 Guyton, A.C. & Hall, J.E. (2020). Textbook of Medical Physiology. 14th Ed., Elsevier.
- 3 Sherwood, L. (2023). Human Physiology: From Cells to Systems. 11th Ed., Cengage Learning.
- 4 Marieb, E.N. & Hoehn, K. (2021). Human Anatomy & Physiology. 12th Ed., Pearson Education.
- 5 Robbins, S.L., Kumar, V., & Cotran, R.S. (2020). Pathologic Basis of Disease. 10th Ed., Elsevier.
- 6 Wilson, J. (2020). Human Anatomy and Physiology for Nurses. CBS Publishers.

E-Resources:

- 1 www.openstax.org/details/books/anatomy-and-physiology-2e
- 2 https://usq.pressbooks.pub/anatomy?spm=a2ty_o01.29997172.0.0.737b5171uK0AYJ
- 3 https://pressbooksdev.oer.hawaii.edu/anatomyandphysiology2021/?spm=a2ty_o01.29997172.0.0.737b5171uK0AYJ

SEMESTER V
24UBT752 - CODING SYSTEM PRACTICES

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Explain the fundamentals of computers, algorithms, and coding principles	K1 – K3
Unit II	CO II	Apply basic Python programming methods to solve simple problems	K1 – K3
Unit III	CO III	Utilize coding tools for handling data, loops, functions, and file operations	K1 - K4
Unit IV	CO IV	Implement coding skills for simple biological data analyses	K1 – K4
Unit V	CO V	Analyze the role of coding in biotechnology research, diagnostics, and industry	K1 – K5

K1- Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 - Create

SYLLABUS

Unit-I Fundamentals of Coding and Computer Concepts:

Basic components of computers, operating systems, and software used in scientific fields. Coding languages, importance of computational skills in biotechnology, and basics of algorithms, flowcharts, variables, data types, and logical problem-solving.

Unit-II Basics of Coding Practices in Biotechnology:

Foundational concepts of coding required for biotechnology applications. Basic rules of writing code, including syntax, indentation, input/output operations and the use of operators. Analysing biological data and practice writing beginner-level codes for tasks such as processing DNA/RNA sequences, performing basic laboratory calculations and managing simple biological datasets

Unit-III Data Handling and Programming Logic:

Python data types like strings, lists, tuples, and dictionaries, along with conditional statements, loops, and functions. Simple files, including text and CSV files, to support basic data processing tasks.

Unit-IV Applications of Coding in Lifesciences:

Basic biological data handling. DNA/RNA sequence manipulation, GC percentage calculation, codon counting, and introduction to simple Biopython operations. Real-world biological datasets.

Unit-V Mini Projects and Real-Time Case Studies:

Coding skills to simple biotechnology problems. DNA sequence analysis tools, basic data visualizations, calculator programs (BMI, molarity), and simple automation tasks. Case studies highlight how coding enhances laboratory processes, diagnostics, and biotech industry workflows.

TEXT BOOKS

- 1 Medical coding Programming for Beginners –Buck and John S. Smiley, 2020
- 2 Automate the Boring Stuff with Coding Concepts – Al Sweigart, 2019
- 3 Bioinformatics Programming Using Python – Mitchell L. Model, 2009

REFERENCE BOOKS

- 1 Programming Logic and Techniques – Eric Matthes, 2019
- 2 Learning Programming Concepts – Mark Lutz, 2013
- 3 Practical Programming: An Introduction to Computer Science – Paul Gries et al., 2017
- 4 Bioinformatics for Beginners – Supratim Choudhuri, 2014
- 5 Introduction to Computer Science – ITL Education Solutions, 2011

e-Resources

- 1 <https://www.python.org/doc/>
- 2 <https://www.w3schools.com/python/>
- 3 <https://biopython.org/tutorial/>
- 4 <https://github.com/python-for-bioinformatics>

SEMESTER V
24UBT704 - MEDICAL CODING CERTIFICATION

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Explain healthcare systems, coding standards, and ethical practices.	K1 – K3
Unit II	CO II	Apply medical terminology and anatomical knowledge in coding contexts.	K1 – K3
Unit III	CO III	Apply CPT and HCPCS coding for healthcare procedures.	K1 - K4
Unit IV	CO IV	Analyze medical billing processes and compliance requirements.	K1 – K4
Unit V	CO V	Evaluate coding cases and prepare for professional certification exams.	K1 – K5

K1- Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 - Create

SYLLABUS

Unit-I Introduction to Medical Coding and Healthcare System:

Overview of healthcare delivery systems and insurance models, History, purpose, and importance of medical coding, Roles and responsibilities of medical coders, Overview of coding standards and ethical practices, Types of coding systems: ICD, CPT, HCPCS. Medical record components and documentation requirements.

Unit-II Medical Terminology and Anatomy Review:

Medical word structure: roots, prefixes, suffixes. Terminology related to body systems (skeletal, muscular, nervous, cardiovascular, respiratory, digestive, endocrine, urinary, and reproductive). Basic human anatomy and physiology for coders. Terminology used in diagnostic and procedural coding. Exercises in decoding and constructing medical terms.

Unit-III ICD-10-CM Coding System (Diagnosis Coding):

Structure and format of ICD-10-CM codes. Conventions and guidelines for coding diseases and conditions. Coding for infectious diseases, neoplasms, endocrine, circulatory, and respiratory disorders. Injury, poisoning, and external cause codes. Coding practice with case studies. Overview of ICD-11 transition and updates.

Unit-IV CPT and HCPCS Coding (Procedural Coding):

Overview of Current Procedural Terminology (CPT) and Healthcare Common Procedure Coding System (HCPCS). CPT code structure – sections and modifiers. Surgical, radiology, pathology, and evaluation & management (E/M) coding. HCPCS Level II codes for supplies, drugs, and durable medical equipment. Case-based coding exercises using CPT and HCPCS manuals.

Unit-V Medical Billing, Compliance, and Certification Preparation:

Overview of the medical billing process and revenue cycle management. Claim forms (CMS-1500, UB-04) and payer requirements. HIPAA compliance and data protection. Fraud prevention and ethical issues in medical coding. Audit and quality assurance in coding. Preparation for certification exams: CPC (AAPC), CCS (AHIMA), and CCA.

Text books:

- 1 Carol J. Buck (2022).Step-by-Step Medical Coding. 16th Ed., Elsevier.
- 2 AAPC (2023).CPC Certification Study Guide. American Academy of Professional Coders.

References:

- 1 Deborah J. Grider (2021).Medical Coding: Understanding ICD-10-CM and CPT. Delmar Cengage Learning.
- 2 Lorraine Papazian-Boyce (2020).Medical Billing and Coding For Dummies. Wiley.
- 3 Linda M. Smith (2023).Comprehensive Health Insurance: Billing and Coding. Cengage Learning.

e-resources:

- 1 Centers for Medicare & Medicaid Services (CMS) – Coding & Billing Guidelines
<https://www.cms.gov>
- 2 World Health Organization (WHO) – Health Systems & ICD Resources
<https://www.who.int/standards/classifications>

SEMESTER V

24UBT705 - INTRODUCTION TO QUALITY CONTROL

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Acquire fundamental knowledge of quality concepts in biotechnology industries.	K1 – K3
Unit II	CO II	Describe about structure, functions of a Quality Control department.	K1 – K3
Unit III	CO III	Understand national and international regulatory frameworks of biotechnology industries.	K1 - K4
Unit IV	CO IV	Analyze quality systems implemented in biopharmaceutical and fermentation industries.	K1 – K4
Unit V	CO V	Evaluate ethical practices and risk management strategies in quality systems.	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I Basics concepts of Quality Control:

Definitions of quality control and the evolution of quality systems. Importance of quality in biotechnology and pharmaceutical industries, outlines the principles of quality management, and relationship between quality, safety, and efficacy of bioproducts.

Unit-II Quality Control Organization and Documentation:

The structure and functions of a Quality Control department, roles and responsibilities of QC personnel, documentation hierarchy, standard operating procedures (SOPs), record maintenance, and data integrity practices in laboratory environments.

Unit-III Regulatory Framework in Quality Control:

National and international regulatory requirements governing biotechnology industries. Regulatory compliance, licensing requirements, inspection systems, and the importance of adhering to approved standards in manufacturing and testing.

Unit-IV Quality Systems in Biotechnology Industries:

Quality systems implemented in biopharmaceutical and fermentation industries. Batch control, raw material approval, in-process monitoring, finished product evaluation, and quality audits for maintaining consistency in production.

Unit-V Ethics, Biosafety and Risk Management:

Professional ethics in quality control, laboratory biosafety practices, risk assessment, hazard identification, corrective and preventive actions, and the importance of maintaining transparency and accountability in quality systems.

Text Books

- 1 Biotechnology: Quality Assurance and Validation – Avis, Wagner & Wu
- 2 Quality Control Training Manual: Comprehensive Training Guide for API, Finished Pharmaceutical and Biotechnologies Laboratories – Syed Haider & Erfan Asif
- 3 Quality Control and Regulatory Affairs for Biopharmaceuticals – Singh et al (2024)

References

- 1 Biotechnology: Quality Assurance and Validation – Avis, Wagner & Wu
 - 2 Quality Control Training Manual: Comprehensive Training Guide for API, Finished Pharmaceutical and Biotechnologies Laboratories – Syed Haider & Erfan Asif
 - 3 Pharmaceutical Quality Systems – Oliver Schmidt
 - 4 Good Manufacturing Practices for Pharmaceuticals (7th Ed.) – Graham P. Bunn
 - 5 Pharmaceutical Calibration, Validation and Qualification: A Comprehensive Approach – Shukla et al.
 - 6 Pharmaceutical Quality by Design: Principles and Applications – Edited by Sarwar Beg & Md Saquib Hasnain
 - 7 Introduction to Quality by Design in Pharmaceutical Manufacturing and Analytical Development – Breitzkreitz & Goicoechea (Springer, 2023)
 - 8 Quality Assurance and Quality Management in Pharmaceutical Industry – Y. Anjaneyulu & R. Marayya
 - 9 Quality Operations Procedures for Pharmaceutical, API, and Biotechnology – Syed Imtiaz Haider & Erfan Syed Asif
 - 10 Handbook of Quality System, Accreditation and Conformity Assessment – Bhatnagar et al.
- e.Resources
- 1 <https://www.perlego.com/book/1506883/quality-control-training-manual-comprehensive-training-guide-for-api-finished-pharmaceutical-and-biotechnologies-laboratories-pdf>
 - 2 https://bio.libretexts.org/Courses/West_Los_Angeles_College/Biotechnology/12%253A_Quality_Assurance_and_Quality_Control_in_Biotechnology/12.01%253A_Principles_of_Quality_Assurance_%28QA%29_and_Quality_Control_%28QC%29

SEMESTER V
24UBT753 - QUALITY CONTROL TECHNIQUES

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Explain fundamental analytical techniques.	K1 – K3
Unit II	CO II	Apply chromatographic and electrophoretic methods for biomolecules in quality testing.	K1 – K3
Unit III	CO III	Analyze microbiological quality control procedures in clean room facilities.	K1 - K4
Unit IV	CO IV	Evaluate molecular and immunological techniques for product identity and purity assessment.	K1 – K4
Unit V	CO V	Design and implement instrument calibration protocols	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I Analytical Techniques in Quality Testing:

Basic analytical methods used in biotechnology industries: spectrophotometry, colorimetry, titration, gravimetric analysis, pH measurement, conductivity testing, and dissolved oxygen analysis for product evaluation.

Unit-II Chromatographic and Electrophoretic Methods:

Chromatographic techniques: HPLC, GC, and TLC, along with electrophoresis methods including SDS-PAGE and agarose gel electrophoresis for separation and analysis of biomolecules.

Unit-III Microbiological Quality Control Methods:

Sterility testing, microbial limit tests, contamination detection, media quality assessment, environmental monitoring, and validation of sterilization procedures used in cleanroom facilities.

Unit-IV Molecular and Immunological Techniques:

Advanced QC methods: PCR-based testing, ELISA, immunoassays, endotoxin detection, and molecular diagnostics used for ensuring product purity and identity.

Unit-V Instrument Calibration and Statistical Quality Control:

Calibration and validation of laboratory instruments: qualification procedures (IQ, OQ, PQ), accuracy and precision concepts, control charts, statistical analysis, and interpretation of test results in quality assessment.

Text Books

- 1 Quality Control in the Pharmaceutical Industry – Murray S. Cooper (Comprehensive coverage of QC principles, analytical testing, sterility testing, and regulatory aspects.)
- 2 Pharmaceutical Analysis – David G. Watson (Detailed explanation of analytical techniques including spectrophotometry, chromatography, and electrophoresis.)
- 3 Analytical Biochemistry – David J. Holme & Hazel Peck (Fundamental biochemical and analytical methods relevant to biotechnology industries.)

References

- 1 Instrumental Methods of Chemical Analysis – Galen W. Ewing
- 2 Principles and Techniques of Biochemistry and Molecular Biology – Wilson & Walker
- 3 Pharmaceutical Microbiology – W.B. Hugo & A.D. Russell
- 4 Basic Tests for Pharmaceutical Substances – World Health Organization
- 5 Quality Assurance of Pharmaceuticals – World Health Organization
- 6 Biopharmaceuticals: Biochemistry and Biotechnology – Gary Walsh
- 7 Statistical Quality Control – Grant & Leavenworth
- 8 Good Manufacturing Practices for Pharmaceuticals – Joseph D. Nally

e. Resources

- 1 <http://archive.nptel.ac.in/courses/102/107/102107028/>
- 2 https://bio.libretexts.org/Courses/West_Los_Angeles_College/Biotechnology/12%3A_Quality_Assurance_and_Quality_Control_in_Biotechnology/12.01%3A_Principles_of_Quality_Assurance_%28QA%29_and_Quality_Control_%28QC%29

SEMESTER V

24UBT706 - TOTAL QUALITY MANAGEMENT IN BIOTECHNOLOGY INDUSTRIES

Credits: 4

Contact Hours: 4

Internal Marks: 25

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Explain the principles	K1 – K3
Unit II	CO II	Apply quality planning methods	K1 – K3
Unit III	CO III	Utilize quality tools and techniques such as Six Sigma	K1 - K4
Unit IV	CO IV	Implement quality assurance systems	K1 – K4
Unit V	CO V	Analyze strategic quality management practices including cost of quality	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Unit-I Principles of Total Quality Management:

The philosophy of Total Quality Management (TQM): objectives, benefits, and its role in biotechnology industries. Customer-focused quality systems and continuous improvement strategies.

Unit-II Quality Planning and Process Improvement:

Quality planning methods, benchmarking, process optimization, workflow management, and performance measurement tools used to enhance productivity and product reliability.

Unit-III Quality Tools and Techniques:

Quality improvement tools: basics of Six Sigma, principles of Lean manufacturing, Kaizen, Pareto analysis, fishbone diagram, 5-why analysis, and problem-solving methodologies used in industrial settings.

Unit-IV Quality Assurance and Compliance Systems:

Implementation of quality assurance programs, internal and external audits, quality certifications, supplier quality management, and maintaining compliance with international standards.

Unit-V Strategic Quality Management and Industrial Excellence:

Leadership in quality management, cost of quality analysis, risk-based thinking, sustainability practices, digital quality systems, and long-term strategies for achieving operational excellence in biotechnology industries.

Text Books

- 1 Total Quality Management – Barrie G. Dale, 2015, Wiley-Blackwell publisher
- 2 Total Quality Management – Dale H. Besterfield et al., 2003, Pearson Education publisher
- 3 Quality Management for Organizational Excellence – David L. Goetsch & Stanley B. Davis, 2014, Pearson publisher

Reference Books

- 1 Juran's Quality Handbook – Joseph M. Juran, 2017, McGraw-Hill Education
- 2 Out of the Crisis – W. Edwards Deming, 1986, MIT Press
- 3 The Six Sigma Handbook – Thomas Pyzdek & Paul A. Keller, 2014, McGraw-Hill Education
- 4 Lean Thinking – James P. Womack & Daniel T. Jones, 1996, Simon & Schuster
- 5 Quality Assurance of Pharmaceuticals – World Health Organization, 2013, WHO Press
- 6 Pharmaceutical Quality Assurance – Manohar A. Potdar, 2008, Nirali Prakashan
- 7 Good Manufacturing Practices for Pharmaceuticals – Sidney H. Willig & James R. Stoker, 2012, CRC Press

e.Resources

- 1 <http://www.iso.org/iso/home/standards/management-standards/iso9001.html>
- 2 http://www.who.int/medicines/areas/quality_safety/quality_assurance/en/

SEMESTER V

24UBT707 - FUNDAMENTALS OF MEDICAL LABORATORY TECHNOLOGY

Credits: 3

Contact Hours: 3

Internal Marks: 25

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Explain the organization, safety protocols, and ethics of medical laboratories.	K1 – K3
Unit II	CO II	Demonstrate operation and maintenance of laboratory instruments and preparation of reagents.	K1 – K3
Unit III	CO III	Perform basic hematological investigations and blood grouping techniques.	K1 - K4
Unit IV	CO IV	Analyze clinical biochemistry parameters and interpret urine examination results.	K1 – K4
Unit V	CO V	Apply microbiological staining, culture, and serological diagnostic techniques.	K1 – K5

K1- Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 - Create

SYLLABUS

Unit-I Introduction to Medical Laboratory Science:

Scope and importance of Medical Laboratory Technology (MLT). Organization and functions of a clinical laboratory. Roles and responsibilities of medical laboratory technologists. Laboratory hazards and safety measures: physical, chemical, biological, and fire safety. First aid and emergency procedures. Good Laboratory Practices (GLP) and ethics in laboratory work.

Unit-II Laboratory Instruments and Basic Techniques:

Principle, operation, and maintenance of laboratory instruments - Microscope, centrifuge, colorimeter, spectrophotometer, pH meter, autoclave, hot air oven, incubator, refrigerator. Calibration and quality control of instruments. Cleaning and sterilization of glassware and instruments. Preparation of reagents, buffers, and solutions. Units of measurement, concentration (molarity, normality, ppm).

Unit-III Clinical Hematology and Blood Banking:

Composition and functions of blood, Collection and handling of blood samples, Anticoagulants and their uses. Haemoglobin estimation, Total RBC and WBC count, ESR, hematocrit, blood indices, Blood grouping and crossmatching, Common hematological disorders: anemia, leukemia, hemophilia, Blood bank organization, donor selection and blood storage.

Unit-IV Clinical Biochemistry and Urine Analysis:

Principles of clinical biochemistry, Analysis of blood glucose, urea, creatinine, cholesterol, and liver enzymes, Quality control and interpretation of biochemical test results, Collection and preservation of urine samples, Routine and microscopic examination of urine, Tests for abnormal constituents: glucose, protein, ketone bodies, bile pigments.

Unit-V Clinical Microbiology and Serology:

Collection, transport, and processing of clinical specimens (urine, sputum, pus, blood, stool, swabs), Principles of sterilization and disinfection, Staining techniques: simple, Gram, and acid-fast staining, Culture media preparation and microbial identification. Common laboratory tests: Widal, VDRL, ELISA, and rapid diagnostic tests (RDTs). Laboratory biosafety levels and waste management.

References

- 1 Sood, R. (2022).Textbook of Medical Laboratory Technology. Jaypee Brothers Medical Publishers.
- 2 Kanai, L. & Praveen, G. (2021).Medical Laboratory Technology Methods and Interpretations. 7th Ed., Jaypee Brothers.
- 3 Godkar, P.B. &Godkar, D.P. (2020).Textbook of Medical Laboratory Technology. Bhalani Publishing House.
- 4 Bhatia, R. (2019).Essentials of Medical Microbiology. Jaypee Brothers.
- 5 Murray, P.R. et al. (2020).Medical Microbiology. 9th Ed., Elsevier.
- 6 Harold Varley (2019).Practical Clinical Biochemistry. 7th Ed., CBS Publishers.
- 7 Bishop, M.L., Fody, E.P., &Schoeff, L.E. (2022).Clinical Chemistry: Techniques, Principles, Correlations. 9th Ed., Wolters Kluwer.
- 8 Tille, P.M. (2022).Bailey & Scott's Diagnostic Microbiology. 15th Ed., Elsevier.

SEMESTER V

24UBT708 - PRACTICAL IN CLINICAL DIAGNOSIS

Credits: 2

Internal Marks: 40

Contact Hours: 4

External Marks: 60

Course Outcomes:

CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
CO I	Demonstrate laboratory safety practices and sample handling techniques.	K1 – K3
CO II	Perform hematological diagnostic procedures accurately.	K1 – K3
CO III	Conduct biochemical tests and interpret results.	K1 - K4
CO IV	Apply microbiological staining and culture techniques.	K1 – K4
CO V	Perform serological diagnostic tests and evaluate outcomes.	K1 – K5

K1- Remember, **K2** - Understand, **K3** - Apply, **K4** - Analyze, **K5** - Evaluate, **K6** - Create

SYLLABUS

Basic Laboratory Techniques

1. Preparation and labeling of biological samples.
2. Study of common laboratory glassware and equipment.
3. Demonstration of sample preservation and transport techniques.

Hematological Techniques

4. Estimation of hemoglobin and hematocrit.
5. Total and differential leukocyte count.
6. ESR and blood grouping.

Clinical Biochemistry

7. Estimation of blood glucose by colorimetric method.
8. Estimation of serum urea and creatinine.
9. Liver function test – estimation of bilirubin and enzymes.

Microbiological Techniques

10. Gram staining of pus/urine samples.
11. Isolation and culture of pathogenic bacteria.
12. Antibiotic susceptibility testing.

Serological Diagnostics

13. Widal agglutination test.
14. VDRL test.
15. Demonstration of ELISA procedure (kit-based).

References

- 1 Sood, R. (2022).Textbook of Medical Laboratory Technology. Jaypee Brothers Medical Publishers. 2. Godkar, P.B. &Godkar, D.P. (2020).Textbook of Medical Laboratory Technology. Bhalani Publishing House.
- 2 Bhatia, R. (2019).Essentials of Medical Microbiology. Jaypee Brothers.
- 3 Bishop, M.L., Fody, E.P., &Schoeff, L.E. (2022).Clinical Chemistry: Techniques, Principles, Correlations. 9th Ed., Wolters Kluwer.
- 4 Tille, P.M. (2022).Bailey & Scott's Diagnostic Microbiology. 15th Ed., Elsevier.
- 5 Cheesbrough, M. (2017).District Laboratory Practice in Tropical Countries. Cambridge University Press.

SEMESTER V
24UBT708 - ADVANCED DIAGNOSTICS

Credits: 4

Internal Marks: 25

Contact Hours: 4

External Marks: 75

Course Outcomes:

Unit	CO NO	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	COGNITIVE LEVEL
Unit I	CO I	Explain modern diagnostic systems, automation, and accreditation standards.	K1 – K3
Unit II	CO II	Apply advanced immunodiagnostic techniques in clinical case scenarios.	K1 – K3
Unit III	CO III	Perform and interpret molecular diagnostic techniques such as PCR and sequencing.	K1 - K4
Unit IV	CO IV	Analyze biomarkers, biosensors, and imaging data in disease diagnosis.	K1 – K4
Unit V	CO V	Evaluate emerging diagnostic trends including liquid biopsy and precision medicine.	K1 – K5

K1- Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 - Create

SYLLABUS

Unit-I Overview of Modern Diagnostic Systems:

Evolution of diagnostic technologies: Conventional to advanced, Classification of diagnostic methods – biochemical, immunological, molecular imaging, Concept of Point-of-Care Testing (POCT) and Lab-on-a-Chip technology, Automation in diagnostics and laboratory information systems (LIS), Quality control, validation, and accreditation (NABL, ISO 15189).

Unit-II Advanced Immunodiagnostics:

Principle and applications of immunoassays: RIA, ELISA, CLIA, and lateral flow immunoassays, Monoclonal and polyclonal antibodies in diagnostics, Immunofluorescence, immunohistochemistry (IHC), and flow cytometry. Case studies: diagnostic applications in autoimmune and infectious diseases.

Unit-III Molecular Diagnostics:

Nucleic acid extraction and quantification, Polymerase Chain Reaction (PCR) (Eg)– RT-PCR, qPCR, Multiplex PCR, and Digital PCR, DNA sequencing techniques: Sanger, NGS (Next-Generation Sequencing), nanopore sequencing, Microarrays and gene expression profiling, Molecular diagnosis of genetic, infectious and oncological diseases.

Unit-IV Advanced Biochemical and Imaging Diagnostics:

Biosensors and nanodiagnostics: electrochemical, optical, and immunosensors, Biomarkers – discovery, validation, and clinical applications, Clinical metabolomics and proteomics in diagnostics, Imaging techniques: CT, MRI, PET, ultrasound, and molecular imaging, AI and machine learning applications in medical image analysis.

Unit-V Emerging Trends and Ethical Aspects in Diagnostics:

Personalized and precision medicine, Liquid biopsy and circulating tumor DNA (ctDNA), Companion diagnostics and pharmacogenomics, Point-of-care diagnostic devices and wearable biosensors, Ethical, legal, and regulatory aspects of diagnostic testing and patient data management.

References

- 1 McPherson, R.A. & Pincus, M.R. (2023). Henry's Clinical Diagnosis and Management by Laboratory Methods. 25th Ed., Elsevier.
- 2 Burtis, C.A., Ashwood, E.R., & Bruns, D.E. (2022). Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. 7th Ed., Elsevier.
- 3 Desai, S.R. (2020). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
- 4 Wild, D. (2013). The Immunoassay Handbook: Theory and Applications of Ligand Binding, ELISA, and Related Techniques. 4th Ed., Elsevier.
- 5 Campbell, I.D. & Reece, J.B. (2021). Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications. Wolters Kluwer
- 6 Niemeyer, C.M. & Mirkin, C.A. (2021). Nanobiotechnology: Concepts, Applications and Perspectives. Wiley-VCH.
- 7 Voet, D. & Pratt, C.W. (2022). Principles of Biochemistry. 6th Ed., Wiley.
- 8 Roy, S. (2022). Advances in Molecular Diagnostics and Treatment of Human Diseases. Springer.