Syllabus for B.Sc., Biotechnology

(From the Academic Year 2019-20 onwards)

Department of Biotechnology and Microbiology

National College

(Autonomous)

Tiruchirappalli – 620 001.

NATIONAL COLLEGE (AUTONOMOUS)

TIRUCHIRAPPALLI – 620 001.
(College with Potential for Excellence)
(Nationally Reaccredited at 'A+' Level by NAAC)

DEPARTMENT OF BIOTECHNOLOGY AND MICROBIOLOGY

Vision:

To create potential and competent professionals through career oriented training aided with advanced technical skills and equipping them with professional ethics, environmental and societal apprehension.

Mission:

- Dissemination of global demand based knowledge through teaching with technical professionalism.
- Creation of individuals with social and environmental concern.
- Training the students to create economically and environmentally viable solutions.

Programme Educational Objectives (PEOs):

PEO 1: Cognitive Objective

PEO 1a: Developing the potential for vertical career growth in biotech-oriented industries, service sectors and related avenues.

PEO 1b: Inculcating technical and managerial skills crucial for real time scenarios through the enhancement of problem solving skills and advanced technical documentation ability.

PEO 2: Affectionate Objective

Grooming the students with technical proficiency to equip them for the emergence of sustainable technology and solutions for prevailing environmental, societal and cultural concerns.

PEO 3: Behavioral Objective

Instilling knowledge and awareness on professional ethics, bioethical and health issues, intellectual property rights and life-long learning through career oriented courses such as IPR, biosafety and bioethics.

Programme Outcomes (POs):

PO1: Proficient knowledge in the lead domains of biotechnology including Bioprocess technology, Animal biotechnology and Bioinformatics.

PO2: Competent professionals with the ability to develop/revise biotech based concepts/systems/protocols.

PO3: Efficient and equipped individuals with complex problem solving and technical expertise.

PO4: Intellectual candidates embossed with managerial work ethics and entrepreneurial skills.

PO5: Substantial understanding in the mechanisms of life forms for the involvement in medicine and research.

PO6: Ability to instill public awareness on environment and health through data collection, analysis, interpretation and presentation adeptness.

PO7: Competency to critically relate and analyze existing situation and to provide economically and scientifically viable solutions.

PO8: Ability and proficiency for the selection and application of appropriate tools/instruments for the demanding situations and studies.

PO9: Richly enriched professionals in written and verbal communication for the dissemination of knowledge and ideas.

PO10: Individuals with self-introspected attitudes and thirst for *life-long learning.*

B.Sc. BIOTECHNOLOGY
COURSE STRUCTURE UNDER C.B.C.S.

(Applicable to Candidates admitted from the Academic Year 2019-20 onwards)

Sem	Part	Course	Course Title	Inst. Hrs./ Wk	Credit	Exam Hrs.	Marks			Total
							CIA	External		
								W	O	
I	I	U19T1/U19H1/ U19S1	Tamil – I/ Hindi – I/ Sanskrit – I	6	3	3	25	75	-	100
	II	U19E1	English – I	6	3	3	25	75	-	100
	III	Core Theory I U19BT1	Cell Biology and Genetics	5	5	3	25	75	-	100
		U19BT2P	Lab in Cell Biology, Genetics and Molecular Biology	3	-	-	-	-	-	-
		U19ABT1	Biochemistry	5	3	3	25	75	-	100
		U19ABT2P	Lab in Biochemistry	3	-	-	-	-	-	-
	IV	U19ES	Environmental Studies	2	2	3	25	75	-	100
Total				**30**	**16**					**500**
II	I	U19T2/ U19H2/ U19S2	Tamil – II/Hindi – II/ Sanskrit – II	6	3	3	25	75	-	100
	II	U19E2	English – II	4	2	3	25	75	-	100
		U19CE1	Communicative English – 1	2	1	3	25	70	05	100
	III	U19BT2P	Lab in Cell Biology, Genetics and Molecular Biology	3	6	3	25	70	05	100
		Core Theory III U19BT3	Molecular Biology	5	5	3	25	75	-	100
		U19ABT2P	Lab in Biochemistry	3	3	3	25	70	05	100
		U19ABT3	Intermediary Metabolism	5	3	3	25	75	-	100
	IV	U19SBE 1	Computer Applications	2	2	3	25	75	-	100
Total				**30**	**25**					**800**

III	I	U19T3/U19H3/ U19S3	Tamil – III/Hindi – III/ Sanskrit – III	6	3	3	25	75	-	100
	II	U19E3	English – III	6	3	3	25	75	-	100
	III	Core Theory IV U19BT4	Immunology	4	4	3	25	75	-	100
		U19ABT4	General Microbiology	4	3	3	25	75	-	100
		U19BT5P	Lab in Immunology	3	-	-	-	-	-	-
		U19ABT5P	Lab in Microbiology	3	-	-	-	-	-	-
	IV	U19SBE4	Medical Lab Technology	2	2	3	25	75	-	100
		U19SBE5P	Medical Lab Technology – Practical	2	2	3	25	70	05	100
Total				**30**	**17**					**600**
IV	I	U19T3/U19H4/ U19S4	Tamil – IV/Hindi – IV/ Sanskrit – IV	6	3	3	25	75	-	100
	II	U19E4	English – IV	4	2	3	25	75	-	100
		U19CE2	Communicative English – II	2	1	3	25	70	05	100
	III	Core Theory VI U19BT6	rDNA Technology	4	4	3	25	75	-	100
		U19ABT6	Applied Microbiology	4	3	3	25	75	-	100
		U19BT5P	Lab in rDNA Technology and Immunology	3	5	3	25	70	05	100
		U19ABT5P	Lab in Microbiology	3	3	3	25	70	05	100
	IV	U19NMBT1	Non- Major Elective#	2	2	3	25	75	-	100
		U19VE	Value Education	2	2	3	25	75	-	100
Total				**30**	**25**					**900**

V	III	Core Theory VII U19BT7	Bioinstrumentation	5	5	3	25	75	-	100
		Core Theory VIII U19BT8	Bioprocess Technology	5	5	3	25	75	-	100
		Elective – Theory U19BT9E	Biostatistics and Bioinformatics	5	4	3	25	75	-	100
		Elective - Theory U19BT10E	Enzyme Technology	5	4	3	25	75	-	100
		Lab U19BT11P	Lab for courses in Sem V	6	5	3	25	70	05	100
	IV	Non-Major Elective U19NMBT2	Non-Major Elective	2	2	3	25	75	-	100
		U19SS	Soft Skills	2	2	3	25	75	-	100
Total				**30**	**27**					**700**
VI	III	Core Theory X U19BT13	Plant Biotechnology	6	6	3	25	75	-	100
		Core Theory XI U19BT14	Animal Biotechnology	6	6	3	25	75	-	100
		Core Theory XII U19BT15	Environmental Biotechnology	6	6	3	25	75	-	100
		Elective - Theory U19BT16E	IPR, Biosafety and Bioethics	5	4	3	25	75	-	100
		Lab U19BT12P	Lab in Plant Biotechnology, Animal Biotechnology and Environmental Biotechnology	6	6	3	25	70	05	100
	IV	U19GS	Gender Studies	1	1	3	25	75	-	100
		-	Extension Activities	-	1	-	-	-	-	-
Total				**30**	**30**					**600**
Grand Total				**180**	**140**					**4100**

SEMESTER - I		CODE - U19BT1
Core Course I: CELL BIOLOGY AND GENETICS		
CREDITS - 5		HOURS - 5

Objectives:

- To understand the structural organization of cells.
- To interpret the diversified functions of every organelles in the cell.
- To understand the mechanisms of Mendelian genetics.
- To differentiate sex linked inheritances.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Interpret the functions and structural properties of both prokaryotic and eukaryotic cells.	C3
➢ Describe the structural and functional aspects of cellular organelles.	C2
➢ Utilize the concepts of Mendelian genetics for the understanding of phenotypic and genotypic characteristics.	C3
➢ Explain the mechanisms of linkage and crossing over.	C3

C1 – Remember C2 – Understand C3 – Apply

Unit I:

Cell as a basic unit: Discovery of the cells, Structure of plant and animal cell. Development of cell theory: Prokaryotic and Eukaryotic cell organization. Membrane Architecture: Unit membrane model, Fluid mosaic model. Cell Cycle Mitosis and Meiosis.

Unit II:

Ultra structure and Function of Organelles: Nucleus, Mitochondria, Chloroplast, Endoplasmic Reticulum, Golgi,Ribosomes, Lysosomes, Vacuoles, Peroxisomes and Glyoxisomes.

Unit III:

Mendelian Genetics: Definitions of common terms in genetics- Phenotype, genotype, heterozygous, homozygous, allele, gene, gene locus, pure line, hybrid, Mendel's laws. Monohybrid cross, Dihybrid cross, Test cross, Back cross and Incomplete dominance.

Unit IV:

Interaction of factors: Complementary, lethal and epistatic. Linkage and crossing over in *zea mays*. Polygenic inheritance.

Unit V:

Sex linked and limited inheritance, sex determination in Drosophila, Genic balance theory of determination. Sex determination in human being. Brief outline of allosomal (Klinefelter syndrome), autosomal (Down syndrome) disorders. Population Genetics - Hardy – Weinberg law.

Textbooks

1. Cell Biology – Gerald Karp, McGraw-Hill,1979
2. De Robertis, E.D.P and De Robertis E.M.F., 2001, Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkins, New York.
3. Gardner, E.J. &Snusted, D.P. (1984): Principles of Genetics (7th edition) John Wiley &Sons,N.Y.
4. Lewin, B. (1985): Genes IV Wiley EasternLtd.,
5. Sinnott, E.W., L.C. Dunn & J. Dobshansky (1958): Principles of Genetics (5th Edition)McGraw Hill Publishing Co., N.Y. Toronto,London

SEMESTER - I		CODE - U19ABT1
Allied Course I: BIOCHEMISTRY – I: BIOMOLECULES		
CREDITS - 3		HOURS - 5

Objectives:

- To understand the atomic, molecular structures and bonding.
- To understand the occurrence and structure of carbohydrates.
- To correlate the protein functions with their native conformations.
- To differentiate the different classes and forms of lipids.
- To comprehend the basic characteristics of nucleic acids and enzymes.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Recognize the different classes and forms of carbohydrates and their occurrence in the ecosystem.	C1
➢ Interpret the functions of proteins relative to their native structures.	C2
➢ Describe the various forms of lipids and their functions relative to their location.	C2
➢ Utilize the structure of nucleic acids for the understanding of central dogma of life.	C3
➢ Interpret the mechanism of enzyme actions and kinetics.	C3

C1 – Remember C2 – Understand C3 – Apply

UNIT I:

Atoms, molecules, Bonding – types, Water – properties, Acids, Bases and Buffers. Chemistry of Carbohydrates: Atoms, bonding, acid, base and buffer. Definition and Classification of carbohydrates, linear and ring forms (Haworth formula) for monosaccharides for glucose and fructose. Disaccharides - sucrose and lactose. Mutarotation, Oxidation, Reduction. Disaccharide - sucrose and lactose - occurrence, structure; Polysaccharides: starch and cellulose - occurrence, structure. Functions of carbohydrates.

UNIT II:

Aminoacids - biological role. General structure of amino acids. 3- letter abbreviation. Classification of amino acids based on nature of R group (polar, non polar, acidic, basic, neutral). Modified amino acids in protein, non protein amino acids. Levels of organization of protein structure – primary structure – composition, Secondary structure – α helix (egg albumin), β - pleated sheath (keratin), triple helix (collagen). Tertiary structure –with reference to myoglobin. Quaternary structure with reference to haemoglobin.

UNIT III:

Lipids- Chemical nature, biological functions and classification of lipids. Fatty acids – definition, classification – saturated, unsaturated, hydroxy and cyclic fatty acids - structure and properties of fatty acids. Simple and mixed triglycerides – structure and general properties. Characterization of fats – iodine value, saponification value, acid number, Reichert-Meissl number.

UNIT IV:

Structure of purine and pyrimidine bases, nucleosides and nucleotides and their biological importance. Types of DNA : A, B, C, Z DNA, structure and biological significance, superhelicity. Isolation, purification, identification and estimation of DNA. Properties of DNA – hypochromic and hyperchromic effect, melting temperature, viscosity. Denaturation and annealing.

UNIT V:

Enzymes: Occurrence, cellular localization. Nomenclature, classification, EC Number. Enzyme properties (kinetics), Enzyme preparation and purification. Catalytic activity, Specific activity, Turn over, Mechanism of action, model and theories of enzyme action. Clinical significance-inborn errors (phenyl ketone urea).

TEXT BOOKS:

1. Donald Voet, Judith G. Voet and Charlotte W. Pratt, "Fundamentals of Biochemistry – Life at the molecular level". John Wiley and Sons, Inc., Asia, 2006.
2. Robert K. Murray, Daryl K. Granner and Victor W. Rodwell, "Harper's Illustrated Biochemistry". McGraw Hill Education (Asia), 2006.
3. Jeremy M. Berg, John L. Tymozko and LubertStryer, "Biochemistry", Fifth edition, W.H. Freeman and Company, New York, 2002.
4. David L. Nelson and Michael M. Cox, "Lehninger Principles of Biochemistry" Fourth Edition, W H Freeman and Company, New York, 2005.

SEMESTER – II		CODE - U19BT3
Core Course III: Molecular Biology		
CREDITS - 5		HOURS - 5

Objectives:

- To understand the scientific evidences on the genetic material and its organization.
- To describe the events and processes involved in the duplication and expression of the genetic material.
- To analyze the mechanisms of mutations and DNA repair.
- To correlate the development and causes of cancer to mutagenesis and gene expression.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Recognize the different classes and forms of carbohydrates and their occurrence in the ecosystem.	C1
➢ Interpret the functions of proteins relative to their native structures.	C2
➢ Describe the various forms of lipids and their functions relative to their location.	C2
➢ Utilize the structure of nucleic acids for the understanding of central dogma of life.	C3
➢ Interpret the mechanism of enzyme actions and kinetics.	C3

C1 – Remember C2 – Understand C3 – Apply

UNIT I:

Experiments on genetic material (Griffith, Hershey and Chase; Avery and McCarty experiments); Watson and Crick model; Chargaff's rule.

Genome Organization: Prokaryotic and Eukaryotic; Chromosome: structure and function, Chromatin (Hetero and Euchromatin); Chloroplast and Mitochondrial DNA; Gene families and Clusters.

UNIT II:

Replication: Prokaryotic and Eukaryotic DNA replication; Transcription: Mechanism (Prokaryotic and Eukaryotic); Post transcriptional modification (Polyadenylation and capping) and splicing mechanism; Translation: Genetic code; mechanism of translation; Post translational modifications (Phosphorylation, methylation, glycosylation, Acetylation, ubiquitination and lipidation).

UNIT III:

DNA repair mechanisms; Mutations: Mutagenesis, Types of Mutations, Biochemical basis of mutants, Mutational Hot Spots, Reversion; Transposable elements (Insertion Sequence and transposons, Integrons and Antibiotic Resistance Cassettes).

UNIT IV:

Gene Regulation mechanisms: General aspects of Regulation, The lactose system and the operon model, The Galactose operon, The Tryptophan operon, Concept of Feedback Inhibition.

UNIT V:

Chromosomal Variations and Mapping: Chromosomal aberrations (in Number & Structure) – Ploidy and structural aberrations; Position Effect; Chromosome Mapping.

Oncogenesis: Development, causes and types of cancer; Oncogenes: proto and tumor suppressor gene.

TEXT BOOKS

1. Lodish H., 2016, Molecular Cell Biology, 8th edition, W. H Freeman and company, New York.
2. De Robertis, E.D.P and De Robertis E.M.F., 2001, Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkins, New York.
3. Friefelder D., 2009, Molecular Biology, 2nd Edition, Narosa Publishing House, New Delhi.

REFERENCE BOOKS

1. Lewin B., 2008, Genes IX, Jones and Bartlett, Burlington.
2. Rastogi, S.C., 2004, Cell Biology, 2nd Edition, New Age International Publishers, New Delhi.

SEMESTER – II		CODE - U19ABT3
Allied Course III: Biochemistry II: Intermediary Metabolism		
CREDITS - 3		HOURS - 5

Objectives:

- To understand the thermodynamics of biological systems.
- To interpret the metabolic pathways of carbohydrates and their significance in energy production.
- To understand the anabolic and catabolic mechanisms relative to proteins.
- To differentiate the biological significance of nucleic acids, co-factors and co-enzymes.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Interpret the thermodynamic principles in any biological system.	C2
➢ Interpret the functions of carbohydrates relative to their structure.	C3
➢ Describe the various mechanisms involved in the synthesis and degradation of amino acids.	C2
➢ Utilize the structure of nucleic acids for the understanding of central dogma of life.	C3
➢ Explain the mechanism of co-factors and co-enzymes in biological processes.	C3

C1 – Remember C2 – Understand C3 – Apply

UNIT I:

Bioenergetics: Molecular basis for evolution. Principles of thermodynamics - free energy functions - ATP as main career of free energy. Carbohydrates – Glycolysis, citric acid cycle, pentose phosphate pathway and its regulation. Gluconeogenesis, glycogenesis and glycogenolysis, glyoxylate and Gamma amino butyrate shunt pathways, Cori cycle, anaplerotic reactions, Entner-Doudoroff pathway, glucuronate pathway. Hormonal regulation of carbohydrate metabolism.

UNIT II:

Amino Acids – General reactions of amino acid breakdown and synthesis, scheme - Transamination, decarboxylation, oxidative & non-oxidative deamination of amino acids. Urea cycle and its regulation.

UNIT III:

Lipids –Introduction, hydrolysis of tri-acylglycerols, oxidation of fatty acids. Fatty acid biosynthesis, Acetyl CoA carboxylase, fatty acid synthase, Lipid biosynthesis, Metabolism of cholesterol and its regulation.

UNIT IV:

Nucleotides – Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation. Purine salvage pathway. Biosynthesis of deoxyribonucleotides and polynucleotides including inhibitors of nucleic acid biosynthesis. Porphyrins – Biosynthesis and degradation of porphyrins. Production of bile pigments.

UNIT V:

Coenzymes and Cofactors–Role and mechanism of action of NAD+/NADP+, FAD, lipoic acid, thiamine pyrophosphate, tetrahydrofolate, biotin, pyridoxal phosphate, B12 coenzymes and metal ions with specific examples.

TEXT BOOKS:

1. Donald Voet, Judith G. Voet and Charlotte W. Pratt, "Fundamentals of Biochemistry – Life at the molecular level". John Wiley and Sons, Inc., Asia, 2006.
2. Robert K. Murray, Daryl K. Granner and Victor W. Rodwell, "Harper's Illustrated Biochemistry". McGraw Hill Education (Asia), 2006.
3. Jeremy M. Berg, John L. Tymozko and LubertStryer, "Biochemistry", Fifth edition, W.H. Freeman and Company, New York, 2002.
4. David L. Nelson and Michael M. Cox, "Lehninger Principles of Biochemistry" Fourth Edition, W H Freeman and Company, New York, 2005.

SEMESTER – I & II		CODE - U19BT2P
Core Course Lab II: LAB IN CELL BIOLOGY, GENETICS & MOLECULAR BIOLOGY		
CREDITS - 6		HOURS - 6

Lab in Cell Biology, Genetics & Molecular Biology
(Group & Individual practical – under STAR College Scheme)

CELL BIOLOGY

1. Equipment used in laboratory, general practice and maintenances
2. Identification of various stages of cell division (mitosis and meiosis).
3. Mitosis and Meiosis – onion root tip and grasshopper testis squash methods

MOLECULAR BIOLOGY (Individual Experiment under STAR College Scheme)

4. Isolation of genomic DNA from bacterial culture
5. Isolation of genomic DNA from plant tissue.
6. Quantification of DNA using UV spectrophotometer.
7. Agarose gel electrophoresis of genomic DNA.

REFERENCES

1. Molecular Cloning by J. Sambrook and D. W. Russell (2001). Cold Spring Harbour Lab. Press.
2. A short course in Bacterial Genetics by J.H. Miller (1992) Cold Spring Harbor Laboratory.
3. Methods for Genetics and molecular Bacteriology by Ed. RGF Murray, WA. Wood & NB krieg (1994) American society for Microbiology.

SEMESTER – I & II		CODE - U19ABT2P
Allied Course Lab II: LAB IN BIOCHEMISTRY		
CREDITS - 3		HOURS - 6

Lab in Biochemsitry
(Group & Individual practical – under STAR College Scheme)

1. Basic calculations in Biochemistry - Normality, Molarity, Molality percent solutions (v/v, w/v).
2. Calibration of pH meter
3. Preparation of biological buffer - phosphate buffer
4. Extraction of Proteins from biological materials
5. Protein separation methods:-Ammonium sulphate Precipitation
6. SDS PAGE – Group Experiment
7. Estimation of Proteins by Lowry's method
8. Estimation of Proteins by Biuret method
9. Purity check of DNA & RNA by UV Spectrophotometry - A260/280
10. Separation of amino acids by Paper Chromatography
11. Separation of sugars by Paper Chromatography
12. Separation of amino acids by Thin layer chromatography
13. Separation of sugars by Thin layer chromatography

REFERENCES

1. An Introduction to Practical Biochemistry by Rodney Boyer (2003). Pearson Education.
2. Laboratory Manual of Biochemistry by J.Jayaraman (1988) Wiley Eastern
3. Practical Biochemsitry by Wilson and Walker (1994). Cambridge University Press
4. Handbook of Laboratory culture media, Reagents, Stains and Buffers by N. Kannan (2003), Panima Publishers, New Delhi

SEMESTER - III		CODE - U19BT4
Core Course IV : IMMUNOLOGY		
CREDITS - 4		HOURS - 4

Objectives:

- To understand the basic functions of immune system and its components.
- To interpret the various types of antibodies and their relative functions.
- To understand the mechanism of hypersensitivity and its implications.
- To analyze the issues and challenges in transplants and grafts.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Define basic concepts and components in immunology,	C1
➢ Understand Innate and Adaptive immunity and the components	C2
➢ Understand mechanisms of Immune response	C2
➢ Apply basic techniques of antigen-antibody interactions	C3

C1 – Remember C2 – Understand C3 – Apply

UNIT I

Basics of Immune System: Historical perspectives and overview of immune system – Immunity – Classification: Innate, Acquired (Natural, Artificial - Active and Passive) – Innate: Anatomic, Physiological, Phagocytic and Inflammatory barriers – Acquired: Two arms (Humoral and Cellular), Haematopoiesis – Cells, tissues and organs of the immune system – their structure and functions – Interrelationship between innate and adaptive immunity.

UNIT II

Antigens Definition and types – Antigenicity – immunogen and immunogenicity – properties - epitope – hapten – adjuvants – Immune response and its types – Antibodies - structure – types – function – Clonal selection theory – Monoclonal Antibodies and its applications - Hybridoma Technology for MAb production- Complement – structure -properties – functions of complement components and pathways.

UNIT III

Antigen-Antibody Interactions: Definition, different levels of interactions - types – *in vitro* methods – agglutination – precipitation – ABO Blood grouping and Rh typing - ELISA – RIA – IF – Flowcytometry – HA & HI – CFT – *in vivo* methods – Skin tests - immune complex tissue demonstrations.

UNIT IV

Cell Mediated Immunity: T-cells and types - Antigen processing and presentation – Major histocompatability complex – Class 1 & 2. Cytokines: Interleukins and interferons - Cytokine receptors – Hypersensitivity – Definition - Gell and Coombs classification – Antibody mediated: Anaphylaxis (IgE mediated), Cytotoxic (antibody-dependent), immune complex mediated - Delayed type hypersensitivity - Autoimmune diseases - Immune tolerance.

UNIT V

Transplantation immunology – Blood Transfusion reactions – Tissue and Organ transplantation - Graft rejection – Graft vs Host reaction – Tumor immunology – tumor associated antigens. Immune response to tumor - Vaccines –Immunization types – Vaccine types – live attenuated vaccines, killed vaccines, purified polysaccharide vaccines – toxoid vaccines – recombinant vaccines and DNA vaccines.

TEXTBOOKS

1. Punt J, Sharon Stranford, Patricia Jones and Judith A Owen. J. Kuby Immunology (2018) 8th ed. WH Freeman.
2. Roitt, I.M., M.David Roth, Jonathan Brostoff and David Male (Editors). Immunology (2012) 8th Edn, Elsevier Saunders, London, UK.
3. Richard Coico and Geoffrey Sunshine. Immunology: A Short Course, (2015) 7th Edn,Wiley Blackwell, NY,
4. Gabrial Virella (Editor) Medical Immunology (2001) 5th Edition, Marcel Dekkar, NY.
5. Weir M. D. and J. Stewart, Immunology (1997), 8th Ed., Churchill Livingston, USA.
6. Roitt, I.M., Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Roitt's Essential Immunology (2017) 13th Edition, Wiley-Blackwell Publishers, UK
7. Hyde R. M., Microbiology and Immunology (2012), 3rd Edition. Springer Science & Business Media.
8. Ananthanarayanan R and C.K.Jayaram Paniker, Textbook of Microbiology, (2005) 7th ed., Orient Longman Publishers.
9. Pelczar M.J., E.C.S. Chan and N. R. Krieg, Microbiology, (2001), 5th ed., McGraw Hill Publications

SEMESTER -III		CODE - U19ABT4
Allied Course IV : GENERAL MICROBIOLOGY		
CREDITS - 3		HOURS - 4

Objectives

- This course is offered for the II year (IIIrd Semester) Biotechnology students to acquire knowledge on different groups of Microorganisms
- To provide basic understanding in the classification, concepts and theories in Microbiology.

Course Outcomes:

On successful completion of the course, students will be able to

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Define basic concepts of Microbiology and to understand different groups of Microorganisms and their classification.	C1
➢ Familiarize basic concepts in microscopy and sterilization procedures	C1
➢ Explain general characters of different groups of microbes.	C2
➢ To understand on the different types of media and methods to isolate pure culture.	C2
➢ Explain nutritional types of Microorganisms, effect of environment on them and methods to identify and preserve microorganisms	C2

C1 – Remember C2- Understand C3 - Apply

UNIT I

Introduction – Definition, scope and history of microbiology. Classification of microorganisms – general principles and nomenclature – Haeckel's three kingdom concept, Whittaker's five kingdom concept.Classification and characterization of bacteria according to Bergey's Manual of Systematic Bacteriology (9th edition).Basic understanding of classification of viruses, algae, fungi andprotozoa.

UNIT II

Microscopy: Principles and applications of simple, compound, bright field, dark field, phase contrast, fluorescent and electron microscopy. Principles of staining : types of staining – simple, differential, negative and spore staining, Sterilization : Principles and methods – physical (moist heat, dry heat, filtration, pasteurization, tyndallization, radiations) and chemical (alcohols, aldehydes, phenols, halogens andhypochlorites.

UNIT III

General structure and characteristics and nature of Archaebacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsiae, Chlamydias, Spirochaetes, Actinomycetes, Protozoa, Algae, Fungi and Viruses.

UNIT IV

Types of media: simple, defined, differential, selective, enriched, enrichment and transport media with specific examples for each type. Isolation and purification of cultures from different samples. Growth curve: Diauxy - continuous culture – chemostat – turbidostat - synchronized growth.Measurement of microbial growth – Total cell count method - viable cell count method and biomass determination.

UNIT V

Nutritional types of Microorganisms.Effect of environment on microbial growth: -Temperature, pH, water activity, oxygen concentration, salt concentration, pressure and radiation.Determination of levels of antimicrobial activity.Methods of maintenance and preservation ofmicrobes.Methods of bacterial identification.

TEXTBOOKS

1. Bernard D. Davis. Renato Dulbecco. Herman N. Eisen.and Harold, S. Ginsberg. (1990).Microbiology (4th edition).J.B .Lippincott company, NewYork.
2. Holt, J.S., Kreig, N.R., Sneath, P.H.A and Williams,S.T. Bergey's Manual of Determinative Bacteriology (9th Edition), Williams and Wilkins,Baltimore.
3. Prescott L.M. Harley J.P. and Klein D.A. (2003). Microbiology (5th edition) McGraw Hill, New York.
2. Madigan, M.T. Martinko.J.M and Parker J Brock T.D.(2017)Biology of Microorganisms.(15th edition).Prentice Hall International Inc,London.
3. PelczarJr, M.J. Chan, E.C.S. and Kreig, N.R. (2006). Microbiology, Mc. Graw Hill.Inc, NewYork.
4. Salle, A.J. (1996). Fundamental principles of Bacteriology.(7thedition).Tata McGraw-Hill publishing company Ltd, NewDelhi.
5. James G. Cappucina, Natalie Sherman. (1996). Microbiology – A laboratory manual, The Benjamin (Cummings Publishing C ompany,Inc.)
6. Mackie and McCartney. (1989). Practical Medical Microbiology, ChurchillLivingston.
7. Stainer, Ingharam, Wheelis and Painter. 1987. General Microbiology. 5th Edition. Macmillan Education,London.
8. PowarandDaginawala.2010.GeneralMicrobiology.VolumeI&II.HimalayaPublishingHouse.
9. A Text book of Microbiology. Dubey, RC and Maheswari DK (2005). S. Chand & Company Ltd., NewDelhi.
10. Tortora, G.J., Funke, B.R. and Case, C.L. 2012. Microbiology - An Introduction. 11th Edition. Pearson Education.

SEMESTER -III		CODE – U19SBE2
PART – IV: Skilled Based Elective II : MEDICAL LABORATORY TECHNOLOGY		
CREDITS - 2		**HOURS - 2**

Objectives:

- To gain basic knowledge on medical laboratory procedures
- To understand methods of measurable clinical parameters
- To understand basics of histopathology
- To understand the principles of biomedical equipment used in diagnosis

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Define diagnostic principles and methods	C1
➢ Understand the concepts of blood formation and status of maturation	C2
➢ Understand Collection, processing and preservation of blood and clinical samples	C2
➢ Describe methods of histopathological studies	C3

C1 – Remember C2 – Understand C3 – Apply

Unit I

Basic laboratory principles -Organization of clinical laboratory and Safety measures -personnel hygiene,code of conduct. Overview of Lymphatic system, Urinary system, respiratory system and circulatory system.

Unit II

Sample collection-Urine, sputum, Blood. Types of blood collection: capillary puncture-venipuncture, Anticoagulants. Composition of blood. Outline of Hematopoiesis. ABO blood grouping, Rh typing. Blood transfusion- Donor selection, Screening of donor (history, age, weight, Hb, pulse, BP, temperature, interval, registration), Post donation care, Preservation of samples.

Unit III

Blood cells count: Total count, differential cell count, platelet count, Hemoglobin Estimation, Packed cell volume (PCV) , Erythrocyte Sedimentation Rate [E.S.R.] – Westergren's Method, Bleeding time, clotting time, Latex agglutination test. Pregnancy test.

Unit IV

Introduction to Histopathology, Tissue preparation, labeling, Fixation – Simple fixative, compound fixative, histochemical fixative, Dehydration- Ethyl alcohol – Acetone, Clearing, impregnantion, embedding- Paraffin wax, sectioning. Microtome and its application.Staining of tissues - H&E Staining. Bio-Medical waste management- an overview.

Unit V

Diagnostic Methods- Outline of Radio imaging, X-Ray, MRI, CT, Ultra sound scan, Mamography,ECG, EEG, Nephalometry, sphygmomanometer. Autoanalyser-Types of Auto Analysers-Semi and Fully automated Electrolyte Analyser (ISE). Need for Automation,Advantages of Automation.

REFERENCE BOOKS

1. GradWohl, Clinical Laboratory-methods and diagnosis, Vol-IKanai L. Mukherjee, Medical Laboratory Technology Vol. I.Tata McGraw Hill 1996, NewDelhi.
2. Gradwohls, 2000. Clinical Laboratory Methods and Diagnosis. (ed) AlesC.
3. Sonnenwirth and Leonard jarret, M.D. B.I. Publications, NewDelhi
4. Sood Ramnik,(2015), Text book of Medical Laboratory Technology,2nd edition, Jaypee Publications

SEMESTER -III		CODE – U19SBE3P
PART – IV: Skilled Based Elective II : MEDICAL LABORATORY TECHNOLOGY		
CREDITS - 2		**HOURS - 2**

1. Blood collection
2. Differential count of Leucocyte
3. Estimation of Haemoglobin
4. Packed Cell Volume [PCV]
5. Erythrocyte Sedimentation rate [ESR]
6. Bleeding Time, Clotting Time.
7. Latex Agglutination
8. Liver function tests (SGPT, SGOT)
9. Pregnancy test

References

1. Bernadette F. Rodak, George A. Fritsma, Kathryn Doig (2007) Hematology: Clinical Principles and Applications 3rd Ed, Elsevier HealthSciences.
2. RamanicSood,LaboratoryTechnology(Methodsandinterpretation)4thEd.J.P.Bros,NewDelhi
3. Mukharji, Medical LaboratoryTechniques, Vol - I, II & III, 5th Edn. Tata McGrawHill, Delhi.

SEMESTER - IV		CODE - U19BT6
Core Course VI: rDNA TECHNOLOGY		
CREDITS - 4		HOURS - 4

Objectives:

- To understand the types of restriction enzymes.
- To describe the stages of gene cloning and cloning vectors in application.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Interpret the restriction sites through restriction mapping.	C3
➢ Utilize the mechanisms of cloning vectors in genetic engineering.	C3
➢ Understand the basics of cloning and its techniques.	C2
➢ Employ sequencing methods for genetic experiments.	C3
➢ Differentiate the working of microarrays.	C2

C1 – Remember C2 – Understand C3 – Apply

UNIT I

Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, exonuclease & endonuclease, Concept of restriction and modification - Restriction endonucleases, DNA modifying enzymes, Ligases.

UNIT II

Different Kinds of Vectors - Plasmids, Phage vectors, Cosmids, Phagemids, Virus vectors, Shuttle vectors and expression vectors- YAC, BAC- S. cerevisiae system as a model. Methods of Transformation, Recombinant Selection and Screening, Molecular cloning.

UNIT III

Sequencing (chemical degradation; chain termination and automated sequence). Mutagenesis, altered expression and engineering genes. Site-directed mutagenesis.

DNA amplification using polymerase chain reaction (PCR): Key Concepts, Analysis of Amplified Products. Applications of PCR: RFLP, RAPD, DNA Finger printing. Blotting techniques.

UNIT IV

Strategies for the production of recombinant proteins - insulin- human growth hormone- industrially important proteins. Construction of genomic library- cDNA library.

UNIT V

Application of rDNA Technology in plants: Transgenic plants with reference to virus and pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt); Bio-pharmaceuticals and secondary metabolite production.

REFERENCE BOOKS:

1. Bernard R, Glick and Jack J. Pasternak. (2002). Molecular Biotechnology, Panima Publishing House, New Delhi.
2. Brown T. A. (2001). Gene Cloning, Blackwell Science Publishers.
3. Ernst L and Winnacker. (2003). Genes to Clones, Panima Publishing House, New Delhi.
4. Glover D.M and Hames B.D. (1995). DNA cloning I & II, IRL Press.
5. Innis M. A, Gelfand D.H and Sninskey D. J. J. (1995). PCR strategies, Acadmic Press.
6. Primrose S. B. (2001). Molecular Biotechnolgy, Panima Publishing House, New Delhi.
7. Watson J.D, Gilman M, Witkowski and Zoller M. (1992). Recombinant DNA, Scientific American books.

SEMESTER - IV		CODE - U19ABT6
Allied Course VI: APPLIED MICROBIOLOGY		
CREDITS - 4		HOURS - 4

Objectives:

- To acquire knowledge on different types of viruses causing diseases to plants and humans.
- To learn their method of cultivation and preventive aspects.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Understand the basic role of Microorganisms in the food industry and methods to preserve food.	C1
➢ Gain knowledge and understand the microbial balance and interactions in soil and water	C1
➢ Get exposed to the role of microorganisms in degradation of pollutants and their harmful effects	C2
➢ Get exposed to the clinical aspects of Microorganisms	C2

C1 – Remember C2 – Understand C3 – Apply

UNIT I

Food as a substrate for microorganisms – Principles of Food Preservation. General principles and application methods – asepsis, removal of microorganisms, anaerobic conditions, high temperature, low temperature, drying and food additives. Factors affecting the growth of microorganisms in food, feed and fodder. Extrinsic and Intrinsic factors, chemical preservatives and food additives. Heat processing; D, Z, and F values and working out treatment parameters for canned foods; Canning Spoilage of food: milk and milk products, meat and meat products, fish, seafoods and canned foods.

UNIT II

Soil as a habitat for microorganisms; Microbial balance in soil.Factors affecting microbial community in soil-soil moisture, organic and inorganic chemicals. Microbial interactions; negative interactions. Ammensalism, competition, parasitism and predation (mycoparasitism, mycophagy, namatophagy – predaceous fungi), commensalism positive interactions – mutualism, synergism, associative symbiosis, cyanobacterial bacterial (Rhizobium legume symbiosis).

UNIT III

Water ecosystem and its type, marine microorganisms and their importance, Eutrophication, brief account of major water borne diseases and their control measures. Water treatment –wastes types, solid and liquid wastes characterization, Primary secondary, tertiary solid waste treatment, Bioaccumulation, Bioremediation, Bioleaching of copper and uranium.

UNIT IV

Microbiology of xenobiotics - novel pollutants, persistence and biomagnifications. Petroleum hydrocarbons - their microbial degradation. Bio remediation of soil and water. Corrosion of metals due to microbial growth and biofilms.

UNIT V

Beneficial Microbial Interactions with Human: Normal microbial population of healthy human body -Entry of pathogens into the host, types of bacterial pathogens, Mechanism of bacterial pathogenicity, colonization and growth, Virulence, Virulence factors – exotoxins, enterotoxins, endotoxins, neurotoxins. – avoidance of host defense mechanisms, damage to host cell, Host factors for infection and innate resistance to infection. Collection, transport and culturing of clinical samples.

REFERENCE BOOKS:

1. Davis B. D, Dulbecco R, Eisen H.N and Ginsberg H.S. (1980). Microbiology, Harper Intl. Edition.
2. Pelczar M.J, Jr. Chan E.C.S and Krieg N.R. (2001). Microbiology, Tata McGraw Hill Publishing Co.
3. Paul E.A. (Ed.) (2015) Soil Microbiology, Ecology and Biochemistry, 4th Edn, Academic Press.
4. Tortora, Funke and Case. (1995). Microbiology – An Introduction, Benjamin-Cummings Publications.
5. Jay,J.M. (2000). Modern Food Microbiology. CRC Press. London.

SEMESTER -IV		CODE – U19BT5P
Core Course Lab V **LAB IN IMMUNOLOGY AND rDNA TECHNOLOGY**		
CREDITS - 5		**HOURS - 3**

Lab in rDNA Technology and Immunology
(Group & Individual practical)

1. Blood Grouping
2. Total WBC and RBC
3. Estimation of Haemoglobin
4. Preparation of Serum components
5. Radial Immunodiffusion test
6. Double Immunodiffusion test
7. Restriction Digestion of plasmid DNA
8. Ligation of restricted fragments

SEMESTER -IV		CODE – U19ABT5P
Allied Course Lab V **LAB IN MICROBIOLOGY**		
CREDITS - 3		**HOURS - 3**

Lab in Microbiology
(Group & Individual practical)

1. Microbiology laboratory: general practices and maintenances.
2. Microscopes – Basic Parts and Handling
3. Sterilization Principles and Techniques
4. Hanging Drop Experiment
5. Staining Techniques: Simple, Gram, Acid Fast, Spore
6. Media preparation: liquid, solid and agar slants, basal, enriched, enrichment, differential and selective
7. Inoculation techniques – pour plate – spread plate –dilution techniques
8. Pure culture and subculture techniques.

SEMESTER - V		CODE – U18BT7
Core Course VII : BIOINSTRUMENTATION		
CREDITS - 5		HOURS - 5

Objectives:

- To understand the principle and working of spectroscopic techniques.
- To understand the practical applications of separation techniques.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Understand the basics of instruments	C2
➢ Explain the separation technique and Structural elucidation	C3
➢ Separation and purification of biomolecules by Chromatography	C3
➢ Employ separation techniques for Proteins and Nucleic acid	C3

C1 – Remember C2 – Understand C3 – Apply

UNIT I

Basics of Instrumental analysis: Selection of analytical methods, Accuracy, Precision, Detection Limit, Sensitivity and Analytical Range – Types of errors: Random and Systematic – Calibration methods: Standard curve and internal standard addition.

UNIT II

Spectroscopic and Imaging Analysis: Principles, Instrumentations and Applications of UV-Visible and IR spectrophotometry, Fluorescence, **Electron Microscopy** (Scanning Electron Microscopy and Transmission Electron Microscopy) and Flow Cytometry.

UNIT III

Structure Elucidation Techniques: NMR, MS–Ionization (MALDI, ESI), Analyzer (TOF and Quadrupole) and Detector. **Separation Techniques:** Centrifugation – Principle and applications; Types (Differential, Ultra and industrial centrifugation).

UNIT IV

Chromatographic Techniques: Theories on chromatography: Rate and Plate theory and Van Deemter equation – Resolution of chromatography – Principle, Instrumentation and Applications of Thin Layer, Adsorption, Gel Exclusion, Ion exchange, Affinity, Gas and Liquid chromatography (HPLC).

UNIT V

Electrophoretic Techniques: Concepts of influential factors and troubleshooting – Principle, Instrumentation and Applications of Gel (Agarose, PAGE and SDS-PAGE), Capillary, Pulse field and Native. Isoelectric focusing: Theory, Instrumentation and Applications.

TEXT BOOKS

1. Skoog, D. A., Holler, F. J., and S. R. Crough. "Instrumental Analysis, 6th." (2007). Brooks Cole Publishing Company. USA.
2. Wilson, K., and J. Walker. "Principles and Techniques of Practical Biochemistry and Molecular Biology, 7th." (2010). Cambridge University Press, U.K.
3. R., and S.K. Anand. "Instrumental Methods of Chemical Analysis, 5th," 2012. Himalaya Publishing House, India.

REFERENCE BOOKS

1. Sharma, B.K. "Instrumental Methods of Chemical Analysis, 24th." (2014). GOEL Publishing House, India.

SEMESTER - V		CODE - U18BT8
Core Course VIII : BIOPROCESS TECHNOLOGY		
CREDITS - 5		HOURS - 5

Objectives:

- To understand the principle and applications of bioprocess technology.
- To analyze the growth curve values in different types of fermentation modes.
- To understand the upstream and downstream processing for product recovery and purification.
- To discuss the important aspects in bioprocess technology for commercialization purpose of biotechnology products.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Evaluate factors that contribute in enhancement of cell and product formation during fermentation process.	C2
➢ Analyze growth curve of cell and the product formation in batch, continuous and fed batch cultures.	C3
➢ Differentiate the rheological changes during fermentation process.	C2
➢ Understand and apply various techniques involed in downstream proceesing.	C2
➢ Describe the production and application of various biotechnology products.	C3

C1 – Remember C2 – Understand C3 – Apply

Unit I

Introduction to White Biotechnology: Isolation and screening of industrially important microbes. Strain improvement - mutation and recombination. Media/substrates for industrial fermentation/process - typical media, media formulation. Media formulation/optimization. Preservation of industrially important microorganisms.

Unit II

Fermentation and its types: History and Concepts of basic modes of fermentation – Batch, Fed batch and Continuous fermentation. Phases of cell growth in batch cultures Fermentor/Bioreactor design and operations - basic function, design, components and body construction. Sterilization of Fermentor/Bioreactor - air and media sterilization. Bioprocess control and monitoring - online measurement - on / off control - PID control.

Unit III

Types of Fermentors / Bioreactors: Mechanical - Stirred tank bioreactors, pneumatic - Airlift fermentors, photo bioreactors, solid state fermentors, anaerobic solid stage silage fermentors, bed fermentors, tower fermentors, bubble cap fermentor, animal cell culture reactors and plant cell culture reactors.

Unit IV

Downstream Processing: Objectives and criteria – Intra and extra cellular products. Primary separation- Cell disruption; foam separation; flocculation; precipitation methods; filtration; Centrifugation. Secondary separation- Liquid - liquid extraction, two-phase aqueous extraction solvent recovery. Membrane based separation (micro & ultra-filtration). Purification- Chromatography. Drying devices, crystallization and whole broth processing.

Unit V

Bioprocess Economics and Industrial Production: Bioprocess economics. Production of enzymes- amylases. Acetone – Butanol - Ethanol (ABE) fermentation. Antibiotic production - penicillin. Amino acid - proline and glutamic acid. Vitamin production - vitamin B12. Organic acid production – acetic and citric acid. Cell and enzyme immobilization.

TEXT BOOKS

1. Arnold L. Demain and Julian E. Davis. (2004). Industrial Microbiology and Biotechnology, ASM Press.
2. Casida L.E. (1968). Industrial Microbiology, John Wiley & Sons.
3. Emt.el-Mansi and Bryce C.F.A. (2004). Fermentation Microbiology and Biotechnology, Taylor and Francis Ltd.
4. Prescott L. M, Harley J. P and Klein D. A. (1999). Microbiology, 4th edition, Mc Graw Hill.
5. Stainer R.Y, Ingrtham J.L, Wheels M.L and Painter P.R. (1987). General Microbiology, MacMillan.
6. Stanbury P.F, Whitaker A and Hall S.J. (1997). Principles of fermentation technology, Oxford University Press.
7. Belter P.A, Cussler E and Wei Shan Hu, Bioseparation – Downstream Processing for Biotechnology, Wiley Interscience, 1988.

SEMESTER – V		CODE - U18BT9E
Elective Course I: BIOSTATISTICS AND BIOINFORMATICS		
CREDITS - 4		HOURS - 5

Objectives:

- To understand the significance of statistical analysis in biology.
- To acquire knowledge on biological databases and algorithms for biological applications.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Interpret the experimental data with statistical tools.	C3
➢ Utilize the concepts of hypotheses and experimental designs for practical purposes.	C3
➢ Understand the basics of biological databases.	C2
➢ Employ algorithms for sequence analysis.	C3
➢ Differentiate the various analysis methods for structure prediction.	C2

C1 – Remember C2 – Understand C3 – Apply

UNIT I

Bio-Statistics: Concepts of statistics-types of data, methods of collection of data. Sampling design – essentials of sampling – sampling methods – statistical laws and errors. Experimental designs. Data representation: Tabulation, Diagrammatic and graphical representation of data.

UNIT II

Measures of central tendency – mean, median and mode. Measures of dispersion: Mean deviations, standard deviation. Correlation analysis (Karl Pearson's and Spearman's Rank). Regression analysis – simple linear.

UNIT III

Tests of significance -'t'-test, Chi-square and goodness of fit, 'F' test - Analysis of variance (ANOVA): One-way.& Two-way.

UNIT IV

Biological Databases: Sequence databases – Nucleic Acid sequence Databases: Genbank ;Protein Sequence Databases: UniProt; Searching Sequence Databases – Non-redundant Databases – Low Annotation Databases – Specialized sequence Databases – Structural Databases – Motif Databases – Genome Databases – Proteome Databases.

UNIT V

Pairwise Sequence Analysis Tools: BLAST– Steps involved in using BLAST – Interpreting BLAST results; FASTA – Alignment Scores -Multiple Alignment –– ClustalW – Phylogenetic Tree – Sequence Analysis using EMBOSS. Protein Structure Prediction: Secondary structure Prediction –PDB-FSSP-SCOP-CATH- Chou-Fasman – Jpred – Q3 – Transmembrane protein prediction – Tertiary structure prediction – Comparative Modelling – Fold recognition – Ab initio prediction – modeler – RASMOL – Emerging areas of bioinformatics.

TEXT BOOKS

1. Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W.K. Freeman. San Francisco.
2. Zar, J.H. 2003. Biostatistical Analysis. Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi.
3. Harshawardhan, P. (2005) Bioinformatics principles and application.Tata Mc Graw Hill
4. Publishers.New Delhi.
5. Manikand Vijayaraj, 2002. Bioinformatics for beginners, Kalaikathir Achchagam, Coimbatore
6. Mount, D.W. 2005. Bioinformatics Sequence and genome analysis (II edition) CBS Publishers. New Delhi

SEMESTER - V		CODE - U19BT10E
Elective Course II : ENZYME TECHNOLOGY		
CREDITS - 4		HOURS - 5

Objectives:

- To understand the basic functions of immune system and its components.
- To interpret the various types of antibodies and their relative functions.
- To understand the mechanism of hypersensitivity and its implications.
- To analyze the issues and challenges in transplants and grafts.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Define basic concepts and classification of Enzymes	C1
➢ Explain enzyme activity and enzyme assays	C2
➢ Understand the mechanism of enzyme action	C2
➢ Describe enzymes of clinical importance	C3
➢ Describe the application of enzymes	C3

C1 – Remember C2 – Understand C3 – Apply

UNIT I

Definition, Nomenclature, Classification of Enzymes – Properties, Enzymes as biological Catalyst.

UNIT II

Enzyme activity – Specificity of Enzymes – Units of Enzyme Activity, Turnover number, Factors influencing Enzyme activity, Michaelis Menten Equation.

UNIT III

Mechanism of Enzyme action, active side, Lock and Key Hypothesis, Induced fit Hypothesis, Enzyme – Substrate Complex.

UNIT IV

Coenzymes – NAD, NADP, FAD, PLP, TPP. Allosterie Enzyme – Phosphofructokinase – Multi Enzyme Complex – Pyruvate dehydrogenase complex, Isoenzymes – Lactate dehydrogenase.

UNIT V

Immobilifed Enzymes – Methods, Principle and application. Industrial applications of Enzymes – Amylase, Lipase. Clinical importance of Enzymes – LDH, Creatine kinase, Aspartate transaminase, Alanine transaminase, Alkaline and acid phosphatase.

TEXT BOOKS

1. Biophysical Chemistry – Principles and Techniques – Upadhyay, Upadhyay and Nath. 3
2. Principles and techniques of Practical Biochemistry – Wilson & Walker
3. Principles and techniques of Practical Biochemistry – Williams and Wilson.

REFERENCE BOOKS

1. Laboratory Manual in Biochemistry – J.Jeyaraman.
2. Practical Biochemistry – Plummer.

SEMESTER -V		CODE – U18BT11P
Core Course Lab IX **LAB FOR COURSES IN SEMESTER V**		
CREDITS - 5		**HOURS - 6**

LAB FOR COURSES IN SEMESTER V
(Group & Individual practical)

1. Isolation of DNA
2. Agarose gel electrophoresis (Group)
3. Paper chromatography
4. Qualitative analysis of DNA
5. Parts and designs of bioreactors.
6. Production of biomass
7. Batch and continuous fed batch fermentation.
8. Recovery of products.
9. BLAST & MSA
10. Phylogenetic tree analysis
11. Databases handling & sequence retrieval
12. Protein structure prediction
13. Motif & Domain prediction
14. Comparative analysis of DNA & Proteins
15. Enzyme Assay – Qualitative
16. Effect of pH
17. Effect of Temperature
18. Effect of Substrate Concentration – Km value detection
19. Specific Activity of Enzymes

SEMESTER - VI		CODE – U19BT13
Core Course X : PLANT BIOTECHNOLOGY		
CREDITS - 6		HOURS - 6

Objectives:

- To understand the basic concepts of tissue culture techniques.
- To describe the methods of gene transfer techniques.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Understand the fundamentals of tissue culture media and techniques	C3
➢ Know the knowledge of mechanical barriers in the In-Vitro propagation and germplasm conservation	C3
➢ Apply the methods of Gene Transfer Techniques	C3
➢ Interpret the transferred gene through the molecular markers	C2
➢ Understand the basics of Molecular biology of plant pathogen interactions	C2

C1 – Remember C2 – Understand C3 – Apply

UNIT I

Outline of Plant breeding Techniques-Conventional and Non-conventional breeding methods. History of plant cell tissue and organ culture. Plant Tissue Culture – Introduction, laboratory organization – Sterilization, composition of media (Whites, MS), Media Preparation – Callus culture, Organogenesis, meristem culture and Micropropagation, hardening and Green House Technology.

UNIT II

Techniques of overcoming incompatibility barriers – Anther culture, embryo culture, Somatic embryogenesis, embryoids, Synthetic Seeds, Protoplast isolation and fusion, Cybrid Production. Cell Culture – Production of Secondary Metabolites. Conservation of plant materials- Cryopreservation. Applications of plant tissue culture.

UNIT III

Genetic Engineering in Plants - Molecular biology of Agrobacterium mediated DNA transfer- Ti plasmid Vectors- Binary and co-integrated vectors- Transformation strategies in plants – *Agrobacterium tumefaciens*. Physical methods of gene transfer- Electroporation and gene gun methods.

UNIT IV

Molecular Markers- Selectable markers, reporter genes and promoters used in plant vectors. Plant DNA finger printing, PCR based markers (RFLP, RAPD, and SSR's).

Plant Genome Mapping- Physical and molecular maps, gene tagging. Seed production techniques, release of new varieties and plant breeder's right: UPOV and PPVFR.

UNIT V

Molecular biology of plant pathogen interactions and application of gene transfer techniques in pest resistance (Bt genes, edible vaccines and Delayed fruit ripening). Management aspect of plant genetic engineering. Transgene escape – tagging - mapping and cloning of plant genes.

REFERENCE BOOKS

1. Bernard R. Glick and Jack J. Pasternak. (2001). Molecular Biotechnology- Principles and applications of recombinant DNA technology. ASM Press,Washington DC.
2. Bhojwani S.S. and Razdan M.K. (2004). Plant Tissue culture: theory and practice, Elsevier science.
3. Chrispeels M.J and Sadava D.F. (1994). Plants, Genes and Agriculture. Jones and Bartlett Publishers.
4. Dixon R.A and Gonzales R.A. (2004).Plant cell culture, IRL press.
5. Erbisch F.H and Maredia K.M. (2000). Intellectual property in agricultural Biotechnology, University Press.
6. Glick and Paster Mark (2002). Molecular Biotechnology, Panima Publishers.
7. Hammond J, McGarvey P and Yusibov V. (Eds). (1999). Plant Biotechnology – New products and Applications, Springer Publication.
8. Kalyankumar De. (2007). An Introduction to Plant Tissue Culture Techniques. New Central Book Agency, Kolkata.
9. Lycett G.W. and Grierson D. (1990). Genetic Engineering of crop plants.

SEMESTER - VI		CODE - U19BT14
Core Course XI : ANIMAL BIOTECHNOLOGY		
CREDITS - 6		HOURS - 6

Objectives:

- To understand principles of animal culture, media preparation and culture methods.
- To describe the methods of introducing DNA into cell lines
- To explain Invitro fertilization and embryo transfer technology.
- To understand the stem cell technology and its application
- To describe production of therapeutic proteins.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Define Cell culture techniques and methods	C1
➢ Understand methods of insertion of DNA	C2
➢ Understand the methods of ART Procedures	C2
➢ Apply basic techniques of cell culture in stem cell technology for production	C3

C1 – Remember C2 – Understand C3 – Apply

Unit I

Embryology: Gametogenesis and fertilization in animals, Molecular events during fertilization, genetic regulations in embryonic development - Invitrofelitizations and embryo transfer, Collection and preservation of embryo, culture of embryos, culture of embryonic stem cells and its applications.

Unit II

Animal cell culture: Fundamentals. Facilities and Applications. Media for Animal cells.Types of cell culture: Primary cell culture, secondary culture, cell transformation, cell lines, Insect cell lines,stem cell cultures, cell viability and cytotoxicity. Biology of cultured cells, measurement of growth, cell synchronization, senescence and apoptosis Organ culture. Cryopreservation.

Unit III

Genetic engineering in animals: methods of DNA transfer into animal cells- calcium phosphate co precipitation, micro-injection, electroporation, Liposome encapsulation, Biological vectors. Hybridoma technology, Vaccine production.

Unit IV

Gene therapy, mapping of human genome. RFLP and applications. DNA finger printing and Forensic Science. Molecular diagnosis of Genetic disorders.

Unit V

Transgenics: Transgenic animals. Production and recovery of products from animal tissue cultures: cytokines, Plasminogen activators, Blood clotting factors, Growth hormones.- Transgenic animals – Merits and demerits -Ethical issues in animal biotechnology.

TEXT BOOKS

1. Freshney, E. D. 2000. Animal Cell Culture: A practical approach. John Wiley Pub.,New York.
2. Mather, J.P. and Barnes, D. (Eds.). 1998. Animal Cell Culture Methods (Methods in Cell Biology. VOL. 57). Academic Press, London.
3. Butler, M. (Ed.). 1990. Mammalian Cell Biotechnology- A Practical Approach. Oxford Univ. Press, Oxford.
4. Singer, M. and P. Berg. (Ed.). 1997. Exploring Genetic Mechanisms. University Science Books, Sausilato, CA, USA.
5. E.J. Murray (Ed) .1991. Gene Transfer and Expression Protocols – Methods in Molecular Biology Vol.7. Humana Press,Totowa, NJ.
6. Watson, J.D., N.H.Hopkins, T.W.Roberts, J.A.Steitz and A.M. Weiner.1987. Molecular Biology of Gene. Benjamin Cummins, San Franscisco.

SEMESTER – VI		CODE - U19BT15
Core Course XII: ENVIRONMENTAL BIOTECHNOLOGY		
CREDITS - 6		HOURS - 6

Objectives:

- To understand the basic concepts of fundamentals of ecology.
- To describe the events and methods which involved in the effluent treatment and application of recent techniques in the environmental biotechnology.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Understand the fundamentals of tissue culture media and techniques	C3
➢ Know the knowledge of mechanical barriers in the In-Vitro propagation and germplasm conservation	C3
➢ Apply the methods of Gene Transfer Techniques	C3
➢ Interpret the transferred gene through the molecular markers	C2
➢ Understand the basics of Molecular biology of plant pathogen interactions	C2

C1 – Remember C2 – Understand C3 – Apply

UNIT I

Basic Ecological Concepts and Principles Our Environment: Geological Consideration, and Homeostasis; Biological control of chemical environment; Energy transfer in an ecosystem; Food chain, food web; Energy budget; Production and decomposition in a system; Ecological efficiencies; Trophic structure and energy pyramids; Ecological energetics; Principles pertaining to limiting factors; Biogeochemical cycles (N, C, P cycles). Over view of Freshwater Ecology; Marine Ecology; Estuarine Ecosystem; and Terrestrial Ecosystem.

UNIT II

Concept of Environmental Pollution: Origin of pollution; Classification and nature of Environmental Pollutants; Industrial pollutions. Overview of Noise pollution. Radiation Pollution Types and possible hazards of radioactive substances; Soil Pollution - Waste land formation - Deforestation, Shifting cultivation. Impact of Dams, Loss of soil fertility. Global environmental changes; Green house effect. Over view of Water pollution - oil spills.

UNIT III

Microbiology of waste water treatment, aerobic process – activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process: Anaerobic digestion,

anaerobic filters, up-flow anaerobic sludge blanket reactors. Biotechnology in tannery, dairy, distillery, textile, pulp, paper and Antibiotic industries effluent treatment.

UNIT IV

Remote sensing and its applications in resource management and pollution monitoring - IRS satellites & their sensors. Biosensors, Bioremediation (Mycorrizhae - in restoration of soil fertility) and pollution abatement: Biotechnological applications for Xenobiotics degradation, hydrocarbons, oil pollutants, surfactants and pesticides. Bioleaching. Phytoremediation. Recycling of metallic waste; a brief note on panchakavya.

UNIT V

Quality of environment for life on earth and man - Deterioration of environmental quality with reference to anthropogenic impact. Methods of assessment of environmental quality; Short term studies/surveys. Environmental Impact Assessment (EIA) - The Environmental Protection Act, 1986. Green peace friendly concept.

REFERENCE BOOKS:

1. Harvinder Sohal & A K Srivastava (1982) - Environment and Biotechnology, Black Well publishers. New Delhi.
2. Kumar H D (1982) - Modern Concepts of Ecology - Vikas Publishing House Pvt. Ltd.
3. Environmental Chemistry A.K. De, Wiley Eastern Ltd.
4. Environmental Biotechnology and Clean air Bioprocess by E.J. Olguin, G. Sanchez and E. Hernandez (2003) Taylor& Francis.
5. Kumaraswamy.K. Algappa Moses A, Vasanthi M: Environmental Studies-Bharathidasan University Publication, Trichy.
6. Agarwal. K.C, 2001. Environmental Pollution: Causes, Effects and Control-Nidhi Publishers (India) Bikaner.
7. Environmental Biotechnology 1995, S.N.Jogdand Himalaya Publishing House.
8. Waste water engineering – treatment, disposal and reuse. Metcalf and Eddy Inc., Tata McGraw Hill, New Delhi.

SEMESTER – VI		CODE - U19BT16E
Elective Course III: IPR, BIOSAFETY AND BIOETHICS		
CREDITS - 4		HOURS - 5

Objectives:

- To learn the Significance and Framework of Intellectual Property Rights and to understand the protocols of Patenting.
- To learn the importance of Biosafety protocols and Bioethics.
- To learn the available opportunities in the field of Applied Biotechnology.

Course Outcomes:

At the completion of the course, the student would be able to:

COURSE OUTCOMES	COGNITIVE LEVEL
➢ Understand the significance of IPR in biotechnology.	C2
➢ Utilize IPR for research purposes.	C3
➢ Understand the basics of biosafety protocols.	C2
➢ Employ biosafety protocols in experimental research.	C3
➢ Differentiate between ethical concerns.	C2

C1 – Remember C2 – Understand C3 – Apply

UNIT I

Intellectual Property Rights: Significance of IPR - Types of IP: Patents, Trademarks, Copyright, Industrial Designs, Trade Mark, Trade secret and Geographical Indications – Treaties on IPR, GATT, WTO, WIPO and TRIPS - Farmers rights.

UNIT II

Patents and Patenting System: Patent law: Principles – Need for patent law in biotechnology – Types of patents –Role of a Country Patent office – Patent applications: Forms and guidelines– Types of patent application – Patent specification: provisional and complete specification – Patent databases: India, USPTO, and EPO – Patent infringement: Case studies on Turmeric and Neem.

UNIT III

Biosafety: Definition – Causes: classification, identification of hazards – Issues. Handling – Typesof accidents, first aid and precautionary measures – Clean room procedures: Classification specification – Basic methods for safe handling, transport, and storage of biological and chemical materials – Equipment related hazards.

UNIT IV

Levels of Biosafety: Biological safety cabinets: Horizontal and Vertical Laminar Air Flow Cabinet, Fume hood – Primary and secondary containments – Biosafety levels of specific Microorganisms (food and water borne pathogens), Infectious Agents (Chemicals and carcinogens) – Material Safety

Data Sheet. Guidelines: Biosafety Guidelines and regulations (National and International including Cartegana Protocol) of Government of India – GMOs and LMOs – Roles of Institutional Biosafety Committee.

UNIT V

Bioethics: Introduction to ethics and bioethics and its framework – Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research - Ethical implications of GM crops, GMOs, human genome project and cloning, designer babies, biopiracy and biowarfare – Eugenics –Animal right activities and Ethical limits– Green peace - Human Rights and Responsibilities.

TEXT BOOKS:

1. Erbisch, F.H, Maredia, K.M, Intellectual property rights in agricultural biotechnology, Universities Press (India) Ltd, 2000., ISBN 9788173712555.
2. Deepa Goel and Shomini Parashar, IPR, Biosafety and Bioethics, Pearson Educationpublisher, (2013), ISBN 9789332514010.
3. Senthil Kumar Sadasivam and Mohammed Jaabir M. S. (2008). IPR, Biosafety and Biotechnology Management, Jasen Publications, India.

REFERENCE BOOKS:

1. Singh. K.K, Intellectual Property Rights in Biotechnology, Springer India, 2015. ISBN 9788132220589.
2. Sasson A. Biotechnologies and Development, UNESCO Publications.
3. Rajmohan Joshi (Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.

SEMESTER -VI		CODE – U19BT12P
Core Course Lab XIII **LAB FOR COURSES IN SEMESTER VI**		
CREDITS - 6		**HOURS - 6**

LAB FOR COURSES IN SEMESTER VI
(Group & Individual practical)

1. Determination of BOD and COD of polluted and pond water.
2. Isolation, identification of microbe from extreme environment soil and water.
3. Assessment of water quality by MPN technique
4. Air quality test to determine CO2 by titration method.
5. Preparation of panchakavya.
6. Plant tissue culture- sterilization, media preparation, hormones.
7. Micropropagation, shoot induction and root induction.
8. Callus induction, Anther culture, Ovule culture, Protoplast isolation, viability and culture
9. Synthetic seeds preparation
10. Agrobacterium-mediated transformation in plants (Demo).
11. Undertake plant genomic DNA isolation by CTAB method and its quantitation by visual as well as spectrophotometeric methods.
12. Primary Cell Cultures (Demo)
13. Trypsinization (Demo)
14. Cell Counting