DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

CIRCULAR NO.SU/B.Sc./CBC&GS/99/2024

It is hereby inform to all concerned that, the Revised syllabi prepared by the Board of Studies/Ad-hoc Board and recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 08 April 2024 has accepted** the following Syllabi under the Faculty of Science & Technology **as per Norms of Choice Based Credit Grading System** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	**B.Sc.Biotechnology (Optional)**	**Vth & VIth semester**
2.	**B.Sc.Instrumentation Practice (Optional)**	**Vth & VIth semester**

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2024/ 26911-19
Date:- 15.05.2024

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Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
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5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHHATRAPATI SAMBHAJINAGAR

B.Sc. Biotechnology (Optional)

Vth & VIth semester

As per Choice Based Credit Grading System

Under the Faculty of Science & Technology

M B Patil

Dr.Mayavati Patil,
Chairperson,
Ad-hoc Board in
Biotechnology & Bioinformatics

From the Academic Year 2024-25 & Onwards/-

B.Sc. Biotechology (Optional) Paper Structure at Glance (to be implemented from June 2024) Semester V								
Course Type	**Course Code**	**Course Name**	**Total Periods (Teaching period/week)**	**Credits**	**Scheme of Examination**			
					Max Marks	**CIA**	**UA**	**Min Marks**
Optional I (DSE-1-A) Discipline specific elective	BTO-511	DSE-1A(1) (Theory Paper-IX) (Select any one paper from A1/B1/C1/D1 **DSE-1A(1)- A1-** Bioprocess Engineering, **DSE-1A(1)- B1-**General Virology, **DSE-1A(1)- C1-** Developemental Biology, **DSE-1A(1)- D1-**Cell Communication & Signaling	45 (3/week)	2	50	10	40	20
	BTO-512	DSE-1A(2) (Theory Paper-X) (Select any one paper from A2/B2/C2/D2, **DSE-1A(2)- A2-** Recombinant DNA Technology, **DSE-1A(2)- B2-**Ecology & Evolution, **DSE-1A(2)- C2-** Metabolism of Macromolecules, **DSE-1A(2)- D2-**Clinical Biochemistry	45 (3/week)	2	50	10	40	20
	BTOP-521	Practical based on BTO-511	45 (3/week)	1.5	50	10	40	20
	BTOP-522	Practical based on BTO-512	45 (3/week)	1.5	50	10	40	20
Skill Enhancement Course (SEC-3)	BTO-513	SEC-3 Any one skill to be chosen out of two SEC-3(E), SEC-3(F) **SEC-3(E)-** Bioinstrumentation techniques, **SEC-3(F)-** Basics of Immunology	45 (3/week)	2	50	10	40	20
			225	**9**	**250**	**50**	**200**	**100**
			Total Credits for Semester V: 9 (Theory=6, Laboratory=03					

B.Sc. Biotechnology (Optional) Paper Structure at Glance (to be implemented from June 2024) Semester VI								
Course Type	**Course Code**	**Course Name**	**Total Periods (Teaching period/week)**	**Credits**	**Scheme of Examination**			
					Max Marks	**CIA**	**UA**	**Min Marks**
Optional I (DSE-1-A) Discipline specific elective	BTO-611	DSE-1B(1) (Theory Paper-IX) (Select any one paper from A1/B1/C1/D1 **DSE-1B(1)-A1-** Microbial Biotechnology, **DSE-1B(1)- B1-**Plant Physiology, **DSE-1B(1)- C1-**Advance Enzymology, **DSE-1B(1)- D1-**Genomics & Proteomics	45 (3/week)	2	50	10	40	20
	BTO-612	DSE-1B(2) (Theory Paper-X) (Select any one paper from A2/B2/C2/D2, **DSE-1B(2)- A2-** Bioinformatics, **DSE-1B(2)- B2-**Tissue Culture Technlogy, **DSE-1B(2)- C2-**Advance Immunology, **DSE-1B(2)- D2-**Animal Physiology,	45 (3/week)	2	50	10	40	20
	BTOP-621	Practical based on BTO-611	45 (3/week)	1.5	50	10	40	20
	BTOP-622	Practical based on BTO-612	45 (3/week)	1.5	50	10	40	20
Skill Enhancement Course (SEC-4)	BTO-613	SEC-4 Any one skill to be chosen out of two SEC-4(E), SEC-4(F) **SEC-4(E)-** Quality control in Food and Pharma Industry, **SEC-4(F)-** Microbial Biofertilizer Production	45 (3/week)	2	50	10	40	20
			225	**9**	**250**	**50**	**200**	**100**
			Total Credits for Semester VI: 9 (Theory=6, Laboratory=03					

BSc. Third Year
Semester V
Bioprocess Engineering

BTO-511-DSE-1A(1)-A1 **Credit: 02** **Marks: 50**

Objectives:

- This course provides students with basic concepts and prepare them to meet the challenges of the new and emerging biotechnology industry.
- To study how to analyze and control of bioreactors and fermenters, and downstream processing of bioreaction of products.
- To estimate kinetic parameters from raw fermentation media.

Outcomes

- Analyze metabolic network and metabolic flux.
- Estimate kinetic parameters from raw fermentation data.
- Analyze and formulate mechanisms for enzymatic reactions.

1.Introduction: Design of basic fermenter, Bioreactor configuration, design features, individual parts, baffles, impellers, foam separators, sparger, culture vessel, cooling and heating devices, probes for online monitoring,. Batch, Continuous and solid state fermentations.

2.Basics of Industrial Fermentation Processes: Screening, physicochemical and biological assays of fermentation products, inoculum development and various methods of preservation of industrially important microorganisms such as serial transfers, lyophilization and liquid nitrogen storage. Brief introduction to different techniques employed for strain improvement.

3.Fermentation Media: Media composition, utilization of cheap natural raw materials employed for different fermentations (media economics). Different methods of media sterilization control of bacterial and phage contamination during fermentation. Scale up of fermentations.

4.Downstream Processing: Methods employed for process recovery Viz., Sedimentation, centrifugation, filtration, precipitation, liquid-liquid extraction, chromatography, membrane process, drying and crystallization.

References:

1. Baily & Ollis Biochemical Engineering Fundamentals, Tata Mcgraw hill New York.
2. Stanbury & Whittaker Principles of Fermentation technology Pergamon Press, oxford
3. Creuger & Creuger, Biotechnology, A text book of industrial Microbiology, Sinaeur Associates.
4. H.J.Rehm & Reed G, Biotechnology: A comprehensive treatise, VCH
5. L.E. Cassida, Industrial Microbiology Wiley Eastern
6. Applied Microbiology series
7. Veith W.F Bioprocess Engineering kinetics, Mass transport, Reactors, & Gene Expression, John Wiley & Sons.
8. Atkinsons B Biochemical reactors Pion Ltd, London.
9. Battley, E.H. Energetics of Microbial growth, John Wiley & Sons.
10. Davis , J.E and Demain, A.L- Manual of Industrial Microbiology and Biotechnology 2nd Edition , ASM, Publication.

Practical Based on BTO-511-DSE-1A(1)-A1

Code- BTOP-521 **Credit 1.5** **Marks 50**

1. Isolation of industrially important microbes from the environment.
2. Determination of TDP & TDT of microorganisms.
3. Determination of growth curve of a industrial organism & compute substrate degradation profile, specific growth rate & growth yield.
4. Screening & enrichment for a primary secondary metabolite from the environment.
5. Strain improvement for a higher yield of product
6. Random & strategic screening for a metabolite.
7. Media balancing experiment.
8. To study the sterilization kinetics of the given sample of microorganism and determine the holding time at 121°C.

BSc. Third Year
Semester V
General Virology

BTO-511-DSE-1A(1)-B1 **Credit: 02** **Marks: 50**

Objectives

1. This Course aims to provide a basic and advanced level of understanding about viruses and functioning of the viruses.
2. Characterisation of viruses with special emphasis on the different virus mediated pathogens of human, animal and plant origin.
3. Students should get acquainted with the infrastructure required for working with viruses.

Outcomes

1. On completion of this course students should gain fundamental knowledge on various aspects of virology.
2. To conceptualise, study and address the growing incidence of epidemics with special emphasis on public health.
3. They should also develop basic ideas on how a virological laboratories functions with specific facilities and protocols while complying with rules of biosafety, ethics and intellectual property rights.

Unit 1. General aspects

Classification and nomenclature of viruses in general, their properties, morphology and ultrastructure typical bacteriophage, animal virus and plant virus, types of envelope, theircomposition, Viroids and Prions.

Unit 2. Animal Viruses

Classification of animal viruses, life cycle and pathogenicity of important viruses, genomeorganization and replication of DNA viruses, RNA viruses, Adeno virus, Pox virus, SV40, Vaccinia, Lentivirus. Clinical diagnosis and treatment of HIV, Influenza and Hepatitis, Corona Virus.

Unit 3. Plant Viruses

Classification plant viruses, life cycle and pathogenicity of important viruses. Genome organization and replication of common plant viruses, such as; TMV CaMV, Potato X Virus, Gemini Virus. Transmission of plant viruses by vectors and other means. Diagnostic techniques in seed, seed stocks and diseased plants.

Unit 4. Bacteriophages

Structure and organization of bacteriophages, lytic and lysogenic life cycles –T4 and lambda. Genetic switch for control of lytic and lysogeny of lambda phage. Genome organization, infection and multiplication of T odd and T even phages. Lambda phage,M13, Mu phage.

References:

1. General Virology by S. E. Luria
2. Molecular Virology, pathogenesis and control, ASM Press, Washington DC
3. Plant Virology by REF Matthews
4. Dimmock N. J., Primrose S. B. 1994 Introduction to modern Virology, 4th edition, Blackwell scientific Publications, Oxford.

Morag C and Embury M. C. 1994, Medical Virology 10th edition, Churchil

Practical Based on BTO-511-DSE-1A(1)-B1

Code- BTOP-521 **Credit 1.5** **Marks 50**

1. Isolation of coliphages
2. Titration of bacteriophages
3. One step growth curve
4. Viral DNA extraction
5. Demonstration of nucleic acid type of viral sample
6. Isolation of plant virus from clinical specimen
7. Isolation of animal virus from clinical specimen.
8. Direct detection of viral infections using molecular methods (Agorose gel electrophoresis)

B.Sc. Biotechnology Third year
Semester V
Developmental Biology

BTO-511 DSE-1A (1)-C1 **Credits 2** **Marks 50**

Course Objectives

- To understand different developmental stages in unicellular and multicellular eukaryotic organisms.
- To understand early embryonic development and organogenesis in animals.
- To understand concept of aging and cell death

Course outcomes

After successful completion of this course, students will:

- Get knowledge about concept of development in organisms
- Understand different cleavage patterns and its mechanism
- Get an idea about concept of regeneration and cell death

Unit 1: Developmental Biology an overview: Introduction of animal development: Development among unicellular eukaryotes- *Acetabularis*, *Naegleria*. The origins of sexual reproduction Fertilization: structure of gametes, recognition of sperm and egg-action at distance and contact of gametes. Cleavage: Patterns of embryonic cleavage, radial holoblastic cleavage, spiral holoblastic cleavage, mechanisms of cleavage-regulation of cleavage cycles.

Unit 2: Early Embryonic Development : Gametogenesis, Fertilization, Embryo sac development and double fertilization in plants, blastula formation, Types of Cleavage, Gastrulation and formation of germ layers in animals.

Unit 3: Morphogenesis and organogenesis in animals: Cell aggregation and differential in *Dictyostelium;* axes and pattern formation in *Drosophila*, organogenesis- vulva formation in *Caenorhabditis elegans*; eye lens induction, limb development in vertebrates, neuron differentiation, larval formation, metamorphosis; environmental regulation of normal development.

Unit 4: Extra embryonic membrane, Cell death and regeneration: Study of extra-embryonic membrane in chick, concept of regeneration, programmed cell death, aging and senescence.

References:

1. Developmental Biology by Scott Gilbert 9th edition
2. Balinsky-An introduction to embryology CBS College Publishers
3. Lodish H, *et. Al.*, Molecular Cell Biology
4. Albert Bruce, *et al.*, Molecular Biology of the Cell Sinauer
5. Grant-Biology of Development systems, Holt. Reihart, Winston.
6. Developmental biology website companion to Gilbert-
http://www.devbio.com/contents.php

B.Sc. Biotechnology Third year
Semester V
Practicals based on BTO-511 DSE-1A (1)-C1

BTOP-521 **Credits 1.5** **Marks 50 (45)**

1) Study of Egg(s). (Drosophila/ Chicken).
2) Study of cleavage pattern in chicken/snail (Discoidal/spiral)
3) Study of developmental stages in chick embryo
4) Study of metamorphosis in *Drosophila.*
5) Study of cell death during embryonic development in chick and its role in morphogenesis and histogenesis (by using Neutral Red/ Nile blue/methylene blue)
6) Study of meiosis in Grasshopper testis
7) Study of development of frog embryo from permanent slides (at least five).
8) Study of different types of cancer cells.

B.Sc. Biotechnology Third year
Semester V
Cell communication and cell signaling

BTO-511 DSE-1A (1)-D1 **Credits 2** **Marks 50 (45)**

Course Objectives

- To understand different cell –cell interactions.
- To understand cell signaling and cellular communication.
- To understand concept of uncontrolled cell growth and cancer.

Course outcomes

After successful completion of this course, students will:

- Get knowledge about cellular communication and signaling.
- Understand different signal transduction pathways and its regulation.
- Get an idea about concept of oncogenes and uncontrolled cell growth.

Unit 1- Host parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

Unit 2- Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two- component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

Unit 3- Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrin, neurotransmission and its regulation.

Unit 4- Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

References:-

1. The cell, a molecular approach, Geoffrey M. Cooper, Robert E. Hausman
2. Molecular Cell Biology, Lodish et al., FreemanandCompany, New York, 1999
3. Essential Cell Biology-An introduction to the molecular Biology of thec ell- Alberts, Bray,Johnson, Lewis,Raff.Roberts, Walter, GarlandPublishing.
4. Molecular Biology of the cell-Bruce Alberts, GarlandPublishingInc.
5. Cell Biology-Ashortcourse,Secondedition, StephenR Bolsover, WielyPublication
6. Genes XI-Benjamin Lewin, Prentice HallPublication
7. An introduction to Practical Biochemistry- David T Plummer, Tata McGraw- HillEdition
8. Developmental Biology,Ninth edition,S.F.Gilbert, Sinauer Associates Inc.

B.Sc. Biotechnology Third year
Semester V
Practicals based on BTO-511 DSE-1A (1)-D1

BTO-521 **Credits 1.5** **Marks 50**

1) Effect of lipid composition on membrane permeability.
2) The effect of detergents on the erythrocyte membrane.
3) Lipid solubility of membrane.
4) Studies on Plasmoptysis and Plasmolysis.
5) Transport across membrane.
6) Effect of detergent on permeability of membrane.
7) To study the effect of cholesterol on the anion permeability of a phospholipid membrane.
8) Preparation of liposome.

B. Sc. Biotechnology Third year
Semester - V
Recombinant DNA Technology

BTO-512-DSE-1A(2)-A2 **Credits -2** **Marks - 50**

Course objective :
1)To inculcate knowledge on RDT and Vector .
2)To install the knowledge about blotting technique.
3)To impart the fundamental knowledge about vectors.
4)To understand knowledge about enzyme in RDT.
Course Outcomes :
After sucessful completion of this course , student will able to 1)Understand role of vectors and it construction.
2)Apply this knowledge in day to days life. 3)Understand application of RDT.
4)Understand steps involve in recombinant technology.

1. **Introduction to Recombinant DNA Technology**: Definitions, steps in gene cloning, tools and techniques and applications. Molecular Tools and Applications: Enzymes-Type II restriction endonuclease, Nucleases, Polymerases, Phosphatases and Kinases, DNA ligases, PCR-Essential features, design of primers, DNA polymerases for PCR. Radiolabelling of Nucleic acids: end labeling, Nick translation, labeling by primer extension.
Southern Northern Hybridization, DNA sequencing and enzymatic method.
Techniques of introducing DNA into cell-calcium chloride transformation & High efficiency transformation by electroporation, Agrobacterium-mediated transformation, Protoplast transformation, Particle bombardment

2. **Gene Cloning Vehicles:** Plasmid vectors for ***E. coli***-pBR322, pUC18, Bacteriophage vectors for *E. coli*- λ insertion vectors, λ replacment vectors, M13mp18, Hybrid plasmid / phage vectors, Vectors for use in Eukaryotic cells- Vectors for plant cell: Ti-plasmid, viral Cauliflower mosaic virus, Binary vectors. Vectors for animal cell: P elements, SV40. Artificial chromosomes: YACs & BACs.
Cloning strategies- cloning from mRNA, cloning from genomic DNA,

3. **Recombinant Analysis and Applications of rDNA technology:** Genetic selection and screening methods- Chromogenic substrates, insertional inactivation, complementation, Screening using nucleic acid hybridization – Nucleic acid probes, screening clone banks, Immunological screening for expressed genes, Analysis of cloned genes- in vitro mRNA translation, restriction mapping, blotting techniques, DNA sequencing

4.**Applications of rDNA technology** – in understanding genes & genomes, in biotechnology (protein production & protein engineering), in medicine & forensics, transgenic plants & animals.

References:
1. An introduction to Genetic Engineering –Desmond S T Nicholl, Cambridge university press, 2nd Ed.
2. Watson J.D,. Recombinant DNA: A short Course, Scientific American.
3. Old R.W & Primrose S.B., Principles of Gene manipulations, Blackwell Scientific publications.
4. Ausbel S. M , Brent R, Current Protocols in Molecular Biology., Wiley International New York.
5. Maniatis I, Fritchh E.F, & Sambrook J, Molecular cloning.
6. Winneker From Genes to Clones.
7. Setlow & Hollander A, Genetic Engineering: Principles & Methods, Plenum Press.
8. D.M Glover, DNA cloning, A practical approach.
9. Methods in Enzymology series, vol 152, 185, Academic press inc, Sandiego.

Practical Based On BTO-512-DSE-1A(2)-A2

BTOP-522 **Credits 1.5** **Marks 50**

1. Study of Conjugation in *E. coli.*
2. Generalized Transduction in *E. coli* using P1 phage.
3. Transduction of tn family and insertional inactivation in *E. coli*. 4. Phage titration.
5. Gene expression in *E. coli*
6. Isolation of plasmid from *E. coli*,
7. Restriction fragment analysis.
8. Transformation of *E. coli*.
9. Transformation with phage DNA & isolation of lysogens.
10. Isolation of genomic DNA.

B.Sc Biotechnology Third year
Semester VI
Ecology and Evolution

BTO-512-DSE-1A (2)-B2 **Credits 2** **Marks 50**

Unit 1: Introduction: Definition of ecology, branches of ecology, ecological tools andtechniques, significance of ecology for man.

Unit 2: Environment: Definition, types, Abiotic and biotic factors, Biotic communities, Ecosystem and its structure: abiotic & biotic living components, food chains and its types (Grazing, detritus), food pyramids, energy flow in ecosystems.

Unit 3: Evolution: Introduction, theories of organic evolution, Examples and types of natural selection, classification of evolution, evidence for evolution through cladogenesis and natural selection, evolutionary trends and systematics

Unit 4: Adaptation, Adaptive radiation, Speciation: Nature of speciation, Modes of speciation, instantaneous speciation.

References:

1. Darwin's Universe: Evolution from A to Z by Richard Milner
2. Cell biology, genetics, Molecular biology, evolution and ecology by P.S Vermaand V.K Agrawal
3. Fundamentals of ecology by Eugene Odum

B.Sc Biotechnology Third year
Semester VI
Practical Based on BTO-512-DSE-1A (2)-B2

BTOP-522 **Credits 1.5** **Marks 50**

1. Isolation of microorganisms from different habitats and study their morphologicaland biochemical characteristics.
2. Study of Symbiotic association between microbes and plant -mycorrhiza
3. Study of plant plant interactions –orchids
4. Stud of Symbiotic association between microbes and sea animal –bioluminescence
5. Study of Parasitism –plant –plant
6. Poisonous sea fishes –demonstration
7. Mapping plant diversity of specific location

B.Sc. Biotechnology
Semester V
Metabolism of Macromolecule

BTO-512-DSE -1A(2)-C2 **Credit -2** **Marks 50**

Course Objective

- Understand the concepts of monomer and polymer, and how they relate to macromolecules.
- To describe, the chemical changes catalyzed by the component enzymes of the route
- Describe the structure of ATP and identify the major class of macromolecules to which ATP belongs

Course Outcomes

After successful completion of this course, students will able to;

- Describe structure, function, and classification of Macromolecules
- Rationalize energy gain and loss during metabolic process.
- Describe metabolic pathways and their regulations.

Unit I: Carbohydrate Metabolism

Importance of glucose in metabolism, glucose transport, Definition, concept, Metabolic map with enzyme and overall Balance sheet of Net gain of ATP; Glycolysis, TCA, HMP, Gluconeogenesis. Electron transport & Oxidative phosphorylation, components involved in Electron transport, Respiratory chain, Oxidative phosphorylation & mechanism. Energies of oxidative phosphorylation.

Unit II: Lipid Metabolism:

Fatty acid are activated and transported in Mitochondria. Oxidation of fatty acid (Palmitic acid) Fatty acid biosynthesis: Formation of malonyl COA from Acetyl COA, FAS – Multienzyme complex & Reaction of palmitic acid.

Unit III: Biosynthesis of Amino Acid

Metabolic fates of amino groups, Deamination, Decarboxylation & Transamination reactions. Biosynthesis of phenylalanine, Tyrosine & Tryptophan; Biosynthesis of Chorismate , Chorismate to Tryptophan, Phenylalanine & Tyrosine with chemical reaction and enzymes.

Unit IV: Biosynthesis of nucleotides

Denovo & Salvage pathway (introductory).,Denovo purine nucleotide synthesis from PRPP to IMP, IMP to AMP& GMP; Pyrimidine nucleotide biosynthesis Denovo.

References:

1. Biochemistry by Lubert Stryer ,III edn,1988. W.H. Freeman & Co.
2. Principles of Biochemistry by Lehninger, II edn, 1978, Worth Publisher Inc.
3. Biochemistry by Zubay, III edn, 1933, W.C Brown Publisher.
4. Outline of Biochemistry by Cohn and Stump.
5. Practical Biochemistry by D. Plummer.
6. Practical Biochemsitry by J. Jayraman

Practical based on BTO-512-DSE -1A(2)-C2

Code- BTO-522 **Credits – 1.5** **Marks -50**

i. Detection of Phospholipids content in oil.
ii. Isolation & Detection of Succinate dehydrogenase.
iii. Separation of DNA, RNA, Protein from tissue extract.
iv. Estimation of amino acid by ninhydrin Method.
v. Estimation of aromatic amino acid by Folin-Phenol reagent
vi. Quantitative estimation of DNA by Diphenylamine method.
vii. Quantitative estimation of RNA by Orcinol method.
viii. Qualitative test for Proteins
    a. Precipitation reaction,
    b. Colour reaction,
    c. Identity test for albumin ,Globin, Peptone

B.Sc. Biotechnology Third Year
Semester V
Clinical Biochemistry

BTO-512-DSE-1A(2)-D2 **Credits 2** **Marks 50**

Course Objectives

-To understand the disorders of major type of metabolism
-To know disorders of carbohydrate
-To understand disorders of nucleic acid and protein metabolism
-To understand disorders of lipid metabolism

Course Outcomes

- Study metabolic disorders
- Learn disorders of carbohydrate metabolism
- Know the metabolism disorder of lipid metabolilsm
- Understand the disorders of protein metabolism.

Unit I-

Disorders of fluids, electrolyte balance and gastrointestinal system, disorder involving change in hydrogen ion concentration, Metabolism of bilirubin. Liver function tests, jaundice, haemolytic , hepatic and obstructive jaundice. Renal function tests, normal and abnormal constituents of urine.

Unit II-

Disorders of carbohydrate metabolism – Sugar level in normal blood, maintenance of blood sugar concentration – endocrine influence on carbohydrate metabolism, hypoglycemia, glycosuria, renal threshold value, diabetes mellitus – classification, complications, glucose tolerance test (GTT), diabetic coma, diabetic ketoacidosis, glycogen storage diseases, fructosuria, galactosemia, and hypoglycemic agents.

Unit III-

Disorders of lipid metabolism – lipid metabolism in liver and adipose tissue, plasma lipoproteins, cholesterol triglycerides and phospholipids in health and diseases, fatty liver, atherosclerosis, lipid storage diseases, hypolipoproteinemia and hyperlipoproteinemia.

Unit IV-

Disorders of protein, amino acid and nucleic acid metabolism – plasma proteins, their origin, significance and variation in diseases. Nitrogen balance, proteinuria, multiple myeloma, Wilsons disease. Phenyl ketonuria, alkaptonuria, tyrosinosis, albinism, Hartnups disease. Fanconic syndrome, cystinuria, Gout.

References:

1. Clinical biochemistry by Kaplan L.A. and Pesce A.J.C.V. Mosby 1998.
2. Clinical biochemistry by W.J. Marshall and S.K. Bangery, Chirchill Livinston

3.MedicalBiochemistrybyN.V.Bhagavan ,Elsevier Publishers(2002)
4.Text Book of Biochemistry by M.N.Chatterjee ,Jaypee Publishers(2006)
5. Fundamentals of Biochemistry by Ambika shanmugam ,S.Chand Publishers (1986)
6.Medical Laboratory Technology by Mukherjee , Tata Mc Graw Publishers

Practicals based on BTO-512-DSE-1A(2)-D2

BTOP-522 **Credits 1.5** **Marks 50**

1. Residual chlorine in water.
2. Qualitative test for food adulteration in food.
3. Analysis of blood group.
4. Haemocytometric analysis.
5. Serum protein fractionation.
6. Blood haemoglobin determination. Erythrocyte sedimentation rate (ESR).
7. Glucose tolerance test (GTT).
8. 11. Kidney function test (blood urea, creatinine, serum Na+ K+).

B.Sc. III Biotechnology
Semester V
Bioinstrumentation Techniques

BTO-513- SEC 3(E) **Credits 2** **Marks 50**

Course Objectives:
By the end of this course, Students should able to:
- Introduction of different Instruments: Understanding of all basic instruments which require to do all practical purpose.
- Understand the theory and operating procedure of basic Instrumental techniques.
- Application of instruments in Biotechnology.

Course outcome:
After Successful completion of this course, students will be able to:
- Understand and explain the principles and SOP of laboratory instruments.
- Explain the principle and working of Microscope, Spectrophotometer. etc.

Unit–1. Unit-I Basic Instruments:
Theory , Principle and application of Autoclave ,pH meter, Incubator, Colorimeter and spectrophotometer .

Unit-2 Biophysical methods:
Centrifugation- types, preparative, analytical and differential, sedimentation velocity and sedimentation equilibrium.

Unit -3 Microscopy: Microscope and its different parts : Eye piece, Objectives, coarse adjustment ,Fine adjustment ,iris diaphragam, condenser

Unit–4
Spectroscopy: Basic principles theory instrumentation and applications of UV-visible, Infra- Red, NMR, (Nuclear magnetic resonance)

Practicals:
1. Observation of Bacteria using Microscope.
2. Hanging drop technique (Motility).
3. Study of different parts of Microscope(Eye piece, objectives etc).
4. Absorption spectra of DNA.
5. Study of yeast cells morphology.
6. Absorption spectra of protein .
7. Determination of Lambda max of methyl red dye.
8. Determination of Lambda max of Malachite green dye.

References:

- Biophysical Chemistry by Nath and Upadhya.
- Analytical Biochemistry by Holme.
- Instrumental methods of chemical analysis by Chatwal and Anand.

B. Sc Biotechnology Third year
Semester V
Basics of Immunology

BTO-513- SEC 3 (F) **Credits O2** **Marks:**50

Course objectives:

1) To provide basic understanding of Immunology and related concept.
2) To make student aware of various advances and Applications of immunology.
3) To demonstrate practical utility and potential of the subject.

Course Outcome:

1) CO1: Understand and explain importance of immunology.
2) CO2: Explain concept of Immunity, Antigen, Antibody, Immune system.
3) CO3: Practical aspects of Immunology-Antigen-Antibody reactions, vaccines etc.

Unit I: Basic Immunology-

1) Introduction, History, Scope and Definition of Immunology,
2) Normal flora of Human body.
3) Infection, Process, sources and Factors in Infection.
4) Immune response and Line of Defence in host: Introduction

Unit II: Immunity and Immune system-

1) Immunity: definition and classification,
2) Antigens: Definition, Types and Determinants of Antigenicity.
3) Antibody: Introduction and Structure of Antibody, Classes of Immunoglobins,
4) Immune system: Cells and Organ of Lymphoid system.

Unit III: Applied Immunology-

1) Antigen- antibody reaction: General features, types and applications.
2) Immunizing agents- Vaccines, Immunoglobulins and antisera,
3) Stem cells and stem cell therapy: Introduction.
4) Hypersensitivity, Immunodeficiency diseases and Autoimmunity (In brief).

Unit IV Vaccines

Introduction definition Types: Live, Attenuated, Conjugated, DNA vaccines, New generation vaccines

Practicals:

1. Study of Immune Cells TLC/DLC
2. Isolation of O & H Antigen from *Salmonella typhi*
3. Isolation of Protein A from *Staphylococcus aureus*
4. Purification of Immunoglobulin by Precipitation
5. Diagnostic Assay for Typhoid using Widal Kit
6. Diagnosis of RA by Agglutination
7. Haemagglutination
8. Immunoelectrophoresis

References:

1.Textbook of Microbiology by Ananthanarayan and Panikers tenth edition, University press
2. Essential of Immunology by Riott I. M. 1998. ELBS, Blackwell Scientific Publishers, London.
3.Microbiology by Micael J. Pelczer. 5th edition Tata McGraw-Hill publisher,
4. Kuby Immunology 7th edition by Owen, Punt and Stranford.

B.Sc. Biotechnology (Third Year)
Semester VI
Microbial Biotechnology

BTO-611-DSE-1B(1)-A1 **Credit-2** **Marks - 50**

Course objectives

- To include the knowledge about food and dairy microbiology.
- To describe the knowledge about food borne disease.
- To get idea about waste waste water treatment.
- To include the knowledge about normal microflora

Course outcomes
After successful completion of this course, student will able to

- Understand in detail microbial spoilage in food.
- Understand chemical and physical method of food preservation.
- Capable to explain BOD and .
- Explain disease of various system.

1. Introduction to microbial technology
History and scope of Microbial Biotechnology ,
Food microbiology - Role of microorganisms in food spoilage, factors affecting growth of Microbes in food ,spoilage of meat and poultry, fruits, and vegetable ,canned food,
Principle of food preservation ,Method of preservation -chemical , physical methods
Dairy microbiology- Information Milk: Definition, Composition of milk, Normal and abnormal microflora of milk, Sources of contamination of milk, International standards of Milk.
Milk Spoilage- Flavour and colour defects, Stormy fermentation, Sweet curdling, Ropiness.
Grading of milk- Direct and Indirect Tests
Preservation of Milk- Pasteurization and efficiency of pasteurization.
Microbial processing of milk- Curd,Yogurt, Butter, Kefir,Cheese.
Food borne diseases- Food infection and intoxication

2. Medical Microbiology

Medical Microbiology: Normal flora, Diseases of various systems
Tuberculosis, Leprosy, Typhoid, Polio, Syphilis, Tetanus, causative agent, symptoms, morphology, pathogenesis, diagnosis and treatment.

3. Microbes in Waste treatment Processes Water borne diseases:
Indicators of faecal pollution, Routine bacteriological analysis of water for potability: Presumptive, Confirmed, Completed test, Membrane Filter Technique and Eijkman tests.
Bacteriological standards of drinking water.(WHO, BSI)
Sewage and Industrial waste water: Types of wastes, relevance of COD and BOD determination in analysis of waste water
Methods and principles of treatment of sewage (primary, secondary and tertiary treatment methods

4. Applications of Microbial Biotechnology

Geomicrobiology-Ore leaching (methods and examples), MEOR. Bioweapons Biofertilizers and Biopesticides and Microbial plant growth Promoter (gibberellin and IAA) GMOs-Norms and applications Microbial Sweeteners (Thaumatin, Monelin) Microbial toxins and their applications Microbial Polysaccharide production: any 2 examples Concept of Synthetic Biology and Biometabolite Production

References Books :

1)Food Microbiology, Frazier & Westhoff, 4th edition, Tata McGraw Hill Publications Modern
2)Food Microbiology, James Jay, 7th edition, Springer Publications
3)Advances in Biotechnology, S. N. Jogdand, Himalaya Publishing House
4)Milk & Milk Products, C. Eckles, 4th edition, Tata McGraw Hill Publications

5)Prescott, S.C. and Dunn, C.G., (1983) Industrial Microbiology, Reed G. AVI tech books
6)General Microbiology - Stanier R.Y., 5th edition, (1987)Macmillan Publication, UK.
7)Fundamental Principles Of Bacteriology, Salle,A.J.,McGraw Hill Company, New York
8)Tortora, G.J., Funke, B.R., Case, C.L, 1992. Microbiology: An introduction 5th Edition, Benjamin Pub. Co. NY
9)Davis B.D., Delbacco, 1990 Microbiology 4th edition, J.B. Lippincott Co. NY
Wolfgang K. Joklik, 1992, Zinsser Microbiology 20th Edition, McGraw-Hill Professional Publishers
10) Dey, N.C and Dey, TK. 1988, Medical Bacteriology, Allied Agency, Calcutta, 17thEdition
11)Ananthnarayana, R. and C.E, Jayaram Panikar, 1996 Text book of microbiology, 5th edition, Orient Longman. .Park and Park, Preventive and Social medicine. 2013, Publisher:Banarsidas Bhanot, Jabalpur

Practical Based on BTO-611-DSE-1B(1)-A1

BTOP-621 **Credit 1.5** **Marks 50**

1.Isolation and identification (Genus level) of spoilage causing microorganisms from spoiled food
2. Grading of raw milk (Dye reduction test, DMC)
3. Determination of efficiency of Pasteurization by phosphatase test
4. Study of Normal flora of humans (Skin and oral cavity)
5. Assessment of potability of water: Presumptive Confirmed and complete test
6. Assessment of potability of water: IMViC tests & Eijkman's test.
7. Isolation of *S.typhi* from spoiled food sample
8. Visit to Dairy/ Effluent treatment plant / Sewage Treatment /Biofertilizer plant/ any other relevant industry and report writing.

B.Sc. Biotechnology

Semester VI

Plant Physiology

BTO-611-DSE -1B(1)-B1 **Credits -2** **Marks 50**

Course Objective

- Exhibit a brief and concise knowledge on Photosynthesis and Electron Transport system
- Learn about the basic techniques of Plant Physiology
- Acquire a Knowledge on Plant growth regulators and nitrogen fixation.

Course Outcomes

After successful completion of this course, students will able to;

- Understand the Plant and plant cells in relation to water
- Understand the process of Photosynthesis in higher plants, with particular emphasis of light and dark reaction, C3 & C4 pathways.
- Learn about the movement of sap and absorption of water in plant body.

Unit1. Plant water relations

Cell as a physiological unit. Osmosis, Imbibition. Diffusion, D.P.D. Water potential, Absorption of water, (active & passive). Plasmolysis, cohesion, tension and transpiration pull theory. Significance, factors affecting transpiration, mechanism of stomatal opening and closing, (k+ transport theory). Guttation and antitranspirants.

Unit2. Photosynthesis

Significance, site of photosynthesis, pigments, photochemical phase. Electron transport chain. Photophosphorylation, cyclic and non cyclic. Biosynthetic phase, Calvin cycle, C3 and C4 pathways. Photorespiration, Crassulacean Acid Metabolism, factors affecting photosynthesis. Law of limiting factors, light, temperature, water, nutrient supply. Leaf factors. Chemosynthesis. Essential, non- essential, macro and micro elements.

Unit 3. Plant Growth & Regulation

Phases of growth, growth curve. Plant growth regulators - Auxins, Gibberillins, Cytokinins Ethylene, Absisic acid - physiological functions. Senescence

Unit 4. Photoperiodism And Vernalization

Structure, function and mechanisms of action of phytochromes, cryptochromes and Phytotropins; photoperiodism and biological clocks.

Stress Physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress.

REFERENCES

1. Bilgrami K.S & Dube - A text book 0n Modern Plant Pathology. Vikas Publishing House, New Delhi.
2. Develin & Witham - Plant Physiology-C.B.S.Publishers.
3. Fritsch F.E - Structure and reproduction of Algae. Vol 1 and Vol11 Cambridge University Press London.
4. Kumar & Purohith - Plant Physiology. Fundamentals- Agrobios.
5. Kumar. H.D& Singh A.N - A text book on Algae. Chand & Company.
6. Malik C.P & Srivastava.- A text book of Plant Physiology Kalayani Publishing Co.

New Delhi.
7. Pandae & Trivedi - A text book of Fungi, Bacteria and Virus Vikas Publishing House New Delhi.
8. Parihar N.S - An introduction to Bryophyta Central Book Depot Allahabad
9. Smith G.M Cryptagamic Botany Vol 11Mc Grae Hill Co. New Delhi.
10. Smith K.M - A text book of Plant diseases S. Chand & Company.
11. Sporne K.R. - Morphology of Pteridophytes.- Hutchins university Library . London.
12. Vashista P.C. - Gymnosperms—S. Chand & Company. New Delhi
13. Vasistha B, - Bryophyta, S. Chand & Company.
14. Willam G. Hopkins. - Introduction to Plant Physiology. John Wiley.
15. Robert A Wallace. Biology, The world of life. Harper Collins

Practical based on BTO-611-DSE -1B(1)-B1

Code- BTO-621 **Credits – 1.5** **Marks -50**

a) Explain with suitable diagrams and working of experiments setup to demonstrate various physiological phenomenon.
b) Osmosis - Thistle funnel osmoscope.
c) Effect of stomatal number on rate of transpiration. (Cobalt chloride test)
d) Effect of root pressure on ascent of sap.
e) Relation between absorption and transpiration. (Water balance)
f) Rate of transpiration by Ganong's potometer.
g) Separation of different photosynthetic pigment using paper chromatography.
h) Rate of photosynthesis by Wilmot's bubbler.

B.Sc. III year
Semester VI
Quality Control in Food and Pharma Industry

BTO-613-SEC-4(E) **Credits 02** **Marks 50**

Course Objectives:
By the end of this course, Students should able to:
- Students understand the good laboratory practices.
- They Understand biochemical and immunological methods.
- Students will understand cultivation of Microorganisms.

Course Outcome :
- After Successful completion of this course, students will be able to:
- Understanding of GMP and Analysis of Pharmaceutical smples.
- Students able to understand HACCP

Unit –1 Microbiological Laboratory and Safe Practices
Good laboratory practices –Good Laboratory practices, good microbiological practices Biosafety cabinates-Working of biosafety cabinets, using protective clothings, specification for BSL-1,BSL-2,BSL-3.Discarding biohazardous waste –Methodology of Disinfection ,Autoclaving and Incineration .

Unit-2 Determining Microbes Pharmaceutical Samples
Cultures and microscopic methods –Standard plate count, Most probable numbers, Direct Microscopic counts ,Biochemical and immunological methods :Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products Molecular methods-Nucleic acid probes, PCR based detection ,biosensor.

Unit-3 Pathogeinc Microorganisms of Importance in food & water
Enrichment culture technique, Detection of specific microorganisms –on XLD agar, Salmonella Shigella agar, Mannitol salt agar ,EMB agar, McConkeys agar, Sabrauds agar ,Ascertaning microbial quality of milk by MBRT ,Rapid detection methods of microbiological quality of milk at milk collection centers .

Unit -4 HACCP for Food Safety and Microbial standards
Hazard analysis of critical control point (HACCP)- Principles, Flow diagrams, limitations ,Microbial Standards for different foods and water –BIS standards for common foods and drinking water.

Practical
1. Methods of disinfection, autoclaving & incineration
2. Demonstration of PCR
3. Sterility testing of pharmaceutical product (Any 1)
4. isolation of pathogen from food sample (Any I pathogen from one food sample)
5. Microbial quality of milk by MBRT
6. Microbial quality of milk by 10 Min Resazurin assay
7. Study of BIS standards of common foods (Any 2)
8. Visit to Pharmaceutical/Food processing industry

Refrences :
1.Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press
2. Garg N. Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology 1 K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner M, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer
4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Farmaceudeal and Medical Devices, Taylor and Francis Inc.

9. ' Cell Biology, Genetics, Evolution and Ecology' by P.S.Varma and V.K. Agrawal; S.Chand and Company.
10. ' Animal nutrition' by P.Mc Donald, R.A. Edwards, J.F.D. Greenhalgh, C.A. Morgan.

B.Sc Biotechnology Third Year
Semester VI
Practical Based on BTO-612-DSE-1B (2)-D2

BTOP-622 **Credits 1.5** **Marks 50**

1. Qualitative analysis of Carbohydrates
2. Qualitative analysis of proteins
3. Qualitative analysis of lipids
4. Detection of normal and abnormal constituents of urine – sugar, albumenbile and blood cells.
5. Demonstration of salivary amylase.
6. Effect of temperature and pH on amylase
7. Leukocyte count
8. Determination of hemoglobin

B.Sc Biotechnology Third year
Semester VI
Animal Physiology

BTO-612-DSE-1B (2)-D2 **Credits 2** **Marks 50**

Unit 1.Physiology of digestion and excretion

Definition of digestion and types of digestion – extra and intracellular. Digestion of Carbohydrates, proteins, lipids and cellulose digestion. Absorption and assimilation of digested food materials. gastrointestinal hormones- control of digestion.

Definition of excretion. Forms of nitrogenous waste material and their formation; classification of animals on the basis of excretory products. Structure and function of Nephron– Counter current mechanism.

Unit 2.Physiology of respiration and circulation

Types of respiration – external and internal respiration. Transport of oxygen – formation of oxyhaemoglobin and affinity of haemoglobin for Oxygen, Oxygen dissociation curves. Transport of CO2 – Chloride shift, Bohr effect.

Open and closed circulation. Heartbeat and cardiac cycle. Myogenic and neurogenic hearts. Regulation of heart rate – Tachycardia and Bradycardia.

Unit 3. Physiology of muscle contraction and nerve impulse

General structure and types of muscles. Ultra structure of skeletal muscle. Sliding filament mechanism of muscle contraction. Chemical changes during muscle contraction – role of calcium, ATP utilization and its replenishment.

Structure of nerve cell. Nature of nerve impulse – resting potential and action potential. Properties of nerve impulse – threshold value, refractory period, all or none response. Conduction of nerve impulse along an axon – local circuit theory and saltatory conduction theory. Structure of synapse, mechanism of synaptic transmission – electrical and chemical transmissions.

Unit 4. Physiology of endocrine system and homeostasis

Relationship between hypothalamus and pituitary gland. Hormones of hypothalamus. Hormones of Adenohypophysis and Neurohypophysis. Hormones of pineal gland, thyroidgland, parathyroid, thymus, adrenal and pancreas. Endocrine control of mammalianreproduction – Male and female hormones – Hormonal control of menstrual cycle in humans. Concept of Homeostasis and its basic working mechanism. Mechanism of Homeostasis –giving three illustrations viz., Hormonal control of glucose levels, Water and ionic regulationby freshwater and marine animals and temperature regulation in man.

REFERENCE BOOKS

1. 'Essentials of Animal Physiology' by S.C.Rastogi'
2. 'Animal Physiology' by H.C. Nigam.
3. 'Biology' by Campbell & Reece.
4. 'Animal Physiology' – Agarwal, R.A. Srivastava, Kaushal, Anil and Kumar.
5. 'Animal Physiology and Biochemistry' by Dr. B.Annadurai.
6. 'Principles of Animal Physiology' by Christopher D.Moyes, Patricia M Schulte.
7. 'Biology: The Science of Life' by R.A. Wallace, G.P. Sanders & R.J. Ferl.
8. 'Biology: Concepts and Applications' by Starr

References:

1. Immunology Kuby, R.A. Goldsby, T.J. Kind 1997, 4th Edition B.A. Osborne.
2. Essential of immunology Ivan Riot-Blakswel 1997, 4th Edition B.A. Osborne
3. Fundamentals of Immunology Paul W.E. (Eds.) 1998 Raven press, New York.
4. Text book of Microbiology, Panikar and Anantnarayan, tenth edition, University press
5. General Microbiology by Davis
6. Medical Microbiology by Duguid and Cruikshank.

Practical based on BTO-612-DSE-1B (2)-C2

BTOP 622 **Credit:1.5** **Marks:50**

1. Study of Immune Cells TLC/DLC
2. Isolation of O & H Antigen from *Salmonella typhi*
3. Isolation of Protein A from *Staphylococcus aureus*
4. Purification of Immunoglobulin by Precipitation
5. Diagnostic Assay for Typhoid using Widal Kit
6. Diagnosis of RA by Agglutination
7. Haemagglutination
8. Immunoelectrophoresis

B. Sc Biotechnology Third year (optional)
Semester VI
Advance Immunology

BTO-612-DSE-1B (2)-C2 **Credits O2** **Marks: 50**

Course objectives:

1) To provide students awareness of progression in the field of Immunology.
2) To make student aware of various advances and Applications of immunology.
3) To practically implement various technique in applied Immunology.

Course Outcome:

1) CO1: Students will understand importance of applied immunology.
2) CO2: Students will be able to explain various advances in Immunology.
3) CO3: Practical implementation-monoclonal antibody, vaccines etc.

Unit I. Transplantation and Inappropriate immune response: Tissue and organ transplant Graft and its fate: Types of graft, mechanism of graft rejection, prevention of graft rejection. Foetus as graft, Inappropriate Immune response: Immunodeficiency, hyper- sensitivity and Autoimmunity (in brief).

Unit II.Vaccines-Introduction and Types: Vaccines: Live attenuated, Heat killed with suitable examples, Synthetic vaccines, (Preparations, standardization and storage) Future developments- Recombinant Vaccines, Vaccines against alzheimeirs disease, Vaccines for AIDS, vaccine for Meningitis C, Super vaccine immunodulators, vaccine against Cervical Cancer.

Unit III. Monoclonal antibody and its Application: Fusion on myeloma cell with lymphocytes Production of monoclonal antibodies. Chimeric antibody, humanized antibody. Methods of preparation, their clinical applications and applications in Research and development.

Unit IV. Cancer and immunology: tumour immunity, Cancer terminology Basic proportion of a cancer cell, the causes of cancer, the genetics of cancer- tumour- Suppressor genes and oncogenes, Tumour antigens, Cancer immunotherapy.

B.Sc Biotechnology Third Year

Semester VI

Practical Based on BTO-612-DSE-1B (2)-B2

BTO-622 **Credits 1.5** **Marks 50**

1. Plant tissue culture media preparation & sterilization.
2. Induction of callus using suitable explants
3. Anther culture.
4. Suspension culture.
5. Micropropagation.
6. Embryo Rescue.
7. Plant regeneration from callus.
8. Animal cell culture Preparation of media and filter sterilization
9. Anchorage Dependent Cell Culture
10. Anchorage Independent Cell Culture
11. Cell Viability analysis –by staining method

B.Sc Biotechnology Third Year

Semester VI

Tissue Culture Technology

BTO-612-DSE-1B (2)-B2 **Credits 2** **Marks 50**

Unit 1: Terminology- Totipotency, Competency, Determinism, Requirements of tissue culture facilities, surface sterilization of materials, Basic procedure for Aseptic Tissue transfer, Culture media, composition of media, phytohormones, media components (Vitamins, Unidentified supplements, carbohydrate for energy source, Nitrogen source and organic supplements, complex substances, Activated charcoal) An appraisal of different media, Hormones: Auxins, cytokinins, Gibberellins, Abscisic Acid, ethylene.

Unit 2: Establishing callus and cell culture, Dynamics of callus growth, callus subculture and maintenance, Growth Measurements, Organ cultures-Shoot cultures, root cultures. Somaclonol variation, cell suspension culture, Plant Propagation—Meristem Cultures, Somatic Embryogenesis and their practical applications, Plant Cell Cultures and Pharmaceuticals, and pigment Compounds.

Unit 3: Culture Media: Natural media –Plasma Clot, biological fluids tissue extract, Importance of Serum in media. Chemically defined media. Primary Culture – Cell lines, isolation of tissue, enzyme disaggregation, and mechanical disaggregation. Secondary Culture – transformed animal cells and continuous cell lines.

Unit 4: Transfection of animal cell lines. Selectable Makers. Production of Vaccines in animal Cells. Production and Applications of monoclonal antibodies. Growth factors promoting proliferation of animal cells- EGF, FGF, PDGF, IL-1, IL-2, NGF and Erythropoietin. Transgenic Animals-Techniques and Applications (Transgenic mice and sheep).

References:

1. Plant Cell and Tissue Culture- A Tool in Biotechnology Basics and Application, Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani, Springer-Verlag Berlin Heidelberg
2. Plant Tissue Culture: Theory and Practice, S.S. Bhojwani, M.K. Razdan - Elsevier Science.
3. Culture of Animal Cells. A Manual of Basic Technique, Freshney, Wiley
4. Cell Culture Lab Fax. Eds. M. Butler & M. Dawson, Bios Scientific Publications Ltd., Oxford.
5. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
6. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods. Ed. Jenni P. Mather and David Barnes. Academic Press.
7. Cell Growth and Division: A Practical Approach. Ed. R. Basega, IRL Press.

Practical based on BTO-612-DSC-1B(2)-A2

BTOP 622 **Credit: 1.5** **Marks: 50**

1. Applications of computers in biology using MS-Office.
2. An introduction to INTERNET, search engines, websites, browsing and Downloading.
3. Searching research articles in Medline and Pubmed.
4. Exploring public domain databases for nucleic acid (NCBI, EMBL) and protein sequences (SWISSPROT, PDB).
5. Database searching for nucleic acid and proteins.
6. Sequence similarity search using BLAST/FASTA and analysis.
7. Secondary structure prediction of proteins /enzymes
8. Protein structure prediction by homology modeling and structure evaluation

B. Sc Biotechnology Third year (optional)
Semester VI
Bioinformatics

BTO-612-DSC-1B(2)-A2 **Credits** 02 **Marks:** 50

Course objectives:

1) To provide basic understanding of Bioinformatics and related concept.
2) To make student aware of different tools in Bioinformatics.
3) To demonstrate practical Applicability of the Bioinformatics.

Course Outcome:

1) CO1: Understand and explain importance of Bioinformatics.
2) CO2: Students will be able to use different techniques of Bioinformatics.
3) CO3: Awareness of Practical advances in field.

Unit I. Introduction to Bioinformatics: History of bioinformatics, a brief idea about various biological data banks (e.g. NCBI), primary sequence databases: Protein sequence data bank, nucleic acid sequence data banks, Secondary sequence databases and composite sequence databases, search engines- SRS & Entrez.

Unit II. Sequence Alignment & Analysis: Sequence alignment definition and types, sequence analysis using programs like BLAST, FASTA, multiple sequence analysis using ClustalW, applications of sequence analysis.

Unit III. Genomics: Definition and brief introduction of: ORF, gene and genome annotation, functional & comparative genomics. Proteomics: Definition and significance. Primary structure (Primary, secondary, tertiary & quaternary), Structural Classification (SCOP & CATH), Protein secondary structure prediction methods: Chou Fasman, GOR, HMM, Protein tertiary structure prediction methods: AB initio, Homology modeling and threading, Structure Visualization tools: Rasmol & Swiss PDB viewer

Unit IV: Applications of Bioinformatics: Genome and proteome analysis using microarray, DNA microarray: printing oligonucleotides on glass slides, Nitrocellulose paper, application of this microarray in diagnosis, whole genome analysis using labeled probes, analysis of single nucleotide polymorphism. Protein micro arrays: proteome analysis by 2D electrophoresis, advantages, uses of this technology Medical informatics, Human Genome Project and its significance, drug designing brief introduction.

References:

1. Baxevanis Bioinformatics: A practical guide to analysis of genes & protein.
2. S.Sunderrajan & Balaji R – Introduction to Bioinformatics, Himalaya Publishing House.
3. Attwood, Introduction to Bioinformatics
4. Claverie, Bioinformatics A Beginner'S Guide
5. S. C. Rastogi, Namita Mendiratta, Parag Rastogi, Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discover

7) Fershit, A. Structure and Mechanism in Protein Science, W. H. Freeman (1999).
8). Carey P. R. (Ed) Protein engineering and design, Academic Press (1996)
9) Strachan T. and Read A. P. Human Molecular Genetics, 2nd edition. Bios (1999)
10) Glack, Bernard R. and Pasternak J. J., Molecular Biotechnology: principles and applications of recombinant DNA, 2nd ed. ASM Press (1998)
11) Brown T. A Genomes, Bios (1999)
12) Attwood T.K and Parry-Smith D. J. Introduction to Bioinformatics, Longman (1999).
13) Rees A R. Sterberg MJ E and Wessel R., Protein Engineering - a practical approach, IRI. Press (1992

B.Sc. III Biotechnology
Semester VI
Genomics and Proteomics

BTO-611 DSE-1B (1)-D1 **Credit 2** **Marks 50**

Course Objectives:
By the end of this course, Students should able to:
- Introduction of protein structure, Primary and Secondary .
- Understanding of protein folding, database sequence .

Course outcome:
After Successful completion of this course students will be able to:
- Understand the structure and function of proteins.
- Understand the Mechanism of protein folding .
- Understand the genome sequence and different bioinformatics tools .

UNIT -1
Protein structure, secondary structure and super-secondary structure. Mechanisms of protein folding, tertiary folds. Formating of oligomers. Relationship between protein structure and function. Prions

UNIT -2
Structure prediction and human proteomics. Mutant proteins. Use of computer simulations and knowledge-based methods in the design process. De-novo design, making use of databases of sequence and structure. Protein structure and drug discovery, Proteins in disease.

UNIT -3
The structure, function and evolution of the human genome. Strategies for large-scale sequencing projects. Human disease genes Expression.

UNIT- 4
Bioinformatics for the analysis of sequence data, approaches for determining gene expression patterns and functions.

Practical:
1 Project should be NOT less than 10000 word
2) One copy of the project should be hand-written
3) Other 3 copy typed and submit to Collage/ Institute/Department 4) Project should be written in International standard With minimum 25 references
5) Project may pertain to above mentioned themes or relevant to any course studied in last three years.

Reference :
1) Lesk, Arthur M, Introduction to Informatics, 2nd Edition, Oxford University Press, 2005, ISBN 0 19 9277877.
2) Lesk, Arthur M, Introduction to Protein Science, Oxford University Press, 2004, ISBN 0 19 9265119.
3) Nature, Genome gateway:
http://www.nature.com/nature/supplements/collections/humangenome/index.html
4) Science, Human Genome special issue
http://www.sciencemag.org/content/vol291/issue5507/index.dil
5)This Unit Web site: http://www.Isbu.ac.uk/biology/proteomics/
6)Campbell, A. Malcolm and Heyer, Laurie J., Discovering Genomics, Proteomics & Bioinformatics, Benjamin Cummings, 2002.

and Co.
6) Laboratory manual in Biochemistry by J. Jayaraman. 2006, New Age International.
7) Source book of Microbiology by Primrose.

Practicals based on BTO-611-DSE-1B(1)-C1

BTOP-621 **Credits 1.5** **Marks 50**

1. Production of bacterial / fungal – alpha amylase.
2. Partial purification of – amylase by salt precipitation method.
3. Assay of alpha amylase in terms of reducing sugar produced & calculation of enzyme unit.
4. Extraction of unease from horse gram seed / jack bean meal & estimation of its activity in terms
5. Ammonia Extraction of papain form papaya leaves. Estimation of its activity in terms of Ammonia.
6. Characterization of alpha Amylase, invertase using PAGE.
7. Determination of Km &Vmax
8. effect of temperature on Alpha amylase

B.Sc. Biotechnology Third year
Semester VI
Advanced Enzymology

BTO-611-DSE-1B(1)-C1 **Credits 2** **Marks50**

COURSE OBJECTIVES

-To learn the classification , properties and isolation of enzymes
-To understand the structure and functions of enzymes
-To demonstrate the kinetics of enzymes
-To apply the uses of enzymes in clinical and industry field

COURSE OUTCOMES

Remember the classification of enzymes and its properties Coenzymes – its structure and functions
Comprehend the methods of enzyme isolation and purification
Apply the kinetics of enzyme such as MM Ap equation, LB plot and Eadie Einstein
Discuss the immobilized enzymes and its apllications

Unit 1. Extraction & Purification of Enzymes

Different sources of enzymes, Extraction of soluble enzymes Physical and chemical methods of cell disintegration to obtain enzymes. Extraction of membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods : different electrophoresis and chromatographic methods.

Unit 2. Enzyme Kinetics

Effect of pH, temperature, substrate concentration enzyme concentration, reaction time, metal ions on enzyme catalyzed reactions. Kinetics of single substrate enzyme catalyzed reactions (Derivation of Michaelis Mentan Equation and its significance). Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots.

Enzyme inhibitors, Introduction to irreversible and reversible (competitive, uncompetitive and non competitive inhibitions with suitable examples.)
Allosteric enzymes, feed back inhibition and its significance in metabolic regulation. (Sequential and concerted).

Unit 3. Enzyme Immobilization

Importance of enzyme immobilization, different methods of enzyme immobilization. Properties of immobilized enzymes and application of immobilized enzymes.

Unit 4. Applications of Enzymes

Uses of enzymes in food and beverages, textile industries, leather industries and detergents. Enzymes in clinical diagnosis and therapeutic applications. Enzymes as environmental and therapeutic biosensors.

Reference Books

1) Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 by Trevor Palmer, East – West Press Edition.
2) Fundamentals of Enzymology 2003 by Nicholas C. Price and Lewis Stevens Oxford University Press.
3) Enzyme kinetics by Paul Engal. 1977, John Willey and Sons Inc.
4) Enzymes by Dixon and Web. Acad. Press.
5) Principles of enzyme kinetics by Athel Cornish. 1976. Bowden and Butterworth

B.Sc Biotechnology Third year
Semester VI
Animal Physiology

BTO-612-DSE-1B (2)-D2 **Credits 2** **Marks 50**

Unit 1.Physiology of digestion and excretion

Definition of digestion and types of digestion – extra and intracellular. Digestion of Carbohydrates, proteins, lipids and cellulose digestion. Absorption and assimilation of digested food materials. gastrointestinal hormones- control of digestion.

Definition of excretion. Forms of nitrogenous waste material and their formation; classification of animals on the basis of excretory products. Structure and function of Nephron– Counter current mechanism.

Unit 2.Physiology of respiration and circulation

Types of respiration – external and internal respiration. Transport of oxygen – formation of oxyhaemoglobin and affinity of haemoglobin for Oxygen, Oxygen dissociation curves. Transport of CO2 – Chloride shift, Bohr effect.

Open and closed circulation. Heartbeat and cardiac cycle. Myogenic and neurogenic hearts. Regulation of heart rate – Tachycardia and Bradycardia.

Unit 3. Physiology of muscle contraction and nerve impulse

General structure and types of muscles. Ultra structure of skeletal muscle. Sliding filament mechanism of muscle contraction. Chemical changes during muscle contraction – role of calcium, ATP utilization and its replenishment.

Structure of nerve cell. Nature of nerve impulse – resting potential and action potential. Properties of nerve impulse – threshold value, refractory period, all or none response. Conduction of nerve impulse along an axon – local circuit theory and saltatory conduction theory. Structure of synapse, mechanism of synaptic transmission – electrical and chemical transmissions.

Unit 4. Physiology of endocrine system and homeostasis

Relationship between hypothalamus and pituitary gland. Hormones of hypothalamus. Hormones of Adenohypophysis and Neurohypophysis. Hormones of pineal gland, thyroidgland, parathyroid, thymus, adrenal and pancreas. Endocrine control of mammalianreproduction – Male and female hormones – Hormonal control of menstrual cycle in humans. Concept of Homeostasis and its basic working mechanism. Mechanism of Homeostasis –giving three illustrations viz., Hormonal control of glucose levels, Water and ionic regulation by freshwater and marine animals and temperature regulation in man.

REFERENCE BOOKS

1. 'Essentials of Animal Physiology' by S.C.Rastogi'
2. 'Animal Physiology' by H.C. Nigam.
3. 'Biology' by Campbell & Reece.
4. 'Animal Physiology' – Agarwal, R.A. Srivastava, Kaushal, Anil and Kumar.
5. 'Animal Physiology and Biochemistry' by Dr. B.Annadurai.
6. 'Principles of Animal Physiology' by Christopher D.Moyes, Patricia M Schulte.
7. 'Biology: The Science of Life' by R.A. Wallace, G.P. Sanders & R.J. Ferl.
8. 'Biology: Concepts and Applications' by Starr

9. ' Cell Biology, Genetics, Evolution and Ecology' by P.S.Varma and V.K. Agrawal; S.Chand and Company.
10. ' Animal nutrition' by P.Mc Donald, R.A. Edwards, J.F.D. Greenhalgh, C.A. Morgan.

B.Sc Biotechnology Third Year
Semester VI
Practical Based on BTO-612-DSE-1B (2)-D2

BTOP-622 **Credits 1.5** **Marks 50**

1. Qualitative analysis of Carbohydrates
2. Qualitative analysis of proteins
3. Qualitative analysis of lipids
4. Detection of normal and abnormal constituents of urine – sugar, albumenbile and blood cells.
5. Demonstration of salivary amylase.
6. Effect of temperature and pH on amylase
7. Leukocyte count
8. Determination of hemoglobin

B.Sc. III year
Semester VI
Quality Control in Food and Pharma Industry

BTO-613-SEC-4(E) **Credits 02** **Marks 50**

Course Objectives:
By the end of this course, Students should able to:
- Students understand the good laboratory practices.
- They Understand biochemical and immunological methods.
- Students will understand cultivation of Microorganisms.

Course Outcome :
- After Successful completion of this course, students will be able to:
- Understanding of GMP and Analysis of Pharmaceutical smples.
- Students able to understand HACCP

Unit –1 Microbiological Laboratory and Safe Practices
Good laboratory practices –Good Laboratory practices, good microbiological practices Biosafety cabinates-Working of biosafety cabinets, using protective clothings, specification for BSL-1,BSL-2,BSL-3.Discarding biohazardous waste –Methodology of Disinfection ,Autoclaving and Incineration .

Unit-2 Determining Microbes Pharmaceutical Samples
Cultures and microscopic methods –Standard plate count, Most probable numbers, Direct Microscopic counts ,Biochemical and immunological methods :Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products Molecular methods-Nucleic acid probes, PCR based detection ,biosensor.

Unit-3 Pathogeinc Microorganisms of Importance in food & water
Enrichment culture technique, Detection of specific microorganisms –on XLD agar, Salmonella Shigella agar, Mannitol salt agar ,EMB agar, McConkeys agar, Sabrauds agar ,Ascertaning microbial quality of milk by MBRT ,Rapid detection methods of microbiological quality of milk at milk collection centers .

Unit -4 HACCP for Food Safety and Microbial standards
Hazard analysis of critical control point (HACCP)- Principles, Flow diagrams, limitations ,Microbial Standards for different foods and water –BIS standards for common foods and drinking water.

Practical
1. Methods of disinfection, autoclaving & incineration
2. Demonstration of PCR
3. Sterility testing of pharmaceutical product (Any 1)
4. isolation of pathogen from food sample (Any I pathogen from one food sample)
5. Microbial quality of milk by MBRT
6. Microbial quality of milk by 10 Min Resazurin assay
7. Study of BIS standards of common foods (Any 2)
8. Visit to Pharmaceutical/Food processing industry

Refrences :
1.Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press
2. Garg N. Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology 1 K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner M, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer
4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Farmaceudeal and Medical Devices, Taylor and Francis Inc.

B.Sc. Biotechnology Third year
Semester VI
Microbial Bio fertilizer production

BTO-613-SEC-4(F) **Credits 2** **Marks 50**

Course Objectives:-

- To make the students to understand role of bio fertilizers and its mechanism of action in agriculture
- To make the students understand the basic principles of production of different bio fertilizers as per need of agriculture.
- To teach isolation, characterization, mass inoculum production and field application of bio fertilizers.

Course outcomes:-

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

- Understand advantages of bio fertilizers over chemical fertilizers.
- Explain isolation and role of various soil bacteria in bio fertilizer production.
- Describe production steps and specific requirements for each bio fertilizer.

Unit 1:- Introduction and types of fertilizers, chemical fertilizers, bio fertilizers, Comparison between Chemical and bio fertilizers, Applications, General account about the microbes used as bio fertilizer-

Rhizobium- isolation, identification, mass multiplication, and carrier based inoculant. Actinorrhizal symbiosis.

Unit 2:- *Azotobacter*- classification, characteristics- crop response to azotobacter inoculum, maintenance and mass production. Cyanobacteria (blue green algae), Azolla and anabena association.

Phosphate solubilizing microbes (any one) - isolation, characterization, mass inoculum production.

Potassium solubilizing bacteria- isolation and characterization.

Unit 3:- Mycorrhizal association, its types, taxonomy, occurrence and distribution, Phosphorus nutrition, growth and yield- colonization of VAM – isolation and inoculum production of VAM and its influence on growth and yield of crop plants.

Unit 4:- Organic farming – Green manuring and organic fertilizers, recycling of biodegradable municipal, agricultural and industrial wastes- biocompost making methods, types and method of vermicomposting- field application.

Practicals

1) Isolation and characterization of *Rhizobium*
2) Production of liquid and solid biofertilizers from *Rhizobium*
3) Isolation and characterization of *Azospirillum* & *Azotobacter.*
4) Production of liquid and solid biofertilizers from *Azospirillum* & *Azotobacter.*
5) Isolation and Characterization of cyanobacteria from water bodies.

6) Production of Cyanobacteria based flakes.
7) Isolation and Characterization of PSM from soil.
8) Production of liquid and solid biofertilizers from Phosphate solubilizing microorganisms
9) Industrial visit to Bio fertilizer production plant.

References:-

1) Kumaresan, V. (2005) Saras Publications, New Delhi.
2) Biotechnology of Biofertilizers Kanniyan, S., 920030, CHIPS, Texas.
3) Soil Microbiology Subha Rao, N.S. (2000), Oxford & IBH Publishers, New Delhi.
4) A Textbook of Biotechnology- Dubey, R.C., (2005) S. Chand & Co, New Delhi.
5) Hand book of Microbil Biofertilizers Rai, M.K., (2005), The Haworth Press, Inc. New York.
6) Sathe, T.V. (2004). Vermiculture and organic farming. New Delhi