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**Rayat Shikshan Sanstha's
KARMAVEER BHURAO PATIL COLLEGE, VASHI.
NAVI MUMBAI
(AUTONOMOUS COLLEGE)**

Sector-15- A, Vashi, Navi Mumbai - 400 703

**Syllabus for S.Y.B.Sc. Biotechnology
Program: B.Sc.
Course: Biotechnology
(Choice Based Credit, Grading and Semester System
with effect from the academic year 2019-2020**

Preamble of the Syllabus:

Bachelor of Science (B.Sc.) in Biotechnology is a under graduation course of Department of Biotechnology, Karmaveer Bhaurao Patil College Vashi, Navi Mumbai, affiliated to University of Mumbai (MH).

Biotechnology is defined as the application of technological principles for the processing or manipulating biological agents to provide goods and services. It derives its strength by harnessing biological processes that sustain life. It is a technology that is more reliable and firm. Biotechnology has the potential to transform the lives of the people by impacting hugely on agriculture, animal husbandry, health and medicines, environment, sustainable development, etc. Biotechnology has accomplished tremendous applications in just a matter of time. People have just started to recognize the endless window of opportunities it has open. Biotechnology has revolutionized the recent advancements in research and development.

CBSGS: The Choice Based Semester and Grading System to be implemented through this curriculum, would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities.

Syllabus for S.Y.B.Sc. Biotechnology

Program Education Objective:

To prepare students to prime for-

- Higher education and research in field of biotechnology and related subjects.
- Careers related broadly to biotechnology and life sciences. Students will embark upon diverse career paths medical coding/pharmaceutical/biotechnology industries, and use their education in a variety of related endeavors.

Objectives of the Course:

- To produce students who understand biotechnology as an interdisciplinary subject. Also they will understand fundamental as well as advanced topics in biotechnology and apply that understanding to analyze, solve problems in further years and Biotechnology industries.

Course Outcome: By the end of the course:

1. Students will gain knowledge about concepts of Applied Chemistry, Biochemistry, Immunology, Cell Biology, Genetics, Fermentation Technology, Ecology, Evolution, Medical Microbiology, Genetic Engineering, Research Methodology, Entrepreneurship.
2. Students will be able to –
 - Demonstrate knowledge of concepts of Biotechnology
 - Understand ecology and evolution as a science and its importance in research.
 - Possess hands on skills
 - demonstrate improvement in maintenance of a laboratory notebook and written reports.
 - Understand to design a research project and proper channels to carry out research
 - Develop oral and written communication skills.
3. Students would have adequate knowledge to understand, analyze, differentiate between expected and unexpected results, interpret results and make conclusions from experiments.

S. Y. B. Sc. Biotechnology

For the subject of Biotechnology there shall be seven papers for 45 lectures each, comprising of three units of 15 L each.

Semester-III

1. Paper-I Applied Chemistry - I
2. Paper-II Cell Biology
3. Paper III Immunology - I
4. Paper IV Virology and Genetics
5. Paper V Fermentation Technology
6. Paper VI Evolution and Ecology
7. Paper VII Research Methodology, Scientific Writing and Communication Skills

Semester-IV

1. Paper-I Applied Chemistry - II
2. Paper-II Biochemistry
3. Paper III Immunology - II
4. Paper IV Medical Microbiology
5. Paper V Genetic Engineering
6. Paper VI Bioinformatics and Biostatistics
7. Paper VII Entrepreneurship Development

Scheme of examination for Each Semester:

Continuous Internal Evaluation: 40 Marks (Common Test-20 Marks & 20 Marks for- Assignment, Projects, Group discussion, Open book test, online test etc.)

Semester End Examination: 60 Marks will be as follows -

I.	Theory:	
	Each theory paper shall be of two and half hour duration.	
	All questions are compulsory and will have internal options.	
	Q – I	From Unit – I (having internal options.) 15 M
	Q – II	From Unit – II (having internal options.) 15 M
	Q – III	From Unit – III (having internal options.) 15 M
	Q – IV	Questions from all the THREE Units with equal weightage of marks allotted to each Unit. 15 M
II.	Practical	The External examination per practical course will be conducted as per the following scheme.
Sr. No.	Particulars of Semester End Practical Examination	Total Marks
1	Semester end Practical Exam	300

Semester III

**Choice Based Credit, Grading and Semester System with effect
from the academic year 2019-20**

S. Y. B. Sc. Biotechnology

SEMESTER III

Sr. No.	Paper Code	Title of Paper	Credits	L / Week
1.	UGBT301	Applied Chemistry - I	2	3
2.	UGBT302	Cell Biology	2	3
3.	UGBT303	Immunology – I	2	3
4.	UGBT304	Virology and Genetics	2	3
5.	UGBT305	Fermentation Technology	2	3
6.	UGBT306	Evolution and Ecology	2	3
7.	UGBT307	Research Methodology, Scientific Writing and Communication Skills	2	3
8.	UGBTP301	Practicals of UGBT301 and UGBT306	2	6
9.	UGBTP302	Practicals of UGBT302 and UGBT303	2	6
10.	UGBTP303	Practicals of UGBT304 and UGBT305	2	6

S. Y. B. Sc. Biotechnology

Semester III

Paper I : Applied Chemistry – I

Paper Code : UGBT301

Learning Outcome

Students will be able to –

- Discuss role of Organic Compounds in Biology and Synthesis of Organic Compounds.
- Discuss role of Green Chemistry and its application in Industry.

Unit 1: Titrimetry & Gravimetry

15L

Titrimetric Analysis:

Titration, Titrant, titrand, End point, Equivalence point, Titration Error, Indicator, Primary and Secondary standards characteristics and examples

Types of Titration – Acid –Base, Redox Precipitation, Complexometric titration.

Acid – base titration.-Strong Acid Vs Strong Base -Theoretical aspects of titration curve and end point evaluation.

Theory of Acid –Base Indicators, Choice and suitability of Indicators.

Gravimetric Analysis:

Solubility and Precipitation, Factors affecting Solubility, Nucleation, Particle Size, Crystal Growth, Colloidal State, Ageing/Digestion of Precipitate.

CoPrecipitation and Post-Precipitation.

Washing, drying and ignition of Precipitate (Numericals Expected)

Unit 2: Organic Chemistry

15L

Introduction to Types of Organic Reactions: Addition, Elimination and Substitution Reactions.

Essential and Non-essential Elements in Biological Systems.

Role of Metal Ions in Biological Systems.

Metal Coordination in Biological Systems: Enzymes, Apoenzymes and Coenzymes.

Biological Role of Metalloenzymes wrt Myoglobins, Haemoglobin.

Biological Role of Carboxypeptidases, Catalases and Peroxidases.

Structure and Function: Dioxygen Binding, Transfer and Utilization;

Metal Complexes in Medicines

Unit 3: Synthesis of organic compounds & Green chemistry

15L

Synthesis of Organic Compounds:

Criteria for Ideal Synthesis; Selectivity and Yield. Linear and Convergent Synthesis and Multicomponent Reactions.

Microwave Assisted Organic Synthesis,

Ultrasound in Synthesis and Polymer supported Synthesis.

Retrosynthesis.

Green Chemistry and Synthesis:

Introduction to Green Chemistry;

Need and Relevance of Green Chemistry;

Principles of Green Chemistry.

Green Synthesis in Industry: Green Materials, Green Reagents, Green Solvents and Green Catalysts.

References:

1. Organic Chemistry, R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, 7th Edition, Pearson Education (2011)
 2. Organic Chemistry, T.W.G. Solomon and C.B. Fryhle, 9th Edition, John Wiley & Sons, (2008)
 3. A guide to mechanism in Organic Chemistry, 6th Edition, Peter Sykes, Pearson Education
 4. Fundamentals of Organic Chemistry , G. Marc Loudon, 4th Edition Oxford
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Paper II : **Cell Biology**

Paper Code : **UGBT302**

Learning Outcome

Students will be able to –

- Develop an understanding of the various aspects of cell biology.
- Understanding the principles of cellular transport and its role in different processes in body.
- Understanding the structures of cell skeleton and its role.

Unit 1: Cytoskeleton

15L

Overview of the Major Functions of Cytoskeleton.

Microtubules: Structure and Composition.

MAPs: Functions- Role in Mitosis, Structural Support and Cytoskeleton Intracellular Motility. Motor Proteins: Kinesins, Dynein; MTOCs. Dynamic Properties of Microtubules. Microtubules in Cilia and Flagella.

Microfilaments: Structure, Composition, Assembly and Disassembly.

Motor Protein: Myosin. Muscle Contractility: Sliding Filament Model.

Actin Binding Proteins: Examples of Nonmuscular Motility.

Intermediate Filaments: Structure and Composition; Assembly and Disassembly; Types and Functions

Unit 2: Cell Membrane

15L

Cell Membrane: Uptake of Nutrients by Prokaryotic Cells; Cell Permeability.

Principles of Membrane Transport Transporters and Channels;

Active Transport, Passive Transport;

Types of Transporters;

Types of ATP Driven Pumps - Na⁺ K⁺ Pump.

Cell Junctions;

Cell Adhesion and Extracellular Material Microvilli;

Tight Junctions, Gap Junctions;

Cell Coat and Cell Recognition.

Cellular Interactions.

Unit 3: Cell Signaling and signal transduction

15L

General Principles of cell communication: Introduction,

Extracellular signal molecules binding to receptors,

Cell signalling & Signal Forms of intercellular signalling - Autocrine, Transduction Contact dependent, Paracrine, Synaptic and Endocrine.

Role of gap junction in signalling response to multiple extracellular signal molecules

Morphogens,

Lifetime of intracellular molecule,

Role of Nitric oxide and nuclear receptors Binding reaction and role of K_d,

Extracellular messengers and their receptors, GPCRs RTKs, Second messengers
Role of Calcium- Introduction, Calcium binding proteins

References:

1. The Cell : Molecular Approach, Cooper
 2. Molecular Biology of Cell, Bruce Alberts
 3. Cell and Molecular Biology, Karp
 4. Lehninger's Biochemistry, Nelson Cox
 5. Biochemistry, Satyanarayana
 6. Harper's Illustrated Biochemistry, Murray
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Paper III : Immunology – I

Paper Code : UGBT303

Learning Outcome

Students will be able -

- Understand the significance of immune system.
- Understand various mechanisms of eliciting an immune response.
- Get an insight in effector molecules and organs involved in eliciting immune response.
- Develop an understanding of vaccinology.

Unit 1: Introduction to Immunology and Effectors of Immune Response 15L

Overview of Immune system.

Innate and Adaptive Immunity.

Hematopoiesis

Cells of the Immune System: Lymphoid Cells [B Lymphocytes (B Cells), T Lymphocytes (T Cells)], Natural Killer Cells, Mononuclear Phagocytes, Granulolytic Cells, Mast Cells, Dendritic Cells, Follicular Dendritic Cells.

Organs of the Immune System: Primary Lymphoid Organs, Secondary Lymphoid Organs

Unit 2: Antigens and Antibodies 15L

Antigens: Immunogenicity Versus Antigenicity, Epitopes, Types of Antigens, Haptens, Adjuvants

Antibodies: Basic Structure of Antibodies, Antibody Classes and Biological Activity,

Antigenic Determinants on Immunoglobulins

Monoclonal Antibodies, Hybridoma Technology

Unit 3: Vaccines 15L

Active and Passive Immunization

Attenuated Vaccines,

Inactivated or "Killed" Vaccines, Subunit Vaccines, Peptide Vaccines, Vector Vaccines, Conjugate Vaccines, Genetic Immunization, Anti Covid-19 vaccines

Role of Biotechnology in Vaccine Production.

References:

1. Immunology, Barbara A. Osborne and Janis Kuby
2. Textbook of Microbiology, Ananthnarayan
3. Immunology, C.V.Rao
4. New Generation Vaccines, 4th ed., Myrone M. Levine
5. Molecular Biotechnology, Glick and Pasterneck

Paper IV : Virology and Genetics

Paper Code : UGBT304

Learning Outcome

Students will be able to –

- Understand the general structure, taxonomy, reproduction of bacterial, animal and plant viruses.
- Introducing virioids and prions structure and diseases
- Understanding different types of DNA mutations and repair systems.
- Study of different mechanisms of DNA exchange in bacteria and about jumping genes.

Unit 1: Virology

15L

Introduction to viruses-Position in biological spectrum; Virus properties, General structure of viruses, Baltimore and ICTV Classification and Taxonomy
Cultivation of viruses and purification of viruses, Viral assays, Cytocidal infections and cell damage
Reproduction of ds DNA phages (T even phages- lytic cycle), Lambda Phage- Lysogenic cycle (no regulation), one step growth curve
Reproduction of ss RNA (Polio or influenza virus), Retrovirus (HIV)
Reproduction of plant virus (TMV)
Viroids and Prions

Unit 2: Mutation and DNA Repair

15L

Definition and Types of Mutations.
Mutagenesis and Mutagens, Examples of Physical, Chemical and Biological Mutagens
Types of Point Mutations,
DNA REPAIR - Photoreversal, Base Excision Repair, Nucleotide Excision Repair, Mismatch Repair, SOS Repair and Recombination Repair

Unit 3: Gene Transfer Mechanisms and Transposable elements

15L

Genetic analysis in Bacteria- Prototrophs, Auxotrophs.
Mechanism of Genetic Exchange in Bacteria: Conjugation; Transformation; Transduction; (Generalized Transduction, Specialized Transduction), Bacterial Transposable Elements.

References:

1. Genetics, 5th ed., Russell
2. iGenetics, Peter J. Russell
3. Molecular Biology, David Clarke
4. Microbial Genetics, David Freifelder

Paper V : Fermentation Technology

Paper Code : UGBT305

Learning Outcome

Students will be able to –

- Develop an understanding of the various aspects of Fermentation technology.
- Develop skills associated with screening of Industrially important Microbial Strains.
- Understanding the principles of design of fermentor and fermentation process.
- Understanding the principles of various biological and chemical assays.

Unit 1: Introduction to fermentation technology and types of microorganisms used **15L**

Definition, Applications of fermentation technology in Food and other Industries.

Types of Microorganisms used in Industrial Processes:

Bacteria, Actinomycetes, fungi and algae.

Screening and maintainance of Strains:

Primarry Screening, Secondary Screening,Cultivation

Preservation of Industrially Important Microbial Strains

Unit 2: Fermenter and Fermentation processes Design of fermenter **15L**

Fermenter and Fermentation processes Design of fermenter

Stirred Tank Fermentor- Basic Design, Parts of a Typical Industrial fermenter.

Fermentation Media:

Components, Design and Optimization.

Sterilization:

Sterilization of fermentor and fermentation media.

Process parameters:

pH, Temperature, Aeration, Agitation(Dissolved Oxygen), Foam etc.

Types of fermentation:

Surface and submerged, Batch and continuos, Aerobic and Anaerobic.

Unit 3: Production, assays and Fermentation processes **15L**

Production:

Production of Penicillin, Cheese, Butter, Ethanol, Citric acid, Acetic acid by fermentation

Assay of Industrial products:

Chemical and Biological assays.

Types and

Subtypes; Kinetics.

Advantages and Disadvantages.

References:

1. Industrial Microbiology , Casida
 2. Industrial Microbiology, A H Patel
 3. Principles of Fermentation Technology, Stanbury
 4. Modern Pharmacology, Craig and Stizel. 5th ed.,
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Paper VI : Evolution and Ecology

Paper Code : UGBT306

Learning Outcome

Student will be able to –

- understand the study of evolution as a science
- understand how the forms, functions, and life histories of organisms have evolved
- understand the interconnections among organisms and the environment
- recognize the major ecological patterns in nature and what causes them
- apply the scientific process to ecological problems
- make informed predictions on how organisms respond to environmental conditions and to biotic interactions

Unit 1: Evolution

15L

Origin of Life;

Theories of Evolution, Lamarckism and Darwinism;

Evidences of Evolution;

Natural Selection, Evidences, Modes, Sexual selection;

Pattern of evolution, Convergent, Coevolution, Parallel, Adaptive radiation, Red queen hypothesis

Unit 2: Species and Speciation

15L

Species concept; reproductive isolations, Haldane's rule

Speciation, Types, Evolutionary forces involved in speciation, Pattern of evolutionary changes;

Nature of evolution

Molecular Phylogeny, Molecular clock, Phylogenetic tree, classification

Unit 3: Ecosystem and Interactions

15L

Ecology and Biogeography.

Ecosystems, Definition and Components, Structure and Function of Ecosystems.

Aquatic and Terrestrial Ecosystems, Biotic and Abiotic Factors, Trophic Levels, Food Chain and Food Web, Ecological Pyramids (Energy, Biomass and Number)

Nutrient Cycle and Biogeochemical Cycles: Water, Carbon, Oxygen, Nitrogen and Sulphur.

Interactions, Commensalism, Mutualism, Predation and Antibiosis, Parasitism.

References:

1. Cell Biology, Genetics, Molecular biology, Verma and Agarwal 2005
2. Life Sciences Fundamentals and practice Part II Kumar and Mina, sixth edition

Paper VII : Research Methodology and Scientific Writing

Paper Code : UGBT307

Learning Outcome

Student will be able to –

- Understand the principles of research methodology and its significance
- Understand the methods of data collection, interpretation and report writing
- Understand the importance of communication and its role in science

Unit 1: Introduction to research methodology

15L

Meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, criteria of good research, problems encountered by researchers in India, Research problem, selecting the problem, necessity of defining the problem, techniques involved in defining the problem

Unit 2: Research design, Data collection, interpretation and Report writing

15L

Need for research design, Features of a good design, Primary data, Secondary data, Different methods for the collection of primary and secondary data, other methods of data collection, Case study method

Interpretation, Technique of interpretation, Precautions in interpretation, Significance of report writing, Different steps in writing report, Layout of the research report, Mechanics in writing report

Examples of scientific and unscientific writing, Writing papers, Reviews, Bibliography
Plagiarism- Introduction to plagiarism, Examples of plagiarism

Unit 3: Importance of communication skills

15L

Introduction to communication elements, Scope of communication and communication as part of science

Communication elements: verbal and non-verbal communication

Principles of effective communication, oral presentations

Communication methods in science

Internal Evaluation

Submission of Research Report/ Project/ Case

Study/ Assignment

References:

1. Research Methodology, C.R.Kothari
2. Basic Communication Skills for Technology, Andea J. Rutherford

S.Y.B.Sc. Biotechnology
Semester III Practicals

UGBTP301: Practicals of UGBT301 and UGBT302

1.	Purification of any TWO Organic Compounds by Recrystallization Selecting Suitable Solvent.
2.	Organic Estimations: Acetone, Amide, Benzoic Acid.
3.	Organic Preparations : a) Acetylation of Primary Amine (Preparation of Acetanilide). b) Base Catalysed Aldol Condensation (Synthesis of Dibenzalpropanone).
4.	Study of mitosis in onion root tips.
5.	Study of meiosis
6.	Study of endocytosis of salts through semi-permeable membrane
7.	Study of exocytosis of salts through semi-permeable membrane
8.	Purification of proteins by dialysis

UGBTP302: Practicals of UGBT303 and UGBT304

1.	To study cells and organs of immune system in mouse
2.	Differential Count of WBC's by Romanowsky Staining
3.	Preparation and sterility testing of TAB Vaccine
a.	Determination of thermal death point
b.	Determination of thermal death time
c.	Enumeration of
d.	Vaccine preparation
e.	Sterility testing of vaccine
4.	Plaque assay
5.	Effect of mutagens on cells- Chemicals Physical : UV as a mutagen.
6.	Problems based on mapping of DNA by conjugation, transformation, transduction
7.	Replica plate technique

UGBTP303: Practicals of UGBT305 and UGBT306

1.	Screening for Antibiotic Producing Strain of Microorganism..
2.	Screening for an Alcohol Producing Strain of Microorganism
3.	Screening for an Amylase Producing Strain of Microorganism.
4.	Lab Scale Production of Ethanol, Penicillin
5.	Purification of Ethanol from Broth culture of <i>Saccharomyces spp.</i> by Distillation.
6.	Estimation of Penicillin from Recovered broth by chemical(Iodometric Method) and biological (Bioassay) method

7.	Estimation of Alcohol from recovered broth by Dichromate method
8.	Study of Interactions Commensalism, Mutualism, Predation and Antibiosis, Parasitism
9.	Setting up of Winogradsky column and it's study.
10.	Study of Nutrient Cycle and Biogeochemical Cycles.
11.	Problems based on phylogenetic tree
12.	Project based on evolutionary studies.

Semester IV

**Choice Based Credit, Grading and Semester System with effect
from the academic year 2019-20**

S. Y. B. Sc. Biotechnology

SEMESTER IV

Sr. No.	Paper Code	Title of Paper	Credits	L / Week
1.	UGBT401	Applied Chemistry – II	2	3
2.	UGBT402	Biochemistry	2	3
3.	UGBT403	Immunology - II	2	3
4.	UGBT404	Medical Microbiology	2	3
5.	UGBT405	Genetic Engineering	2	3
6.	UGBT406	Bioinformatics and Biostatistics	2	3
7.	UGBT407	Entrepreneurship Development	2	3
8.	UGBTP401	Practicals of UGBT401 and UGBT402	2	6
9.	UGBTP402	Practicals of UGBT403 and UGBT404	2	6
10.	UGBTP403	Practicals of UGBT405 and UGBT406	2	6

S. Y. B. Sc. Biotechnology

Semester IV

Paper I : Applied Chemistry - II

Paper Code : UGBT401

Learning Outcome

Student will be able to –

- Gain knowledge of Natural Product Chemistry and related acquired skills.
- Gain an understanding of basic concepts in Polymer Chemistry and Nanomaterials.
- Explain the tools to derive the rate law for simple reaction mechanisms

Unit 1: Sampling and Separation Techniques

15L

Sampling : Importance of Sampling and Sampling Techniques

Types of Sampling - Random and Non-Random Sampling of Solids, Liquids and Gases.

Separation Techniques: Types of Separation Techniques - Filtration, Zone Refining, Distillation, Vacuum Distillation.

Solvent Extraction - Partition Coefficient and Distribution Ratio, Extraction Efficiency, Separation Factor,

Role of Complexing Agents, Chelation, Ion Pair Formation, Solvation, and Soxhlation.

Centrifugation - Basic Principles of Sedimentation.

Unit 2: Natural Product Chemistry

15L

Natural Product Chemistry: Primary and Secondary Metabolites.

Classification of Natural Products based on BioSynthesis.

Classification of Natural Products based on Structure- Alkaloids, Phenolics, Essential Oils and Steroids.

Structure Determination of Natural Products.

Commercial Synthesis of Natural Products.

Chromatographic Separation of Natural Products:

Gas Chromatography and its Applications.

Liquid Chromatography: HPLC and its Applications. HPTLC for Separation and Analysis of Natural Products.

Unit 3: Polymers and Nanomaterials

15L

Separation of Binary (Solid-Solid) Mixture (Min 4 Compounds).

Identification of Organic Compound of Known Chemical Type (Min 4 Compounds).

HPLC analysis and Interpretation of any one Secondary Metabolite from Plants

Analysis of Essential Oils from any Plant Source using GC.

HPTLC fingerprint analysis of any one Medicinally Important Plant.

Chemical and Biological Synthesis of Silver Nanoparticles and its Characterisation by UV-

VIS Spectrophotometer.

References:

Organic Chemistry, L.G. Wade Jr and M.S. Singh, 6th Edition, 2008

Organic Chemistry, Paula Y. Bruice, Pearson Education, 2008

Organic Chemistry, J.G. Smith, 2nd Edition Special Indian Edition, Tata 21 McGraw Hill

Organic Chemistry, S.H. Pine, McGraw Hill Kogakusha Ltd

Paper II : Biochemistry

Paper Code : UGBT402

Learning Outcome

Students will be able to –

- Understand various pathways underlying metabolism of biomolecules such as carbohydrates, amino acids, lipids and nucleotides
- Understand various components involved in process of metabolism.

Unit 1: Carbohydrate Metabolism

15L

Carbohydrate Metabolism: Glycolytic Pathway and its Regulation, Homolactic Fermentation;

Alcoholic Fermentation; Energetics of Fermentation; Citric Acid Cycle and its Regulation; Gluconeogenesis; Pentose Phosphate Pathway; Glyoxalate Pathway; Reductive TCA . (Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above Pathways)

Electron Transport System: Electron Transport and Oxidative Phosphorylation. Inhibitors of ETS. Energy Rich Compounds: ATP as Energy Currency, Structure of ATP, Hydrolysis, Other Energy Rich Compounds other than ATP like PEP, Creatine Phosphate, etc.

Unit 2: Amino Acid Metabolism

15L

Amino Acid Breakdown: Deamination, Transamination, Urea Cycle, Breakdown of Glucogenic and Ketogenic Amino Acids.

Amino Acids as Biosynthetic Precursors: Biosynthesis of Epinephrine, Dopamine, Serotonin, GABA, Histamine, Glutathione. (Sequence of Reactions, Regulation and Metabolic Disorders of the above Pathways)

Unit 3: Lipid and Nucleotide Metabolism

15L

Lipid Metabolism: Mobilization, Transport of Fatty Acids. Beta, Alpha and Omega Oxidation of Saturated Fatty Acids;

Oxidation of Unsaturated Fatty Acids; Oxidation of Odd Chain Fatty Acids.

Energy Yield,

Ketone Body Breakdown to Yield Energy. (Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above Pathways)

Nucleotide Metabolism : Degradation of Purines and Pyrimidines.

References:

1. Lehninger's Biochemistry, Nelson Cox
2. Biochemistry, Satyanarayana
3. Harper's Illustrated Biochemistry, Murray

Paper III : Immunology - II

Paper Code : UGBT403

Learning Outcome

Student will be able to –

- Describe the interactions between antigens and antibodies
- Understand significances of various methods of antigen/antibody detection and quantification.
- Understand the receptors involved in signal transductions to elicit an immune response.
- Understand the negative effects of overexpression of immune response.

Unit 1: Antigen – Antibody Interaction

15L

Precipitation reaction,

Precipitin curve,

Immunodiffusion reactions – single/ double/ radial, immunoelectrophoresis

Agglutination reactions,

Radioimmunoassay

ELISA, ELISPOT, Western blotting, CFT, Immunoprecipitations, Immunofluorescence,

Chemiluminiscence, Flow cytometry

Unit 2: Major Histocompatibility Complex, Cell Receptors and Antigen Presentation

15L

3 major classes of MHC

MHC Class I molecule, MHC Class II molecule

TCR- T cell receptor complex- TCR:CD3, T cell accessory membrane molecules,

T cell maturation

BCR – B cell coreceptors, B cell maturation

Antigen Processing and Presentation – cytosolic pathway, endocytic pathway.

Unit 3: Hypersensitive Reactions and Autoimmunity

15L

Hypersensitive Reactions – type I, type II, type III, type IV

Organ specific Autoimmunity diseases due to-

Direct cellular damage, Stimulation and blocking auto-antibodies

Systemic Autoimmunity diseases

Animal models for auto immune diseases

Proposed mechanism for induction of autoimmunity

Immunodeficiency diseases - Acquired Immuno Deficiency Syndrome

References:

1. Immunology, Barbara A. Osborne and Janis Kuby
2. Textbook of Microbiology, Ananthnarayan
3. Immunology, C.V.Rao

Paper IV : Medical Microbiology

Paper Code : UGBT404

Learning Outcome

Students will be able to –

- List the factors playing a role in causing a disease.
- Discuss the various aspects of systemic infections including causative agents, symptoms and prophylaxis
- Gain the technical capability of handling, isolating and identifying various bacteria.

Unit 1: Infectious Diseases

15L

Normal Flora- Origin, Gnotobiotic life, rearing germ free animals

Etiology of infectious disease- Koch's Postulates.

Classifying infectious diseases (Types of infection), Signs and Symptoms, Stages of disease

Factors In The Development Of Infection- portal of entry, adhesion, invasion of host (antiphagocytic factors, exoenzymes, toxins), portal of exit

Origin Of Pathogens- Reservoirs (human, animal and non-living)

Transmission Of Disease- Contact, Vehicle and vector transmission

Nosocomial Infections

Epidemiology of infectious diseases

Unit 2: Medical Microbiology Causative Organisms- I

15L

Skin : *S. aureus*, *S. pyogenes*. Tinea Infections

Respiratory Tract Infections :

M. tuberculosis, (Characteristics Transmission, Course of Infection, Lab Diagnosis, Management of TB, Prevention and Control, Immuno and Chemoprophylaxis, DOTS and MDR).

S. pneumoniae,

SARS CoV2 (viral genome, Transmission of COVID 19, Pathogenesis, Lab diagnosis, Treatment, Prophylaxis and preventive measures- social distancing)

Urinary Tract Infections :

E.coli : Characteristics, Virulence, Clinical disease,

Proteus spp.

Unit 3: Medical Microbiology Causative Organisms- II

15L

GI Tract Infections :

E.coli: enteropathogenic strains of *E. coli*

Salmonella and Shigella spp. (Characteristics, Virulence- Pathogenesis and Immunity, Clinical Disease, Carriers Lab Diagnosis, Prophylaxis and Treatment).

Sexually Transmitted Diseases : Syphilis and Gonorrhoea.

Nosocomial Infections : *Ps. aeruginosa*

Parasitic Blood infection-Malarial parasites: Life Cycle, Diagnosis and Treatment

Medical mycology – Tinea Infections

References:

1. Microbiology, An Introduction, Tortora, Funke, Case, 10th Edition
2. Medical Microbiology, Murray, Rosenthal, Pfaller, 7th edition
3. Microbiology, Prescott, Harley and Klein, 5th edition
4. Textbook of Microbiology, Ananthanarayan, 7th edition

Paper V : Genetic Engineering

Paper Code : UGBT405

Learning Outcome

Students will be able to-

- Describe the components of recombinant DNA technology
- Understand techniques involved in genetic engineering.

Unit 1: Enzymes in Gene Cloning

15L

Sources, Mode of Action, Applications of-

Nucleases – Endo, exo, DNase –I, RNase, S1 Nuclease, Mung bean nuclease

Restriction endonucleases - types, nomenclature, target sites, nature of cut ends, host control restriction and modification, star activity, isoschizomeres, neoschizomeres, examples with restriction sites.

Ligases, DNA polymerase, Reverse transcriptase, Alkaline phosphatases, Polynucleotide kinase, Terminal transferase

Unit 2: Vectors

15L

Properties of ideal vector, copy number

Plasmid cloning vector – pBR322, pUC19

Phage vectors – Lambda phage vectors, M13

Cosmids, Shuttle vectors, Expression vectors

pET vectors

YAC, BAC

Plant vectors – Ti Plasmid derived vector, Plant viruses derived vectors

Unit 3: Techniques in Genetic Engineering

15L

Recombinant DNA technology, Detection of clones, Electrophoresis,

Construction and screening of gDNA and cDNA libraries, Restriction digestion,

Southern Blot analysis, Northern Blot analysis, Western blot analysis,

DNA sequencing,

Polymerase chain reaction and variations,

Chromosome walking, jumping

References:

1. Biotechnology, S.S. Purohit
2. Principles of Gene Manipulations, Primrose
3. Gene Cloning, T.A. Brown
4. The Dictionary of Cell and Molecular Biology, 4th ed., J.M. Lackie

Paper VI : Bioinformatics and Biostatistics

Paper Code : UGBT406

Learning Outcome

Students will be able to –

- Gain an understanding of the basic concepts of Bioinformatics and Biostatistics.
- Understand the tools used in Bioinformatics.
- Apply the various Statistical Tools for Analysis of Biological Data.

Unit 1: Bioinformatics and Biological Databases

15L

Bioinformatics, History, Goals, applications of bioinformatics

Biological Databases : Classification of Databases - Raw and Processed Databases;

Primary (NCBI), Secondary (PIR) and Tertiary or Composite (KEGG) Databases;

Structure and Sequence Databases.

Specialized Databases - Protein Pattern Databases;

Protein Structure and Classification Databases (CATH/SCOP).

Genome Information Resources: DNA Sequence Databases Specialized Genomic

Resources. Protein Databases based on Composition, Motifs and Patterns.

Protein Structure Visualization Software

Unit 2: BLAST and Sequence Alignment BLAST and Sequence Alignment

15L

BLAST and its Types; Retrieving Sequence using BLAST.

Pairwise Alignment : Identity and Similarity;

Global and Local Alignment; Pairwise Database Searching.

Multiple Sequence Alignment: Goal of Multiple Sequence Alignment;

Computational Complexity;

Manual Methods; Simultaneous Methods; Progressive Methods;

Databases of Multiple Alignment;

Secondary Database Searching; Analysis Packages;

MSA and Phylogenetic Trees

Unit 3: Biostatistics

15L

Theory and Problems based on- Coefficient of Correlation and Regression Analysis;

Steps in Testing Statistical Hypothesis;

Parametric Tests:- Z Test – Single Mean and Two Means, tTest – Single Mean, Paired and

Unpaired; Chi Square Test

Rereferences:

1. Basic Bioinformatics, S. Ignacimuthu
2. Introduction to Bioinformatics, T.K.Attwood
3. Introduction to Bioinformatics, Sundara Rajan
4. Methods in Biostatistics, B.K.Mahajan

Paper VII : Entrepreneurship Development
Paper Code : UGBT407

Learning Outcome

Students will be able to –

- Develop an understanding of the systematic process and to select and screen a Business Idea.
- Design strategies for successful implementation of ideas.

Unit 1: Introduction to entrepreneurship development 15L

Concept of Entrepreneur; Entrepreneurship;
Need and Importance;
Factors Influencing Entrepreneurship;
Essentials of a Successful Entrepreneur

Unit 2: Setting up an enterprise and planning 15L

Location of Enterprise;
Real Estate and Human Resource Planning,
Financial Planning;
Role of Government and Financial Institutions in Entrepreneurship Development;
Raising Money from Venture Capitalists, Government Grants,
Product Selection and Ideas;
Project Planning and Formulation; Project Feasibility Assessment;
Regulatory Affairs, Corporate Laws, Innovation, IPR generation and Protection,
Preparation of a Business Plan, Characteristics and Importance of Planning

Unit 3: Marketing, Sales, Advertising and International market research 15L

Marketing Plan for an Entrepreneur;
Strategic Alliances,
Advertising and Sales Promotion;
Market Assessment,
Need for International Market Research,
Domestic vs. International Market Research,
Cost and Methodology of Market Research,
Desk and Field Research

References:

1. Introduction to Entrepreneurship, National Open University of Nigeria
2. Entrepreneurial Development, M.C.Garg

S.Y.B.Sc. Biotechnology Semester IV Practicals

UGBT401: Practicals of UGBT401 and UGBT402

1.	Separation of Binary (Solid-Solid) Mixture (Min 4 Compounds).
2.	Identification of Organic Compound of Known Chemical Type (Min 4 Compounds).
3.	HPLC analysis and Interpretation of any one Secondary Metabolite from Plants
4.	Analysis of Essential Oils from any Plant Source using GC.
5.	HPTLC fingerprint analysis of any one Medicinally Important Plant.
6.	Chemical and Biological Synthesis of Silver Nanoparticles and its Characterisation by UV- VIS Spectrophotometer.
7.	Determination of Lactate Dehydrogenase (LDH) Activity in Blood Serum.
8.	Determination of Total, LDL and HDL Cholesterol in Serum.
9.	Organ Function Tests: Liver (SGPT, SGOT); Kidney (Urea from Serum).
10.	Estimation of Uric Acid and Creatinine in Urine.
11.	Qualitative Detection of Ketone Body in Urine.
12.	Isolation of Mitochondria and Demonstration of ETC using a Marker Enzyme

UGBT402: Practicals of UGBT403 and UGBT404

1.	Determination of relationship between 2 given antigen by Ouchterlony's method
2.	Determination of the concentration of antigen using Radial immunodiffusion technique
3.	To determine the presence of antigen by sandwich ELISA method
4.	To determine the presence of antigen by DOT ELISA method
5.	To determine the RA antigen
6.	Detection of specific antigen by immunoelectrophoresis
7.	Hemagglutination test
8.	Identification of <i>S.aureus</i> -Isolation, Catalase, Coagulase Test.
9.	Identification of <i>E.coli</i> -Isolation, Sugar Fermentations, IMViC.
10.	Identification of <i>Salmonella</i> - Isolation, Sugar Fermentations, TSI Slant.
11.	Identification of <i>Shigella</i> - Isolation, Sugar Fermentations, TSI Slant.
12.	Identification of <i>Proteus</i> - Isolation, Sugar Fermentations, IMViC.
13.	Identification of <i>Pseudomonas</i> - Isolation, Urease test, Oxidase Test, TSI Slant.

UGBT403: Practicals of UGBT405 and UGBT406

1.	Isolation of genomic DNA from E.coli
2.	Isolation of plasmid DNA
3.	Separation of DNA by AGE
4.	Study of restriction digestion
5.	To amplify the gene using PCR
6.	To separate protein samples using SDS PAGE

7.	Detection of specific protein by western blotting technique.
8.	Familiarization with NCBI, EMBL, DDBJ, PIR, KEGG Databases.
9.	Use of NCBI BLAST Tool.
10.	Pairwise and Multiple Sequence Alignment and Phylogeny.
11.	Classification of Proteins using CATH/SCOP.
12.	Visualization PDB Molecules using Rasmol/Raswin.

