The Kelkar Education Trust's
Vinayak Ganesh Vaze College of Arts, Science & Commerce (Autonomous)
Mithaghar Road, Mulund East, Mumbai-400081, India
College with Potential for Excellence

Syllabus for B. Sc. First Year Program in BIOTECHNOLOGY
Syllabus as per Choice Based Credit System (NEP-2020)

Board of Studies in Biotechnology
V. G. Vaze College of Arts, Science and Commerce (Autonomous)

Submitted by
Department of Biotechnology
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FYBSC Biotechnology SEMESTER I

Course Code	Name of the Course
	MAJOR:
VBBT100	Biotechnology I: Introduction to Biotechnology
VBBM101	Basic Microbiology: Microbial Technology
VBPR102	Practicals of Basic Biotechnology & Basic Microbial techniques
	OPEN ELECTIVES:
VFDP122	Digital Skills & Problem Solving
VFDC123	Digital Productivity & Career Development
VFMS125	Mathematical & Statistical Techniques
VFRF126	Regulatory Framework of Business
VFIC127	Introduction to Computers
VFLA128	Law and Automation I
VFFM129	Financial Markets
	VOCATIONAL & SKILL ENHANCEMENT COURSE
VBBC104	Bioorganic Chemistry I
VBPR105	Practicals of Bioorganic Chemistry I
	ABILITY ENHANCEMENT COURSE
VFEC132	Effective Communication Skills - I
	VALUE EDUCATION COURSE
VCI135	The Constitution of India. (Department of History)
	INDIAN KNOWLEDGE SYSTEM
VFHB144	History of Biotechnology.
	CO-CURRICULAR COURSES
VCA141	Community Engagement Activities
VCE142	Cultural Activities

VNS143	National Service Scheme (NSS)
VSA144	Sports Activities
VYG145	Yoga
VKB146	Rhythmic Narratives: History & Foundation of Kathak and Bollywood Dance
VSS147	Sangeet Sadhana

FYBSC Biotechnology SEMESTER II

Course Code	Name of the Course
	MAJOR:
VBBT150	Biotechnology II: Genetics and Molecular Biology
VBLS151	Basic Life Science: Biodiversity and Cell Biology
VBPR152	Practicals of Biotechnology II & Basic Life Science
	MINOR:
VBAPI153	ATC, PTC & Immunology
	OPEN ELECTIVES:
VFDV172	Data Visualization Techniques
VFBC173	Basics of Cybersecurity
VFRF175	Regulatory Framework of Business
VFVC176	Visual Communication
VFMS177	Mathematical & Statistical Techniques
VFBA178	Basics of Accountancy I
VFLA179	Law and Automation II
VFIF180	Indian Financial System
	VOCATIONAL & SKILL ENHANCEMENT COURSE
VBBC155	Bioorganic Chemistry II
VBPR156	Practicals of Bioorganic Chemistry II
	ABILITY ENHANCEMENT COURSE
VFEC183	Effective Communication Skills - II
	VALUE EDUCATION COURSE
VHR185	Human Rights (Department of History)
	CO-CURRICULAR COURSES
VCA141	Community Engagement Activities
VCE142	Cultural Activities
VNS143	National Service Scheme (NSS)
VSA144	Sports Activities
VYG145	Yoga
VKB146	Rhythmic Narratives: History & Foundation of Kathak and Bollywood Dance
VSS147	Sangeet Sadhana

SEMESTER I

B. Sc. (Biotechnology)		Semester – I	
Course Name: Biotechnology I: Introduction to Biotechnology			
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objectives

To aquaint students with various fields of Biotechnology and their applications.
To impart the knowledge of food technology and fermentation techniques

I Scope and Introduction to Biotechnology	Definition of Biotechnology. Branches of Biotechnology- Plant, Animal, Marine, Agriculture, Healthcare,Industrial, Pharmaceutical and Environmental Biotechnology.	**10 LEC**
II Applications Biotechnology	GM Food: GM Papaya, GM Tomato, Golden Rice. Molecular Pharming, Plant based vaccines. Fungal and Insect Resistant Plants - BT Cotton and BT Brinjal. Biotechnological applications in Crop and Livestock. Ethics in Biotechnology and IPR	**10 LEC**
III Food and Fermentation Biotechnology	Biotechnological applications for enhancement of Food Quality. Role of microbes in food products: Yeast, Bacterial and other Microorganisms based process and products. Modern Biotechnological RegulatoryAspects in Food Industries. Biotechnology and Food - Social Appraisal Microbial Fermentations Overview of Industrial Production ofChemicals (Acetic Acid, Citric Acid and Ethanol), Antibiotics, Enzymes and Beverages	**10 LEC**

Course Outcome	
Learners should be able to	
CO1	Understand the scope of Biotechnology.
CO2	Understand various applications of Biotechnology.

Books and References:

Sr. No.	Title	Author/s	Publisher
1.	**Textbook of Biotechnology**	**R.C.Dubey**	**S.Chand**
2.	**Biotechnology**	**H.K.Das**	**Himalaya**
3	**Advances in Biotechnology**	**S.N. Jogdand**	**Himalaya**

B. Sc (Biotechnology)		Semester – I	
Course Name: Basic Microbiology: Microbial Technology			
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objectives

To aquaint students with various aspects of Microbiology and their applications.
To impart the knowledge of microbial diversity and Mendelian genetics.

Unit	Details	Lectures
Unit I	Introduction to Microbial Diversity: Archaebacteria, Eubacteria, Cyanobacteria, Actinomycetes, Fungi, Eumycota Bacteria: Classification, Types, Morphology (Size, Shape and Arrangement) Modes of cell division Ultrastructure of Prokaryotic Cell: Concept of Cell Shape and Size, Detail Structure of Slime Layer, Capsule, Flagella, Pilli, Cell Wall (Gram Positive and Negative), Cell Membrane, Protoplast and Spheroplast, Cytoplasm and Genetic Material Storage Bodies and Spores	**10 LEC**
Unit II	Enumeration of Microorganisms: Direct and Indirect Methods: Direct microscopic count – Breed's count, Petroff -Hausser counting chamber, Haemocytometer. Viable count – Spread plate and Pour plate technique. Turbidity measurements – Nephelometer and spectrophotometer techniques Growth curve: Phases of growth, generation time, growth rate Sterilization and Disinfection: Definition, Sterilization of media and glass wares; Types and Applications- Dry Heat, Steam under pressure, Gases, Radiation and Filtration; Chemical Agents and their Mode of Action- Aldehydes, Halogens, Phenol, Alcohol, and Detergents; Ideal Disinfectant Properties, and Evaluation of Disinfectant	**10 LEC**
Unit III	Mendel's Laws of Heredity Monohybrid Cross: Principle of Dominance and Segregation. Dihybrid Cross: Principle of Independent Assortment. Application of Mendel's Principles	**10 LEC**

	Punnett Square. Mendel‘s Principle in Human Genetics. Incomplete Dominance and Co-dominance. Multiple Alleles. Allelic series. Variations among the effect of the Mutation. Genotype and Phenotype. Environmental effect on the expression of the Human Genes. Gene In Epistasis.	

Course Outcomes	**Learners should be able to**
CO1	Understand the scope of Microbiology.
CO2	Understand various aspects of Microbiology.

B. Sc. (Biotechnology)		**Semester – I**	
Course Name: Basic Biotechnology & Basic Microbial techniques Practical			
Periods per week (1 Period is 120 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	4	100
	Internal	**--**	**--**

List of Practicals Basic Biotechnology

1. Assignment- Study of any branch of biotechnology and its applications
2. Microbial examination of food and detection of Pathogenic Bacteria from Food Samples
3. Microscopic determination of Microbial flora from Yoghurt and Lactic Acid Determination
4. Analysis of Milk- Methylene Blue, Resazurin Test, Phosphatase Test
5. Extraction of Caesin from Milk
6. Meat Tenderization using Papain
7. Fermentative production of Alcohol.
8. Determination of Alcohol content.
9. Isolation and purification of DNA (genomic).

List of Practicals -Basic Microbial techniques

1. Monochrome Staining, Differential Staining, Gram Staining, Acid Fast Staining and Romonowsky Staining
2. Sterilization of Laboratory Glassware and Media using Autoclave
3. Preparation of Media- Nutrient broth and Agar, MacConkey Agar, Saborauds Agar
4. Isolation of Organisms: T-streak, Polygon method
5. Colony Characteristics of Microorganisms,
6. Aseptic transfer
7. Enumeration by Breed’s count
8. Growth Curve of *E.coli*
9. Problems in Mendelian Genetics

B. Sc. (Biotechnology)		Semester – I	
Course Name: Bioorganic Chemistry I			
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objectives

To aquaint students with various aspects of Bioorganic Chemistry.
To impart the knowledge of biomolecules.

Unit	Details	Lectures
I	Carbohydrates Structure, Function, Classification. Characteristic Reactions, Physical and Chemical Properties, D & L-Glyceraldehyde, Structure of Monosaccharide, Disaccharides, and Polysaccharides(3L) Isomers of Monosaccharides, Mutarotation Concept of Epimers, anomers.(3L) Chemical/Physical Properties of Carbohydrate Chemical Reactions for Detection of Mono-, Di- and Polysaccharides (3L) Structural and functional polysaccharides-examples (2L) Glycoproteins and proteoglycans-examples(1L)	**10**
II	Nucleic Acids: Structure of Purine and Pyrimidine Bases, Structure of Nucleosides, Nucleotides and Polynucleotides DNA and RNA: Structure, types, and function of DNA and RNA (4L) Properties of DNA and RNA - Hydrogen Bonding between Nitrogenous Bases in DNA, Differences between DNA and RNA, cDNA, Denaturation, Annealing, Tm, Hypo & hyperchromic effect. Chemical synthesis of DNA and DNA hybridization (2L)	**10**

III	Lipids: Classification of Lipids, Concept of Storage Lipids and Structural Lipids Properties of Saturated, Unsaturated Fatty Acids, Rancidity, and Hydrogenation of Oils (4L) Triacylglycerol, Phospholipids, Sphingolipids, Sterols: Basic structure, function, and examples (3L) Lipoproteins- Structure and Function (1L) Use of Lipids as cofactors, signals and pigments (2L) Methods involved in the Extraction, separation and identification of cellular lipids (2L)	**10**

Course Outcomes	**Learners should be able to**
CO1	Understand the structure and function of various biomolecules.
CO2	Understand various aspects Bioorganic Chemistry.

B. Sc. (Biotechnology)		Semester – I	
Course Name: Bioorganic Chemistry I			
Periods per week (1 Period is 120 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	4	100
	Internal	**--**	**--**

List of Practicals Bioorganic Chemistry

1. Spot test for Carbohydrates (Benedict, Anthrone and Molisch),
2. Spot test for Fats.
3. Spot test for Nucleic acids.
4. Paper Chromatography of carbohydrates & amino acids.
5. Estimation of reducing sugar by DNSA method.
6. Estimation of protein by Biuret method and Lowry method
7. Estimation of DNA by DPA method.
8. Estimation of RNA by Orcinol method.
9. Saponification of Fats: Saponification Value of Oil or Fat.
10. Iodine value of Oil.
11. Determination of rate constant for the saponification reaction between ethyl acetate and NaOH by back titration method.

B. Sc (Biotechnology)		Semester – I	
Course Name: History of Biotechnology			
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**02**	**60**
	Internal		**40**

Course Objectives

To aquaint students with historical aspects of Biotechnology.
To impart the knowledge of evolution and diversification of Biotechnology.

Unit	Details	Lectures
I	Advent of Biotechnology, Traditional and Modern Biotechnology- Tracing biotechnology through ages, Biotechnology in Healthcare, Public perception of Biotechnology,	**10**
II	Ethics in Biotechnology. Biotechnological Research in India, Biotechnology Institutions in India (Public and Private sector), Consumption of Biotech products, Biotech policy initiatives, Biotechnology in context of developing World	**10**
III	Biotech success stories in India, Biotechnology in India- Bio-business (Biotechnology market) in India, Ethical issues in Biotechnology in India.	**10**

Course Outcomes	Learners should be able to
CO1	Understand the historical aspects of Biotechnology.
CO2	Understand evolution of Biotechnology.

Books and References:				
Sr. No.	Title	Author/s	Publisher	Edition
1.	Textbook of Biotechnology	R.C.Dubey	S.Chand	4th
2.	Biotechnology	H.K.Das	Himalaya	3rd
3	Advances in Biotechnology	S.N. Jogdand	Himalaya	6th

SEMESTER II

B. Sc. (Biotechnology)		Semester – II	
Course Name: Biotechnology II: Genetics and Molecular Biology			
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objectives

To aquaint students with various aspects of Biotechnology.
To impart the knowledge of population genetics and basic molecular processes in biology.

Unit	Details	Lectures
I	DNA Replication in Prokaryotes and Eukaryotes-Semi-conservative DNA replication, DNA Polymerases and its role, E. coli Chromosome. Replication, Bidirectional Replication of Circular DNA molecules, Rolling Circle Replication, DNA Replication in Eukaryotes, End replication problem, Action of Telomerase Recombinant DNA technology: Genetic Engineering in E.coli, Cloning Vector - Plasmid, Enzymes - DNA Polymerases, Restriction Endonucleases, Ligases, Reverse Transcriptases, Nucleases, Terminal Transferases, Phosphatases	**10**
II	Mutations: Definition and Types of Mutations, Mutagens (Examples of Physical, Chemical and Biological Mutagens) Types of Point Mutations, DNA repair – Photo reversal, Base Excision Repair, Nucleotide Excision Repair, Mismatch Repair, SOS Repair Genetic analysis in Bacteria & Bacteriophages: Prototrophs, Auxotroph Mechanism of Genetic Exchange in Bacteria-Conjugation; Transformation; Transduction (Bacteriophages – Lytic and Lysogenic cycle).	**10**
III	Genetic Structure of Populations – Genotypic Frequencies and Allelic Frequencies, Hardy- Weinberg Law and its assumptions Genetic Variations in Populations- Measuring Genetic Variation at Protein Level and measuring Genetic Variations at DNA level Natural Selection. Genetic Drift Speciation Role of Population Genetics in Conservation Biology	**10**

Course Outcomes	Learners should be able to
CO1	Understand basics of population genetics.
CO2	Understand genetics of bacteria and bacteriophages.
CO3	Understand DNA replication in prokaryotes and eukaryotes.
CO4	Understand basics of recombinant DNA technology and mutagenesis.

Book					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	iGenetics-A Molecular Approach	Peter Russell	Pearson	3rd	2005

B. Sc. (Biotechnology)		Semester – II	
Course Name: Basic Life Science: Biodiversity and Cell Biology			
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objectives

To aquaint students with various aspects of Life Sciences.
To impart the knowledge of biodiversity, ultrastructure of eukaryotic cell, plant physiology and animal physiology

Unit	Details	Lectures
I	Origin of Life, Chemical and BiologicalEvolution, Origin of Eukaryotic Cell. Concept of Biodiversity, Taxonomical, Ecological and Genetic Diversity & its significance. Introduction to Plant Diversity: Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms (with one example each) Introduction to Animal Diversity: Non-Chordates and Chordates (with at least one representative example.) Introduction to Microbial Diversity: Archaebacteria, Eubacteria, Blue-greenAlgae, Actinomycetes, Eumycota- Habitats, Examples and Applications.	10
II	Ultrastructure of Eukaryotic Cell: Plasma membrane, Cytoplasmic Matrix, Microfilaments, Intermediate Filaments, and Microtubules Organelles of the Biosynthetic- Endoplasmic Reticulum & Golgi Apparatus. Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome Eukaryotic Ribosomes, Mitochondria and Chloroplasts Nucleus –Nuclear Structure, Nucleolus External Cell Coverings: Cilia and Flagella Comparison of Prokaryotic and Eukaryotic Cells	10
III	Plant Physiology: Photosynthesis, Intracellular Organization of Photosynthetic System, Photosynthetic Pigments, Fundamental Reactions of Photosynthesis. Role of Light. Hills Reaction and its Significance, Light Reactions, Cyclic and Non-	10

	Cyclic Photo Induced Electron Flow, Energetics of Photosynthesis, Photorespiration, Dark Phase of Photosynthesis, Calvin Cycle, C-4 and CAM pathway. Animal Physiology: Physiology of Digestion, Movement of Food and Absorption, Secretary functions of Alimentary Canal, Digestion and Absorption, assimilation in Gut of Mammals. Anatomy of Mammalian Kidney, Structure of Nephron, Physiology of Urine Formation and Role of Kidney in Excretion and Osmoregulation Physiology of Respiration, Mechanism of Respiration, Principles of Gaseous Exchange in the Blood and Body Fluids Blood and Circulation: Blood Composition, Structure and Function of its Constituents, Blood Coagulation and Anti- Coagulants, Haemoglobin and its Polymorphism Regulation of the Circulation Mechanism and working of Heart in Human.	

Course Outcomes	**Learners should be able to**
CO1	Understand biodiversity.
CO2	Understand ultrastructure of eukaryotic cell.
CO3	Understand plant physiology.
CO4	Understand animal physiology.

B. Sc. (Biotechnology)		Semester – II	
Course Name: Practicals of Biotechnology II & Basic Life Science			
Periods per week (1 Period is 120 minutes)		**2**	
Credits		2	
		Hours	**Marks**
Evaluation System	**Practical Examination**	4	100
	Internal	**--**	**--**

List of Practicals:

1. Study of Hill's reaction.
2. Colorimetric study of Absorption Spectrum of Photosynthetic Pigments.
3. Movement of Food in Paramoecium- Demonstration.
4. Analysis of Urine.
5. Study of Mammalian Blood-Differential count.
6. Blood count using Haemocytometer.
7. Estimation of Haemoglobin in Mammalian Blood.
8. Study of Human Blood Groups.
9. Study of Mammalian Kidney and Heart.
10. Problems in Mandelian Genetics
11. Study of Mitosis and Meiosis.
12. Study of Karyotypes – Normal Male and Normal Female.
13. Study of Interactions Commensalism, Mutualism, Predation and Antibiosis, Parasitism.
14. Staining of Plant and Animal Tissues using Single and Double Staining Techniques
15. Study of Plant, Animal and Microbial Groups with at least one examples from each
16. Study of Photomicrographs of Cell Organelles

B. Sc (Biotechnology)		Semester – II	
Course Name: ATC, PTC & Immunology			
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objectives

To aquaint students with various aspects of applications of Biotechnology.
To impart the knowledge of animal tissue culture, plant tissue culture, and immunology.

Course Outcomes	**Learners should be able to**
CO1	Gain an overview of immunology.
CO2	Understand basic plant tissue culture techniques.
CO3	Understand basic animal tissue culture techniques.

Unit	**Details**	**Lectures**
I	Overview of Immune Systems, Cell and Organs involved, T and B cells. Innate Immunity, Acquired Immunity, Local and Herd Immunity, Humoral and Cellular Immunity-Factors Influencing and Mechanisms of each. Antigens and Antibodies: Types of Antigens, General Properties of Antigens, Haptens and Superantigens Discovery and Structure of Antibodies (Framework region) Classes of Immunoglobulins, Antigenic Determinants. Antigen-Antibody Interactions Monoclonal Antibodies, Vaccines (Live, Killed) and Toxoid. Production of -Insulin; recombinant vaccine for Hepatitis B virus. Molecular farming, Edible vaccines and their advantages	10
II	Basics of Plant Tissue Culture: Cell Theory, Cellular Totipotency, Concept of Cell Culture, Design of PTC lab with equipment, Plant tissue culture media and phytohormones. Applications of	10

	PTC - Clonal and micro-propagation, callus culture, development of synthetic seeds and GMO	
III	Basics of Animal Tissue Culture: Introduction to Animal Cell Culture; Terminologies - Primary cell culture, Passaging, Confluency, Cell line, Organ culture; Equipments - CO2 Incubator, Laminar-Air flow, Inverted microscope, Medium filtration devices, Cell counters, liquid-nitrogen-storage tanks; Design of ATC laboratory; Applications of ATC - Cell lines for vaccine production, therapeutic proteins, pharmaceutical agents, and anticancer agents	10

Course Outcomes	**Learners should be able to**
CO1	Gain an overview of immunology.
CO2	Understand basic plant tissue culture techniques.
CO3	Understand basic animal tissue culture techniques.

B. Sc (Biotechnology)		Semester – II	
Course Name: Bioorganic Chemistry II			
Periods per week (1 Period is 60 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2**	**60**
	Internal	**--**	**40**

Course Objectives

To aquaint students with various aspects of Bioorganic Chemistry.
To impart the knowledge of buffers, Proteins and basics of enzymology.

Unit	Details	Lectures
I	Water, Solutions and Buffers Chemistry of Water: Properties of Water, Interaction of Water with Solutes (Polar, Non-Polar, Charged), Non-Polar Compounds in Water – Change in its Structure and the Hydrophobic Effect, Role of Water in Biomolecular Structure and Function, Water as a Medium for Life (2L) Solutions: Normality, Molarity, Molality, Mole fraction, Mole concept, Solubility, Weight ratio, Volume ratio, Weight to Volume ratio, ppb, ppm, millimoles, milliequivalents (Numericals expected). (3L) Primary and Secondary Standards: Preparation of Standard Solutions, Principle of Volumetric Analysis. (1L) Acids and Bases: Lowry-Bronsted and Lewis Concepts. Strong and Weak Acids and Bases - Ionic Product of Water - pH, pKa, pKb. Hydrolysis of Salts. (3L) Buffer solutions: Concept of Buffers, Types of Buffers, Derivation of Henderson equation for Acidic and Basic buffers, Buffer action, Buffer capacity, pH of Buffer Solution. (3L)	**10**
II	Proteins and amino acids Amino Acids: Classification, Preparation and Properties, (3L) Isoelectric Point, Titration Curve of Amino Acids, Concept of Isoelectric pH, Zwitter-ion, Structure of Peptides, Peptide Synthesis (3L) Proteins: Classification based on Structure and Functions,(2L) Primary Structure, N-terminal (Sanger and Edmans Method) and C-terminal Analysis (Enzyme) (2L) Reactions of Amino Acids, Sorenson's Titration, Ninhydrin Test, Denaturation of protein, Glycoproteins	**10**

III	Enzymes Definition, Classification, Nomenclature, Chemical (1L) Nature and Properties of Enzymes, Co- Factors, Zymogens, Active Sites, Enzyme Specificity (3L) Mechanism of Enzyme Action (1L) Effect of pH, Temperature and Substrate Concentration on Enzyme Activity (2L) Enzyme Kinetics, Michaelis - Menten Equation (2L) Types of Enzyme Inhibitions - Competitive, Uncompetitive, Non-Competitive Allosteric, Modulators	**10**

Course Outcomes	**Learners should be able to**
CO1	Understand the chemistry of water and buffers.
CO2	Understand structure and function of proteins.
CO3	Understand basics of enzymology.

B. Sc (Biotechnology)		Semester – II	
Course Name: Practicals of Bioorganic Chemistry II			
Periods per week (1 Period is 120 minutes)		**2**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2**	100
	Internal	**--**	**--**

List of Practical

1. Preparation of Standard (Molar, Molal and Normal solutions) and Buffer Solutions.
2. Determination of strength of HCl in commercial sample.
3. Determination of amount of NaHCO3 + Na2CO3 in the given solid mixture titrimetrcially.
4. Separation of amino acids by paper chromatography.
5. Estimation of Protein by Biuret method.
6. Estimation of Protein by Lowry method.
7. Meat Tenderization using Papain
8. Activity of Salivary Amylase on Starch
9. Qualitative Assay of Enzyme Amylase, Invertase, Urease, Lipase, Catalase and Dehydrogenase.
10. Enzyme Kinetics Vmax Km determination.
11. Study of the effect of pH, Temperature on activity of Enzyme.