



Hindi Vidya Prachar Samiti's

Ramniranjan Jhunjhunwala College

of Arts, Science & Commerce

(Autonomous College)



Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for the S.Y.B.Sc.

Program: B.Sc. BIOTECHNOLOGY

Program Code: RJSUBT

(CBCS 2019-2020)

PROGRAM OUTCOMES FOR UNDERGRADUATE DEGREE PROGRAMS IN BIOTECHNOLOGY

The Post graduate program in Biotechnology has been designed to empower students to obtain domain knowledge, analyze and apply. The courses have been designed to hone the analytical skills of students so as to solve real life situations. Modern tools have been introduced for studying biotechnology without compromising on the basic concepts. All the courses in the program are carefully designed to equip students for teaching the subject as well as qualify competitive examinations like GAT-B, IIT-JAM, CUTE, TIFR, etc.

Some basic attributes which a student would acquire after completion of undergraduate program are listed below.

Application of Knowledge

Maintain a high level of scientific excellence in research with specific emphasis on the technological advances in microbiology, molecular biology techniques and bioinformatics. Create, select and apply appropriate techniques and modern technology in a multidisciplinary way. Apply the subject knowledge to design experiments, analyze and interpret data to reach an effective conclusion.

Ability to convey the concept clearly

They would identify, formulate, and analyze the complex problems and reach a conclusion. Logical thinking with application of biological, physical, and chemical sciences. Learning that develops analytical skills and integrative problem-solving approaches.

Teamwork

Students would perform functions that demand higher competences in national/international organizations with team spirit and helping each other. Develop qualities of empathy and sympathy for fellow beings

Honesty and Integrity and Ethics

Students will be aware of ethical issues and regulatory considerations while addressing societal needs for growth with honesty.

Environment and Sustainability

The problem-solving skills in students would encourage them to carry out innovative research projects to solve environmental issues. All actions are towards achieving United Nations Sustainable Development Goals.

Lifelong learning and motivating others to learn

Students would lend support to one another for self and institutional growth, contribute to national development and provide equal opportunity.

Global thinking

Students would be equipped with life and technical skills and would be empowered with domain knowledge in thrust areas; these attributes will make them globally competitive.

PROGRAMME SPECIFIC OUTCOMES (PSOs) FOR BSc BIOTECHNOLOGY

Sr. No	A Student Specific completing B.Sc. Biotechnology will be able to :
PSO1	Understand the principle, working, applications of microscopy and spectroscopy.
PSO2	Understanding different aspects of Organic Chemistry, role of thermodynamics in biology & role of Green Chemistry and its application in Industry.
PSO3	Gain insights on the concepts of immunotechnology, complement system and immune cell receptors
PSO4	Understand the fundamentals of cell biology and cytogenetics. Also gain an insight on the concepts of gene expression and regulation.
PSO5	To explore the microorganisms in industrial processes. Also gain insights on the fermentor design, process control and preclinical studies.
PSO6	Explore and evaluate the applications of entrepreneurship, market research and also setting up an enterprise and planning.
PSO7	To understand the fundamentals of intermediary metabolism like carbohydrate, lipid metabolism, electron transport system, amino acid and nucleotide metabolism.
PSO8	To explore the fundamentals behind drugs and biosimilars, molecular spectroscopy, polymers and nanomaterials.
PSO9	To understand the basic concepts related to host parasite relationship, gram positive and gram negative infectious agents. Also gain insights on the science behind disease prevention, diagnosis and treatment.
PSO10	Gain insights on the fundamentals of computational biological database, BLAST and sequence alignment tools used in bioinformatics and understand the concepts of biostatistics and its applications.
PSO11	Understand the basics of molecular diagnostics, nucleic acid amplification methods and diagnostics based on molecular biology.
PSO12	Explore the research methodologies applied across the world for solving research problems, collecting data, research design and interpretation of results and report writing.

Core subject

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT301	Paper - Biophysics			45 hours
	I	Microscopy & Spectroscopy	2	
	II	Osmosis and adsorption		
	III	Electrophoretic Techniques		

Core subject

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT302	Paper - Green Chemistry			45 hours
	I	Organic chemistry	2	
	II	Thermodynamics		
	III	Green Chemistry & synthesis		

Core subject

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT303	Paper - Immunotechnology			45 hours
	I	Complement system	2	
	II	Immune Cell Receptors		
	III	Immunotechnology		

Core subject

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT304	Paper - Cell Biology and Cytogenetics			45 hours
	I	Cytoskeleton	2	
	II	Cell membrane		
	III	Cytogenetics		

Core subject

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT305	Paper - Gene expression and Regulation			45 hours
	I	Transcription	2	
	II	Translation		
	III	Regulation of Gene Expression		

Skill Enhancement Course

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT306	Paper - Bioprocess Technology			45 hours
	I	Microorganisms in Industrial Processes	2	
	II	Preclinical studies		
	III	Fermentor and process control		

General Elective

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT307	Paper - Entrepreneurship Development			45 hours
	I	Introduction to Entrepreneurship Development	2	
	II	Market research		
	III	Setting-up of an Enterprise and Planning		

Core subject practicals

Course Code	Topic Headings	Credits	Duration
RJSUBTP301	Practicals of RJSUBT301 & RJSUBTP302	2	30 hours
RJSUBTP302	Practicals of RJSUBT303 & RJSUBTP304	2	30 hours
RJSUBTP303	Practicals of RJSUBT305 & RJSUBTP306	2	30 hours

S.Y.B.Sc. BIOTECHNOLOGY SEMESTER II

Core subject

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT401	Paper - Intermediary metabolism			45 hours
	I	Carbohydrate and lipid metabolism	2	
	II	Electron transport system		
	III	Amino acid and nucleotide metabolism		

Core subject

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT402	Paper - Applied Chemistry			45 hours
	I	Drugs and Biosimilars	2	
	II	Molecular Spectroscopy		
	III	Polymers and Nanomaterial		

Core subject

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT403	Paper - Medical Microbiology			45 hours
	I	Host Parasite relationship	2	
	II	Gram- positive infectious agents		
	III	Gram negative infectious agents		

Core subject

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT404	Paper - Biotechnology and healthcare			45 hours
	I	Disease prevention	2	
	II	Disease diagnosis		
	III	Disease treatment		

Core subject

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT405	Paper - Bioinformatics and Biostatistics			45 hours
	I	Introduction to computers and biological database	2	
	II	BLAST and sequence alignment		
	III	Biostatistics		

Skill Enhancement Course

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT406	Paper - Molecular Diagnostics			45 hours
	I	Basics of Molecular Diagnostics	2	
	II	Nucleic Acid Amplification Methods		
	III	Molecular Biology based Diagnostics		

General Elective

Course Code	Unit	Topic Headings	Credits	Duration
RJSUBT407	Paper - Research Methodology			45 hours
	I	Research Methodology and Research Problem	2	
	II	Research Design and Data collection		
	III	Interpretation and Report Writing		

Core subject Practicals

Course Code	Topic Headings	Credits	Duration
RJSUBTP401	Practicals of RJSUBT401 & RJSUBTP402	2	30 hours
RJSUBTP402	Practicals of RJSUBT403 & RJSUBTP404	2	30 hours
RJSUBTP403	Practicals of RJSUBT405 & RJSUBTP406	2	30 hours

SYLLABUS GRID

YEAR	SEMESTER	CORE SUBJECT						APPLIED COMPO NENT	SKILL DEVELO PMENT COURSE	SKILL ENHAN CEMEN T COURS E (SEC)	DISCIP LINE SPECIF IC ELECT IVE (DSE)	PRAC TICA LS	TOTAL
FY	I	2	2	2	2	2	2	-	2	1	-	6	21
	II	2	2	2	2	2	2	-	2	1	-	6	21
TOTAL		4	4	4	4	4	4	-	4	2	-	12	42
SY	III	2	2	2	2	2	-	-	2	2	2	6	22
	IV	2	2	2	2	2	-	-	2	2	2	6	22
TOTAL		4	4	4	4	4	-	-	4	4	4	12	44
TY	V	3	3	3	3	-	-	3	-	-	-	8	23
	VI	3	3	3	3	-	-	3	-	-	-	8	23
TOTAL		6	6	6	6	-	-	6	-	-	-	16	46

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	BIOPHYSICS
COURSE CODE	:	RJSUBT301
CREDITS	:	2
DURATION	:	45

LEARNING OBJECTIVES	
1	Be able to understand the principle behind the working of microscopes and spectroscopy
2	Develop an understanding of the different aspects of Physics.
3	Gain knowledge on the separation of macromolecules using electrophoresis.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To introduce to principle, working and applications of electron microscopy, fluorescence microscopy and spectrophotometer.	1	BT levels 1,2 & 3
CO2	To acquaint students with properties, measurements and significance of osmosis and adsorption	1	BT levels 1,2 & 3
CO3	To give a detailed account of the principle of electrophoresis, types of electrophoresis depending on the supporting matrix used, separation conditions used and types of detection methods.	1	BT levels 1,2 & 3

Paper Code: RJSUBT301	Paper-I: Biophysics	Credits 2
Unit I	Microscopy & Spectroscopy	15 hrs
	<p>Microscopy: Types of Microscopy; Electron Microscopy-Preparation of Specimen, SEM, TEM and Immuno-Electron Microscopy. Fluorescence Microscopy</p> <p>Spectroscopy: Types and Properties of Spectra; Basic Laws of Light Absorption. Spectrophotometer:-Principle, Instrumentation and Applications; UV-Vis Spectrophotometer, Single and Dual Beam Spectrophotometer.</p>	
Unit II	Osmosis & Adsorption	15 hrs
	<p>Osmosis: Measurement of osmotic pressure, theories of osmotic pressure and semi permeability, osmotic behavior of cells, molecular weight determination from osmotic pressure measurements, significance of osmosis in biology</p> <p>Adsorption: Types, characteristics, molecular orientation, adsorption from solutions, importance of adsorption phenomena</p>	
Unit III	Electrophoretic Techniques	15 hrs
	<p>Migration of Ions in an applied electric field; Factors affecting Electrophoretic Mobility; Moving Boundary Electrophoresis; Principle of Electrophoresis; Supporting Matrix; Paper Electrophoresis; AGE; Native and SDS PAGE (reducing and non-reducing, continuous and Discontinuous)</p> <p>IEF and 2D PAGE. Staining and Detection Methods; Gel-Documentation Applications in Biology</p>	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	GREEN CHEMISTRY
COURSE CODE	:	RJSUBT302
CREDITS	:	2
DURATION	:	45

LEARNING OBJECTIVES	
1	Develop an understanding of the different aspects of Organic Chemistry.
2	Discuss the synthesis of Organic compounds
3	Discuss role of Green Chemistry and its application in Industry.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To introduce different types of organic reactions, structure, functions and applications of metals in biology and medicine.	2	BT levels 1,2 & 3
CO2	To acquaint students with the basics of synthesis of organic compounds, criteria for ideal synthesis, selectivity and yield.	2	BT levels 1,2 & 3
CO3	To give a detailed account of the principle & need of green chemistry and strategies, material, catalysts used in green synthesis of various compounds in industries.	2	BT levels 1,2 & 3

Paper Code: RJSUBT302	Paper-II: Green chemistry	Credits 2
Unit I	Organic Chemistry	15 hrs
	Types of Organic Reactions: Addition, Elimination and Substitution Reactions Structure and Function: Dioxygen Binding, Transfer and Utilization; Metal Complexes in Medicines	
Unit II	Synthesis of organic compound	15 hrs
	Criteria for ideal synthesis; selectivity and yield. Linear and convergent synthesis and multi component reactions. Microwave assisted organic synthesis, Ultrasound in synthesis and Polymer supported synthesis.	
Unit III	Green chemistry & Synthesis	15 hrs
	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	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	IMMUNOTECHNOLOGY
COURSE CODE	:	RJSUBT303
CREDITS	:	2
DURATION	:	45

LEARNING OBJECTIVES	
1	Understand the role complement system in Immunology.
2	Understand the structure and functioning of receptors significant to immune mechanisms.
3	Understand the principles underlying various immunotechniques.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To introduce students to types, mechanism, regulation & disorders of complement systems	3	BT levels 1,2 & 3
CO2	To acquaint students with structure & functions of MHC molecules, TCR and BCR in innate and adaptive immunities.	3	BT levels 1,2 & 3
CO3	To discuss in detail various immunological techniques like that can be used in diagnosis with their pros and cons	3	BT levels 1,2 & 3

Paper Code: RJSUBT303	Paper-III: Immunotechnology	Credits 2
Unit I	Complement System	15 hrs
	Complement System- Classical, Alternate and Lectin. Regulation and Biological Effects of Complement System; Deficiencies of Complement System	
Unit II	Immune Cell Receptors	15 hrs
	MHC Classes - Structures and Peptide Interactions, Antigen Presentation -Endocytic and Exocytic Pathways; MHC Restriction. T-cell Receptor and B-cell Receptor: Structure and function.	
Unit III	Immunotechnology	15 hrs
	Antigen-antibody reaction – features, antibody generation, Immunoprecipitation based techniques, Agglutination Reactions; Coomb's Test. Complement Fixation Tests; RIA, ELISA, ELISPOT, Chemiluminescence, Western Blot, Immunofluorescence, Flow Cytometry	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	CELL BIOLOGY AND CYTOGENETICS
COURSE CODE	:	RJSUBT304
CREDITS	:	2
DURATION	:	45

LEARNING OBJECTIVES	
1	Develop an understanding of the Cytoskeletal network and functions.
2	Understand the organization of Cell Membrane with the functions of various components.
3	Discuss the principles underlying Sex Determination, Linkage and Mapping

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To understand structure, composition, assembly and disassembly & functions of microtubules, microfilament, intermediate filaments in a cell.	4	BT levels 1,2 & 3
CO2	To discuss in detail the properties of cell membrane with respect to permeability various solutes and their transportation across the membrane using passive, active transport with the help of transporters. Also to inculcate the understanding of components of cell to cell & cell to ECM junctions and their significance in multicellular organisms.	4	BT levels 1,2 & 3

CO3	To understand mechanisms and significance of sex determination, genetic linkage, crossing over and chromosomal mapping, pedigree analysis & karyotyping	4	BT levels 1,2 & 3
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COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

Paper Code: RJSUBT304	Paper-IV: Cell Biology & Cytogenetic	Credits 2
Unit I	Cytoskeleton	15 hrs
	Microtubules: Structure and Composition. MAPs: Functions, 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 Non-Muscle Motility. Intermediate Filaments: Composition, Structure, Types, Functions, Assembly and Disassembly	
Unit II	Cell Membrane	15 hrs
	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	
Unit III	Cytogenetics	15 hrs
	Sex Determination and Sex Linkage: Mechanisms of Sex Determination (XX-XY, ZZ-ZW, XX-XO) Dosage Compensation and Barr Body. Genetic Linkage, Crossing Over and Chromosomal Mapping: Tetrad Analysis; Two-point Cross; Three point Cross; Pedigree analysis	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	GENE EXPRESSION AND REGULATION
COURSE CODE	:	RJSUBT305
CREDITS	:	2
DURATION	:	45 hours

LEARNING OBJECTIVES	
1	Discuss the mechanisms associated with gene expression at the level of transcription.
2	Understand the molecular basis of protein synthesis and protein modification after translation.
3	Discuss the mechanisms associated with regulation of gene expression in prokaryotes and eukaryotes.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To give a detailed account of initiation, elongation, termination steps of transcription and difference between properties of prokaryotic and eukaryotic promoters, transcription factors, RNA editing, RNA polymerase.	4	BT levels 1,2 & 3
CO2	To understand the processes involved in translation, properties of codons, role of tRNA. Also to explain what types of post translational modifications a protein	4	BT levels 1,2 & 3

	undergoes and its significance in sorting the location in the cell.		
CO3	To acquaint students with operons, gene silencing and genomic imprinting, post-transcriptional control, RNA interference in order to explain how prokaryotic and eukaryotic cells regulate gene expression.	4	BT levels 1,2 & 3

Paper Code: RJSUBT305	Gene expression and regulation	Credits 2
Unit I	Transcription	15 hrs
	Transcription in Prokaryotes: RNA Synthesis; Promoters and Enhancers; Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain. Transcription in Eukaryotes : Eukaryotic RNA Polymerases; Eukaryotic Promoters; Transcription of Protein Coding Genes by RNA Polymerase; Eukaryotic mRNAs; Transcription of other genes; Spliceosomes; RNA editing.	
Unit II	Translation	15 hrs
	Nature of Genetic Code; Wobble Hypothesis. Translation : Process of Protein Synthesis (Initiation, Elongation, Translocation, Termination). Post Translational Modifications; Protein sorting	
Unit III	Regulation of gene expression	15 hrs
	Prokaryotes: lac Operon of E.coli; trp Operon of E.coli. Eukaryotes: Operons in Eukaryotes; Control of Transcriptional Initiation; Gene Silencing and Genomic Imprinting; Post-Transcriptional Control; RNA Interference	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	SKILL ENHANCEMENT COURSE
TITLE OF THE SUBJECT/COURSE	:	BIOPROCESS TECHNOLOGY
COURSE CODE	:	RJSUBT306
CREDITS	:	2
DURATION	:	45 hours

LEARNING OBJECTIVES	
1	Develop an understanding of the various aspects of Bioprocess Technology.
2	Understand The concept of preclinical studies
3	Understand principles underlying design of Fermenter and Fermentation Process

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To discuss in detail screening and maintenance, improvement, preservation methods of industrial strains	5	BT levels 1,2 & 3
CO2	To introduce types of preclinical studies with roles of various pharmacokinetics studies, bioassays and confirmatory tests and regulatory bodies.	5	BT levels 1,2 & 3
CO3	To give a detailed account of role various parts of a fermenter, design and optimization of fermentation media, fermentation process parameters	5	BT levels 1,2 & 3

Paper Code: RJSUBT306	Paper-VI: Bioprocess Technology	Credits 2
Unit I	Microorganisms in Industrial Process	15 hrs
	Types of Microorganisms used in Industrial Processes: Bacteria, Actinomycetes, Fungi and Algae. Screening and Maintenance of Strains: Primary Screening and Secondary Screening. Preservation of Industrially Important Microbial Strains, Strain improvement.	
Unit II	Preclinical Studies	15 hrs
	Introduction to pre-clinical and clinical trials, types of preclinical testing- Acute, chronic, selection of model animals, Tests on Animal Models of Human Disease. Bioassays and Confirmatory Tests, Determination of Pharmacokinetic Parameters, Regulatory Bodies involved in Preclinical Trials	
Unit III	Fermentor and Process Control	15 hrs
	Design of a fermentor: Stirred Tank Fermentor- Basic Design; Parts of a Typical Industrial Fermentor. Fermentation Media: Components; Design and Optimization. Sterilization: Sterilization of Fermentor and Fermentation Media. Inoculum development.. Process Parameters: pH, Temperature, Aeration, Agitation, Foam. Types of Fermentation: Surface and Submerged; Batch and Continuous, Fed-Batch, Aerobic and Anaerobic.	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	GENERAL ELECTIVE
TITLE OF THE SUBJECT/COURSE	:	ENTREPRENEURSHIP DEVELOPMENT
COURSE CODE	:	RJSUBT307
CREDITS	:	2
DURATION	:	45 hours

LEARNING OBJECTIVES	
1	Develop an understanding of the systematic process and to select and screen a Business Idea.
2	Design strategies for successful implementation of ideas.
3	Write a Business Plan

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To explain the concept and importance of Entrepreneurship	6	BT levels 1,2 & 3
CO2	To understand the importance of marketing plan, domestic & international market assessment, desk & field research and need of alliances for a successful business	6	BT levels 1,2 & 3
CO3	To discuss how to do financial planning and to choose the suitable government and financial institutions for grants.	6	BT levels 1,2 & 3

Paper Code: RJSUBT307	Paper-VII: Entrepreneurship Development	Credits 2
Unit I	Introduction to Entrepreneurship and Development	15 hrs
	Concept of Entrepreneur; Entrepreneurship; Need and Importance, Factors Influencing Entrepreneurship. Essentials of a Successful Entrepreneur, Product Selection and Ideas.	
Unit II	Market research	15 hrs
	Marketing Plan for an Entrepreneur; 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; Project Feasibility Assessment, Strategic Alliances	
Unit III	Setting - Up of an Enterprise and Planning	15 hrs
	Financial Planning - Cost, Break Even Point Analysis; Role of Government and Financial Institutions in Entrepreneurship Development; Raising Money from Venture Capitalists, Government Grants. Project Planning and Formulation; Business Models, IPR generation and Protection, Characteristics and Importance of Planning.	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	INTERMEDIARY METABOLISM
COURSE CODE	:	RJSUBT401
CREDITS	:	2
DURATION	:	45

LEARNING OBJECTIVES	
1	Understand the sugar and lipid metabolic pathways
2	Understand the role of energy rich molecules in metabolism.
3	Know the catabolic pathways and disorders associated with breakdown of amino acids and nucleotides in cells.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To explain in detail various metabolic pathways, fate and energy production efficiency of sugar and fat metabolism.	5	BT levels 1,2 & 3
CO2	To give an account of how reducing equivalents can be used in the electron transport chain to produce ATP by oxidative phosphorylation.	5	BT levels 1,2 & 3
CO3	To study the various catabolic pathways and reactions of amino acids and nucleotides.	5	BT levels 1,2 & 3

Paper Code: RJSUBT401	Paper-I: Intermediary Metabolism	Credits 2
Unit I	Carbohydrate and lipid metabolism	15 hrs
	Carbohydrate Metabolism : Glycolysis and gluconeogenesis and Regulation, Homolactic Fermentation; Alcoholic Fermentation; Citric Acid Cycle and its Regulation; Pentose Phosphate Pathway. Lipid Metabolism : Beta Oxidation of Saturated Fatty Acids, odd chain fatty acids, omega oxidation of fatty acids. Ketone Body Breakdown to Yield Energy.	
Unit II	Electron Transport System	15 hrs
	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 III	Amino Acid and Nucleotide Metabolism	15 hrs
	Amino Acid Breakdown : Decarboxylation, Deamination, Transamination, Urea Cycle, Breakdown of Glucogenic and Ketogenic Amino Acids. Nucleotide Metabolism : Degradation of Purines and Pyrimidines.	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	APPLIED CHEMISTRY
COURSE CODE	:	RJSUBT402
CREDITS	:	2
DURATION	:	45 hours

LEARNING OBJECTIVES	
1	Develop an understanding of biosimilars.
2	Understand the principle of various molecular spectroscopy techniques
3	Gain an understanding of basic concepts in polymer chemistry and nanomaterials.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To give a detailed account of the difference between biosimilars and generic drugs, development process & regulations of biosimilars.	8	BT levels 1,2 & 3
CO2	To understand different types of interactions of electromagnetic radiation with matter and how to use these interactions for analytical purposes.	8	BT levels 1,2 & 3
CO3	To acquaint students with the properties, types & applications of polymers and nanomaterials.	8	BT levels 1,2 & 3

Paper Code: RJSUBT402	Paper-II: Applied Chemistry	Credits 2
Unit I	Drugs and Biosimilars	15 hrs
	Overview - History of Biotechnology, Biopharmaceuticals, Biologics & Biosimilars. Biosimilars – Definitions and terminologies, Examples of biosimilars, difference between generics, biosimilars and interchangeable products. Biosimilar development process, Regulations for biosimilars, Global & Indian scenario	
Unit II	Molecular spectroscopy	15 hrs
	Electromagnetic radiation, electromagnetic spectrum, Planck's equation, interaction of EMR with matter-absorption, emission, scattering, fluorescence. Interaction of EMR with electronic, vibrational and rotational transitions	
Unit III	Polymers and Nanomaterials	15 hrs
	Introduction to Polymers. Types of Polymers - Monomer, Polymer, Homopolymer, Copolymer, Thermoplastics and Thermosets, Addition and Condensation Polymers, Biodegradable Polymers. Nanomaterials : Introduction to Nanomaterials; Forms of Nanomaterials : Nanoparticles, Nanofilms and Nanotubes; Synthesis and Characterization of Nanomaterials. Applications of Nanomaterials.	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	MEDICAL MICROBIOLOGY
COURSE CODE	:	RJSUBT403
CREDITS	:	2
DURATION	:	45 hours

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

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To understand the concepts of epidemiology, virulence factor.	9	BT levels 1,2 & 3
CO2	To study pathogenesis of Gram positive infectious organisms	9	BT levels 1,2 & 3
CO3	To study pathogenesis of Gram negative infectious organisms	9	BT levels 1,2 & 3

Paper Code: RJSUBT403	Paper-III: Medical Microbiology	Credits 2
Unit I	Host Parasite Relationship	15 hrs
	Normal Flora; Sources of infection, methods of transmission of infections, Virulence Factors, Types of infectious diseases. Epidemiology and Epidemiological Markers	
Unit II	Gram positive infectious agents	15 hrs
	Study of cultural characteristics, pathogenesis, clinical features, diagnosis and prevention for <i>S. aureus</i> , <i>S. pneumoniae</i> & <i>M. tuberculosis</i>	
Unit III	Gram negative infectious agents	15 hrs
	Study of cultural characteristics, pathogenesis, clinical features, diagnosis and prevention for <i>E. coli</i> & <i>Salmonella</i> , <i>Pseudomonas aeruginosa</i> & <i>Neisseria gonorrhoeae</i>	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	BIOTECHNOLOGY AND HEALTHCARE
COURSE CODE	:	RJSUBT404
CREDITS	:	2
DURATION	:	45 hours

LEARNING OBJECTIVES	
1	Understand the various conventional and modern recombinant methods for disease prevention using vaccines.
2	Understand modern techniques used for disease diagnosis.
3	Gain knowledge regarding treatment using products from non-recombinant, recombinant organisms and gene therapy

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To study the working and pros & cons of different types of vaccines	9	BT levels 1,2 & 3
CO2	To understand the use of probes and monoclonal antibodies in diagnosis.	9	BT levels 1,2 & 3
CO3	To discuss various treatment strategies and drug delivery systems	9	BT levels 1,2 & 3

Paper Code: RJSUBT404	Paper-IV: Biotechnology and healthcare	Credits 2
Unit I	Disease prevention	15 hrs
	Ideal vaccine, conventional vaccine, purified antigen vaccine, recombinant vaccine, Recombinant polypeptide vaccine, DNA vaccine.	
Unit II	Disease Diagnosis	15 hrs
	Disease diagnosis using probes, monoclonal antibodies. Detection of genetic disease in fetal cells.	
Unit III	Disease treatment	15 hrs
	Products from non-recombinant and recombinant organisms, interferon, growth factors, antisense nucleotides, monoclonal antibodies, drug designing, delivery and targeting, artificial tissue. Gene therapy – types, augmentation and targeted gene transfer.	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	BIOINFORMATICS & BIOSTATISTICS
COURSE CODE	:	RJSUBT405
CREDITS	:	2
DURATION	:	45 hours

LEARNING OBJECTIVES	
1	Understand the tools used in Bioinformatics.
2	Gain an understanding of the basic concepts of Bioinformatics and Biostatistics.
3	Apply the various Statistical Tools for Analysis of Biological Data.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To study basics of bioinformatics and to understand the types and use of various databases.	10	BT levels 1,2 & 3
CO2	To understand types of sequence alignment, scoring metrics, BLAST tool and interpretation of phylogenetic trees.	10	BT levels 1,2 & 3
CO3	To acquaint students with coefficients of correlation, regression analysis, statistical hypothesis and use of various parametric tests.	10	BT levels 1,2 & 3

Paper Code: RJSUBT405	Paper-V: Bioinformatics & Biostatistics	Credits 2
Unit I	Introduction to Computers and Biological Database	15 hrs
	Computer Basics: Binary Arithmetic; Logic Circuit; Architecture; Operating System. Biological Databases : Classification of Databases - Raw and Processed Databases; Primary (NCBI), Secondary (PIR) and Tertiary or Composite (KEGG) Databases; Genome Information Resources, protein information resource - Sequence Databases, Protein Pattern Databases; Protein Structure and Classification Databases (CATH/SCOP). Protein Structure Visualization Software (RASMOL).	
Unit II	BLAST and Sequence Alignment	15 hrs
	BLAST and its Types; Pairwise Alignment : Identity and Similarity; Global and Local Alignment; Methods of sequence alignment; Scoring matrices (PAM and BLOSUM). Multiple Sequence Alignment: Methods of Multiple Alignment; Introduction to Phylogenetics	
Unit III	Biostatistics	15 hrs
	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, t-Test – Single Mean, Paired and Unpaired; Chi Square Test	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	SKILL ENHANCEMENT COURSE
TITLE OF THE SUBJECT/COURSE	:	MOLECULAR DIAGNOSTICS
COURSE CODE	:	RJSUBT406
CREDITS	:	2
DURATION	:	45 hours

LEARNING OBJECTIVES	
1	Gain an understanding of the basic Principles used in Molecular Diagnosis.
2	Gain critical thinking and analytical skills to understand new Diagnostic Methods.
3	Applying the knowledge and skills gained in the course should be useful in developing new diagnostic kits.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To study the principle of extraction, isolation and detection of DNA, RNA and Proteins, RE mapping and western blotting for diagnosis.	11	BT levels 1,2 & 3
CO2	To understand the fundamentals of PCR, components of a PCR reaction and principle of different types of PCR methods.	11	BT levels 1,2 & 3
CO3	To discuss the use of DNA Polymorphism in diagnosis and significance of genetic counseling.	11	BT levels 1,2 & 3

Paper Code: RJSUBT406	Paper VII: Research Methodology	Credits 2
Unit I	Basics of Molecular Diagnostics	15 hrs
	Characterization and analysis of Nucleic – Acids and Proteins : Extraction, Isolation and Detection of DNA, RNA and Proteins; Restriction Endonucleases and Restriction Enzyme Mapping. Hybridization Techniques : Southern, Northern, Western and FISH; Markers, Probes and its Clinical Applications.	
Unit II	Nucleic Acid Amplification Methods	15 hrs
	Target amplification : PCR - General Principle; Components of a Typical PCR Reaction; Experimental Design; Primer Designing; Control of PCR Contamination and Mispriming; PCR Product Clean-up and Detection. PCR Types: Reverse Transcriptase and Real Time PCR. Probe amplification : Ligase Chain Reaction	
Unit III	Molecular Biology based Diagnostics	15 hrs
	DNA Polymorphism and Identification: RFLP and Parentage Testing; RFLP and Sickle-Cell Anemia. Genetic Counseling and Molecular Diagnosis: Genetic Testing- Need and Uses; genetic counseling. Diagnostic Testing for Cystic Fibrosis; Fragile X Diagnostic and Carrier Testing. Ethical, Social and Legal Issues to Molecular - Genetic Testing	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	GENERAL ELECTIVE
TITLE OF THE SUBJECT/COURSE	:	RESEARCH METHODOLOGY
COURSE CODE	:	RJSUBT407
CREDITS	:	2
DURATION	:	45 hours

LEARNING OBJECTIVES	
1	Understand basic principles of Research Methodology and identify a Research Problem.
2	Understand a general definition of Research Design.
3	Identify the overall Process of Designing a Research Study from its inception to its Report

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To understand objectives of research and approaches in research methodology	12	BT levels 1,2 & 3
CO2	To acquaint students with the concept of research design and methods of data collection	12	BT levels 1,2 & 3
CO3	To study the significance and steps in writing a report and interpretation	12	BT levels 1,2 & 3

Paper Code: RJSUBT407	Paper VII: Research Methodology	Credits 2
Unit I	Research Methodology & Research Problem	15 hrs
	Meaning of Research; Objectives of Research; Motivation in Research; Types of Research; Research Approaches; Significance of Research; Research Methods versus Methodology. Research Process; Criteria of Good Research; Problems Encountered by Researchers in India; What is a Research Problem? Selecting the Problem; Necessity of Defining the Problem; Technique Involved in Defining a Problem	
Unit II	Research Design and Data Collection	15 hrs
	Meaning of Research Design; Need for Research Design; Features of a Good Design; Important Concepts Relating to Research Design; Different Research Designs; Basic Principles of Experimental Designs; Developing a Research Plan. Collection of Primary Data; Observation Method; Interview Method; Collection of Data through Questionnaires; Collection of Data through Schedules; Other Methods of Data Collection, Collection of secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method	
Unit III	Interpretation and Report Writing	15 hrs
	Meaning of Interpretation, Why Interpretation? Technique of Interpretation, Precautions in Interpretation. Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	PRACTICAL-I: PRACTICALS BASED ON RJSUBT301 AND RJSUBT302
COURSE CODE	:	RJSUBTP301
CREDITS	:	2
DURATION	:	30 hours

LEARNING OBJECTIVES	
1	Extraction and separation of plasmid by AGE
2	Use of spectrophotometer to analyze DNA samples
3	Separation of proteins by PAGE
4	Different tests that can be used to differentiate organic compounds

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Extraction of plasmid by alkaline lysis method, working of Agarose Gel.	11	BT levels 2, 3 & 4
CO2	Electrophoresis and would also help students to learn about different conformations of plasmid.	11	BT levels 2, 3 & 4
CO3	Working of spectrophotometer and interpreting the purity of plasmid sample on the basis of ratio (A260/A280) value.	1	BT levels 2, 3 & 4

CO4	Working and principle of native and SDS PAGE as analytical techniques and how to interpret the results with respect to number of chains present and purity of the sample	11	BT levels 2, 3 & 4
CO5	Various Analytical tests than can be used for Identification of organic compounds	2	BT levels 2, 3 & 4

Paper Code: RJSUBTP301	Practical-I: Practicals based on RJSUBT301 and RJSUBT302	Credits 2
1	Extraction of Plasmid DNA and Separation by Agarose Gel Electrophoresis.	
2	Determination of Purity and quantification of Plasmid DNA using UV Spectrophotometry	
3	Electrophoresis of Proteins by PAGE	
4	Identification of organic compounds: Acetone, Amide, Benzoic Acid	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	PRACTICAL-II: PRACTICALS BASED ON RJSUBT303 AND RJSUBT304
COURSE CODE	:	RJSUBTP302
CREDITS	:	2
DURATION	:	30 hours

LEARNING OBJECTIVES	
1	Use of Ouchterlony method to determine immunological relationship between two antigens .
2	Principle of Radial Immunodiffusion to determine antigen concentration
3	Principle of serological semi – quantitative and quantitative Widal tests for typhoid diagnosis.
4	Qualitative diagnosis using complementation test.
5	Principle of Latex bead agglutination/precipitation for detection of Rheumatoid Factor (RF)
6	Use of DOT BLOT for detection of proteins
7	Principle of western Blotting technique
8	Determination of linkage and distance between genes using tetrad analysis.
9	Use of pedigree analysis in diagnosis and genetic counseling

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
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CO1	Making of gel slides to perform two dimension immuno-diffusion and use of precipitin bands to classify into different classes on the basis of sharing epitopes.	3	BT levels 2, 3 & 4
CO2	Use of single radial immunodiffusion for quantitative assay of antigens	3	BT levels 2, 3 & 4
CO3	Dilution of serum samples and determining titre in the unknown sample	3	BT levels 2, 3 & 4
CO4	Use of latex as carrier particles to convert precipitation reaction to agglutination reaction to diagnose RA	3	BT levels 2, 3 & 4
CO5	Use of complement systems and RBCs as indicator systems to detect the serological reaction.	3	BT levels 2, 3 & 4
CO6	Principle of DOT BLOT in semi quantitative identification of proteins	3	BT levels 2, 3 & 4
CO7	Use of Western Blot instruments and how to use enzyme tagged antibodies for detection of proteins	11	BT levels 2, 3 & 4
CO8	Concept of linkage, Tetrad analysis, Two point crosses and three point crosses.	11	BT levels 2, 3 & 4
CO9	Properties of autosomal and sex-linked inheritance and interpretation of pedigree pattern to diagnose inheritance pattern.	11	BT levels 2, 3 & 4

Paper Code: RJSUBTP302	Practical-II: Practicals based on RJSUBT303 and RJSUBT304	Credits 2
1	Determination of antigen identity by Ouchterlony method	
2	Determination of antigen concentration by Mancini method	
3	Widal test-Semi quantitative and Quantitative	
4	Passive Agglutination- RA Factor Test.	
5	Complement Fixation Test (CFT)	
6	DOT-ELISA.	
7	Western Blotting	
8	Mapping based on Tetrad Analysis and Three Point Cross	
9	Pedigree Analysis- Autosomal and Sex-Linked	

COURSE OUTCOMES (COs) B. Sc. BIOTECHNOLOGY

SEMESTER	:	CORE SUBJECT AND SKILL ENHANCEMENT ELECTIVE PRACTICALS
TITLE OF THE SUBJECT/COURSE	:	PRACTICAL-I: PRACTICALS BASED ON RJSUBT305 AND RJSUBT306
COURSE CODE	:	RJSUBTP303
CREDITS	:	2
DURATION	:	30 hours

LEARNING OBJECTIVES	
1	Induction of an operon and determination of specific activity
2	Use of screening method to isolate antibiotic producers
3	Principle of penicillin purification by solvent extraction
4	Quantitative estimation of penicillin by iodometric method
5	Use of bioassay for estimation of penicillin
6	Use of growth curve to study growth kinetics
7	Pattern of Research paper

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Induction of lac operon by growing <i>E.coli</i> in lactose containing media, extraction of beta-galactosidase enzyme and determination of enzyme activity by estimating enzyme activity by O-nitrophenol	4	BT levels 2, 3 & 4

	method and protein content of the extract by Folin Lowry method.		
CO2	Use of crowded plate technique and Wilkins agar method for screening of antibiotic producers from soil.	5	BT levels 2, 3 & 4
CO3	Properties of penicillin and separation of penicillin by solvent extraction on basis of polarity	5	BT levels 2, 3 & 4
CO4	Use of Iodometric method for quantitative estimation of penicillin	5	BT levels 2, 3 & 4
CO5	Use of bioassay and diameter of zone of inhibition against the test organism to estimate the penicillin concentration.	5	BT levels 2, 3 & 4
CO6	Use of side arm flask, colorimeter to study the growth curve of the organism and calculation of generation time and growth rate.	5	BT levels 2, 3 & 4
CO7	Research Paper presentation, it would help students to understand the pattern of a scientific paper.	12	BT levels 2, 3 & 4

Paper Code: RJSUBTP303	Practical-I: Practicals based on RJSUBT305 and RJSUBT306	Credits 2
1	Expression of β -galactosidase and measurement of activity.	
2	Screening for an antibiotic producing strain of microorganism.	
3	Purification of Penicillin from broth culture of Penicillium spp. by solvent extraction	
4	Estimation of Penicillin from recovered broth by chemical (Iodometric) method.	
5	Estimation of Penicillin from recovered broth by biological (Bioassay) method.	
6	Preparation of review reports of Scientific Paper and Presentation (last 5 years)	

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	PRACTICAL-I: PRACTICALS BASED ON RJSUBT401 AND RJSUBT402
COURSE CODE	:	RJSUBTP401
CREDITS	:	2
DURATION	:	30 hours

LEARNING OBJECTIVES	
1	Use of LDH as marker enzyme in diagnosis
2	Significance of estimating urea and uric acid in determining renal health as part of renal function test
3	Use of biological agents for nanoparticles synthesis
4	Use of organic reactions for the synthesis of drugs

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Principle of DNPH method for quantitative assay of LDH enzyme, use of LDH serum concentration for diagnosis of disorders.	7	BT levels 2, 3 & 4
CO2	Principle of phosphotungstate method for estimation of uric acid and the diacetyl monoxime (DAM) method for estimation of urea.	7	BT levels 2, 3 & 4
CO3	Preparation of silver nanoparticles using leaves as biological reducing agent source & its characterization	8	BT levels 2, 3 & 4

	by spectrophotometer and absorption spectrum.		
CO4	Use of substitution reaction for the synthesis of drugs	8	BT levels 2, 3 & 4

Paper Code: RJSUBTP401	Practical-I: Practicals based on RJSUBT401 and RJSUBT402	Credits 2
1	Determination of LDH activity in serum	
2	Estimation of Urea and Uric acid in serum	
3	Biological Synthesis of Silver Nanoparticles and its characterization by UV- VIS Spectrophotometer.	
4	Synthesis of drugs – acetylsalicylic acid and p-nitroacetanilide	

SEMESTER	:	CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	PRACTICAL-II: PRACTICALS BASED ON RJSUBT403 AND RJSUBT404
COURSE CODE	:	RJSUBTP402
CREDITS	:	2
DURATION	:	30 hours

LEARNING OBJECTIVES	
1	Characterization and identification of pathogen
2	Preparation of heat killed vaccine and significance of sterility checking

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Use of culture methods, biochemical tests and direct microscopic examination for characterization of the pathogen.	9	BT levels 2, 3 & 4
CO2	Determination of TDP and TDT , Preparation of Typhoid vaccine and how to check sterility of the prepared vaccine.	9	BT levels 2, 3 & 4

Paper Code: RJSUBTP402	Practical-II: Practicals based on RJSUBT403 and RJSUBT404	Credits 2
1	Identification of organisms using minimum biochemical i. S. aureus ii. E. coli iii. Salmonella spp iv. Pseudomonas spp	
2	TAB vaccine preparation and sterility testing. i. Determination of TDT ii. Determination of TDP iii. Preparation of TAB vaccine iv. Sterility testing of vaccine	

SEMESTER	:	CORE SUBJECT AND SKILL ENHANCEMENT ELECTIVE PRACTICALS
TITLE OF THE SUBJECT/COURSE	:	PRACTICAL-III: PRACTICALS BASED ON RJSUBT405 AND RJSUBT406
COURSE CODE	:	RJSUBTP403
CREDITS	:	2
DURATION	:	30 hours

LEARNING OBJECTIVES	
1	Use of primary and secondary biological databases
2	Importance of alignment in bioinformatics
3	Working of restriction enzymes
4	Study of protein classification using CATH/SCOP
5	Principle of isolation of genomic DNA and its separation
6	Visualization of protein structure
7	Use of forward primer and reverse primer in PCR

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Use of NCBI, EMBL, DDBJ, PIR, KEGG	10	BT levels 2, 3 & 4
CO2	Use of BLAST tool for sequence alignment to study orthologs and paralogs	10	BT levels 2, 3 & 4

CO3	Use of CATH and SCOP databases to classify proteins	10	BT levels 2, 3 & 4
CO4	Use of Rasmol to visualize various aspects of protein	10	BT levels 2, 3 & 4
CO5	Use of Restriction enzyme digestion of plasmid DNA and separation of fragments by AGE	11	BT levels 2, 3 & 4
CO6	Designing primer for PCR using value.	11	BT levels 2, 3 & 4
CO7	Use of extraction buffer and ethanol for isolation of plant genome and its separation by AGE technique	11	BT levels 2, 3 & 4
CO8	Significance of PCR reaction components and use of PCR reader to document the result.	11	BT levels 2, 3 & 4

Paper Code: RJSUBTP403	Practical-III: Practicals based on RJSUBT405 and RJSUBT406	Credits 2
1	Familiarization with NCBI, EMBL, DDBJ, PIR, KEGG.	
2	Use of BLAST Tool	
3	Classification of Proteins using CATH/SCOP.	
4	Visualization PDB Molecules using Rasmol.	
5	Isolation and AGE of Genomic DNA from plants.	
6	Restriction Enzyme Digestion-problems on linear	
7	Primer Designing through Open Online	
8	DNA Amplification – PCR	
9	Field Project	

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Scheme of Examinations

1. For Theory exam - Two Internals of 20 marks each (IA1 and IA 2), duration 30 min each.
2. One External Theory exam (Semester End Examination, SEE) of 60 marks. Duration: 2 hours.
3. Students must appear for at least one of the two Internal Tests to be eligible for the Semester End Examination.
4. Practical evaluation will be done using continuous assessment as well as semester end practical examination totaling up to 100 marks in each of the 3 practical papers
5. A candidate will be allowed to appear for the practical examinations if he/she submits a certified journal of S.Y.B.Sc. Biotechnology or a certificate from the Head of the department / Institute to the effect that the candidate has completed the practical course of S.Y.B.Sc. Biotechnology as per the minimum requirements.
6. In case of loss of journal, a candidate must produce a certificate from the Head of the department /Institute that the practicals for the academic year were completed by the student. However, such a candidate will be allowed to appear for the practical examination, but the marks allotted for the journal will not be granted.
7. Minimum marks for passing the Theory Exam is 40% (Internal and SEE combined in each paper) and in Practical Exam 40 % individual passing in each practical.
8. For any KT examinations, there shall be ODD-ODD/EVEN-EVEN pattern followed.
9. HOD's decision, in consultation with the Principal, shall remain final and abiding to all.

Evaluation and Assessment

Evaluation (Theory): Total marks per paper - 100.

- **IA- 40 marks**
 - IA 1: Written test -20 marks
 - IA 2: Written Test / Assignment / Field Trip report -20 marks
- **Semester End Examination – 60 marks**
 - Question paper covering all units
- **Course Semester End Examination in Semester III -Paper I to VII (RJSUBT301 to RJSUBT307) and Semester IV - Paper I to VII (RJSUBT401 to RJSUBT407)**

Question	Knowledge	Understanding	Application And Analyses	Total Marks-Per Unit
Unit 1	08	03	04	15
Unit 2	08	03	04	15
Unit 3	08	03	04	15
Short notes from topics covering all the units	08	03	04	15
-TOTAL-Per objective	32	12	16	60
%WEIGHTAGE	53	20	27	100%

- **Cumulative Evaluation of DSE Paper will be assignment based**
- **Evaluation of Practicals 300 marks with individual paper passing 100 marks for each practical Sem III - RJSUBTP301, RJSUBTP302 & RJSUBTP303; Sem IV - RJSUBTP401, RJSUBTP402 & RJSUBTP403**
- Continuous Evaluation of components which require adequate duration for completion of the task, observation and interpretation
- Course end Practical Evaluation of skills of students in terms of skill, analysis, interpretation and conclusion.

Mapping of the course to employability/ Entrepreneurship/skill development

S.Y.B.Sc. BIOTECHNOLOGY SEM III

Class	Course Code	Course Name	Topic focussing on Employability/ Entrepreneurship /skill development	Employability/ Entrepreneurship/ Skill development	Specific activity
SYBSc Biotech nology	Biophysics	RJSUBT301	Microscopy and spectroscopy, Osmosis and adsorption, Electrophoretic Techniques	Skill development, Employability in R&D, Pathology lab, sales and marketing and QA/QC, and Entrepreneurship	Microscopic examination and use of electrophoresis for Plasmid, gDNA and proteins separation
	Green Chemistry	RJSUBT302	Organic Chemistry, synthesis of organic compound, Green Chemistry	Skill development by gaining understanding of fundamentals of green and organic chemistry	Analytical chemical tests
	Immunotech nology	RJSUBT303	Complement system, Immune Cell Receptors, Immunotechnolog y	Skill development, employability in R&D, Pathology lab, sales and marketing and QA/QC, and Entrepreneurship	Qualitative & quantitative Immunodiffusion assays
	Cell Biology and Cytogenetics	RJSUBT304	Cytoskeleton, Cell Membrane, Cytogenetics	Skill development, Employability Employability in Genetic counseling, Pathology lab and R&D	Pedigree analysis & Tetrad analysis
	Gene expression and regulation	RJSUBT305	Transcription, Translation, Regulation of gene expression	Skill development in molecular processes of protein synthesis and regulation of gene expression	Protein synthesis and regulation
	Bioprocess Technology	RJSUBT306	Microorganisms in Industrial	Skill development, Employability in	Poster presentation of

Class	Course Code	Course Name	Topic focussing on Employability/ Entrepreneurship /skill development	Employability/ Entrepreneurship/ Skill development	Specific activity
			processes, Preclinical studies Fermentor and process control	R&D and fermentation industry, Pharmaceutical industries and Entrepreneurship	industrial processes
	Entrepreneur ship development	RJSUBT307	Introduction to Entrepreneurship Development, Market research, Setting-up of an Enterprise and Planning	Entrepreneurship, Employability in sales and marketing	Entrepreneurship project proposal & presentation, group activity
	Practicals of	RJSUBTP301 RJSUBTP302 RJSUBTP303		Analytical skills Interpretation skills Writing skills	

S.Y.B.Sc. BIOTECHNOLOGY SEM IV

Class	Course Code	Course Name	Topic focussing on Employability/ Entrepreneurship /skill development	Employability/ Entrepreneurship/ Skill development	Specific activity
SYBSc Biotechnology	Intermediary metabolism	RJSUBT401	Carbohydrate, Amino Acid, Nucleotide and lipid metabolism, Electron transport system	Skill development, by gaining understanding of metabolic pathways and Oxidative phosphorylation	Metabolic Pathways
	Applied chemistry	RJSUBT402	Drugs & biosimilars, Molecular spectroscopy, Polymers and Nanomaterial	Skill development in spectroscopic techniques, nanomaterials and Employability in sales and marketing, QA/QC and Pharma industry.	Nanoparticle, Biosimilars
	Medical Microbiology	RJSUBT403	Host Parasite Relationship , Gram positive infectious agents, Gram negative infectious agents	Skill development in understanding of epidemiology, virulence factors Employability in Diagnostics field	Identification of infectious agents
	Biotechnology and health care	RJSUBT404	Disease prevention, Disease diagnosis Disease treatment	Skill development, Employability in Pathology laboratory, R & D and epidemiology	Disease diagnosis and treatment
	Bioinformatics and Biostatistics	RJSUBT405	Introduction to Computers and Biological Database BLAST and Sequence Alignment, Biostatistics	Skill development, Employability in R&D and Bioinformatics	Bioinformatics and Biostatistics

Class	Course Code	Course Name	Topic focussing on Employability/ Entrepreneurship /skill development	Employability/ Entrepreneurship/ Skill development	Specific activity
	Molecular diagnostics	RJSUBT406	Basics of molecular Diagnostics, Nucleic Acid Amplification Methods, Molecular Biology based Diagnostics	Skill development, Employability in Pathology laboratory, epidemiology, R&D genetics	PCR and molecular diagnostics
	Research methodology	RJSUBT407	Research Methodology and Research Problem, Research Design and Data Collection, Interpretation and Report Writing	Skill development, Employability in epidemiology, editing and advertising	Research Methodology and Report writing
	Practicals of	RJSUBTP401, RJSUBTP402 RJSUBTP403		Analytical skills Interpretation skills Writing skills	