

S. P. Mandali's
Ramnarin Ruia Autonomous College

(Affiliated to University of Mumbai)



Syllabus for

Program: UG Biotechnology

Program Code: RUSBTK

(Credit Based Semester and Grading
System for Academic Year 2024–2025)

GRADUATE ATTRIBUTES

GA	Description
	A student completing Bachelor's Degree in Science program will be able to:
GA 1	Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science.
GA 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.
GA 3	Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools.
GA 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
GA 5	Take complex challenges, work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner.
GA 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
GA 7	Follow ethical practices at work place and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it.
GA 8	Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner

PROGRAM OUTCOMES

PO	Description
	A student completing Bachelor's Degree in Science program in the subject of Biotechnology will be able to:
PO 1	Adept in basic sciences along with a thorough understanding of biotechnology principles and chemical sciences to create a foundation for higher education with the insights into interdisciplinary approach.
PO 2	Demonstrate the applications of fundamental biological processes from the molecular, cellular, industrial and environmental perspective.
PO 3	Develop effective communication skills with improved individual and team work abilities in the domain of scientific research writing. Showcase their innovative ideas and research work efficiently.
PO 4	Reflect, analyse and interpret information or data for investigating the problem in fields of biotechnology. Acquire scientific and entrepreneur skills to furnish sustainable solutions to coeval problems
PO 5	Illustrate the relevance of ethical implications and standard laboratory practices in tissue culture techniques, forensic biology, developmental biology and other fields of biotechnology.
PO 6	Apply the conceptual knowledge to develop coherent, efficacious and proficient practical, technical and analytical skills.

PROGRAMME OUTLINE

YEAR	SEMESTER	PAPER	COURSE CODE	COURSE TITLE	CREDITS
FYB Sc I	I	DSC	RUSBTK.O10 1	Biotechnology I- Fundamentals of biotechnology	3
		DSC	RUSBTKP.O1 01	Practicals based on Biotechnology I- (Fundamentals of biotechnology)	1
		DSC	RUSBTK.O10 2	Fundamentals of chemistry for biotechnology	3
		DSC	RUSBTKP.O1 01	Practicals based on Fundamentals of chemistry for biotechnology	1
		OE	RUSOEBTK. O101	Fitness - I	3
		OE	RUSOEBTKP .O101	Practicals based on Fitness - I	1
		VSC	RUSVSCBTK P.O101	Marine Biotechnology	2
		SEC	RUSSECBTKP. O101	Microscopy and microbial techniques	2
FYB Sc I	II	DSC	RUSBTK.E111	Biotechnology II- Fundamentals of genetics	3
		DSC	RUSBTKP.E11 1	Practical of Biotechnology- II	1
		DSC	RUSBTK.E11 2	Bioorganic chemistry	3
		DSC	RUSBTKP.E1 12	Practical of subject 2	1

		OE	RUSOEBTK. E111	Fitness - II	3
		OE	RUSOEBTKP .E111	Practicals based on Fitness - II	1
		VSC	RUSVSCBTK P.E111	Techniques in forensic science	2
		SEC	RUSSECBTK P.E111	Techniques in tissue culture	2

SEMESTER I**Course code: RUSBTK.O101****Course Title: BIOTECHNOLOGY I -FUNDAMENTALS OF BIOTECHNOLOGY****Academic year 2024-25****COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
CO 1	Enlist and explain the different areas covered in the field of biotechnology and describe their applications.
CO 2	Outline, distinguish and analyse different industrial biotechnological processes and comment on enrichment and screening processes of Industrially Important Strains.
CO 3	Identify, enlist and describe different types, parts, structure, functions and applications of Fermenter.
CO 4	Define immunology and explain its basic concepts.
CO 5	Identify and summarise different components of the immune system. Comment on its structure, function, types and significance.
CO 6	Examine food samples for various adulterants.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
	I	Introduction to biotechnology	15

	<p>History & Introduction to Biotechnology What is Biotechnology? Definition of Biotechnology, Traditional and Modern Biotechnology,</p> <p>Branches of Biotechnology-Plant, Animal Biotechnology, Marine Biotechnology, Agriculture, Healthcare, Industrial Biotechnology, Pharmaceutical Biotechnology, Environmental , Food biotechnology</p> <p>Biotechnology. Biotechnology Research in India. Biotechnology Institutions in India (Public and Private Sector) Biotech Success Stories</p> <p>Biotech Policy Initiatives Biotechnology in context of Developing World Public Perception of Biotechnology</p>	
II	<p>Introduction to industrial biotechnology</p> <p>Microorganisms in Industrial Processes Types of Microorganisms used in Industrial Processes: Bacteria, Fungi,</p> <p>Design of a fermenter: Stirred Tank Fermenter, Air lift, Pneumatic, Tower fermenter, - Basic Design; Parts of a Typical Industrial Fermenter.</p> <p>Process Parameters: pH, Temperature, Aeration, Agitation, Foam, Pressure, Inlet and exit gas analysis, Dissolved oxygen. Carbon dioxide electrodes, microbial biomass, Safety valves.</p>	15
III	<p>Immunology</p> <p>Overview of Immune Systems, Innate Immunity, Acquired Immunity, Local and Herd Immunity, Cell and Organs involved in Humoral and Cellular Immunity - Factors Influencing and Mechanisms of each.</p>	15

Course Code: RUSBTKP.O101**Course Title: Practicals based on Biotechnology I- (Fundamentals of biotechnology)****DETAILED SYLLABUS**

Course Code	Course/ Unit Title	Credits
RUSBTK P.O101	1. Working and use of various instruments used in biotechnology laboratories (Autoclave, Hot air Oven, Centrifuge, Water bath, Incubator and Rotary Shaker, colorimeter (study of beer lambert's law)) 2. Microbial examination of food and Isolation of organisms causing Food Spoilage. 3. Isolation of microorganisms from milk, curd, probiotics, idli batter. 4. Analysis of Milk by using MBRT,RRT and Phosphatase Test 5. Study of food adulterants 6. Qualitative estimation of antioxidant activity of food 7. Screening for Alcohol producer yeast 8. Lab Scale Production of Ethanol. 9. Estimation of Alcohol by Dichromate Method and sugar by ferricyanide method. 10. Determination of MIC for sugar and alcohol .	1

References:

1. Biotechnology – Expanding Horizons; B. D. Singh; B. Sc. Edition Kalyani Publishers.
2. Introduction to Biotechnology; Thieman and Palladino; 3rd edition; Pearson.
3. Industrial Microbiology- A. H. Patel
4. Industrial Microbiology- L. E. Casida- John Wiley & Sons
5. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY
6. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India
7. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA

8. Introduction to Immunology- C V Rao- Narosa Publishing House

RAMNARAIN RUIA AUTONOMOUS COLLEGE

SEMESTER II
Course Code: RUSBTK.E111
Course Title : BiotechnologyII - Fundamentals of
Genetics
Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Elaborate the molecular mechanism of DNA replication in prokaryotes and eukaryotes.
CO 2	Assess mechanism of DNA recombination using Holliday model
CO 3	Elaborate the concepts of Mendelian genetics and the patterns of breeding and crossbreeding
CO 4	Interpret the unusual patterns of inheritance and deviations from the Mendelian laws.
CO 5	Explain different mechanisms of horizontal gene transfer in prokaryotes.
CO6	Relate the effect of population study and its impact on the entire ecosystem.
CO7	Deduce the formation of heterochromatin and Euchromatin and apply diverse techniques to examine the chromosomes.
CO8	Analyse genetic linkage in eukaryotes using mapping techniques and study human genetic inheritance using pedigree analysis.
CO9	Analyse structural and numerical chromosomal abnormalities.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectur e s
	I	<p style="text-align: center;">Replication</p> <p>DNA Replication in Prokaryotes and Eukaryotes- Semi-conservative DNA replication, DNA Polymerases and its role, <i>E.coli</i> Chromosome Replication, Bidirectional Replication of Circular DNA molecules. Rolling Circle Replication, DNA Replication in Eukaryotes DNA Recombination Holliday Model for Recombination, Transformation</p>	15
	II	<p>Mendel's Principle in Human Genetics. Incomplete Dominance and Codominance. Multiple Alleles. Allelic series. Variations among the effects of the Mutation. Genotype and Phenotype. Environmental effect on the expression of the Human Genes. Gene Interaction. Epistasis</p> <p>Population Genetics 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</p>	15
	III	<p style="text-align: center;">Microbial and cytogenetics</p> <p>Microbial Genetics</p> <p>Genetic analysis in Bacteria- Prototrophs, Auxotrophs. Bacteriophages: Lytic and Lysogenic Development of Phage. Mechanism of Genetic Exchange in Bacteria: Conjugation; Transformation; Transduction; (Generalised Transduction, Specialized Transduction) Bacterial Transposable Elements.</p> <p>Cytogenetics: Structure of Chromosome- Heterochromatin, Euchromatin, Polytene Chromosomes. Variation in Chromosomal Structure</p>	15

		and Number: Deletion, Duplication, Inversion, Translocation, Aneuploidy, Euploidy and Polyploidy and Syndromes- Klinefelter, Turner, Cri-du-chat, Trisomy -21, Trisomy 18 and Trisomy 13. Sex Determination and Sex Linkage: Mechanism 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, ThreePoint Cross, Pedigree Analysis	
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RAMNARAIN RUIA AUTONOMOUS COLLEGE

Course Code: RUSBTKP.E111
Course Title: Practicals based on Biotechnology -II (
Fundamentals of genetics)
DETAILED SYLLABUS

Course Code	Course/ Unit Title	Credits
RUSBTKP.E111	<ol style="list-style-type: none"> 1. Problems in mendelian genetics 2. Study of Mitosis and Meiosis 3. Study of Interactions Commensalism, Mutualism, Predation and Antibiosis, Parasitism. 4. Isolation of plasmid from bacteria.and its detection using AGE 5. Isolation of genomic DNA from bacteria.and its detection using AGE 6. Isolation of genomic DNA from yeast.and its detection using AGE 7. Isolation of genomic DNA from plant.and its detection using AGE 8. Study of Abnormal Karyotyping (Chromosomal Aberration) - Deletion, Duplication, Inversion, Translocation and Syndromes- Trisomy 21, Trisomy 13, Trisomy 18, Klinefelter, Turner and Cri-du-Chat. (By usage of Software) 9. Demonstration of G- banding 10. Induction of Polyploidy by PDB/ Colchicine/ UV Treatment Using Suitable Plant material 11. Study of Polytene Chromosomes 12. Mapping based on Tetrad Analysis and Three Point Cross. 13. Pedigree Analysis- Autosomal and Sex- Linked 	1

Course Code: RUSBTK.O102

**Course Title: FUNDAMENTALS OF
CHEMISTRY FOR BIOTECHNOLOGY**

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Calculate and prepare the strengths of solutions using mass based and volume-based units of expressing concentration.
CO 2	Differentiate between primary standards and secondary standards.
CO 3	Comprehend the characteristics of liquid state, its physical properties, concept of viscosity, surface tension and its determination methods.
CO 4	Develop the skills for determination of rate, order and molecularity of reactions.
CO 5	Balance redox reactions using oxidation number method and ion electron method.
CO 6	Calculate equivalent weight of oxidising and reducing agents.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lecture s
	I	Chemical Calculations Chemical calculations: Mole concept, relation with molar mass, conversion of amount into mole and vice versa, relation with the number of particles present. Amount and concentration, volume-based units for concentration, molarity, normality, formality, mass-based unit for concentration - molality and mole	15

	<p>fraction, ppm and ppb, concept of millimoles and milliequivalents</p> <p>Problem solving based on various concentration units, Stoichiometry and calculations based on it, concept of limiting reactant and yield for a chemical reaction.</p> <p>Calculations based on stoichiometry.</p> <p>Primary standards, properties of primary standards, primary standards for different types of titrations, secondary standards, standardization, standard solutions.</p> <p>Chemistry of water</p> <p>Water as a natural resource: Physical and Chemical properties of water, significance of water as a universal solvent and its properties viz. pH, Dielectric constant, boiling point. Anomalous behavior of water. Hydrological cycle. Chemical composition of groundwater. Factors affecting solubility of gases in water. Solubility of CO₂ and O₂ in water. Water quality: Parameters for determining water quality i) Physical parameters: - pH, pE, conductivity, TS, TSS, TDS ii) Chemical Parameters- acidity, alkalinity, hardness, salinity, chlorine demand, DO, COD, iii) Biological parameter – BOD, MPN Standards for Potable and industrial water</p>	
	<p>II Chemical Kinetics:</p> <p>Rate of a reaction, rate constant and measurement of reaction rates. Order and molecularity of reaction. Integrated rate equation for zero, first and second order reactions (with equal and unequal initial concentration of the reactants).</p> <p>Kinetic characteristics of zero, first and second order reactions. Numerical problems based on zero, first and second order reactions. Methods for the determination of the order of a reaction (a) Integration method (b) Graphical method (c) Half time method (d) Ostwald's isolation method (e) differential method.</p> <p>Liquid State</p> <p>Introduction to liquid state, characteristics of liquid state, physical properties of the liquids, Determination of surface tension by drop number method using stalagmometer. Surface active solutes and surface tension, applications of surface tension measurement. Viscosity: Introduction, coefficient of viscosity. Determination</p>	15

		of coefficient of viscosity by Ostwald viscometer. Applications of viscosity measurement	
	III	Oxidation Reduction Chemistry Oxidation Reduction Chemistry, Oxidation state, oxidation number, oxidation- reduction in terms of oxidation number. Balancing redox equations by i) oxidation number method and ii) ion- electron method Calculation of equivalent weight on the basis of chemical nature. Study of, oxides of carbon, sulphur and nitrogen with respect to their Environmental impact	15

Course Code: RUSBTKP.O102

**Course Title: Practicals based on FUNDAMENTALS
OF CHEMISTRY FOR BIOTECHNOLOGY
DETAILED SYLLABUS**

Course Code	Course/ Unit Title	Credits
RUSBTKP.O102	<ol style="list-style-type: none"> 1. Safety measures and Practices in the Chemistry laboratory, including Good Lab Practices. 2. Preparation of a solution of a primary standard for acid base titrations: (any one of following) <ol style="list-style-type: none"> a. Determination of the strength of the supplied sodium hydroxide solution, using solution of a primary standard for acid base titration. b. Determination of the strength of a sample of supplied commercial hydrochloric acid. 3. Use of Secondary standards: Determination of the strength of the supplied sodium thiosulphate solution. Further, determination of the strength of the supplied iodine solution using the sodium thiosulphate solution of known strength. 4. Determination of the rate constant of a reaction: To determine the rate constant of the acid catalysed hydrolysis of methyl acetate. 5. Concept of assay of a component in a sample: (any1) <ol style="list-style-type: none"> a. Assay of acetic acid in a commercial sample of vinegar. b. Determination of the individual amounts of sodium carbonate and sodium bicarbonate in a commercial mixture of the two. 6. Mass based analysis of a given mixture: (any 1) <ol style="list-style-type: none"> a. To determine the percentage composition of a mixture of barium sulphate and ammonium chloride. b. To determine the percentage composition of a mixture of zinc oxide and zinc carbonate. 7. To determine the valence factor of $KMNO_4$ by titrating with 	1

	oxalic acid.	
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RAMNARAIN RUIA AUTONOMOUS COLLEGE

Course Code: RUSBTK.E112

Course Title : Bioorganic chemistry

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Discuss the structure and role of lipids and carbohydrates
CO 2	Classify the different types of proteins depending on their level of complexity
CO3	Determine the structure and sequence of proteins using different analytical techniques
CO 4	Identify the molecules responsible for making up the genetic material of an organism
CO 5	Distinguish between the molecular and conformational arrangement of DNA and RNA
CO 6	Evaluate the conjugal role of biomolecules inside cells and perform suitable tests to detect their presence in clinically significant samples
CO 7	Elucidate the interdependence of different biomolecules on each other

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
	I	Carbohydrates: Structure, Function, Classification, Characteristic	15

	<p>Reactions, Physical and Chemical Properties, D & L Glyceraldehydes, Structure of Monosaccharide, Disaccharides and Polysaccharides.</p> <p>Isomers of Monosaccharides, Chemical/Physical Properties of Carbohydrate, Chemical Reactions for Detection of Mono., Di and Polysaccharides,</p> <p>Lipids: Classification of Lipids, Properties of Saturated, Unsaturated Fatty Acids, Rancidity and Hydrogenation of Oils Phospholipids: Lecithin Cephalin, Plasmalogen Triacylglycerol-Structure and Function Sterols: Cholesterol: Structure and Function, Lipoproteins: Structure and Function, Storage Lipids, Structural Lipids, Action of Phospholipases, Steroids</p>	
II	<p>Proteins and Amino Acids Proteins and Amino Acids: Amino acids: Structure, Properties, Classification, Reaction of amino acids Peptides- Formation of peptide bond Protein- Structure, Classification, Properties, Functions, Primary structure determination, Sequencing of polypeptides, Primary, Secondary, Tertiary, Quaternary Structure, Protein denaturation</p>	15
III	<p>Nucleic Acids: Structure, Function of Nucleic Acids, Properties and Types of DNA, RNA. Structure of Purine and Pyrimidine Bases Hydrogen Bonding between Nitrogenous Bases in DNA Differences between DNA and RNA, Structure of Nucleosides, Nucleotides and Polynucleotides.</p> <p>Vitamins Sources , activity , functions, deficiency disorder, Overconsumption of vitamin - water soluble - B complex , C Fat soluble- A, D,E,K</p>	15

Course Code: RUSBTKP.E112

Course Title: Practicals based on subject -II

DETAILED SYLLABUS

Course Code	Course/ Unit Title	Credits
RUSBTKP.E112	1. Detection of carbohydrates using a molisch test. 2. Detection of carbohydrates using the Iodine test. 3. Detection of carbohydrates using Benedict's test. 4. Detection of carbohydrates using bial's test. 5. Detection of carbohydrates using Fehling's test. 6. Estimation of sugar using DNSA method 7. Qualitative estimation of lipids. 8. Estimation of proteins by Folin Lowry method 9. Paper Chromatography of Amino acids 10. Estimation of protein using bradford's method 11. Native PAGE 12. Estimation of vitamin by DCPIP 13. Quantitative analysis of DNA by DPA/ RNA by Orcinol method	1

MODALITY OF ASSESSMENT**DSC****Theory Examination Pattern****Internal assessment -40%- 30 Marks**

Sr.No	Evaluation Type	Marks
1	One Assignment (Animations/Presentations/Posters/ Video Making/ Skits/ Written assignments)	10
2	One class Test (multiple choice questions or objective & one sentence)	20
	Total Marks	30

B) External examination - 60 %: 45 marks**Semester End Theory Assessment - 45 marks**

I. Duration - These examinations shall be of 1 hour and 30 mins duration.

II. Paper Pattern:

1. There shall be 03 questions each of 15 marks. On each unit there will be one question. All questions shall be compulsory with internal choice within the questions.
2. 60% options will be provided

Questions	Options	Marks	Questions from
Q1	Objectives (1M each) any 3 out of 4 Brief Answer(4M each) any 3 out of 4	3 12	Unit 1
Q2	Objectives (1M each) any 3 out of 4 Brief Answer(4M each) any 3 out of 4	3 12	Unit 2
Q3	Objectives (1M each) any 3 out of 4 Brief Answer(4M each) any 3 out of 4	3 12	Unit 3

Practical Examination Pattern:**(Semester end practical examination): 50 Marks**

PARTICULARS	MARKS
Lab work	40
Journal	5
Viva	5
TOTAL	50