

S. P. Mandali's
Ramnarain 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 2021-2022)

PROGRAM OUTCOMES

PO	PO Description
	A student completing Bachelor's Degree in Science program will be able to:
PO 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.
PO 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.
PO 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.
PO 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
PO 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.
PO 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
PO 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.
PO 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 SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree in Science program in the subject of Biotechnology will be able to:
PSO 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.
PSO 2	Demonstrate the applications of fundamental biological processes from the molecular, cellular, industrial and environmental perspective.
PSO 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.
PSO 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
PSO 5	Illustrate the relevance of ethical implications and standard laboratory practices in tissue culture techniques, forensic biology, developmental biology and other fields of biotechnology.
PSO 6	Apply the conceptual knowledge to develop coherent, efficacious and proficient practical, technical and analytical skills.

PROGRAM OUTLINE

YEAR	SEMESTER	COURSE CODE	COURSE TITLE	CREDITS
I	I	RUSBTK101	Basic chemistry I	2
		RUSBTK102	Bioorganic Chemistry	2
		RUSBTKP101	Practicals based on RUSBTK101 & RUSBTK102	2
		RUSBTK103	Biodiversity and cell biology	2
		RUSBTK104	Microbial techniques	2
		RUSBTKP103	Practicals based on RUSBTK103 & RUSBTK104	2
		RUSBTK105	Introduction to Biotechnology	2
		RUSBTK106	Molecular Biology-II	2
		RUSBTKP105	Practicals based on RUSBTK105 & RUSBTK106	2
I	II	RUSBTK107	Societal Awareness	2
		RUSBTK201	Basic Chemistry-II	2
		RUSBTK202	Physical Chemistry	2
		RUSBTKP201	Practicals based on RUSBTK201 & RUSBTK202	2
		RUSBTK203	Physiology and Ecology	2
		RUSBTK204	Genetics	2

		RUSBTKP203	Practicals based on RUSBTK203 & RUSBTK204	2
		RUSBTK205	Tissue Culture	2
		RUSBTK206	Enzymology, Immunology and Biostatics	2
		RUSBTKP205	Practicals based on RUSBTK205 & RUSBTK206	2
		RUSBTK207	Globalization, Ecology and Sustainable Development	2
II	III	RUSBTK301	Biophysics	2
		RUSBTK302	Applied Chemistry- I	2
		RUSBTKP301	Practicals based on RUSBTK301 & RUSBTK302	2
		RUSBTK303	Immunology	2
		RUSBTK304	Cell Biology and Cytogenetics	2
		RUSBTKP303	Practicals based on RUSBTK303 & RUSBTK304	2
		RUSBTK305	Molecular Biology	2
		RUSBTK306	Bioprocess Technology & General Microbiology	2
		RUSBTKP305	Practicals based on RUSBTK305 & RUSBTK306	2
		RUSBTK307	Research Methodology and Scientific Writing	2

II	IV	RUSBTK401	Biochemistry	2
		RUSBTK402	Applied chemistry II: Physical Chemistry	2
		RUSBTKP401	Practicals based on RUSBTK401 & RUSBTK402	2
		RUSBTK403	Medical Microbiology	2
		RUSBTK404	Environmental Biotechnology	2
		RUSBTKP403	Practicals based on RUSBTK403 & RUSBTK404	2
		RUSBTK405	Biostatistics and Bioinformatics	2
		RUSBTK406	Molecular Diagnostics	2
		RUSBTKP405	Practicals based on RUSBTK405 & RUSBTK406	2
		RUSBTK407	Entrepreneurship Development	2
III	V	RUSBTK501	Cell Biology	2.5
		RUSBTK502	Biochemistry	2.5
		RUSBTKP501	Practicals based on RUSBTK501 & RUSBTK502	3
		RUSBTK503	Genetics and Molecular Biology	2.5
		RUSBTK504	Industrial Biotechnology	2.5
		RUSBTKP502	Practicals based on RUSBTK503 & RUSBTK504	3
		RUSBTK505	Forensic sciences-I	2

		RUSBTKP503	Practicals Based on RUSBTK505	2
III	VI	RUSBTK601	Immunology, Virology and Instrumentation	2.5
		RUSBTK602	Developmental biology and transgenesis	2.5
		RUSBTKP601	Practicals Based on RUSBTK601 & RUSBTK602	3
		RUSBTK603	Pharmacology	2.5
		RUSBTK604	Biosafety and Plant biotechnology	2.5
		RUSBTKP602	Practicals Based on RUSBTK603 & RUSBTK604	3
		RUSBTK605	Forensic sciences-II	2
		RUSBTKP603	Practicals Based on RUSBTK605	2

SEMESTER I**Course Code: RUSBTK101****Course Title: Basic Chemistry-I****Academic year 2021-22****COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
CO 1	Determine 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, physical properties and the concept of viscosity and surface tension and its determination methods.
CO 4	Know the difference between the rate of reaction and molecularity of a reaction and also the methods involved in determining the molecularity of the reaction.
CO 5	Write IUPAC name of mono and bi-functional aliphatic compounds including their cyclic analogues.
CO 6	Draw structures of organic compounds based on their systematic names.
CO 7	Comprehend the fundamental concepts which govern the structure, bonding, hybridization, bond angles and shapes of molecules.
CO 8	Know the concept of electronic effects.
CO 9	Understand the importance of reaction intermediates.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK101	I	<p style="text-align: center;">Chemical Calculations</p> <p>Chemical calculations:</p> <p>Mole concept, relation with molar mass, conversion of amount into mole and vice versa, relation with the number of particles present.</p> <p>Amount and concentration, volume-based units for concentration, molarity, normality, formality, mass-based unit for concentration - molality and mole 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>	15
	II	<p style="text-align: center;">Chemical Kinetics Liquid State</p> <p>Chemical Kinetics:</p> <p>Rate of a reaction, rate constant and measurement of reaction rates. Order and molecularity of reaction.</p> <p>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</p>	15

	<p>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</p> <p>Determination of surface tension by drop number method using stalagmometer.</p> <p>Surface active solutes and surface tension, applications of surface tension measurement.</p> <p>Viscosity: Introduction, coefficient of viscosity.</p> <p>Determination of coefficient of viscosity by Ostwald viscometer.</p> <p>Applications of viscosity measurement</p>	
	<p>III Nomenclature of Organic Compounds:</p> <p>IUPAC nomenclature of mono functional aliphatic compounds.</p> <p>IUPAC nomenclature of bi-functional aliphatic compounds and their cyclic analogues.</p> <p>Bonding and Structure of organic compounds: Concept of Hybridization (sp^3, sp^2 and sp hybridization)</p> <p>Hybridization: sp^3, sp^2 and sp hybridization of carbon and nitrogen; sp^3 and sp^2 hybridizations of oxygen in organic compounds and their geometry with suitable examples.</p> <p>Basic concepts involved in organic reaction mechanism:</p> <p>Electronic Effects: Inductive, electrometric, resonance effects, hyperconjugation</p> <p>Carbocations, Carbanions and Free radicals:</p> <p>Homolytic and heterolytic fission, examples of the same. Formation of carbocations, carbanions and free radicals. (primary, secondary, tertiary, allyl, benzyl), their relative stability.</p> <p>Organic acids and bases; their relative</p>	<p>15</p>

		strengths.	
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References:

1. University General Chemistry, 1st edition (2000), C.N. R. Rao, Macmillan Publishers, India
2. Organic Chemistry, 6th edition, (1992), Morrison Robert Thornton, Pearson Publication, Dorling Kindersley (India Pvt. Ltd.)

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Course Code: RUSBTK102

Course Title: Bioorganic Chemistry

Academic year 2021-22

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Enlist the different types of lipids and carbohydrates
CO 2	Classify the different types of proteins depending on their level of complexity
CO 3	Identify the molecules responsible for making up the genetic material of an organism
CO 4	Distinguish between the molecular and conformational arrangement of DNA and RNA
CO 5	Determine the conjugal role of biomolecules inside cells and perform suitable tests to detect their presence in clinically significant samples
CO 6	Develop understanding about the inter-dependence of various biomolecules on each other

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK102	I	Biomolecules: Carbohydrates and Lipids Carbohydrates: Structure, Function, Classification, Characteristic Reactions, Physical and Chemical Properties, D & L Glyceraldehydes, Structure of Monosaccharide, Disaccharides and Polysaccharides.	15

		<p>Isomers of Monosaccharides,</p> <p>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</p> <p>Triacylglycerol-Structure and Function</p> <p>Sterols: Cholesterol: Structure and Function, Lipoproteins: Structure and Function, Storage Lipids, Structural Lipids, Action of Phospholipases, Steroids</p>	
	II	<p>Biomolecules:Proteins and Amino Acids</p> <p>Proteins and Amino Acids: Amino acids: Structure, Properties, Classification, Reaction of amino acids</p> <p>Peptides- Formation of peptide bond</p> <p>Protein- Structure, Classification, Properties, Functions, Primary structure determination, Sequencing of polypeptides, Primary, Secondary, Tertiary, Quaternary Structure, Protein denaturation</p>	15
	III	<p>Biomolecules: Nucleic Acids</p> <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,</p> <p>Structure of Nucleosides, Nucleotides and Polynucleotides.</p>	15

References:

1. Outlines of Biochemistry: 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA
2. Principles of Biochemistry, 4th edition (1997), JefferyZubey, McGraw-Hill College, USA
3. Lehninger , Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.
4. Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet& Judith Voet , John Wiley and Sons, Inc. USA

5. Biochemistry: 7th Edition, (2012), Jeremy Berg, Lubert Stryer, W.H. Freeman and company, NY
6. Proteins: biotechnology and biochemistry, 1st edition (2001), Gary Walsch, Wiley, USA

Ramnarain Ruia Autonomous College

Course Code: RUSBTKP101**Course Title: Practicals Based on RUSBTK101 and RUSBTK102****DETAILED SYLLABUS**

Course Code	Course/ Unit Title	Credits
RUSBTKP101	<p>1. Safety measures and Practices in the Chemistry laboratory, including Good Lab Practices.</p> <p>2. Preparation of a solution of a primary standard for acid base titrations: (any one of following)</p> <ol style="list-style-type: none"> Determination of the strength of the supplied sodium hydroxide solution, using solution of a primary standard for acid base titration. Determination of the strength of a sample of supplied commercial hydrochloric acid. <p>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.</p> <p>Determination of the rate constant of a reaction: To determine the rate constant of the acid catalyzed hydrolysis of methyl acetate.</p> <p>Concept of assay of a component in a sample: (any 1)</p> <ol style="list-style-type: none"> Assay of acetic acid in a commercial sample of vinegar. Determination of the individual amounts of sodium carbonate and sodium bicarbonate in a commercial mixture of the two. <p>Mass based analysis of a given mixture: (any 1)</p> <ol style="list-style-type: none"> To determine the percentage composition of a mixture of barium sulphate and ammonium chloride. To determine the percentage composition of a mixture of zinc oxide and zinc carbonate. <p>Methods of purification in Organic Synthesis: Purification of a given compound by crystallization: A minimum of three organic compounds to be given for</p>	2

	<p>crystallization, using water and ethanol as solvents.</p> <ol style="list-style-type: none">3. Estimation of proteins by Folin Lowry method.4. Paper Chromatography of Amino acids5. Qualitative estimation of lipids.6. Quantitative analysis of DNA by DPA/ RNA by Orcinol method	
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Course Code: RUSBTK103**Course Title: Biodiversity and Cell Biology****Academic year 2021-22****COURSE OUTCOMES:**

COURSE OUTCOME	CO DESCRIPTION
CO 1	Explain the importance of taxonomy and distinguish between various living groups
CO 2	Enlist the functions of various cellular organelles
CO 3	Analyse the differences between the ultra-structures of various types of living cells
CO 4	Construct a mind-map with respect to Biodiversity of animals, plants and micro-organisms
CO 5	Justify the need for studying and cultivating bacterial and viral species
CO 6	Combine the knowledge obtained with respect to prokaryotic and eukaryotic cell structure with its evolutionary significance

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK103	I	Origin of Life and Biodiversity (Animal, Plant, Microorganisms) Concept of Biodiversity, Taxonomical, Ecological and Genetic Diversity & its Significance Introduction to Plant Diversity: Algae, Fungi, Bryophyta, Pteridophyta,	15

	<p>Gymnosperms and Angiosperms (with one example each)</p> <p>Introduction to Animal</p> <p>Diversity: Non-Chordates and Chordates (with at least one representative example.)</p> <p>Introduction to Microbial Diversity: Archaeobacteria, Eubacteria, Blue-green</p> <p>Algae, Actinomycetes, Eumycota- Habitats, Examples and Applications.</p>	
II	<p>Ultra-Structure of Prokaryotic and Eukaryotic Cell.</p> <p>Ultrastructure of Prokaryotic Cell: Concept of Cell Shape and Size. Detail. Structure of Slime Layer, Capsule, Flagella, Pili, Cell Wall (Gram Positive and Negative), Cytoplasm and Storage Bodies and Spores</p> <p>Ultrastructure of Eukaryotic Cell:</p> <p>Plasma membrane, Cytoplasmic Matrix, Microfilaments, Intermediate Filaments, and</p> <p>Microtubules Organelles of the Biosynthetic- Endoplasmic Reticulum & Golgi Apparatus. Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome Eukaryotic Ribosomes, Mitochondria and Chloroplasts</p> <p>Nucleus -Nuclear Structure, Nucleolus External Cell Coverings: Cilia and Flagella, Comparison of Prokaryotic And Eukaryotic Cells</p>	15
III	<p>Bacteria and Viruses</p> <p>Bacteria: Classification, Types, Morphology and fine structure (Size, Shape and Arrangement) Cultivation of Bacteria. Reproduction and Growth (Binary Fission, Conjugation and Endospore formation. Significance of Bacteria</p> <p>Viruses: General Characters, Classification (Plant, Animal and Bacterial Viruses), Significance</p>	15

References:

1. Microbiology-6th Edition (2006), Pelczar M.J., Chan E.C.S., Krieg N.R., The McGraw Hill Companies Inc. NY
2. Prescott's Microbiology, 8th edition (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, Linda M Sherwood, Christopher J Woolverton, Chris Woolverton, McGrawHil Science Engineering, USA
3. Microbiology- Frobisher
4. General Principles of Microbiology- Stanier
5. Fundamental Principles of Bacteriology - A. J. Salle McGraw Hill

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Course Code: RUSBTK104
Course Title: Microbial Techniques
Academic year 2021-22

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand and use the basic microscope and other microbiology lab instruments
CO 2	Demonstrate various laboratory experiments while maintaining a sterile environment
CO 3	Apply appropriate sterilization techniques depending on the need of the experiment
CO 4	Decide on the different enrichment, culturing, maintenance techniques of various microorganisms
CO 5	Analyse microbial growth by enumeration techniques and conclude about the growth statistics of a given organism
CO 6	Construct an optimum culture medium system and suitable growth condition parameters for a given organism

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK104	I	Microscopy and Stains Microscope- Simple and Compound: Principle. Parts, Functions and Applications. Dark Field and Phase Contrast Microscope.	15

		Stains and Staining Solutions- Definition of Dye and Chromogen. Structure of Dye and Chromophore. Functions of Mordant and Fixative. Natural and Synthetic Dyes. Simple Staining, Differential Staining and Acid-Fast Staining with specific examples. Special staining	
	II	<p style="text-align: center;">Sterilization Techniques</p> <p>Definition: Sterilization and Disinfection. Methods-Physical and chemical. (Physical types: -Temperature, adiation, Filtration. Chemical types: -Phenol and phenolic compounds, alcohols, halogens, heavy metals and their compounds, dyes, detergents, quaternary ammonium compounds,aldehydes, gaseous agents)</p> <p>Ideal Disinfectant. Examples of Disinfectants and Evaluation of Disinfectant</p>	15
	III	<p style="text-align: center;">Nutrition, Cultivation and Enumeration of Microorganisms</p> <p>Nutrition and Cultivation of Microorganisms</p> <p>Nutritional Requirements: Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulphur and Growth Factors. Classification of Different Nutritional Types of Organisms. Design and Types of Culture Media.</p> <p>Simple Medium, Differential, Selective and Enrichment Media, Concept of Isolation and Methods of Isolation. Pure Culture Techniques Growth and Enumeration Growth Phases,</p> <p>Enumeration of Microorganisms- Direct and Indirect Methods</p>	15

References:

1. Microbiology-6th Edition (2006), Pelczar M.J., Chan E.C.S., Krieg N.R., The McGraw Hill Companies Inc. NY
2. Prescott's Microbiology, 8th edition (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, Linda M Sherwood, Christopher J Woolverton, Chris Woolverton, McGrawHil Science Engineering, USA
3. Microbiology- Frobisher
4. General Principles of Microbiology- Stanier
5. Fundamental Principles of Bacteriology - A. J. Salle McGraw Hill

Course Code: RUSBTKP103**Course Title: Practicals Based on RUSBTK103 and RUSBTK104****DETAILED SYLLABUS**

Course Code	Course/ Unit Title	Credits
RUSBTKP103	<ol style="list-style-type: none"> 1. Components and working of Simple, Compound, Dark Field, Fluorescent and Phase Contrast Microscope 2. Use of balance and calibration of pipettes 3. Study of Beer Lambert's law and λ_{max} 4. Staining of Plant and Animal Tissues using Single and Double Staining Techniques 5. Monochrome Staining, Differential Staining, Gram Staining, and Acid-Fast Staining and Romanowsky Staining 6. Special Staining Technique for Cell Wall, Capsule and Endospores and Fungal Staining, Lipid granules, metachromatic, flagella, spirochetes 7. Motility test 8. Sterilization of Laboratory Glassware and Media using Autoclave 9. Preparation of Media- Nutrient broth and Agar, MacConkey Agar, Sabouraud's Agar 10. Isolation of Organisms, Macroscopic and microscopic studies: T-streak, Polygon method, Colony characteristics of microorganisms 11. Enumeration of microorganisms: Serial Dilution, Pour Plate, Spread Plate Method, Nephelometry, Haemocytometry, Breeds count 12. Growth Curve of <i>E. coli</i> 13. Effect of pH and temperature on growth of organisms 14. Slide culture technique 	2

Course Code: RUSBTK105

Course Title: Introduction to Biotechnology

Academic year 2021-22

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Compare biotechnology and its growth over time
CO 2	Enlist and explain its major applications and areas under research
CO 3	Identify the major allied sciences to this field
CO 4	Examine the major application areas of healthcare, food, beverage and drug industry
CO 5	Determine and distinguish its past and existing commercial products from major biotech industries
CO 6	Develop a society-oriented temperament with the knowledge gained about the applications of Biotechnology

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK105	I	<p>Scope and Introduction to Biotechnology</p> <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,</p>	15

		<p>Pharmaceutical Biotechnology, Environmental 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>Health care Biotechnology</p> <p>Introduction, Disease prevention (Vaccines), types of vaccines, Disease Diagnosis, Detection of genetic diseases, Disease treatment, Drug designing, Drug delivery and targeting, Gene therapy</p>	15
	III	<p>Food and Agriculture Biotechnology</p> <p>Food Biotechnology</p> <p>Biotechnological applications in enhancement of Food Quality Microbial role in food products Yeast, Bacterial and other Microorganisms based process and products Unit Operation in Food Processing, Food Deterioration and its Control. Study of food contaminants.</p> <p>Agriculture biotechnology</p> <p>GM Food, GM Papaya, GM Tomato, Fungal and Insect Resistant Plants Bt Crops, Bt Cotton and Bt brinjal, Golden Rice.</p>	15

References:

1. Biotechnology - Expanding Horizons; B. D. Singh; B. Sc. Edition Kalyani Publishers.
2. Introduction to Biotechnology; Thieman and Palladino; 3rd edition; Pearson.

Course Code: RUSBTK106
Course Title: Molecular Biology
Academic year 2021-22

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Define basic terms in molecular biology
CO 2	Outline the molecular model of DNA and its replication in various ways
CO 3	Construct the repercussions of different types of mutations
CO 4	Assess the various possibilities and probable reasons which may lead to mutation
CO 5	Analyse certain medical conditions related to one's genetics
CO 6	Elucidate the applications of genetics by performing appropriate tests to isolate DNA and RNA molecules.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK106	I	<p style="text-align: center;">Replication</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	15

		Transformation	
	II	<p style="text-align: center;">Mutation and DNA Repair</p> <p>Definition and Types of Mutations. Mutagenesis and Mutagens. (Examples of Physical, Chemical and Biological Mutagens). Types of Point Mutations, DNA REPAIR Photoreversal, Base Excision Repair, Nucleotide Excision Repair, Mismatch Repair, SOS Repair and Recombination Repair.</p>	15
	III	<p style="text-align: center;">Genetic variation and chromosomal basis of inheritance</p> <p>Types: Discontinuous and continuous, molecular basis of allelic variation. Historical development of chromosomal theory, nature of chromosome, chromosomal behaviour and Inheritance in eukaryotes</p>	15

References:

1. Molecular Biotechnology- Glick and Pasternan ASM Press
2. Cell and Molecular Biology - De Robertis- Lippincott Williams& Wilkins
3. Cell and Molecular Biology- Concepts and Experiments–Karp - Wiley International
4. Essential iGenetics- Peter Russell -Pearson Education
5. Microbial Genetics- Freifelder -Narosa Publishing House
6. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA
7. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA
8. Molecular Biology, 5th Edition (2011), Weaver R., McGraw Hill Science. USA
9. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press
10. Molecular Biology: genes to proteins, 4th edition (2011), Burton E Tropp Jones& Bartlett Learning, USA

Course Code: RUSBTKP105**Course Title: Practicals Based on RUSBTK105 and RUSBTK106****DETAILED SYLLABUS**

Course Code	Course/ Unit Title	Credits
RUSBTKP105	1. Working and use of various instruments used in biotechnology laboratories (Autoclave, Hot air Oven, Centrifuge, Water bath, Incubator and Rotary Shaker). 2. Microbial examination of food and Isolation of organisms causing Food Spoilage. 3. Determination of TDP, TDT, MIC 4. Isolation of microorganisms from milk, curd, probiotics, idli batter. 5. Analysis of Milk- Methylene Blue, Resazurin Test, Phosphatase Test 6. Study of food adulterants 7. Extraction of Casein from Milk 8. Meat Tenderization using Papain 9. Qualitative estimation of antioxidant activity of food 10. Isolation and purification of DNA from plant sources (genomic) 11. Agarose gel electrophoresis of Genomic DNA	2

Course Code: RUSBTK107

Course Title: Societal Awareness

Academic year 2021-22

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Get acquainted with multi-cultural diversity of Indian society and the characteristics of urban and rural population
CO 2	Comprehend the concept of disasters and how disasters can be managed and the role of disaster management agencies
CO 3	Understand the concept of marginalized groups and their rights and problems
CO 4	Apprehend the concept of minorities, their rights and related issues
CO 5	Imbibe important writing skills as well as soft skills
CO 6	Know the basics of Blog writing

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK107	I	<p>Overview of Indian Society</p> <p>a. Understanding Multi-cultural diversity of Indian society through its demographic composition: population distribution according to religion, caste and gender</p> <p>b. The concept of linguistic diversity in Indian context</p> <p>c. Regional variations – rural, urban and tribal characteristics</p>	11

	II	Rights of vulnerable groups a. Minorities: Religious and linguistic minorities: Rights, Issues and Safeguards b. Scheduled Castes: Rights, Violations, Safeguards and Social Inclusion c. Scheduled Tribes: Rights, Displacement related issues and Safeguards	12
	III	Disaster management a. Disaster management – concept, types and general effects on Human life b. Dealing with disasters and role of disaster management agencies c. Human Rights issues in addressing disasters – compensation, equitable and fair distribution of relief, resettlement and rehabilitation	11
	IV	Writing skills – I a. Business Letter/Email Writing - Job Application with CV, Statement of Purpose and Request for a Recommendation letter, Formal Email Writing b. Report Writing - Newspaper Report, Eyewitness Report, Activity Report c. Blog Writing – Food blog, Travel blog, fashion blog	11
	CLASS TEST	UNIT I	

References:

1. Ahuja, Ram, Social Problems in India, Rawat Publications, Paperback, 3rd Ed., 2014.
2. Baron, R. A., & Kalsher, M. J., Psychology: From Science to Practice, Pearson Education inc., Allyn and Bacon, 2nd Ed., 2008.
3. Bhatnagar Mamta and Bhatnagar Nitin, Effective Communication and Soft Skills, Pearson India, New Delhi, 2011.
4. Biju, M.R., Human Rights in a Developing Society, Mittal Publications, New Delhi, 2005.

5. Goel, S.L., Encyclopedia of Disaster Management, Vol. I, II & III; Deep and Deep Publications Pvt. Ltd., New Delhi, 2006.
6. Lahey, B.B., Psychology: A Introduction, McGraw Hill Publications, New York, 2007.
7. Motilal, Shashi, and Nanda, Bijoy Lakshmi, Human Rights: Gender and Environment, Allied Publishers, New Delhi, 2007.
8. Murthy, D. B. N., Disaster Management: Text and Case Studies, Deep and Deep Publications, New Delhi, 2013.
9. Parsuraman, S., and Unnikrishnan, ed., India Disasters Report II, Oxford, New Delhi, 2013
10. Rajawat, M. Human Rights and Dalits, Anmol Publications, New Delhi, 2005.
11. Reza, B. K., Disaster Management, Global Publications, New Delhi, 2010.
12. Shivananda, J, Human Rights, Alfa Publications, New Delhi, 2006
13. Teltumbde, Anand, Globalization and the Dalits, Sanket Prakashan, Nagpur, 2001
14. Thorat, Sukhdeo, Dalits in India: Search for a Common Destiny, Sage Publications, New Delhi, 2009

Modality of Assessment

Theory Examination Pattern:

A. Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	One Assignment (Animations/Presentations/Posters/ Video Making/ Skits/ Written assignments)	20
2	One class Test (multiple choice questions or objective & one sentence)	20
	Total Marks	40

B. External examination - 60 %: 60 marks

Semester End Theory Examination: (Deviation from the usual modality)

Owing to the pandemic situation prevailing in 2020 and continuing in 2021, the external examinations (Semester End) may be conducted online as per the instructions/circulars received from the University of Mumbai and Maharashtra State notifications from time to time. The conventional mode of external examination will commence again only after the declaration of normalcy by the Government authorities.

Semester End Theory Assessment - 60 marks

i. Duration - These examinations shall be of **02 hours** duration.

ii. Paper Pattern:

1. There shall be **03** questions each of **20** 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 on
Q.1)A)	Any 5 out of 8	05	Unit I

Q.1)B)	Any 3 out of 5	15	
Q.2)A)	Any 5 out of 8	05	Unit II
Q.2)B)	Any 3 out of 5	15	
Q.3)A)	Any 5 out of 8	05	Unit III
Q.3)B)	Any 3 out of 5	15	
	TOTAL	60	

Practical Examination Pattern:

(A) Internal Examination:

Heading	Practical
Journal	10
Experimental Tasks	30
Total	40

Note- Similar pattern for internal practical will be followed for all three Practical papers.

B) External (Semester end practical examination):

Particulars	Practical
Experimental Tasks	RUSBTKP101 RUSBTKP103 RUSBTKP105
Laboratory work	60
2 major practicals	20/25
1 minor practical	10
Viva	05
Spots	05
Total	60

Note – Similar pattern for external Practical will be followed for all three practical papers

Overall Examination & Marks Distribution Pattern**SEMESTER I**

Course	RUSBTK101			RUSBTK102			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP101						
	Internal			External			

Practicals	40	60	100
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Course	RUSBTK103			RUSBTK104			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP103						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK105			RUSBTK106			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP105						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK107			Grand Total
	Internal	External	Total	
Theory	40	60	100	100

Modality of Assessment (RUSBTK107)

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	One Assignment/Project based on Unit - 4	20
2	One class Test on Unit - I	20
	TOTAL	40

B) External Examination- 60%- 60 Marks

Semester End Theory Examination: (Deviation from the usual modality)

Owing to the pandemic situation prevailing in 2020 and continuing in 2021, the external examinations (Semester End) may be conducted online as per the instructions/circulars received from the University of Mumbai and Maharashtra State notifications from time to time. The conventional mode of external examination will commence again only after the declaration of normalcy by the Government authorities.

Duration - These examinations shall be of **2 hours** duration.

Paper Pattern:

- There shall be **4** questions each of **15** marks. On each unit there will be one question with internal choice Q. 1 to 3 and Q.4 will be Short notes on all three units.
- All questions shall be compulsory with internal choice within the questions.

Paper Pattern:

Question	Options	Marks	Questions Based on
Q.1)	Any 1 out of 2	15	Unit I
Q.2)	Any 1 out of 2	15	Unit II
Q.3)	Any 1 out of 2	15	Unit III

Q.4)	Write notes on - Any 2 out of 3	15	Unit I to III
	TOTAL	60	

SEMESTER II

Course Code: RUSBTK201

Course Title: Basic Chemistry - II

Academic year 2021-22

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Identify types of isomers of given organic compounds.
CO 2	Assign stereo-descriptors using CIP rules.
CO 3	Compare the stability of cycloalkanes.
CO 4	Draw the spatial arrangement of alkanes.
CO 5	Know the reactions involved in aliphatic hydrocarbons
CO 6	Recognise the mechanism involved in electrophilic aromatic substitution reactions.
CO 7	Understand the effect of nitro group on nucleophilic aromatic substitution reaction.
CO 8	Know the directing effect of the groups on electrophilic aromatic substitution reactions.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
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RUSBTK201	I	<p style="text-align: center;">Basic Chemistry II</p> <p>Stereochemistry:</p> <p>Optical Isomerism: optical activity, specific rotation, chirality, enantiomers, molecules with two similar and dissimilar chiral-centres, distereoisomers, meso structures, racemic mixture.</p> <p>Flying-wedge, Fischer, Newman and Sawhorse projection formulae (erythro, threo isomers) and their interconversion.</p> <p>Relative and absolute configuration: D/L and R/S designations.</p> <p>Geometrical isomerism in alkenes and cycloalkanes: cis-trans isomerism and E/Z notations with C.I.P rules.</p> <p>Conformation analysis of alkanes (ethane, propane and n-butane) and their relative stability on the basis of energy diagrams.</p> <p>Cycloalkanes and Conformational Analysis:</p> <p>Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of cyclohexane: Chair, boat, half chair, and twist boat forms and their relative stability with energy</p>	15
	II	<p style="text-align: center;">Aliphatic Hydrocarbons</p> <p style="text-align: center;">Chemistry of Aliphatic Hydrocarbons:</p> <p>Carbon-Carbon sigma bond: Chemistry of alkanes: Methods of Preparation of alkanes, Wurtz reaction, Wurtz-Fittig reaction, reactions of alkanes, free radical substitutions: Halogenation - relative reactivity and selectivity.</p> <p>Carbon-Carbon pi bonds: alkenes and alkynes, methods of preparation of alkenes and alkynes by elimination reactions: mechanism of E₁ and E₂. Saytzeff and Hofmann eliminations.</p>	15

		<p>Reactions of alkenes: electrophilic addition and mechanism (Markownikoff/ Anti Markownikoff addition).</p> <p>mechanism of ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2 and 1, 4-addition reactions in conjugated dienes, Diels-Alder reaction; Allylic and benzylic bromination using N-bromosuccinimide and its mechanism.</p> <p>Methods of Preparation and reactions of alkynes: Acidity, electrophilic and nucleophilic additions. hydration to form carbonyl compounds, alkylation of terminal alkynes.</p>	
	III	<p style="text-align: center;">Aromatic Hydrocarbons</p> <p>Aromatic Hydrocarbons:</p> <p>Aromaticity: Benzene, Kekule's formulation of benzene structure (historical background), Hückel's rule, anti-aromaticity, aromatic character of arenes.</p> <p>Aromaticity: cyclic carbocations/carbanions and heterocyclic compounds with suitable examples, aromaticity and acidity, relative stabilities.</p> <p>Electrophilic aromatic substitution: sulphonation and Friedel-Craft alkylation/acylation and mechanisms for the same, mechanism of halogenation, nitration of benzene:</p> <p>Directing effects of the substituent groups on electrophilic aromatic substitution, reactions of mono substituted benzene derivatives (-CH₃, -NH₂, -OH, NO₂, X)</p> <p>Nucleophilic aromatic substitution of Aryl halides (replacement by -OH group and effect of nitro substituent).</p>	15

References:

1. Organic Chemistry, 6th edition, (1992), Morrison Robert Thornton, Pearson Publication, Dorling Kindersley (India Pvt. Ltd.)

Course Code: RUSBTK202**Course Title: Inorganic & Physical Chemistry****Academic year 2021-22****COURSE OUTCOMES:**

COURSE OUTCOME	CO DESCRIPTION
CO 1	Compare the properties of main group elements in the respective groups.
CO 2	Understand Concept of metallic and nonmetallic character with respect to electropositivity.
CO 3	Know the methods of preparation of the compounds which are commercially available along with their properties and uses.
CO 4	Understand different types of oxides and oxyacids of sulphur , nitrogen - their sources and reactions.
CO 5	Balance redox reactions using oxidation number method and ion electron method.
CO 6	Calculate equivalent weight of oxidizing and reducing agents.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK202	I	Physical Chemistry Concept of Qualitative Analysis Macro, Semi-Micro, Micro, Ultra Micro, Trace Analysis Reactions involving liberation of gases, Use of Papers impregnated with Reagents in qualitative analysis (With reference to papers impregnated with starch-iodide, potassium dichromate, lead acetate, dimethyl glyoxime, and oxine reagents) (balanced Chemical Reactions)	15

		<p>problems</p> <p>Enthalpy and enthalpy change in a constant volume and constant pressure process, enthalpy change in a reversible process. Numerical problems</p> <p>limitations of first law, need for the direction of the energy change, conversion of heat into other energy forms, heat engines, mechanical efficiency of a heat engine, Carnot's cycle, Carnot's theorem, Introduction to entropy, second law of thermodynamics, different statements of second law, entropy changes in a reversible and an irreversible process, combined statement of first and second law, entropy changes for different physical processes.</p> <p>Numerical problems Spontaneous processes need for prediction of a spontaneous process, Free energy, Gibbs free energy and Helmholtz free energy, changes in Gibbs and Helmholtz's free energy and inter relation between them, criteria for spontaneity of a process.</p>	
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References:

1. Physical Chemistry University for biological sciences, 1st edition, (2005), Chang R., Science Books, USA
2. Essentials of Physical Chemistry, 24th edition, (2000), B S Bahl, G D Tuli, Arun Bahl, S. Chand Limited, India
3. Concise Inorganic Chemistry .5th edition (2008), Author: J. D. Lee, John Wiley & Sons, USA.

Course Code: RUSBTKP201**Course Title: Practicals Based on RUSBTK201 and RUSBTK202****DETAILED SYLLABUS**

Course Code	Course/ Unit Title	Credits
RUSBTKP201	<p>Paper I</p> <ol style="list-style-type: none"> 1. Characterization of organic compound containing C, H, (O), N, S and X 2. (Minimum of 6 compounds) 3. Chemical synthesis (one step) <ol style="list-style-type: none"> a. Preparation of Iodoform derivative of methyl ketone. b. Preparation of acetyl derivative of primary amine. c. Preparation of 2,4-DNP derivative of carbonyl compound. <p>Paper II:</p> <ol style="list-style-type: none"> 1. Qualitative analysis: (at least 5 mixtures to be analyzed) <ol style="list-style-type: none"> a. Semi-micro inorganic qualitative analysis of a sample containing two cations and two anions. b. Cations (from amongst): c. Pb^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Cu^{2+}, Cd^{2+}, Fe^{2+}, Ni^{2+}, Mn^{2+}, Mg^{2+}, Al^{3+}, Cr^{3+}, K^+, NH_4^+ d. Anions (From amongst): e. CO_3^{2-}, NO_2^-, NO_3^-, Cl^-, Br^-, I^-, SO_4^{2-} f. (The Qualitative analysis should not involve use of H_2S in any form) <p>To determine the valence factor of $KMnO_4$ by titrating with oxalic acid. To determine the acid-neutralising power of commercially available antacid formulation.</p> 	2

Course Code: RUSBTK203

Course Title: Physiology and Ecology

Academic year 2021-22

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Define the basic life processes of plants and animals
CO 2	Illustrate important chemical reactions and pathways involved in major processes of plants and animals
CO 3	Determine hormones and other chemical/ non-chemical factors affecting plant and animal growth characteristics
CO 4	Elucidate on the basic anatomy of organs and their systems along with their linkage to one another
CO 5	Justify the role and function of an organism at a larger level in its environment
CO 6	Interpret connections between various organisms and their environment
CO 7	Enlist various factors, living and non-living, that influence the normal functioning of the ecosystem

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK203	I	<p>Plant Physiology</p> <p>Photosynthesis, Intracellular Organization of Photosynthetic System. Fundamental Reactions of Photosynthesis, Photosynthetic Pigments, Role of Light. Hill Reaction and its Significance, Light Reactions, Cyclic and Non-Cyclic Photo induced Electron Flow, Energetics of Photosynthesis,</p>	15

		Photorespiration, Dark Phase of Photosynthesis, Calvin Cycle, C-3, C-4 pathways	
	II	<p style="text-align: center;">Animal Physiology</p> <p>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,</p> <p>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 Anticoagulants Hemoglobin and its Polymorphism Regulation of the Circulation Mechanism and working of Heart in Human.</p>	15
	III	<p style="text-align: center;">Ecosystem and Interactions</p> <p>Ecology and Biogeography. Ecosystems, Definition and Components, Structure and Function of Ecosystems. Aquatic and Terrestrial Ecosystems, Biotic and Abiotic Factors, Trophic Levels, Food Chain and Food Web, Ecological Pyramids (Energy, Biomass and Number) Ecological Succession.</p>	15

References:

1. Guyton, Text book of Medical Physiology
2. Concise Medical Physiology- Sujit K Chaudhari
3. Human Physiology- Guyton -International Edition
4. Human Anatomy- Marieb
5. Devlin R.M. (1983) - Fundamentals of Plant Physiology (Mac. Millan, New York)
6. Dutta A.C. (2000) A Classbook of Botany (Oxford University Press, UK)
7. Ganguli, Das Dutta (2011) - College Botany Vol I, II and III (New Central Book Agency, Kolkata)
8. Ecology - P.S. Verma and Agarwaal- S. Chand Publications

Course Code: RUSBTK204**Course Title: Genetics****Academic year 2021-22****COURSE OUTCOMES:**

COURSE OUTCOME	CO DESCRIPTION
CO 1	Define and explain the three laws of Heredity
CO 2	Illustrate the patterns of breeding and cross breeding
CO 3	Apply the concept of alleles, their dominant and recessive nature
CO 4	Defend the unusual patterns of inheritance and deviations from the normal laws
CO 5	Explain inheritance with respect to microorganisms
CO 6	Distinguish between different mechanisms of transfer of information between microorganisms
CO 7	Develop brief understanding about population demographics
CO 8	Relate the effect of population study and its impact on the entire ecosystem
CO 9	Relate evolution with respect to population demographics

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK204	I	Genetics Fundamentals Mendel's Laws of Heredity, Monohybrid Cross: Principle of Dominance and Segregation. Dihybrid Cross: Principle of Independent Assortment. Application of Mendel's Principles Punnett Square.	15

		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.	
	II	<p align="center">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; (Generalized Transduction, Specialized Transduction) Bacterial Transposable Elements.</p>	15
	III	<p align="center">Population Genetics</p> <p>Genetic Structure of Populations. Genotypic Frequencies and Allelic Frequencies,</p> <p>Hardy- Weinberg Law and its assumptions</p> <p>Genetic Variations in Populations-</p> <p>Measuring Genetic Variation at Protein Level and measuring Genetic Variations at DNA level</p> <p>Natural Selection. Genetic Drift Speciation</p> <p>Role of Population Genetics in Conservation Biology</p>	15

References:

1. Genetics, (2006) Strickberger MW - (Prentice Hall, India)
2. Essential iGenetics- Peter Russell -Pearson Education
3. Microbial Genetics- Freifelder -Narosa Publishing House
4. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA
5. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA
6. Molecular Biology, 5th Edition (2011), Weaver R., McGraw Hill Science. USA
7. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press.
8. Molecular Biology: genes to proteins, 4th edition (2011), Burton E Tropp Jones & Bartlett Learning, USA

Course Code: RUSBTKP203**Course Title: Practicals Based on RUSBTK203 and RUSBTK204****DETAILED SYLLABUS**

Course Code	Course/ Unit Title	Credits
RUSBTKP203	1. Study of Hill's reaction 2. Colorimetric study of Absorption Spectrum of Photosynthetic Pigments 3. Study of plasmodesmata 4. Study of stomatal apparatus 5. Activity of Salivary Amylase on Starch 6. Analysis of Urine 7. Blood count using Hemocytometer and estimation of 8. Haemoglobin in Mammalian Blood 9. Study of Human Blood Groups 10. Problems in Mendelian Genetics 11. Study of Mitosis and Meiosis 12. Study of Interactions Commensalism, Mutualism, Predation and Antibiosis, Parasitism.	2

Course Code: RUSBTK205**Course Title: Tissue Culture****Academic year 2021-22****COURSE OUTCOMES:**

COURSE OUTCOME	CO DESCRIPTION
CO 1	Construct a mind-map of the trend of cellular growth in vitro
CO 2	Enlist requirements for establishing and maintaining cell culture in laboratory
CO 3	Elaborate on the strict sterility measures to be followed in animal and plant tissue culture laboratories
CO 4	Assess and select appropriate glasswares/ plastic wares and other basic equipments
CO 5	Comprehend the current trends in plant and animal tissue culture
CO 6	Apply the practical knowledge in constructing theoretical scale-up tissue culture experiments

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK205	I	<p>Plant Tissue Culture</p> <p>Cell Theory, Concept of Cell Culture, Cellular Totipotency, Organization of Plant Tissue Culture Laboratory: Equipments and Instruments Aseptic Techniques: Washing of Glassware, Media Sterilization, Aseptic Workstation, Precautions to Maintain Aseptic Conditions. Culture Medium: Nutritional requirements of the explants, PGR's and their in-vitro roles, Media Preparation, Plant hormones. Callus Culture Technique: Introduction,</p>	15

		Principle and Protocols.	
	II	<p align="center">Animal Tissue Culture</p> <p>Basics of Animal Tissue Culture</p> <p>Introduction, Laboratory organization, Culture vessels, Culture media and Cell Culture Techniques, Equipment and Sterilization</p> <p>Methodology.</p> <p>Introduction to Animal Cell</p> <p>Cultures: types of cell culture</p>	15
	III	<p align="center">Current trends in PTC and ATC</p> <p>Current trends in PTC:</p> <p>Tissue culture in agriculture, Germplasm conservation, Embryo culture, Genetic transformation, Protoplast fusion, Haploid production, Micropropagation, Somatic embryogenesis, organogenesis, Tissue culture in pharmaceuticals, Hairy root culture.</p> <p>Current trends in ATC:</p> <p>stem cell biology, IVF technology, cancer cell biology, monoclonal antibody production, recombinant protein production, vaccine manufacturing, novel drug selection and improvement.</p>	15

References:

1. Culture of Animal cells- Ian Freshney -- John Wiley & Sons
2. Principles and Practice of Animal Tissue culture- Sudha Gangal - University Press
3. Plant Biotechnology- K. G. RamavatS.Chand Publications
4. Experiments in Plant tissue culture- Dodds and Roberts- Cambridge University Press

Course Code: RUSBTK206**Course Title: Enzymology, Immunology and Biostatistics****Academic year 2021-22****COURSE OUTCOMES:**

COURSE OUTCOME	CO DESCRIPTION
CO 1	Define immunology and explain its basic concepts
CO 2	Identify and summarize the basic cells and organs of the immune system and comment on the structure, functions and significance of the components of immune system
CO 3	Develop understanding of enzymology and explain its basic concepts
CO 4	Assess the different enzymes and the cascade they work in
CO 5	Perceive a link between the immune and the endocrine system
CO 6	Discuss biostatistics and its routine application in Biotechnology
CO 7	Understand and be able to select appropriate calculation method to approach a given problem

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK206	I	Enzymes Definition, Classification, Nomenclature, Chemical Nature, Properties of Enzymes, Mechanism of Enzyme Action, Active Sites, Enzyme Specificity, Substrate specificity, Regulation of enzyme activity Enzyme kinetics, Michaelis-Menten Equation & kinetics & variation, Inhibition. Effect of pH,	15

		Temperature, Substrate Concentration on Enzyme Activity, Co-Factors, Zymogens	
	II	<p style="text-align: center;">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. Antigens and Antibodies: Types of Antigens, General Properties of Antigens, Haptens and Superantigens</p> <p>Discovery and Structure of Antibodies (Framework region) Classes of Immunoglobulins, Antigenic Determinants</p>	15
	III	<p style="text-align: center;">Biostatistics</p> <p>Definition & Importance of Statistics in Biology</p> <p>Types of Data, Normal and Frequency Distribution</p> <p>Representation of Data and Graphs (Bar Diagrams, Pie Charts and Histogram, Polygon and Curve) Types of Population Sampling Measures of Central Tendency (For Raw, Ungroup & Group Data) Mean, Median, Mode, Measures of Dispersion, Range, Variance, Coefficient of Variance. Standard Deviation. Standard Error. Graphical representation using excel</p>	15

References:

1. Introductory Biostatistics. 1st edition. (2003), Chap T. Le. John Wiley, USA
2. Methods in Biostatistics- B. K. Mahajan -Jaypee Brothers
3. Lehninger , Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.
4. Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet& Judith Voet , John Wiley and Sons, Inc. USA
5. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co., England.
6. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY
7. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and ShubhangiSontakke, University Press, India
8. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA
9. Introduction to Immunology- C V Rao- Narosa Publishing House

Course Code: RUSBTKP205**Course Title: Practicals Based on RUSBTK205 and RUSBTK206****DETAILED SYLLABUS**

Course Code	Course/ Unit Title	Credits
RUSBTKP205	<ol style="list-style-type: none"> 1. Working and use of various Instruments used in Biotechnology Laboratory (Filter Assembly, LAF, pH meter and Colorimeter) 2. Laboratory Organization and Layout for Plant and Animal Tissue Culture Laboratory 3. Preparation of Stock Solutions and Preparation of Media for PTC 4. Aseptic Transfer Technique, Surface Sterilization and Inoculation for Callus Culture 5. Media Preparation and Sterilization (ATC) 6. Trypsinization of Tissue and Viability Count 7. Qualitative Assay of Enzyme - Amylase, Urease, Catalase, Dehydrogenase, invertase, pectinase and pepsin 8. Enzyme Kinetics: Study of the effect of pH, Temperature on activity of Enzyme 9. Study of Effect of Substrate Concentration on enzyme activity and determination of Vmax and Km 10. Biometric Analysis for Mean, Median, Mode and Standard Deviation and Data representation using frequency Polygon, Histogram and Pie Diagram 	2

Course Code: RUSBTK207**Course Title: Globalization, Ecology and Sustainable Development****Academic year 2021-22****COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
CO 1	Understand the meaning of value education and importance of human values
CO 2	Appreciate the spirit of patriotism and national integration
CO 3	Understand the concept of stress, conflicts and their types and reasons
CO 4	Learn some of the techniques of managing stress and conflicts in life
CO 5	Imbibe some important writing skills as well as soft skills
CO 6	Get acquainted with some of the contemporary rights like right to city, right to development and the rights of the working classes

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RUSBTK207	I	Value Education, Human values and National integration a. Value Education - Meaning, Need and Importance b. Human Values - Equality, Tolerance, Secularism and Justice c. Spirit of Patriotism and National Integration	11

	II	<p align="center">Contemporary rights – I</p> <p>a. Right to the City - Meaning, Evolution in India and other countries, Issues</p> <p>b. Right to Development - Evolution, Issues and scenario in India</p> <p>c. Rights of the Working class and their movements in India</p>	12
	III	<p align="center">Stress and conflict management</p> <p>a. Meaning, Types and causes of stress and conflicts</p> <p>b. Coping with stress and conflicts</p> <p>c. Stress management mechanisms - Yoga and other meditation techniques</p>	11
	IV	<p align="center">Soft skills development – I</p> <p>a. Presentation Skills</p> <p>b. Group discussions</p> <p>c. Personal Interview (Preparing Interview monologue)</p>	11
	Class test	Unit – I	

References:

1. Ahuja, Ram, *Social Problems in India*, Rawat Publications, Paperback, 3rd Ed., 2014.
2. Baron, R. A., & Kalsher, M. J., *Psychology: From Science to Practice*, Pearson Education inc., Allyn and Bacon, 2nd Ed., 2008.
3. Bhatnagar Mamta and Bhatnagar Nitin, *Effective Communication and Soft Skills*, Pearson India, New Delhi, 2011.
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6. Lahey, B.B., *Psychology: A Introduction*, McGraw Hill Publications, New York, 2007.

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Modality of Assessment

Theory Examination Pattern:

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B) External examination - 60 %: 60 marks

Semester End Theory Assessment - 60 marks

Semester End Theory Examination: (Deviation from the usual modality)

Owing to the pandemic situation prevailing in 2020 and continuing in 2021, the external examinations (Semester End) may be conducted online as per the instructions/circulars received from the University of Mumbai and Maharashtra State notifications from time to time. The conventional mode of external examination will commence again only after the declaration of normalcy by the Government authorities.

i. Duration - These examinations shall be of **02 hours** duration.

ii. Paper Pattern:

1. There shall be **03** questions each of **20** 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 on
Q.1)A)	Any 5 out of 8	05	Unit I

Q.1)B)	Any 3 out of 5	15	
Q.2)A)	Any 5 out of 8	05	Unit II
Q.2)B)	Any 3 out of 5	15	
Q.3)A)	Any 5 out of 8	05	Unit III
Q.3)B)	Any 3 out of 5	15	
	TOTAL	60	

Practical Examination Pattern:**(A) Internal Examination:**

Heading	Practical I
Journal	10
Experimental Tasks	30
Total	40

Note- Similar pattern for internal practical will be followed for all three Practical papers.

B) External (Semester end practical examination):

Particulars	Practical 1
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Experimental Tasks	RUSBTK201 RUSBTK203 RUSBTK205
Laboratory work	60
2 major practicals	20/25
1 minor practical	10
Viva	05
Spots	05
Total	60

Note – Similar pattern for external Practical will be followed for all three practical papers

Overall Examination & Marks Distribution Pattern

SEMESTER I

Course	RUSBTK201			RUSBTK202			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP201						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK203			RUSBTK204			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP203						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK205			RUSBTK206			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP205						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK207			Grand Total
	Internal	External	Total	
Theory	40	60	100	100

Modality of Assessment (RUSBTK207)

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	One Assignment/Project based on Unit - 4	20
2	One class Test on Unit - I	20
	TOTAL	40

B) External Examination- 60%- 60 Marks

Semester End Theory Examination: (Deviation from the usual modality)

Owing to the pandemic situation prevailing in 2020 and continuing in 2021, the external examinations (Semester End) may be conducted online as per the instructions/circulars received from the University of Mumbai and Maharashtra State notifications from time to time. The conventional mode of external examination will commence again only after the declaration of normalcy by the Government authorities.

Duration - These examinations shall be of **2 hours** duration.

Paper Pattern:

- There shall be **4** questions each of **15** marks. On each unit there will be one question with internal choice Q. 1 to 3 and Q.4 will be Short notes on all three units.
- All questions shall be compulsory with internal choice within the questions.

Paper Pattern:

Question	Options	Marks	Questions Based on
Q.1)	Any 1 out of 2	15	Unit I
Q.2)	Any 1 out of 2	15	Unit II
Q.3)	Any 1 out of 2	15	Unit III
Q.4)	Write notes on - Any 2 out of 3	15	Unit I to III
	TOTAL	60	