



**Autonomous**  
**Syllabus for F.Y.B.Sc.**  
**(Restructured)**

**Programme: B.Sc.**

**Course: Biotechnology**

with effect from the Academic Year

**2019 – 2020**

## PROGRAM OUTCOMES

PO	PO Description
<b>PO 1</b>	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.
<b>PO 2</b>	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.
<b>PO 3</b>	Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools.
<b>PO 4</b>	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
<b>PO 5</b>	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.
<b>PO 6</b>	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
<b>PO 7</b>	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.
<b>PO 8</b>	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
	<b>A student completing Bachelor's Degree in Science program in the subject of Biotechnology will be able to:</b>
<b>PSO 1</b>	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.
<b>PSO 2</b>	Demonstrate the applications of fundamental biological processes from the molecular, cellular, industrial and environmental perspective.
<b>PSO 3</b>	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.
<b>PSO 4</b>	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
<b>PSO 5</b>	Illustrate the relevance of ethical implications and standard laboratory practices in tissue culture techniques, forensic biology, developmental biology and other fields of biotechnology.
<b>PSO 6</b>	Apply the conceptual knowledge to develop coherent, efficacious and proficient practical, technical and analytical skills.

S.P Mandali's  
Ramnarain Ruia College  
**Department of Biotechnology**

**Syllabus for F.Y.BSc Biotechnology**

Credit based and Grading system  
To be implemented from Academic year 2019-20

<b>Semester I</b>					
<b>Course code</b>	<b>Unit</b>	<b>Topic</b>	<b>Credits</b>	<b>Lectures /week</b>	<b>45hrs/w eek</b>
Paper I: Basic chemistry I <b>RUSBTK101</b>	Unit I	Chemical Calculations	2	1	15
	Unit II	Chemical Kinetics Liquid State		1	15
	Unit III	Nomenclature of organic compounds Bonding and structure of organic compounds Basic concepts involved in organic reaction mechanism		1	15
Paper II : Bioorganic Chemistry <b>RUSBTK102</b>	Unit I	Biomolecules: Carbohydrates and Lipids	2	1	15
	Unit II	Biomolecules: Proteins and Amino Acids		1	15
	Unit III	Biomolecules: Nucleic Acids		1	15
Paper III :Biodiversity and cell biology <b>RUSBTK103</b>	Unit I	Biodiversity (Animal, Plant, Microorganisms)	2	1	15
	Unit II	Ultra Structure of Prokaryotic and Eukaryotic Cell.		1	15
	Unit III	Bacteria and Viruses		1	15
Paper IV : Microbial techniques <b>RUSBTK104</b>	Unit I	Microscopy and Stains	2	1	15
	Unit II	Sterilization Techniques		1	15
	Unit III	Nutrition, Cultivation and		1	15

		Enumeration of Microorganisms			
Paper V :Introduction to Biotechnology <b>RUSBTK105</b>	Unit I	Scope and Introduction to Biotechnology	2	1	15
	Unit II	Healthcare Biotechnology		1	15
	Unit III	Food and Agriculture Biotechnology		1	
Paper VI: Molecular Biology-II <b>RUSBTK106</b>	Unit I	Replication	2	1	15
	Unit II	Mutation and DNA Repair		1	15
	Unit III	Genetic variation and chromosomal basis of inheritance		1	15
Paper VII :Societal Awareness <b>RUSBTK107</b>	Unit I	Overview of Indian Society	2	1	15
	Unit II	Concept of Disparity		1	15
	Unit III	The Indian Constitution		1	15
Practicals <b>RUSBTKP1 01</b>	Practicals based on Paper I and Paper II (Chemistry )		2		
Practicals <b>RUSBTKP1 02</b>	Practicals based on Paper III and Paper IV (Life science)		2		
Practicals <b>RUSBTKP1 03</b>	Practicals based on Paper V and Paper VI (Biotechnology)		2		
TOTAL CREDITS			20		

<b>Semester II</b>					
Course code	Unit	Topic	Credits	Lecture s/week	45Hrs/p aper
Paper I: Basic Chemistry-II <b>RUSBTK201</b>	Unit I	Stereochemistry	2	1	15
	Unit II	Chemistry of Aliphatic Hydrocarbons		1	15
	Unit III	Aromatic Hydrocarbons		1	15
Paper II : Physical Chemistry <b>RUSBTK202</b>	Unit I	Concept of Qualitative Analysis	2	1	15
	Unit II	Oxidation Reduction Chemistry		1	15

	Unit III	Chemical Thermodynamics		1	15
Paper III : Physiology and Ecology <b>RUSBTK203</b>	Unit I	Plant Physiology	2	1	15
	Unit II	Animal Physiology		1	15
	Unit III	Ecosystem and Interactions		1	15
Paper IV : Genetics <b>RUSBTK204</b>	Unit I	Genetics Fundamentals	2	1	15
	Unit II	Microbial Genetics		1	15
	Unit III	Population Genetics		1	15
Paper V : Tissue Culture & Scientific Writing and Communication Skills <b>RUSBTK205</b>	Unit I	Plant Tissue Culture	2	1	15
	Unit II	Animal Tissue Culture		1	15
	Unit III	Current trends in PTC and ATC		1	15
Paper VI: Enzymology, Immunology and Biostatistics <b>RUSBTK206</b>	Unit I	Enzymes	2	1	15
	Unit II	Immunology		1	15
	Unit III	Biostatistics		1	15
Paper VII : Globalization, Ecology and Sustainable Development <b>RUSBTK207</b>	Unit I	Globalization and Indian Society and Human Rights	2	1	15
	Unit II	Ecology		1	15
	Unit III	Understanding stress and conflicts – Its management		1	15
Practicals <b>RUSBTKP201</b>	Practicals based on Paper I and Paper II (Chemistry )		2		
Practicals <b>RUSBTKP202</b>	Practicals based on Paper III and Paper IV (Life science)		2		
Practicals <b>RUSBTKP203</b>	Practicals based on Paper V and Paper VI (Biotechnology)		2		
TOTAL CREDITS			20		

## SEMESTER I

### Paper I

#### Learning Objectives:

The basic objective of the first unit of this paper is to recapitulate the various aspects of chemical calculations by student. Also, the various units of concentration and concept of milimoles and miliequivalence must be learned by them. The concept of stoichiometry and problems based on it is discussed profusely. The second unit of this paper significantly underlines the concept of chemical kinetics and liquid state. The student learns elaborately the various aspects of liquid state. The third unit makes student aware of nomenclature of organic compounds.

#### Learning Outcome :

- The student will be able to
- perceive the concept of mole and its relation with molar mass and do the calculations based on that.
- Understand and apply the units of volume and mass based units of concentration
- understand the concept of stoichiometry and will be able to solve the problems on it.
- understand the concept of standardization and its significance.
- understand kinetic theory of gases and various gas laws.
- understand the difference between real gas and ideal gas.
- understand the characteristics of liquid state, physical properties and the concept of viscosity and surface tension and its determination.
- understand the rate of reaction and determination of molecularity of a reaction.
- Understand the nomenclature of organic compounds.

Course code	Unit	Topics	Credits	Lectures
<b>Basic Chemistry-I</b>  <b>RUSBTK101</b>	<b>I</b> <b>Chemical Calculations</b>	<b>Chemical calculations:</b>  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	<b>2</b>	<b>15</b>

		<p>and mole fraction, ppm and ppb, concept of milimoles and miliequivalents</p> <p>Problem solving based on various concentration units</p> <p>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><b>II</b> <b>Chemical kinetics</b> <b>Liquid state</b></p>	<p><b>Chemical Kinetics:</b></p> <p>Rate of a reaction, rate constant and measurement of reaction rates.</p> <p>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.</p> <p>Numerical problems based on zero, first and second order reactions.</p> <p>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)</p>		<p>15</p>



		<p>differential method.</p> <p><b>Liquid State:</b></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><b>III</b> <b>Nomenclature of organic compounds</b></p>	<p><b>Nomenclature of Organic Compounds:</b></p> <p>IUPAC nomenclature of mono functional aliphatic compounds. IUPAC nomenclature of bi-functional aliphatic compounds and their cyclic analogues.</p> <p><b>Bonding and Structure of organic compounds:</b></p> <p>Concept of Hybridization (<math>sp^3</math>, <math>sp^2</math> and <math>sp</math> hybridization) Hybridization: <math>sp^3</math>, <math>sp^2</math> and <math>sp</math> hybridization of carbon and nitrogen; <math>sp^3</math> and <math>sp^2</math> hybridizations of oxygen in organic compounds and their</p>		15

		<p>geometry with suitable examples.</p> <p><b>Basic concepts involved in organic reaction mechanism:</b></p> <p><b>Electronic Effects:</b> Inductive, electromeric, resonance effects, hyperconjugation</p> <p><b>Carbocations, Carbanions and Free radicals:</b></p> <p>Homolytic and heterolytic fission, examples of the same.</p> <p>Formation of carbocations, carbanions and free radicals. (primary, secondary, tertiary, allyl, benzyl), their relative stability.</p> <p><b>Organic acids and bases; their relative strengths.</b></p>		
<b>Paper II</b>				
<p><b>Course Objectives:</b> To acquaint students with Bioorganic Molecules</p> <p><b>Learning Outcome:</b> To impart the knowledge of Classification, Structure and Characterization of Biomolecules</p>				
<p><b>Bioorganic Chemistry</b></p> <p><b>RUSBTK102</b></p>	<p><b>I</b></p> <p><b>Biomolecules: Carbohydrates and Lipids</b></p>	<p><b>Carbohydrates:</b> Structure, Function, Classification, Characteristic Reactions, Physical and Chemical Properties, D &amp;L</p> <p>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>	2	15

		<p><b>Lipids:</b> 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>	
	<p><b>II</b> <b>Biomolecules:</b> <b>Proteins and</b> <b>Amino Acids</b></p>	<p>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
	<p><b>III</b> <b>Biomolecules:</b> <b>Nucleic Acids</b></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, Structure of Nucleosides, Nucleotides and Polynucleotides.</p>	15

**Paper III**

**Course Objectives:**

- To acquaint students with concept of Biodiversity
- To inform about basic cellular structures and functions
- To impart skill in handling and culture of Microorganisms

**Learning Outcome:** By the end of this course student must be able to:

1. Understand importance of taxonomy and distinguish between various living groups

2. Know the function of various cellular organelles
3. Understand and distinguish between various types of living cells and also know the differences in their ultrastructure's
4. Get familiarized with various life forms at cellular level

<p><b>Biodiversity and Cell Biology</b></p> <p><b>RUSBTK103</b></p>	<p style="text-align: center;"><b>I</b></p> <p style="text-align: center;"><b>Origin of Life and Biodiversity (Animal, Plant, Microorganisms)</b></p>	<p>Concept of Biodiversity, Taxonomical, Ecological and Genetic Diversity &amp; its Significance</p> <p><b>Introduction to Plant Diversity:</b> Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms (with one example each)</p> <p><b>Introduction to Animal Diversity:</b> Non-Chordates and Chordates (with at least one representative example.)</p> <p><b>Introduction to Microbial Diversity:</b> Archaeobacteria, Eubacteria, Blue-green Algae, Actinomycetes, Eumycota- Habitats, Examples and Applications.</p>	2	15
	<p style="text-align: center;"><b>II</b></p> <p style="text-align: center;"><b>Ultra-Structure of Prokaryotic and Eukaryotic Cell.</b></p>	<p><b>Ultrastructure of Prokaryotic Cell:</b> 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><b>Ultrastructure of Eukaryotic Cell:</b> Plasma membrane, Cytoplasmic Matrix, Microfilaments, Intermediate Filaments, and Microtubules Organelles of the Biosynthetic- Endoplasmic Reticulum &amp; Golgi Apparatus. Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome Eukaryotic Ribosomes, Mitochondria</p>		15

		and Chloroplasts  Nucleus –Nuclear Structure, Nucleolus External Cell Coverings: Cilia And Flagella, Comparison of Prokaryotic And Eukaryotic Cells		
	<b>III Bacteria and Viruses</b>	<b>Bacteria:</b> 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  <b>Viruses:</b> General Characters, Classification (Plant, Animal and Bacterial Viruses), Significance		<b>15</b>

**Paper IV**

**Course Objectives:**

- To impart theoretical and knowledge of handling basic microbiology laboratory instruments
- To emphasize and practice sterilization techniques in microbiological experiments
- To acquaint students with basic techniques in Staining

**Learning Outcome:** By the end of the course student should be able to:

1. Understand and use the basic microscope and other microbiology lab instruments
2. Perform experiments while maintaining sterile environment
3. Suggest and use appropriate sterilization techniques depending on the need of the experiment
4. Enrich, Culture, maintain various microorganisms
5. Be able to enumerate and conclude about the growth statistics of a given organism
6. Suggest appropriate culture medium and suitable growth condition parameters for a given organism.

<b>Microbial Techniques</b>  <b>RUSBTK104</b>	<b>I Microscopy and Stains</b>	<b>Microscopy and Stains</b> Microscope- Simple and Compound: Principle. Parts, Functions and Applications.  Dark Field and Phase Contrast Microscope  Stains and Staining Solutions- Definition of Dye and Chromogen. Structure of Dye and Chromophore. Functions of Mordant and	<b>2</b>	<b>15</b>
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		Fixative. Natural and Synthetic Dyes. Simple Staining, Differential Staining and Acid-Fast Staining with specific examples Special staining		
	<b>II Sterilization Techniques</b>	Definition: Sterilization and Disinfection. Methods-Physical and chemical. (Physical types:- Temperature, Radiation, Filtration. Chemical types:- Phenol and phenolic compounds, alcohols, halogens, heavy metals and their compounds, dyes, detergents, quaternary ammonium compounds, aldehydes, gaseous agents)  Ideal Disinfectant. Examples of Disinfectants and Evaluation of Disinfectant		<b>15</b>
	<b>III Nutrition, Cultivation and Enumeration of Microorganisms</b>	Nutrition and Cultivation of Microorganisms  Nutritional Requirements: Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulphur and Growth Factors.  Classification of Different Nutritional Types of Organisms. Design and Types of Culture Media. Simple Medium, Differential, Selective and Enrichment Media, Concept of Isolation and Methods of Isolation. Pure Culture Techniques Growth and Enumeration Growth Phases, Enumeration of Microorganisms- Direct and Indirect Methods		<b>15</b>

**Paper V**

**Course Objectives:**

- To acquaint students with various fields of Biotechnology and their applications

- To impart the knowledge of Healthcare and Food-Agri Biotechnology

**Learning Outcome:** By the end the course student must be able to:

1. Define biotechnology and its growth over time
2. Enlist and explain its major applications and areas under research
3. Link major allied sciences to this field
4. Focus on major application areas of healthcare, food, beverage and drug industry
5. Enlist and distinguish its past and existing commercial products from major biotech industries
6. Explain about the products in pipeline and future outcomes

<b>Introduction to Biotechnology</b>  <b>RUSBTK105</b>	<b>I</b> <b>Scope and Introduction to Biotechnology</b>	History & Introduction to Biotechnology What is Biotechnology? Definition of Biotechnology, Traditional and Modern Biotechnology, Branches of Biotechnology- Plant, Animal Biotechnology, Marine Biotechnology, Agriculture, Healthcare, Industrial Biotechnology, Pharmaceutical Biotechnology, Environmental Biotechnology. Biotechnology Research in India. Biotechnology Institutions in India (Public and Private Sector) Biotech Success Stories Biotech Policy Initiatives Biotechnology in context of Developing World Public Perception of Biotechnology	2	15
	<b>II</b> <b>Health care Biotechnology</b>	Introduction, Disease prevention (Vaccines),types of vaccines,Disease Diagnosis, Detection of genetic diseases, Disease treatment, Drug designing, Drug delivery and targeting, Gene therapy		15
	<b>III</b> <b>Food and Agriculture Biotechnology</b>	<b>Food Biotechnology</b> 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. <b>Agriculture biotechnology</b> GM Food, GM Papaya, GM Tomato, Fungal and Insect		15

		Resistant Plants Bt Crops, BT Cotton and BT brinjal, Golden Rice		
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**Paper VI**

**Course Objectives:**

- To acquaint students with DNA Replication, Repair and Genetic Engineering.
- Impart the knowledge of molecular Biology Techniques.

**Learning Outcome:** By the end of the course student must be able to:

1. Understand basic molecular biology terms and definitions
2. Understand the molecular model of DNA and its replication in various ways
3. Define mutations and predict their outcomes
4. Enlist various possibilities and probable reasons which may lead to mutations
5. Explain certain medical conditions related to one's genetics
6. Elucidate the concept of heredity and passing of information from generation to other

<b>Molecular Biology</b>  <b>RUSBTK106</b>	<b>I Replication</b>	DNA Replication in Prokaryotes and Eukaryotes- Semi-conservative DNA replication, DNA Polymerases and its role, E.coli Chromosome Replication, Bidirectional Replication of Circular DNA molecules. Rolling Circle Replication, DNA Replication in Eukaryotes DNA Recombination – Holliday Model for Recombination Transformation	<b>2</b>	<b>15</b>
	<b>II Mutation and DNA Repair</b>	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.		<b>15</b>
	<b>III Genetic variation and chromosomal basis of inheritance</b>	<b>Types:</b> Discontinuous and continuous, molecular basis of allelic variation. Historical development of chromosomal theory, nature of chromosome, chromosomal behaviour and Inheritance in eukaryotes		<b>15</b>

**Paper VII**

**Course Objective:**To acquaint the students with concepts of Societal Awareness

**Learning Outcome:** To impart knowledge of Society and make students aware about the



Problems in Society				
<b>Societal Awareness</b>  <b>RUSBTK107</b>	<b>I</b> <b>Overview of Indian Society</b>	a) Multi-cultural diversity of Indian society through its demographic composition: population distribution according to religion, caste, and gender b) The concept of linguistic diversity in relation to the Indian situation c) Regional variations in the context of rural, urban and tribal demography d) The concept of diversity as difference	2	<b>11</b>
	<b>II</b> <b>Concept of Disparity</b>	<b>Concept of Disparity- I</b> a) The concept of disparity as arising out of social stratification and inequality b) The concept of gender disparity and declining sex ratio in India c) The issues faced by the Minorities and elderly population d) The inequalities faced by persons with disabilities and to know about various welfare schemes available to them <b>Concept of Disparity-II</b> a) The inequalities manifested due to the caste system and inter-group conflicts arising thereof b) The causes and effects of conflicts arising out of regionalism and linguistic differences c) Inter-group conflicts arising out of communalism d) Role of youth in promoting tolerance, peace and communal harmony as crucial		<b>23</b>

		values in strengthening the social fabric of Indian society.	
	<b>III The Indian Constitution</b>	<b>The Indian Constitution</b>  a) Making of the Indian Constitution b) Philosophy of the Constitution as set out in the Preamble c) Salient features of the Indian Constitution d) Fundamental Duties of the Indian Citizens	<b>11</b>

**Topics for Project Guidance: Growing Social Problems in India:**

1. Substance abuse- impact on youth & challenges for the future
2. HIV/AIDS- awareness, prevention, treatment and services
3. Issue of child labour- magnitude, causes, effects and response
4. Child abuse- effects and ways to prevent
5. Trafficking of women- causes, effects and response
6. Local self-government in urban and rural areas
7. Significance of 73<sup>rd</sup> and 74<sup>th</sup> Constitutional Amendment and their implications for inclusive politics
8. Role of women in Indian politics
9. Participation of women in Organized and Unorganized sectors
10. Portrayal of women in media
11. Role of NGOs in addressing social problems in India
12. Any other topic from Module 1 to 4

**SEMESTER-I  
Practical**

<b>COURSE CODE</b>	<b>CREDITS</b>	<b>TITLE</b>	<b>NOTIONAL HOURS</b>
<b>RUSBTKP101</b>	<b>2</b>	<b>Basic Chemistry</b>	<b>30 hrs</b>
	<ol style="list-style-type: none"> <li>1. <b>Safety measures and Practices in Chemistry laboratory</b>, including Good Lab Practices.</li> <li>2. <b>Preparation of a solution of a primary standard for acid base titrations:</b> (any one of following)               <ol style="list-style-type: none"> <li>a. Determination of the strength of the supplied sodium hydroxide solution, using solution of a primary standard for acid base titration.</li> <li>b. Determination of the strength of a sample of supplied commercial hydrochloric acid.</li> </ol> </li> <li>3. <b>Use of Secondary standards:</b> Determination of the strength of the</li> </ol>		

		<p>supplied sodium thiosulphate solution. Further, determination of the strength of the supplied iodine solution using the sodium thiosulphate solution of known strength.</p> <p>4. <b>Determination of the rate constant of a reaction:</b> To determine the rate constant of the acid catalyzed hydrolysis of methyl acetate.</p> <p>5. <b>Concept of assay of a component in a sample:</b> (any 1)</p> <p>a. Assay of acetic acid in a commercial sample of vinegar.</p> <p>b. Determination of the individual amounts of sodium carbonate and sodium bicarbonate in a commercial mixture of the two.</p> <p>6. <b>Mass based analysis of a given mixture:</b> (any 1)</p> <p>a. To determine the percentage composition of a mixture of barium sulphate and ammonium chloride.</p> <p>b. To determine the percentage composition of a mixture of zinc oxide and zinc carbonate.</p> <p>7. <b>Methods of purification in Organic Synthesis:</b> Purification of a given compound by crystallization: A minimum of three organic compounds to be given for crystallization, using water and ethanol as solvents.</p>	
<b>RUSBTKP103</b>	<b>2</b>	<b>Basic Life Science</b>	<b>30 hrs</b>
		<ol style="list-style-type: none"> <li>Components and working of Simple, Compound, Dark Field, Fluorescent and Phase Contrast Microscope</li> <li>Use of balance and calibration of pipettes</li> <li>Study of Beer Lamberts law and <math>\lambda_{max}</math></li> <li>Staining of Plant and Animal Tissues using Single and Double Staining Techniques</li> <li>Monochrome Staining, Differential Staining, Gram Staining, and Acid Fast Staining and Romonowsky Staining</li> <li>Special Staining Technique for Cell Wall, Capsule and Endospores and Fungal Staining, Lipid granules, metachromatic, flagella, spirochetes</li> <li>Motility test</li> <li>Sterilization of Laboratory Glassware and Media using Autoclave</li> <li>Preparation of Media- Nutrient broth and Agar, MacConkey Agar, Sabourauds Agar</li> <li>Isolation of Organisms , Macroscopic and microscopic studies: T-streak, Polygon method, Colony characteristics of microorganisms</li> <li>Enumeration of microorganisms: Serial Dilution, Pour Plate, Spread Plate Method, Nephelometry, Haemocytometry, Breeds count</li> <li>Growth Curve of E.coli</li> <li>Effect of pH and temperature on growth of organisms</li> <li>Slide culture technique</li> </ol>	
<b>RUSBTKP105</b>	<b>2</b>	<b>Basic Biotechnology</b>	<b>30 hrs</b>
		<ol style="list-style-type: none"> <li>Working and use of various instruments used in biotechnology laboratory (Autoclave, Hot air Oven, Centrifuge, Water bath, Incubator and Rotary Shaker).</li> <li>Microbial examination of food and Isolation of organisms causing Food Spoilage.</li> </ol>	

	<ol style="list-style-type: none"> <li>3. Determination of TDP, TDT, MIC</li> <li>4. Isolation of microorganisms from milk, curd, probiotics, idli batter.</li> <li>5. Analysis of Milk- Methylene Blue, Resazurin Test, Phosphatase Test</li> <li>6. Study of food adulterants</li> <li>7. Extraction of Caesin from Milk</li> <li>8. Meat Tenderization using Papain</li> <li>9. Qualitative estimation of antioxidant activity of food</li> <li>10. Isolation and purification of DNA from plant sources (genomic)</li> <li>11. Agarose Gel Electrophoresis of the genomic DNA</li> <li>12. Quantitative analysis of DNA by DPA / RNA by Orcinol method</li> </ol>
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**SEMESTER II**  
**Paper I**

**Learning Objectives:**

In order to facilitate the student to understand, the basic concepts of Organic Chemistry, the coherence of the topics were observed and the topics are included in the current syllabi. The topics such as Stereochemistry, Chemistry of Aliphatic Hydrocarbons and Aromatic Hydrocarbons form the basis of Organic Chemistry, and it is essential for students, who are pursuing higher studies in Chemistry, to have profound knowledge of these topics.

**Learning Outcome :**

After studying these topics, the students will be able to know

- Isomerism and its types
- CIP Rules and E-Z notations
- Types of cycloalkanes and their relative stability with energy
- Electrophilic aromatic substitutions.
- Directing effects of the groups in electrophilic aromatic substitutions.

Course Code	UNIT	TOPICS	Credits	Lectures
<b>Basic Chemistry II</b> <b>RUSBTK201</b>	<b>I</b> <b>Stereochemistry</b>	<b>Stereochemistry:</b>  Optical Isomerism: optical activity, specific rotation, chirality, enantiomers, molecules with two similar and dissimilar chiral-centres, distereoisomers, meso structures, racemic mixture.  Flying-wedge, Fischer, Newman	<b>2</b>	<b>15</b>

		<p>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><b>Cycloalkanes and Conformational Analysis:</b> 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>		
	<p align="center"><b>II Aliphatic Hydrocarbons</b></p>	<p><b>Chemistry of Aliphatic Hydrocarbons:</b></p> <p><b>Carbon-Carbon sigma bond:</b> <b>Chemistry of alkanes:</b> Methods of Preparation of alkanes, Wurtz reaction, Wurtz-Fittig reaction, reactions of alkanes, free radical substitutions: Halogenation - relative reactivity and selectivity.</p> <p><b>Carbon-Carbon pi bonds:</b> alkenes and alkynes, methods of preparation of alkenes and</p>		<p align="center"><b>15</b></p>

		<p>alkynes by elimination reactions: mechanism of E<sub>1</sub> and E<sub>2</sub>. Saytzeff and Hofmann eliminations.</p> <p><b>Reactions of alkenes:</b> 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><b>Methods of Preparation and reactions of alkynes:</b> Acidity, electrophilic and nucleophilic additions. hydration to form carbonyl compounds, alkylation of terminal alkynes.</p>		
	<p><b>III Aromatic Hydrocarbons</b></p>	<p><b>Aromatic Hydrocarbons:</b> Aromaticity: Benzene, Kekule's formulation of benzene structure (historical background), Hückel's rule, anti-aromaticity, aromatic character of arenes. 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,</p>		<p><b>15</b></p>

		<p>mechanism of halogenation, nitration of benzene:</p> <p>Directing effects of the substituent groups on electrophilic aromatic substitution, reactions of mono substituted benzene derivatives (-CH<sub>3</sub>, -NH<sub>2</sub>, -OH, NO<sub>2</sub>, X)</p> <p>Nucleophilic aromatic substitution of Aryl halides (replacement by -OH group and effect of nitro substituent).</p>		
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### Paper II

#### Learning Objectives:

Taking into consideration, the relevance of topics and the convenience of understanding, the topics are framed accordingly. The students are required to know chemistry of main group elements and their important properties. Also, the synthesis, properties and uses of inorganic compounds of commercial importance viz. Plaster of Paris and bleaching powder etc. must be known by them. The concept of Chemical Thermodynamics is of utmost importance in order to study spontaneity of any chemical reaction. Hence, it is included in the syllabi.

#### Learning Outcome :

The Students will be to :

- Do the comparison of the properties of main group elements in the respective groups.
- Understand Concept of metallic and non metallic character with respect to electropositivity.
- Know The methods of preparation of the compounds which are commercially available along with their properties and uses.
- Understand different types of oxides and oxyacids of sulphur, nitrogen - their

sources and reactions

- Identify health hazards their environmental implications remedial measures
- Understand basic terms used in thermodynamics.
- Understand different laws of thermodynamics and their applications
- Learn different processes in thermodynamics and its effect and various thermodynamic properties.
- Learn first law of thermodynamics and its expression in terms of relationship between Heat (q), work (w) and internal energy (U).
- Understand second law of thermodynamics and its implications.

<p><b>Physical Chemistry</b></p> <p><b>RUSBTK202</b></p>	<p><b>I</b></p> <p><b>Concept of Qualitative Analysis</b></p>	<p><b>Concept of Qualitative Analysis</b></p> <p>Macro, Semi-Micro, Micro, Ultra Micro, Trace Analysis</p> <p>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 expected).</p> <p>Precipitation equilibria: Factors affecting the solubility of an ionic compound viz. common ions, uncommon ions, temperature, nature of the solvent, pH, complexing agents (Balanced Chemical Equations and Numerical Problems Expected)</p> <p><b>Acid-Base Theories</b></p> <p>Arrhenius; Lowry-Bronsted concept ; Classification of</p>	<p>2</p>	<p>15</p>
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		<p>solvents, auto dissociation of amphi protic solvents, Lewis concept ; Usanovich concept</p> <p>Hard and Soft Acids and Bases- HSAB (with respect to occurrence and feasibility of chemical reaction);.</p>		
	<p><b>II</b> <b>Oxidation Reduction Chemistry</b></p>	<p><b>Oxidation Reduction Chemistry</b></p> <p>Oxidation state, oxidation number, oxidation- reduction in terms of oxidation number</p> <p>Balancing redox equations by i) oxidation number method and ii) ion- electron method</p> <p>Calculation of equivalent weight on the basis of chemical nature.</p> <p><b>Study of, oxides of carbon, sulfur and nitrogen with respect to their Environmental impact.</b></p>		15
	<p><b>III</b> <b>Chemical Thermodynamics</b></p>	<p><b>Chemical Thermodynamics: Recapitulation:</b> Introduction, terms involved: System, surrounding, open closed and isolated systems, intensive and extensive properties of system, state of a system, state function and path function. Different processes in thermodynamics.</p>		15

		<p>Heat (q), work (w) and internal energy (U) and their sign conventions.</p> <p>Statement of first law, work done in isothermal and adiabatic reversible processes, work done in irreversible process, internal energy change for isothermal and adiabatic processes.</p> <p>Numerical problems</p> <p>Enthalpy and enthalpy change in a constant volume and constant pressure process, enthalpy change in a reversible process.</p> <p>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</p> <p>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</p>	
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		process.		
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**Paper III**

**Course Objectives:**

- To acquaint students with Physiological Processes in Plants and Animals
- To impart the knowledge of Physiology and Ecology

**Learning Objectives :** By the end of the course student must be able to:

1. Understand basic life processes of plants and animals
2. Understand important chemical reactions and pathways involved in major processes of plants and animals
3. Have knowledge about hormones and other chemical/ non chemical factors that affect the plant and animal growth characteristics
4. Have knowledge about the basic anatomy of organs and their systems along with their linkage to one another
5. Understand the role and function of organism at a larger level in its environment
6. Link connections between various organisms and their environment
7. Enlist various factors living and non-living that influence the normal functioning of the ecosystem.

<b>Physiology and Ecology</b>  <b>RUSBTK203</b>	<b>I Plant Physiology</b>	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, Photorespiration, Dark Phase of Photosynthesis, Calvin Cycle, C-3, C-4 pathways	<b>2</b>	<b>15</b>
	<b>II Animal Physiology</b>	Physiology of Digestion Movement of Food and Absorption, Secretary functions of Alimentary Canal, Digestion and Absorption, assimilation in Gut of Mammals Anatomy of Mammalian Kidney, Structure of Nephron, Physiology of Urine Formation and Role of Kidney in Excretion and Osmoregulation Physiology of Respiration, Mechanism of Respiration Principles of Gaseous Exchange in the Blood and Body Fluids Blood and Circulation : Blood		<b>15</b>

		Composition, Structure and Function of its Constituents Blood Coagulation and Anti-Coagulants Hemoglobin and its Polymorphism Regulation of the Circulation Mechanism and working of Heart in Human.		
	<b>III Ecosystem and Interactions</b>	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.		<b>15</b>

**Paper IV**

**Course Objectives:**

- To acquaint students with concepts in Genetics
- To impart skills in Techniques in Genetic Analysis and Population Genetics

**Learning Objectives:** By the end of the course student must be able to:

1. Define and explain the three laws of Heredity
2. Explain the patterns of breeding and cross breeding
3. Explain the concept of alleles, their dominant and recessive nature
4. Explain unusual patterns of inheritance and deviations from the normal laws
5. Explain inheritance with respect to microorganisms
6. Understand different mechanisms of transfer of information between microorganisms
7. Understand population demographics
8. Relate the effect of population study and its impact on the entire ecosystem
9. Relate evolution with respect to population demographics

<b>Genetics</b>  <b>RUSBTK204</b>	<b>I Genetics Fundamentals</b>	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. Mendel's Principle in Human Genetics. Incomplete Dominance and Co-dominance. Multiple Alleles. Allelic series. Variations among the effect of the Mutation. Genotype and Phenotype. Environmental effect on the expression of the Human Genes. Gene Interaction. Epistasis.	<b>2</b>	<b>15</b>
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	<b>II Microbial Genetics</b>	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.		<b>15</b>
	<b>III Population Genetics</b>	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		<b>15</b>

**Paper V**

**Course Objectives:**

- To acquaint students with Techniques of Plant and Animal Tissue Culture
- To impart the skills of PTC, ATC and to know the current trends in tissue culture.

**Learning Outcome:** By the end of the course the student must be able to:

1. Understand behavior of cellular growth *in vitro*
2. Enlist requirements for establishing and maintaining cell culture in laboratory
3. Specify strict sterility measures to be followed in the animal and plant tissue culture laboratories
4. Select appropriate glassware/ plastic ware and other basic equipments
5. Understand the current trends in plant and animal tissue culture.

<b>Tissue Culture</b>  <b>RUSBTK205</b>	<b>I Plant Tissue Culture</b>	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	<b>2</b>	<b>15</b>
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		Callus Culture Technique: Introduction, Principle and Protocols.		
	<b>II Animal Tissue Culture</b>	Basics of Animal Tissue Culture Introduction, Laboratory organization, Culture vessels, Culture media and Cell Culture Techniques, Equipment and Sterilization Methodology. Introduction to Animal Cell Cultures: types of cell culture		<b>15</b>
	<b>III Current trends in PTC and ATC</b>	Current trends in PTC: 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. Current trends in ATC: stem cell biology, IVF technology, cancer cell biology, monoclonal antibody production, recombinant protein production, vaccine manufacturing, novel drug selection and improvement.		<b>15</b>

**Paper VI**

**Course Objectives:**

- To acquaint students with concepts in Enzymology, Immunology and Biostatistics
- To impart the skills in Enzyme Kinetics, Immunological Techniques and Biostatistics

**Learning Outcome:** By the end of the course the student must be able to:

1. Define immunology and explain its basic concepts
2. Familiarize with basic cells of the immune system
3. Define enzymology and explain its basic concepts
4. Familiarize with different enzymes and the cascade they work in
5. Develop a link between the immune and the endocrine system
6. Define biostatistics
7. Understand and be able to select appropriate calculation method to approach a given problem
8. Distinguish between different statistical methods and apply them for given biological calculations

<b>Enzymology, Immunology</b>	<b>I Enzymes</b>	Definition, Classification, Nomenclature, Chemical Nature, Properties of Enzymes,	<b>2</b>	<b>15</b>
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<b>and Biostatistics</b>  <b>RUSBTK206</b>		Mechanism of Enzyme Action, Active Sites, Enzyme Specificity, Substrate specificity, Regulation of enzyme activity Effect of pH, Temperature, Substrate Concentration on Enzyme Activity, Co-Factors, Zymogens		
	<b>II Immunology</b>	Overview of Immune Systems, Innate Immunity, Acquired Immunity, Local and Herd Immunity, Cell and Organs involved  Humoral and Cellular Immunity - Factors Influencing and Mechanisms of each. Antigens and Antibodies: Types of Antigens, General Properties of Antigens, Haptens and Superantigens Discovery and Structure of Antibodies (Framework region) Classes of Immunoglobulins, Antigenic Determinants.		15
	<b>III Biostatistics</b>	Defination&Importance of Statistics in Biology Types of Data, Normal and Frequency Distribution 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 Derivation. Standard Error. Graphical representation using excel		15

**Paper VII**

**Course Objective:** To acquaint the students with concepts of Globalization, Ecology and Environment

**Learning Outcome:** To impart knowledge of Globalization and make students aware about the Problems in Society

<b>Globalization, Ecology and</b>	<b>I Globalization and Indian</b>	<b>Globalization and Indian Society</b> a) Understanding the	<b>2</b>	<b>23</b>
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<p><b>Sustainable Development</b></p> <p><b>RUSBTK207</b></p>	<p><b>Society and Human Rights</b></p>	<p>concepts of liberalization, privatization and globalization</p> <p>b) Growth of Information technology and communication and its impact on everyday life</p> <p>c) Impact of globalization on industry; changes in employment and increasing migration</p> <p>d) Changes in agrarian sector due to globalization; rise in corporate farming and increase in farmers' suicides</p> <p><b>Human Rights</b></p> <p>a) Concept of Human Rights – Its origin and evolution</p> <p>b) The Universal Declaration of Human Rights</p> <p>c) Human Rights constituents with special reference to Fundamental Rights and stated in the Indian constitution</p> <p>d) Directive Principles of the State Policy enshrined in Indian Constitution</p>		
	<p><b>Unit II Ecology</b></p>	<p><b>Ecology</b></p> <p>a) Concept of Ecology and Environment</p> <p>b) Environmental degradation – Its causes and impact on human life</p> <p>c) Sustainable development – concept and components</p> <p>d) Role of an Indian individuals and organizations in environment protection movements</p>		<p><b>11</b></p>



	<b>III Understanding stress and conflicts – Its management</b>	a) Agents of socialization and their role in development of the individual b) Causes and impact of stress and conflicts c) Types of conflicts and conflict resolution, stress management d) Psychological and Philosophical Counseling as methods of coping	<b>11</b>

**Topics for Project Guidance: Growing Social Problems in India:**

1. Impact of Globalization on marginalized groups
2. Increasing urbanization, problems of housing, health and sanitation
3. Changing lifestyle and its impact on Indian culture
4. Impact of consumerism and materialism in today's society
5. Farmers' Suicide and agrarian distress
6. Land acquisition and change of land use
7. Debate regarding genetically modified crops
8. Development projects and human rights violations
9. Increasing crimes among youth and its impact on society
10. Increasing rate of suicide amongst youth and its impact
11. Impact of social media on stress and leading to conflicts
12. Any other topic from Module 1 to 4

**SEMESTER-II  
Practical**

COURSE CODE	CREDITS	TITLE	NOTIONAL HOURS
<b>RUSBTKP201</b>	<b>2</b>	<b>Chemistry</b>	<b>30hrs</b>
	<p><b>Paper I</b></p> <p style="text-align: center;"><b>1. Characterization of organic compound containing C, H, (O), N, S and X</b> (Minimum of 6 compounds) <b>Chemical synthesis (one step)</b></p> <p style="text-align: center;">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> <p><b>Paper II:</b></p>		

		<ol style="list-style-type: none"> <li><b>Qualitative analysis:</b> (at least 5 mixtures to be analyzed) Semi-micro inorganic qualitative analysis of a sample containing two cations and two anions. Cations (from amongst): <math>Pb^{2+}</math>, <math>Ba^{2+}</math>, <math>Ca^{2+}</math>, <math>Sr^{2+}</math>, <math>Cu^{2+}</math>, <math>Cd^{2+}</math>, <math>Fe^{2+}</math>, <math>Ni^{2+}</math>, <math>Mn^{2+}</math>, <math>Mg^{2+}</math>, <math>Al^{3+}</math>, <math>Cr^{3+}</math>, <math>K^+</math>, <math>NH_4^+</math> Anions (From amongst): <math>CO_3^{2-}</math>, <math>NO_2^-</math>, <math>NO_3^-</math>, <math>Cl^-</math>, <math>Br^-</math>, <math>I^-</math>, <math>SO_4^{2-}</math>, (The Qualitative analysis should not involve use of <math>H_2S</math> in any form)</li> <li>To determine the valence factor of <math>KMnO_4</math> by titrating with oxalic acid.</li> <li>To determine the acid-neutralising power of commercially available antacid formulation.</li> </ol>	
<b>RUSBTKP203</b>	<b>2</b>	<b>Life Science</b>	<b>30 hrs</b>
		<ol style="list-style-type: none"> <li>Study of Hill's reaction</li> <li>Colorimetric study of Absorption Spectrum of Photosynthetic Pigments</li> <li>Study of plasmodesmata</li> <li>Study of stomatal apparatus</li> <li>Activity of Salivary Amylase on Starch</li> <li>Analysis of Urine</li> <li>Blood count using Haemocytometer and estimation of</li> <li>Haemoglobin in Mammalian Blood</li> <li>Study of Human Blood Groups</li> <li>Problems in Mendelian Genetics</li> <li>Study of Mitosis and Meiosis</li> <li>Study of Interactions Commensalism, Mutualism, Predation and Antibiosis, Parasitism.</li> </ol>	
<b>RUSBTKP205</b>	<b>2</b>	<b>Biotechnology</b>	<b>30 hrs</b>
		<ol style="list-style-type: none"> <li>Working and use of various Instruments used in Biotechnology Laboratory (Filter Assembly, LAF, pH meter and Colorimeter)</li> <li>Laboratory Organization and Layout for Plant and Animal Tissue Culture Laboratory</li> <li>Preparation of Stock Solutions and Preparation of Media for PTC</li> <li>Aseptic Transfer Technique, Surface Sterilization and Inoculation for Callus Culture</li> <li>Media Preparation and Sterilization (ATC)</li> <li>Trypsinization of Tissue and Viability Count</li> <li>Qualitative Assay of Enzyme - Amylase, Urease, Catalase and Dehydrogenase</li> <li>Enzyme Kinetics: Study of the effect of pH, Temperature on</li> </ol>	

	<p>activity of Enzyme</p> <p>9. Study of Effect of Substrate Concentration on enzyme activity and determination of <math>V_{max}</math> and <math>K_m</math></p> <p>10. Biometric Analysis for Mean, Median, Mode and Standard Deviation and Data representation using frequency Polygon, Histogram and Pie Diagram</p>
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## 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 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	
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**Practical Examination Pattern:**

**(A) Internal Examination:**

Heading	Practical I
<i>Test (2 performing practicals)</i> <i>RUSBTKP101/201</i> <i>RUSBTKP103/203</i> <i>RUSBTKP105/205</i>	30
<i>Journal</i>	10
<b>Total</b>	40

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

**(B) External (Semester end practical examination):**

Particulars	Practical 1
<i>Laboratory work</i>	60
<i>2 major practicals</i>	20/25
<i>1 minor practicals</i>	10
<i>Viva</i>	10/5
<b>Total</b>	<b>60</b>

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

**PRACTICAL BOOK/JOURNAL**

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

**In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / In charge of the department; failing which the student will not be allowed to appear for the practical examination.**

### Overall Examination and Marks Distribution Pattern

Semester: I/ II

Course	<i>RUSBTKP101/201</i>			<i>RUSBTKP102/202</i>			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

Course	<i>RUSBTKP103/203</i>			<i>RUSBTKP104/204</i>			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

Course	<i>RUSBTKP105/205</i>			<i>RUSBTKP106/206</i>			Grand Total
	Internal	External	Total	Internal	External	Total	



<b>Theory</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>200</b>
<b>Practicals</b>	<b>20</b>	<b>30</b>	<b>50</b>	<b>20</b>	<b>30</b>	<b>50</b>	<b>100</b>

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