AC/II(20-21).2.RUS3

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 2020–2021)

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
		RUSBTK107	Foundation Course	2
I	II	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 & Scientific Writing and Communication Skills	2
		RUSBTK206	Enzymology, Immunology and Biostatics	2
		RUSBTKP205	Practicals based on RUSBTK205 & RUSBTK206	2
		RUSBTK207	Foundation Course	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 2020-21

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**	**Chemical Calculations** **Chemical calculations:** Mole concept, relation with molar mass, conversion of amount into mole and vice versa, relation with the number of particles present. Amount and concentration, volume-based units for concentration, molarity, normality, formality, mass-based unit for concentration - molality and mole fraction, ppm and ppb, concept of millimoles and milliequivalents Problem solving based on various concentration units, Stoichiometry and calculations based on it, concept of limiting reactant and yield for a chemical reaction. Calculations based on stoichiometry. Primary standards, properties of primary standards, primary standards for different types of titrations, secondary standards, standardization, standard solutions.	**15**
	II	**Chemical Kinetics Liquid State** **Chemical Kinetics:** Rate of a reaction, rate constant and measurement of reaction rates. Order and molecularity of reaction. Integrated rate equation for zero, first and second order reactions (with equal and unequal initial concentration of the reactants). 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	**15**

		time method (d) Ostwald's isolation method (e) differential method. **Liquid State:** Introduction to liquid state, characteristics of liquid state, physical properties of the liquids Determination of surface tension by drop number method using stalagmometer. Surface active solutes and surface tension, applications of surface tension measurement. Viscosity: Introduction, coefficient of viscosity. Determination of coefficient of viscosity by Ostwald viscometer. Applications of viscosity measurement	
	III	**Nomenclature of Organic Compounds:** IUPAC nomenclature of mono functional aliphatic compounds. IUPAC nomenclature of bi-functional aliphatic compounds and their cyclic analogues. **Bonding and Structure of organic compounds:** Concept of Hybridization (sp3, sp^2 and sp hybridization) 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. **Basic concepts involved in organic reaction mechanism:** **Electronic Effects:** Inductive, electrometric, resonance effects, hyperconjugation **Carbocations, Carbanions and Free radicals:** Homolytic and heterolytic fission, examples of the same. Formation of carbocations, carbanions and free radicals. (primary, secondary, tertiary, allyl, benzyl), their relative stability.	**15**

		Organic acids and bases; their relative strengths.	

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.)

Course Code: RUSBTK102

Course Title: Bioorganic Chemistry

Academic year 2020-21

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**

		Isomers of Monosaccharides, Chemical/Physical Properties of Carbohydrate, Chemical Reactions for Detection of Mono., Di and Polysaccharides, **Lipids:** Classification of Lipids, Properties of Saturated, Unsaturated Fatty Acids, Rancidity and Hydrogenation of Oils Phospholipids: Lecithin Cephalin, Plasmalogen Triacylglycerol-Structure and Function Sterols: Cholesterol: Structure and Function, Lipoproteins: Structure and Function, Storage Lipids, Structural Lipids, Action of Phospholipases, Steroids	
	II	**Biomolecules: Proteins and Amino Acids** Proteins and Amino Acids: Amino acids: Structure, Properties, Classification, Reaction of amino acids Peptides- Formation of peptide bond Protein- Structure, Classification, Properties, Functions, Primary structure determination, Sequencing of polypeptides, Primary, Secondary, Tertiary, Quaternary Structure, Protein denaturation	**15**
	III	**Biomolecules: Nucleic Acids** 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.	**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), Jeffory Zubey, 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, 1stedition (2001), Gary Walsch, Wiley, USA

Course Code: RUSBTKP101

Course Title: Practicals Based on RUSBTK101 and RUSBTK102

DETAILED SYLLABUS

Course Code	Course/ Unit Title	Credits
RUSBTKP101	1. Safety measures and Practices in the Chemistry laboratory, including Good Lab Practices. 2. Preparation of a solution of a primary standard for acid base titrations: (any one of following) a. Determination of the strength of the supplied sodium hydroxide solution, using solution of a primary standard for acid base titration. b. Determination of the strength of a sample of supplied commercial hydrochloric acid. 3. Use of Secondary standards: Determination of the strength of the supplied sodium thiosulphate solution. Further, determination of the strength of the supplied iodine solution using the sodium thiosulphate solution of known strength. 4. Determination of the rate constant of a reaction: To determine the rate constant of the acid catalyzed hydrolysis of methyl acetate. 5. Concept of assay of a component in a sample: (any 1) a. Assay of acetic acid in a commercial sample of vinegar. b. Determination of the individual amounts of sodium carbonate and sodium bicarbonate in a commercial mixture of the two. 6. Mass based analysis of a given mixture: (any 1) a. To determine the percentage composition of a mixture of barium sulphate and ammonium chloride. c. To determine the percentage composition of a mixture of zinc oxide and zinc carbonate. 7. Methods of purification in Organic Synthesis: Purification of a given compound by crystallization: A	**2**

	minimum of three organic compounds to be given for crystallization, using water and ethanol as solvents.	

Course Code: RUSBTK103

Course Title: Biodiversity and Cell Biology

Academic year 2020-21

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**:	**15**

		Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms (with one example each) **Introduction to Animal** **Diversity:** Non-Chordates and Chordates (with at least one representative example.) **Introduction to Microbial Diversity:** Archaebacteria, Eubacteria, Blue-green Algae, Actinomycetes, Eumycota- Habitats, Examples and Applications.	
	II	**Ultra-Structure of Prokaryotic and Eukaryotic Cell.** **Ultrastructure of Prokaryotic Cell:** Concept of Cell Shape and Size. Detail. Structure of Slime Layer, Capsule, Flagella, Pilli, Cell Wall (Gram Positive and Negative), Cytoplasm and Storage Bodies and Spores **Ultrastructure of Eukaryotic Cell:** Plasma membrane, Cytoplasmic Matrix, Microfilaments, Intermediate Filaments, and Microtubules Organelles of the Biosynthetic-Endoplasmic Reticulum & Golgi Apparatus. Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome Eukaryotic Ribosomes, Mitochondria and Chloroplasts Nucleus –Nuclear Structure, Nucleolus External Cell Coverings: Cilia and Flagella, Comparison of Prokaryotic And Eukaryotic Cells	**15**
	III	**Bacteria and Viruses** **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	**15**

		Viruses: General Characters, Classification (Plant, Animal and Bacterial Viruses), Significance	

References:

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

Course Code: RUSBTK104

Course Title: Microbial Techniques

Academic year 2020-21

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.	**15**

		Dark Field and Phase Contrast Microscope. 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	**Sterilization Techniques** 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) Ideal Disinfectant. Examples of Disinfectants and Evaluation of Disinfectant	**15**
	III	**Nutrition, Cultivation and Enumeration of Microorganisms** 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	**15**

References:

1. Microbiology–6th Edition (2006), Pelczar M.J., Chan E.C.S., Krieg N.R., The McGraw Hill Companies Inc. NY
2. Presscott's Microbiology, 8th edition (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, Linda M Sherwood, Christopher J Woolverton, Chris Woolverton, McGrawHil Science Enginering, 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	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 λmax 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 *E. coli* 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 2020-21

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**	**Scope and Introduction to Biotechnology** History & Introduction to Biotechnology What is Biotechnology? Definition of Biotechnology, Traditional and Modern Biotechnology, Branches of Biotechnology-Plant, Animal Biotechnology, Marine Biotechnology, Agriculture,	**15**

		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	
	II	**Health care Biotechnology** Introduction, Disease prevention (Vaccines), types of vaccines, Disease Diagnosis, Detection of genetic diseases, Disease treatment, Drug designing, Drug delivery and targeting, Gene therapy	**15**
	III	**Food and Agriculture Biotechnology** **Food Biotechnology** 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. **Agriculture biotechnology** GM Food, GM Papaya, GM Tomato, Fungal and Insect Resistant Plants Bt Crops, Bt Cotton and Bt brinjal, Golden Rice.	**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 2020-21

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**	**Replication** 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	**15**

		Transformation	
	II	**Mutation and DNA Repair** 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**.**	**15**
	III	**Genetic variation and chromosomal basis of inheritance** **Types:** Discontinuous and continuous, molecular basis of allelic variation. Historical development of chromosomal theory, nature of chromosome, chromosomal behaviour and Inheritance in eukaryotes	**15**

References:

1. Molecular Biotechnology- Glick and Pasterman 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 the genomic DNA 12. Quantitative analysis of DNA by DPA/ RNA by Orcinol method	**2**

Course Code: RUSBTK107

Course Title: FOUNDATION COURSE

Academic year 2020-21

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**	**Overview of Indian Society** a. Understanding 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 Indian context c. Regional variations – rural, urban and tribal characteristics	**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 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 2 major practicals 1 minor practical Viva Spots	60 20/25 10 05 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**

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:

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

Paper Pattern:

1. 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.
2. 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 2020-21

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
RUSBTK201	**I**	**Basic Chemistry II** **Stereochemistry:** Optical Isomerism: optical activity, specific rotation, chirality, enantiomers, molecules with two	**15**

		similar and dissimilar chiral-centres, distereoisomers, meso structures, racemic mixture. Flying-wedge, Fischer, Newman and Sawhorse projection formulae (erythro, threo isomers) and their interconversion. Relative and absolute configuration: D/L and R/S designations. Geometrical isomerism in alkenes and cycloalkanes: cis–trans isomerism and E/Z notations with C.I.P rules. Conformation analysis of alkanes (ethane, propane and n-butane) and their relative stability on the basis of energy diagrams. **Cycloalkanes and Conformational Analysis:** 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	
	II	**Aliphatic Hydrocarbons** **Chemistry of Aliphatic Hydrocarbons:** **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. **Carbon-Carbon pi bonds:** alkenes and alkynes**,** methods of preparation of alkenes and alkynes by elimination reactions: mechanism of E_1 and E_2. Saytzeff and Hofmann eliminations. **Reactions of alkenes:** electrophilic addition and mechanism (Markownikoff/ Anti Markownikoff addition). mechanism of ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2 and 1, 4-addition reactions in conjugated dienes, Diels-	**15**

		Alder reaction; Allylic and benzylic bromination using N-bromosuccinimide and its mechanism. **Methods of Preparation and reactions of alkynes:** Acidity, ectrophilic and nucleophilic additions. hydration to form carbonyl compounds, alkylation of terminal alkynes.	
	III	**Aromatic Hydrocarbons** **Aromatic Hydrocarbons:** 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. Electrophilic aromatic substitution: sulphonation and Friedel-Craft alkylation/acylation and mechanisms for the same, mechanism of halogenation, nitration of benzene: Directing effects of the substituent groups on electrophilic aromatic substitution, reactions of mono substituted benzene derivatives (-CH_3, -NH_2, -OH NO_2, -X) Nucleophilic aromatic substitution of Aryl halides (replacement by –OH group and effect of nitro substituent).	**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 2020-21

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	**15**

		oxine reagents) (balanced Chemical Reactions expected). 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) Acid-Base Theories Arrhenius; Lowry-Bronsted concept; Classification of solvents, auto dissociation of amphi protic solvents, Lewis concept; Usanovich concept. Hard and Soft Acids and Bases-HSAB (with respect to occurrence and feasibility of chemical reaction).	
	II	**Oxidation Reduction Chemistry** Oxidation Reduction Chemistry Oxidation state, oxidation number, oxidation- reduction in terms of oxidation number. Balancing redox equations by i) oxidation number method and ii) ion- electron method Calculation of equivalent weight on the basis of chemical nature. Study of, oxides of carbon, sulfur and nitrogen with respect to their Environmental impact	**15**
	III	**Chemical Thermodynamics** Chemical Thermodynamics: Recapitulation: 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. Heat (q), work (w) and internal energy (U) and their sign conventions. Statement of first law, work done in isothermal and adiabatic reversible processes, work done in irreversible process, internal energy change for	**15**

		isothermal and adiabatic processes. Numerical problems Enthalpy and enthalpy change in a constant volume and constant pressure process, enthalpy change in a reversible process. Numerical problems limitations of first law, need for the direction ofthe 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. 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.	

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	**Paper I** 1. Characterization of organic compound containing C, H, (O), N, S and X 2. (Minimum of 6 compounds) 3. Chemical synthesis (one step) 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. **Paper II:** 1. **Qualitative analysis:** (at least 5 mixtures to be analyzed) 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) 2. To determine the valence factor of $KMnO_4$ by titrating with oxalic acid. 3. To determine the acid-neutralising power of commercially available antacid formulation.	**2**

Course Code: RUSBTK203

Course Title: Physiology and Ecology

Academic year 2020-21

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**	**Plant Physiology** 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	**15**

		Electron Flow, Energetics of Photosynthesis, Photorespiration, Dark Phase of Photosynthesis, Calvin Cycle, C-3, C-4 pathways	
	II	**Animal Physiology** Physiology of Digestion, Movement of Food and Absorption, Secretary functions of Alimentary Canal, Digestion and Absorption, assimilation in Gut of Mammals Anatomy of Mammalian Kidney, Structure of Nephron, Physiology of Urine Formation and Role of Kidney in Excretion and Osmoregulation Physiology of Respiration, Mechanism of Respiration, Principles of Gaseous Exchange in the Blood and Body Fluids, Blood and Circulation: Blood Composition, Structure and Function of its Constituents Blood Coagulation and Anticoagulants Hemoglobin and its Polymorphism Regulation of the Circulation Mechanism and working of Heart in Human.	**15**
	III	**Ecosystem and Interactions** 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.	**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 2020-21

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	**Microbial Genetics** 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.	**15**
	III	**Population Genetics** Genetic Structure of Populations. Genotypic Frequencies and Allelic Frequencies, Hardy- Weinberg Law and its assumptions Genetic Variations in Populations- Measuring Genetic Variation at Protein Level and measuring Genetic Variations at DNA level Natural Selection. Genetic Drift Speciation Role of Population Genetics in Conservation Biology	**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 2020-21

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**	**Plant Tissue Culture** 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, Principle and Protocols.	**15**

	II	**Animal Tissue Culture** 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	**15**
	III	**Current trends in PTC and ATC** 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.	**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. Ramavat S.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 2020-21

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 Effect of pH, Temperature, Substrate Concentration on Enzyme Activity, Co-Factors, Zymogens	**15**

	II	**Immunology** 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 Discovery and Structure of Antibodies (Framework region) Classes of Immunoglobulins, Antigenic Determinants	**15**
	III	**Biostatistics** Definition & 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**

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 Shubhangi Sontakke, 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	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: Foundation course

Academic year 2020-21

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

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

Paper Pattern:

3. 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.
4. 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 III

Course Code: RUSBTK301

Course Title: Biophysics

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Discuss the characteristics and properties of Optics and lasers.
CO 2	Differentiate between various types of spectrophotometer based on its working and construction.
CO 3	Illustrate the applications of spectroscopy and microscopy in analysis & identification of various biological samples.
CO 4	Examine the propagation of different sound waves.
CO 5	Describe the significance of heat and temperature in the construction of temperature sensors and probes.
CO 6	Discriminate the components of various samples based on their migration in the electric field and demonstrate the separation of various biomolecules using the technique of electrophoresis.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK301	**I**	**Spectro Optics and Electromagnetic Radiations** **Introduction to Optics and Lasers:** ***Optics* :** Properties of Light - Reflection, Refraction, Dispersion, Interference. ***Lasers* :** Properties of Lasers, Stimulated Emissions, Laser Action; Applications of Laser. **Electromagnetic Radiations:** Introduction to Electromagnetic radiations **:** Types and Properties of Spectra; Basic Laws of Light Absorption. Spectrophotometer:-Principle, Instrumentation and Applications; UV-Vis Spectrophotometer, Single and Dual Beam Spectrophotometer. **Microscopy:** Types of Microscopy; Electron Optics; Electron Microscopy- Preparation of Specimen, SEM, TEM and Immuno-Electron Microscopy. Fluorescence Microscopy.	**15**
	II	**Heat, Sound, Magnetism and Fluid Dynamics** Heat: Concept of Temperature; Modes of Heat Transfer; Measuring Temperature; Platinum Resistance Thermometer; Thermocouple and Thermistors. Sound:	**15**

		Types of Sound Waves Audible, Ultrasonic and Infrasonic Waves; Doppler Effect; Applications of Ultrasonic Waves. Magnetism: Magnetic Field; Magnetism of Earth; Paramagnetism, Diamagnetism, Ferromagnetism. Nuclear Magnetism and Biomagnetism. Fluid Dynamics: Viscosity: Definition Flow of Liquids through Capillaries; Stokes' Law; Terminal Velocity. Determination of 'η' by Falling Sphere Method; Viscosity Estimation by Oswald's Viscometer. *Surface Tension*: Definition- Surface Tension and Surface Energy; Capillary Action; Angle of Contact; Wettability; Temperature Dependence of Surface Tension. Applications in Biology.	
	III	**Electrophoresis:** Migration of Ions in an applied electric field; Factors affecting Electrophoretic Mobility; Moving Boundary Electrophoresis; Paper Electrophoresis; AGE; Native and SDS PAGE (reducing and nonreducing, continuous and discontinuous); IEF and 2D PAGE, Pulse field and Capillary electrophoresis. Staining and Detection Methods; Gel –Documentation, Applications in Biology	15

References:

1. Principle and techniques of Biochemistry – Wilson and Walker
2. Biophysical Chemistry – Upadhyay, Upadhyay & Nath
3. Principles and techniques of biophysics – V. Kumaresan
4. Introduction to electrodynamics – David Griffiths
5. Elements of electromagnetics – Sadiku
6. A textbook of heat and mass transfer – R. K. Rajput

7. Fundamentals of heat and mass transfer – C P Kothandraman

Course Code: RUSBTK302

Course Title: Applied Chemistry – I

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Discuss the factors affecting the solubility of a precipitate.
CO 2	Enumerate the different steps involved in a precipitation gravimetry.
CO 3	Explain the effect of various experimental factors on the particle size of the precipitate.
CO 4	Define the various terms involved in titrimetric analysis.
CO 5	Explain the theory of acid-base indicators and choose a suitable indicator for a particular acid-base titration.
CO 6	Relate some of the properties of the water to its chemical makeup.
CO 7	Determine the aesthetic quality of water by examining its physical, chemical & biological parameters.
CO 8	Propose the benefits of green chemistry in chemical synthesis.
CO 9	Formulate the synthesis of various green reagents which are environment and eco- friendly.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK302	**I**	**Classical methods of analysis** **Gravimetric analysis:** Introduction to gravimetric analysis, types of gravimetric analysis, conditions for a reaction to be used in gravimetric analysis, solubility and solubility product, factors affecting solubility: temperature, common and diverse ion effect, pH, nature of the solvent, complexation. Unit operations in gravimetric analysis, precipitation, homogeneous and heterogeneous precipitation, relative supersaturation, nucleation and crystal growth, their effect on particle size, Ostwald's ripening, impurities associated with precipitate formation, filtration, washing of the precipitate, drying and incineration, use of thermal methods. **Titrimetric analysis** Introduction to titrimetric analysis, conditions for a reaction to be used in titrimetric analysis, terms involved: titrant, titrand, indicator, equivalence point, endpoint, titration error, types of titrations. **Acid –base titrations** Acid base indicators, theory of acid base indicators, conditions for choosing an indicator. Types of acid base titrations, titration curves. Construction of the titration curves and the choosing of the indicator for A) strong acid –strong base	**15**

		B) strong acid –weak base C) weak acid – strong base D) weak acid –weak base Titration of dibasic acid with a strong base, condition for obtaining two separate equivalence points, qualitative description of the titration curve, determination of the dissociation constant Titration of phosphoric acid with a strong base	
	II	**Environmental Chemistry** Chemistry of water Water as a natural resource: Physical and Chemical properties of water, significance of water as a universal solvent and its properties viz. pH, Dielectric constant, boiling point. Anomalous behavior of water. Hydrological cycle. Chemical composition of groundwater. Factors affecting solubility of gases in water. Solubility of CO_2 and O_2 in water. Water quality: Parameters for determining water quality i) Physical parameters: - pH, pE, conductivity, TS, TSS, TDS ii) Chemical Parameters- acidity, alkalinity, hardness, salinity, chlorine demand, DO, COD, iii) Biological parameter – BOD, MPN Standards for Potable and industrial water	**15**
	III	**Green Chemistry & Nanomaterials** **Green Chemistry and Synthesis:**	**15**

		Introduction to Green Chemistry; Need and Relevance of Green Chemistry; Principles of Green Chemistry. Green Synthesis in Industry: Green Materials, Green Reagents, Green Solvents and Green Catalysts. **Nanomaterials:** Introduction to Nanomaterials. Forms of Nanomaterials: Nanoparticles, Nanofilms and Nanotubes Synthesis and Characterization of Nanomaterials. Applications of Nanomaterials.	

References:

1. University General Chemistry, 1st edition (2000), C.N. R. Rao, Macmillan Publishers, India

2. Physical Chemistry University for biological sciences, 1st edition, (2005), Chang R., Science Books, USA

3. Essentials of Physical Chemistry, 24th edition, (2000), B S Bahl, G D Tuli, Arun Bahl, S. Chand Limited, India.

4. Concise Inorganic Chemistry .5th edition (2008), Author: J. D. Lee, John Wiley & Sons, USA.

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

Course Code: RUSBTKP301

Course Title: Practicals Based on RUSBTK301 & RUSBTK302

DETAILED SYLLABUS

Course Code	Title	Credits
RUSBTKP301	1. Determination of Purity of Plasmid DNA using UV Spectrophotometry. 2. Study of the Structure and Function of an Electron Microscope (Visit / Video Demonstration - including Sample Preparation and Staining). 3. Demonstration of Structure and Working of a Fluorescence Microscope (Stained Preparation). 4. Electrophoresis of Proteins by PAGE. 5. Chemical and Biological Synthesis of Silver Nanoparticles and its Characterisation by UV- VIS Spectrophotometer 6. To study the kinetics of the reaction between $K_2S_2O_8$ and KI for equal concentration 7. To determine the amount of strong acid in the given solution by conductometric titration. 8. To determine the amount of strong acid in the given solution by pH-metric titration. 9. Organic preparation and their purification: 10. Use 0.5-1.0g of the organic compound. Purify the product by recrystallization. Report theoretical yield, percentage yield and melting point of the purified product. Preparation of: a. m-Dinitrobenzene from nitrobenzene	**2**

	b. Phthalic anhydride from phthalic acid by sublimation c. P-bromoacetanilide from acetanilide 11. Quantitative determination of salts such as copper sulphate pentahydrate, nickel chloride hexahydrate, anhydrous cupric chloride using standard volumetric methods (any 1) 12. Gravimetric estimation of Nickel (II) as Ni-DMG.	

References:

1. An Introduction to Practical Biochemistry.3rd Edition, (2001), David Plummer, Tata McGraw Hill Edu.Pvt.Ltd. New Delhi, India
2. SYBSc Chemistry Laboratory Manual.

Course Code: RUSBTK303

Course Title: Immunology

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Examine the molecules involved in immune effector response and mechanism.
CO 2	Discriminate the significance of molecules in eliminating the foreign antigen
CO 3	Establish the mechanism by which the effector molecules distinguish self from non-self-cells.
CO 4	Differentiate the precipitation and agglutination reactions using suitable examples and effectively determine various tests used for detection of antigens.
CO 5	Analyse the significance and applications of advanced immuno techniques.
CO 6	Apply the advanced immuno techniques for detection of pathogens.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK303	**I**	**Effectors of Immune Response** Haematopoiesis; Complement System- Classical, Alternate and Lectin; Regulation and Biological Effects of Complement System; Deficiencies of Complement System	**15**

	II	**Antigen antibody interaction techniques- Precipitation Reactions:** Immunoprecipitation, Immunoelectrophoresis, CIEP, Rocket Electrophoresis and 2-D Immunoelectrophoresis **Agglutination Reactions:** Passive, Reverse Passive, Agglutination Inhibition. Coomb's Test; Complement Fixation Tests. Synthesis of Monoclonal antibodies & Applications.	**15**
	III	RIA, ELISA, ELISPOT, Chemiluminescence, Western Blot, Immunofluorescence, Flow Cytometry. Alternatives to Antigen- Antibody Reactions	**15**

References:

1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY

2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India

3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.

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

Course Code: RUSBTK304

Course Title: Cell Biology & Cytogenetics

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Discuss the structure and components of cytoskeleton.
CO 2	Examine the essential proteins required for muscle contractility.
CO 3	Describe the proteins integral to the structure and function of cell membrane.
CO 4	Devise the techniques to study the movement of protein and lipid molecules in the cell membrane
CO 5	Deduce the formation of heterochromatin and Euchromatin and apply diverse techniques to examine the chromosomes.
CO 6	Analyse the syndrome associated with the improper formation of heterochromatin.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK304	**I**	**Cytoskeleton:** Overview of the Major Functions of Cytoskeleton. Microtubules: Structure and Composition.	**15**

		MAPs: Functions- Role of Mitosis, Structural Support and Cytoskeleton Intracellular Mobility. Motor Proteins: Kinesins, Dynein; MTOCs. Dynamic Properties of Microtubules. Microtubules in Cilia and Flagella. Microfilaments: Structure, Composition, Assembly and Disassembly. Motor Protein: Myosin. Muscle Contractility: Sliding Filament Model. Actin Binding Proteins; Examples of Non Muscle Motility. Intermediate Filaments: Structure and Composition; Assembly and Disassembly; Types and Functions.	
	II	**Cell Membrane:** Uptake of Nutrients by Prokaryotic Cells; Overview of membrane functions, History on Plasma membrane structure, Chemical composition of membranes-Membrane carbohydrates & Membrane lipids. Integral, Peripheral & Lipid anchored membrane proteins, Importance & maintenance of Membrane fluidity, Asymmetry of membrane lipids, Lipid rafts, Diffusion of Membrane proteins after cell fusion, Restrictions on Protein and Lipid mobility, Red Blood cell – An example of Plasma membrane structure.	**15**

	III	**Cytogenetics:** Structure of Chromosome- Heterochromatin, Euchromatin, Polytene Chromosomes. Variation in Chromosomal Structure and Number: Deletion, Duplication, Inversion, Translocation, Aneuploidy, Euploidy and Polyploidy and Syndromes- Klinefelter, Turner, Cri-du-chat, Trisomy -21, Trisomy 18 and Trisomy 13. **Sex Determination and Sex Linkage:** Mechanism of Sex Determination (XX-XY, ZZ-ZW, XX-XO) Dosage Compensation and Barr Body. **Genetic Linkage, Crossing Over and Chromosomal Mapping:** Tetrad Analysis, Two-point Cross, Three Point Cross, Pedigree Analysis	**15**

References:

1. Cell and Molecular Biology – De Robertis- Lippincott Williams& Wilkins
2. Cell and Molecular Biology- Concepts and Experiments—Karp – Wiley International
3. Essential iGenetics- Peter Russell -Pearson Education
4. Microbial Genetics- Freifelder –Narosa Publishing House
5. Genetics, (2006) Strickberger MW - (Prentice Hall, India)
6. Human Genetics- A. M. Winchester – MacMillan Press

Course Code: RUSBTKP303

Course Title: Practicals Based on RUSBTK303 & RUSBTK304

DETAILED SYLLABUS

Course Code	Title	Credits
RUSBTKP303	1. WIDAL test – Qualitative & Quantitative 2. ELISA (Kit based). 3. Dot ELISA 4. Single radial immunodiffusion 5. Ouchterlony's double immunodiffusion 6. Study of Abnormal Karyotyping (Chromosomal Aberration) - Deletion, Duplication, Inversion, Translocation and Syndromes- Trisomy 21, Trisomy 13, Trisomy 18, Klinefelter, Turner and Cri-du-Chat. (By usage of Software) 7. Video demonstration of G- banding 8. Induction of Polyploidy by PDB/ Colchicine/ UV Treatment Using Suitable Plant material 9. Study of Polytene Chromosomes 10. Mapping based on Tetrad Analysis and Three Point Cross. 11. Pedigree Analysis- Autosomal and Sex- Linked.	**2**

References:

1. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India

2. Genetics, (2006) Strickberger MW - (Prentice Hall, India)

3. Human Genetics- A. M. Winchester – MacMillan Press

Course Code: RUSBTK305

Course Title: Molecular Biology

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Examine the steps involved in the transcription of prokaryotes and eukaryotes.
CO 2	Discuss the role of RNA polymerase in the process of transcription.
CO 3	Explain the phenomenon of Wobble hypothesis.
CO 4	Express the in-depth mechanism of protein synthesis.
CO 5	Determine the significance of operon in gene expression.
CO 6	Illustrate the importance of jumping genes in maize

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK305	**I**	**Gene Expression – Transcription** Gene Expression- an Overview. Transcription Process in Prokaryotes: RNA Synthesis; Promoters and Enhancers; Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain. Transcription in Eukaryotes Transcription of Protein Coding Genes by RNA Polymerase	**15**
	II	**Gene Expression- Translation** **Nature of Genetic Code.** **Wobble Hypothesis.** **Translation:** Process of Protein Synthesis (Initiation, Elongation, Translocation, Termination)	**15**

	III	**Regulation of Gene Expression** In prokaryotes: In Bacteria: *Lac* operon of *E. coli, trp* Operon of *E. coli.* In Eukaryotes: Operons in Eukaryotes; Control of Transcriptional Initiation Jumping genes in maize	**15**

References:

1. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA

2. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA

3. Molecular Biology, 5th Edition (2011), Weaver R., McGraw Hill Science. USA

4. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press.

5. Molecular Biology: genes to proteins, 4th edition (2011), Burton E Tropp Jones& Bartlett Learning, USA

Course Code: RUSBTK306

Course Title: Bioprocess technology & General Microbiology

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Develop an understanding of the various aspects of Bioprocess Technology.
CO 2	Determine the techniques used for screening of organisms.
CO 3	Develop skills associated with enrichment and screening of Industrially Important Strains.
CO 4	Establish principles underlying design of Fermenter and Fermentation Process.
CO 5	Illustrate the concept of air sanitation & air borne diseases.
CO 6	Develop the fundamentals of analysis of potable water and demonstrate the significance of media to characterise the organisms.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK306	**I**	Microorganisms in Industrial Processes Types of Microorganisms used in Industrial Processes: Bacteria, Fungi, Algae (Microalgae, Macroalgae & Cyanobacteria), Potentials & Challenges.	**15**

		Screening and Maintenance of Strains: Primary Screening and Secondary Screening; Cultivation; Preservation of Industrially Important Microbial Strains. Strain improvement, Inoculum development – One example each.	
	II	**Fermenter, Fermentation Processes & Industrial Productions** Design of a fermenter: Stirred Tank Fermenter, Air lift, Pneumatic, Bubble column, Tower fermenter, - Basic Design; Parts of a Typical Industrial Fermenter. Process Parameters: *pH*, Temperature, Aeration, Agitation, Foam, Pressure, Inlet and exit gas analysis, Dissolved oxygen. Carbon dioxide electrodes, microbial biomass, Safety valves. Study of Representative Fermentation Processes: Outline of Penicillin, Ethanol, and Streptomycin & Vinegar Production by Fermentation along with a *flow-diagram.*	**15**
	III	**Microbiology of Air** The atmosphere, Aero-microbiological pathway, Number and kind of microorganisms in air, Airborne diseases, Dust, Droplet & Droplet nuclei, Sampling, Quantitative & Qualitative	**15**

		methods for enumeration of bacteria in air, Air sanitation (Chemical & Physical methods) **Microbiology of water** Introduction to aquatic microbiology, Distribution of aquatic environment, Types of microorganisms. Microbiology of potable water a. Introduction – Definition & characteristics, standards, demand & use, various sources, water borne diseases. b. Analysis of potable water – Physical, Chemical & Biological parameters. **Microbiology of Soil** Nature of soil, Microorganisms in soil, Functions of microorganisms in soil.	

References:

1. Industrial Microbiology- A. H. Patel
2. Industrial Microbiology- L. E. Casida- John Wiley & Sons
3. Microbiology–6th Edition (2006), Pelczar M.J., Chan E.C.S., Krieg N.R., The McGraw Hill Companies Inc. NY
4. Presscott's Microbiology, 8th edition (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, Linda M Sherwood, Christopher J Woolverton, Chris Woolverton, McGraw-Hill Science Engineering, USA

Course Code: RUSBTKP305

Course Title: Practicals Based on RUSBTK305 & RUSBTK306

DETAILED SYLLABUS

Course code	Title	Credits
RUSBTKP305	1. Study of *E. coli* Diauxic Growth Curve- (Lactose and Glucose) 2. Expression of β- galactosidase and Measurement of Activity. 3. Screening for an Antibiotic Producing Strain of Microorganism 4. Screening for an Acid producing strain of microorganism 5. Lab Scale Production of Penicillin (Static and Shaker) 6. Lab Scale Production of Ethanol 7. Estimation of Penicillin from Recovery Broth by Chemical (Iodometric) Method. 8. Estimation of Penicillin from Recovery Broth by Biological (Bioassay) Method. 9. Estimation of Alcohol from Recovered Broth by Dichromate Method. 10. Isolation, Quantitative Analysis and AGE of Genomic DNA from Bacteria and Yeast. 11. Enrichment of microorganisms from air. 12. Enrichment of microorganisms from water 13. Enrichment of organisms from soil 14. Study and preparation of Winogradsky's column 15. Contact slide method 16. Demonstration of Reference Management Software (Mendley) 17. Introduction to Grammar software	**2**

References:

1. Principles of fermentation technology – Stanbury and Whittaker.
2. General Microbiology (Volume I) – C B Powar
3. General Microbiology (Volume II) – C B Powar

Course Code: RUSBTK307

Course Title: Research Methodology & Scientific writing

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Illustrate the meaning and objectives of research methodology.
CO 2	Identify the problems involved in research
CO 3	Explain the need and significance of research designs.
CO 4	Determine the significance of data collection and its relationship with research interpretation.
CO 5	Analyse the process of scientific writing.
CO 6	Organize the data for writing a research paper

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK307	**I**	**Introduction to Research Methodology and Research Problem** Meaning of Research; Objectives of Research; Motivation in Research; Types of Research; Research Approaches; Significance of Research; Research Methods versus Methodology;	**15**

		Research Process; Criteria of Good Research; Problems Encountered by Researchers in India; What is a Research Problem? Selecting the Problem; Necessity of Defining the Problem; Technique Involved in Defining a Problem	
	II	**Research Design, Data Collection Interpretation and Report Writing** Meaning of Research Design; Need for Research Design; Features of a Good Design; Important Concepts Relating to Research Design; Different Research Designs; Basic Principles of Experimental Designs; Developing a Research Plan- Collection of Primary Data; Observation Method; Interview Method; Collection of Data through Questionnaires; Collection of Data through Schedules; Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method Meaning of Interpretation, Why Interpretation? Technique of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different steps in report writing, Layout of research report, Types of report, Mechanics of writing a research report, Precaution for writing a research report.	**15**
	III	**Scientific writing** Process of Scientific Writing: Thinking, Planning, Rough Drafts and Revising Contents. Introduction	**15**

		to Scientific Reports and Writings Compilation of Experimental Data, Communication Methods in Science, Examples of Scientific and Unscientific Writing. Writing Papers, Reviews, Bibliography Plagiarism--Introduction to Plagiarism, Examples of Plagiarism. Introduction to Reference Management software (Mendley) & Grammarly software.	

References:

1. Research methodology: Methods and techniques – C R Kothari
2. Research Methodology - T Bhaskara Rao
3. The Craft of Scientific writing – Michael Alley
4. The Scientist's guide to writing – Stephen Heard
5. Writing Science – Joshua Schimel

Modality of Assessment (SEMESTER III)

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/Mind maps/ Concept Maps / Info graphs)	20
2	One class Test (multiple choice questions or objective & one sentence)	20
	Total Marks	40
	TOTAL	**40**

B. External Examination- 60%- 60 Marks

Semester End Theory Examination:

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

2. Theory question paper pattern:

i. 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.

ii. 60% options will be provided.

Paper Pattern:

Question	Options	Marks	Questions Based 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: 40%- 40 Marks**

Particulars	
Journal	10
Experimental tasks	30
Total	**40**

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

B. **External Examination: 60%- 60 Marks**

Semester End Practical Examination:

Particulars	**Paper**
Experimental tasks	RUSBTKP301, RUSBTKP303, RUSBTKP305
Laboratory work	60
2 major practicals	40
1 minor practical	10
Viva / Spots	5 + 5
Total	**60**

Overall Examination & Marks Distribution Pattern

SEMESTER I

Course	RUSBTK301			RUSBTK302			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP301						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK303			RUSBTK304			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP303						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK305			RUSBTK306			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP305						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK307			Grand Total
	Internal	External	Total	
Theory	40	60	100	100

SEMESTER IV

Course Code: RUSBTK401

Course Title: Biochemistry

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Discuss the mechanism and steps involved in the reactions of carbohydrate metabolism and devise appropriate biochemical tests for their detection.
CO 2	Explain the regulation and ATP formation in the breakdown and synthesis pathways.
CO 3	Analyse the energy formation via Oxidative phosphorylation.
CO 4	Estimate the role of amino acids in providing energy and excretion.
CO 5	Differentiate between Glucogenic and Ketogenic amino acids.
CO 6	Analyse the lipid metabolism pathway & correlate between the steps and the reaction energetics.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK401	**I**	**Carbohydrate Metabolism, ETS** **Carbohydrate Metabolism:** Glycolytic Pathway and its Regulation, Homolactic Fermentation; Alcoholic Fermentation; Energetics of Fermentation; Citric Acid Cycle and its Regulation **Electron Transport System:** Electron Transport and Oxidative Phosphorylation. Inhibitors of ETS	**15**
	II	Amino Acid Metabolism Amino Acid Breakdown: Deamination, Transamination, Urea Cycle, Breakdown of Glucogenic and Ketogenic Amino Acids. Amino Acids as Biosynthetic Precursors	**15**
	III	**Lipid Metabolism** Mobilization, Transport of Fatty Acids. Beta, Alpha and Omega Oxidation of Saturated Fatty Acids; Oxidation of Unsaturated Fatty Acids, Oxidation of Odd Chain Fatty Acids. Energy Yield, Ketone Body Breakdown to Yield Energy.	**15**

		(Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above Pathways)	

References:

1. Outlines of Biochemistry: 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA

2. Principles of Biochemistry, 4th edition (1997), Jeffory Zubey, 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

Course Code: RUSBTK402

Course Title: Applied Chemistry – II

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Apply the concepts of Gibbs' and Helmholtz Free Energy to EMF measurements.
CO 2	Describe the types of Electrodes and Electrochemical Cells.
CO 3	Derive Nernst Equation and can give its applications.
CO 4	Calculate the pH for strong and weak electrolytes and Buffer Action.
CO 5	Apply the theoretical principles of chromatography learned to separate and quantify different components present in a sample.
CO 6	Explain the basic principle involved in quantitative analysis using UV-Vis spectroscopy.
CO 7	Describe the function of the different components of a colorimeter and spectrophotometer.
CO 8	Explain the basic principle involved in different types of conductometric titrations.
CO 9	Enlist the advantages and limitations of conductometric titrations.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK402	**I**	**Physical Chemistry** Electrochemistry: Electromotive Force of Galvanic Cells Electrochemical cells, galvanic cells, reversible cells and reversible electrodes, conventions to represent Galvanic cells. Types of electrodes, standard electrode potential, electrochemical series. Cell potential and standard cell potential. Nernst equation and its importance. Calculation of thermodynamic parameters: ΔG, ΔH, ΔS and equilibrium constant from EMF data. Classification of galvanic cells: chemical cells and concentration cells Determination of pH using glass electrode and quinhydrone electrode. pH and Buffers pH concept, calculation of pH for strong and weak electrolytes Buffer, Henderson's equation for acidic and basic buffer Buffer Capacity. Numerical Problems based on Buffers.	**15**
	II	**Separation techniques in analytical chemistry** Introduction to separation Techniques Separation and its importance in analytical chemistry, estimation without separation.	**15**

Classification of separation methods physical and chemical

Chemical methods, precipitation, complex formation.

Physical methods of separation**,** precipitation, fractional precipitation**,** volatilization, distillation, fractional distillation, vacuum distillation.

Solvent extraction

Nernst's distribution law, partition coefficient, distribution ratio,

Percentage extraction, extraction efficiency, percentage extraction for single step and multistep process with the same total volume of the extracting solvent

Modes of extraction: Chelation, ion-pair formation and solvation.

Batch and continuous extraction, Counter current extraction

Chromatography

Introduction, Stationary and mobile phase, common features of all chromatographic techniques, classification of chromatographic methods on the basis of physical state of the two phases.

Paper chromatography

Introduction and basic principles.

Stationary phase, transfer of the sample, mobile phase.

Methods of developing the chromatogram, methods of detection, physical, chemical and enzymatic.

Applications.

Comparison of the paper and thin layer techniques.

Thin layer chromatography

Introduction, mechanism of separation, retardation factor, basic principles.

		Stationary phase, preparation and transfer of the sample, mobile phases and their nature. Methods of development of the chromatogram, detection methods, physical and chemical. Applications, for determination of purity, following the course of a chemical reaction. High Performance Thin Layer Chromatography Introduction, choice of stationary and mobile phases, sample application, development and recording in HPTLC. Detectors used, single beam and double beam detectors, fluorometric detectors, quantitative determination, applications of HPTLC, advantages and limitations. Comparison between TLC and HPTLC.	
	III	UV- Visible Absorption spectroscopy: Recapitulation of basic concept of spectroscopy. Terms involved in absorption spectroscopy, monochromatic and polychromatic radiation, radiant power, absorbance, transmittance, absorptivity, molar extinction coefficient, wavelength of maximum absorption, Statement of Beer's law & Lamberts' law combined mathematical expression for Beer- Lambert's Law, deviations from Beer-Lambert's law, types of deviations. Components of an optical instrument and their functions, photometers and spectrophotometers. Photometers: Sources, monochromators, sample containers and detectors, block diagram for a single and double beam photometer, (Numerical problems expected.) Photometric titrations	**15**

		Basic principles, experimental set up and operational procedures, Requirements for a photometric titration, types of photometric titration curves, and determination of equivalence point. Advantages and limitations Conductometric titrations Conductometry and conductometric titrations, basic principles, operational procedure, determination of the equivalence point., Conductometric titration curves for the titration of 1] Acid –base titrations of all types 2] Mixture of a weak acid and a strong acid vs. strong base and vice versa. 3] Mixture of acid and salt ag. base 4] Precipitation titrations 5] Complexometric titrations Advantages and limitations.	

References:

1.University General Chemistry, 1st edition (2000), C.N. R. Rao, Macmillan Publishers, India.

2. Physical Chemistry University for biological sciences, 1st edition, (2005), Chang R., Science Books, USA

3. Essentials of Physical Chemistry, 24th edition, (2000), B S Bahl, G D Tuli, Arun Bahl, S. Chand Limited, India.

Course Code: RUSBTKP401

Course Title: Practicals Based on RUSBTK401 & RUSBTK402

DETAILED SYLLABUS

Course code	Title	Credits
RUSBTKP401	1. Determination of blood glucose levels for detection of Diabetes mellitus. 2. Organ Function Tests: Liver (SGPT, SGOT) 3. Kidney function tests (Urea from Serum). 4. Qualitative Detection of Ketone Body in Urine. 5. Isolation of Mitochondria and Demonstration of ETC using a Marker Enzyme. 6. Determination of acid number and iodine number of oil/ fats. 7. To determine dissociation constant of weak acid by incomplete titration method using pH meter. 8. Qualitative Analysis of bi-functional organic compounds (minimum four) on the basis of a. Preliminary examination b. Solubility profile c. Detection of elements C, H, (O), N, S and X. d. Detection of functional groups e. Determination of physical constants (M.P/B.P) f. Confirmatory tests to be performed. g. Solid or liquid Compounds containing not more than two functional groups from among the following classes may be given for analysis: Carboxylic acids, phenol, carbohydrates, aldehydes, ketones, ester, amides, nitro, anilides, amines, and alkyl and aryl halides 9. Chromatography:	**2**

	a. Separation of cations: Fe(III), Ni(II) and Cu(II) in a sample by paper chromatography b. Separation of a mixture of o-and p-nitrophenols by thin layer chromatography (TLC).	

References:

1. Biochemical Methods.1st, (1995), S.Sadashivam, A.Manickam, New Age International Publishers, India

2. Analytical Biochemistry, 3 edition, (1998), David Holmes, Peck, Prentice Hall, UK

3. SYBSc Chemistry Laboratory Manual

Course Code: RUSBTK403

Course Title: Medical Microbiology

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Examine the mechanism and pattern of infection.
CO 2	Focus on the importance of vectors in disease acquisition
CO 3	Identify the organisms associated with skin and respiratory tract infection.
CO 4	Illustrate the preventive measures which can be taken to curb the infections.
CO 5	Indicate the organisms associated with GI tract infections & devise suitable tests for clinical studies.
CO 6	Identify the treatment and prophylaxis associated with GI tract infections

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK403	**I**	Infectious Diseases Host Parasite Relationship:	**15**

		Normal Flora; Factors Affecting the Course of Infection and Disease; Mechanisms of Infection and Virulence Factors. Infection: Patterns of Infection; Types of Infections; Signs and Symptoms; Epidemiology and Epidemiological Markers. Diseases: Origin of Pathogens; Vectors; Acquisition of Infection; Koch's Postulates.	
	II	**Medical Microbiology** **Causative Organisms- I** **Skin :** *S. aureus*, *S. pyogenes.* **Respiratory Tract Infections :** *M. tuberculosis, S. pneumonia* (Characteristics Transmission, Course of Infection, Lab Diagnosis, Management of TB, Prevention and Control, Immuno and Chemoprophylaxis, DOTS and MDR **Urinary tract infections***:* *E.coli* : Characteristics, Virulence, Clinical disease and *E.coli* Infections	**15**

	III	**Medical Microbiology - Causative Organisms- II** **GI Tract Infections :** *Salmonella and Shigella spps.* (Characteristics, Virulence-Pathogenesis and Immunity, Clinical Disease, Carriers Lab Diagnosis, Phage Typing Prophylaxis and Treatment). Sexually Transmitted Diseases : Syphilis and Gonorrhoea. Nosocomial Infections : *Ps. Aeruginosa*	**15**

References:

1. Microbiology–6th Edition (2006), Pelczar M.J., Chan E.C.S., Krieg N.R., The McGraw Hill Companies Inc. NY

2. Presscott's Microbiology, 8th edition (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, Linda M Sherwood, Christopher J Woolverton, Chris Woolverton, McGraw-Hill Science Engineering, USA

3. Text book of Medical Microbiology, Anantnarayan

Course Code: RUSBTK404

Course Title: Environmental Biotechnology

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Focus on the significance of renewable energy resources.
CO 2	Develop new renewable energy resource
CO 3	Determine the different xenobiotic compounds which are released into the environment
CO 4	Analyse the mechanisms by which these xenobiotic compounds can be degraded
CO 5	Discuss the various bioremediation strategies
CO 6	Devise the plan of action for treatment of wastewater.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK404	**I**	**Renewable sources of energy** Biogas technology- Biogas plant & types, Bio - digester. Biogas composition, production and factors affecting production, uses. Biofuels – ethanol production. Microbial hydrogen production, Biodiesel, Petrocrops.	**15**

	II	**Xenobiotics & wastewater treatment** Definition and types of recalcitrant xenobiotic compounds, Hazards from xenobiotics, Biodegradation of xenobiotics, Aerobic wastewater treatment Measurement of level of pollution, Process – Preliminary, primary, secondary, tertiary & sludge treatment. Anaerobic treatment of wastewater – Microorganisms in sludge treatment.	**15**
	III	**Bioremediation** Concept of Bioremediation. Microorganisms in Bioremediation, Myco remediation and Phytoremediation. Bioremediation Technologies. Measuring Bioremediation in the Field. Bioaugmentation and Biostimulation. Monitoring the Efficacy of Bioremediation.	**15**

References:

1. Ecology – P.S. Verma and Agarwal- S. Chand Publications

2. Biotechnology: Environmental Processes- Rehm and Reed- Wiley

3. Environmental Biotechnology – Indu Shekhar Thakur

Course Code: RUSBTKP403

Course Title: Practicals Based on RUSBTK403 & RUSBTK404

DETAILED SYLLABUS

Course Code	Title	Credits
RUSBTKP403	1. Identification of *S. aureus*-Isolation, Catalase, Coagulase Test. 2. Identification of *E. coli*-Isolation, Sugar Fermentations, IMViC. 3. Identification of *Pseudomonas* - Isolation, Urease test, Oxidase Test, TSI Slant. 4. Identification of *Streptococcus pyogenes*. 5. Identification of *Klebsiella pneumoniae*. 6. Identification of *Salmonella typhi* 7. Identification of *Shigella* 8. RPR Test (Kit Based). 9. Permanent Slide- *Mycobacterium*. 10. Determination of total solids from an effluent sample. 11. Study of physico-chemical (pH, colour, turbidity, BOD, COD) parameters of any one industrial effluent sample. 12. Effects of different types on stresses on plant growth using an appropriate plant model system. 13. Stresses: Salinity, water stress, temperature stress (heat/cold), heavy and metal stress. Appropriate controls to be used and data analysed using appropriate software for analysis. 14. Most Probable Number (MPN) – Presumptive, Confirmed and Completed Tests. 15. Bioremediation of Metal. 16. Visit to STP / CETP	**2**

References:

1. Biotechnology: Environmental Processes- Rehm and Reed- Wiley

2. Environmental Biotechnology Allan Scragg Oxford University press

3. Environmental Biotechnology Indu Shekhar Thakur IK International (Basic concepts and applications)

4. Textbook of Medical Microbiology, Anantnarayan

5. Microbiology- Frobisher

6. General Principles of Microbiology- Stanier

Course Code: RUSBTK405

Course Title: Bioinformatics and Biostatistics

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Explore the tools available in Bioinformatics.
CO 2	Classify between the raw and processed database.
CO 3	Compare and contrast between different biological databases.
CO 4	Explore the BLAST tool.
CO 5	Extend the use of software in visualization of 3D structures
CO 6	Apply various statistical tools for analysis of biological data.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK405	**I**	**Introduction to Computers and Biological Databases** MS Word, PowerPoint, Excel, Coral Draw **Biological Databases:** Classification of Databases - Raw and Processed Databases; Primary (NCBI),	**15**

		Secondary (PIR) and Tertiary or Composite (KEGG) Databases; Structure and Sequence Databases. Specialized Databases Protein Pattern Databases; Protein Structure and Classification Databases (CATH/SCOP). **Genome Information Resources:** DNA Sequence Databases Specialized Genomic Resources.	
	II	**BLAST & Structural bioinformatics** **BLAST:** BLAST and its Types; Retrieving Sequence using BLAST, BLAST based searching, FASTA & Dot Plot Method, Introduction to molecular representations on computers, Visualization of biomolecular structures (Protein, DNA, RNA, drugs), Analysis of biological structures.	**15**
	III	**Biostatistics** Theory and Problems based on – Coefficient of Correlation and Regression Analysis; Steps in Testing Statistical Hypothesis; Parametric Tests: - Z Test – Single Mean and Two Means, t- Test – Single Mean, Paired and Unpaired; Chi-Square Test.	**15**

References:

1. Introductory Biostatistics. 1st edition. (2003), Chap T. Le. John Wiley, USA

2. Methods in Biostatistics- B. K. Mahajan –Jaypee Brothers

3. Bioinformatics- methods and S.C.Rastogi, N. Mendiratta, PHL Course Pvt. Ltd.

Course Code: RUSBTK406

Course Title: Molecular Diagnostics

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Discuss basic principles used in Molecular Diagnosis.
CO 2	Develop different and precise protocols for extraction and detection of nucleic acids.
CO 3	Construct new techniques for target DNA amplification
CO 4	Develop analytical skills to understand new Diagnostic Methods.
CO 5	Apply the knowledge and skills gained in the course should be useful in developing new Diagnostic Kits
CO 6	Identify the role of molecular diagnostics in diagnosis of infectious diseases.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK406	**I**	**Basics of Molecular Diagnostics** **Introduction to Molecular Diagnostics:** Overview of Molecular Diagnostics; History of Molecular Diagnostics; Molecular Diagnostics in Post Genomic Era; Areas used in Molecular Diagnostics; Future Prospects -	**15**

		Commercializing Molecular Diagnostics, Personalized Medicine, Theranostics. Characterization and analysis of Nucleic – Acids and Proteins: Extraction, Isolation and Detection of DNA, RNA and Proteins; Restriction Endonucleases and Restriction Enzyme Mapping.	
	II	**Nucleic Acid Amplification and hybridization Methods** Target amplification: PCR - General Principle; Components of a Typical PCR Reaction; Experimental Design; Primer Designing; Control of PCR Contamination and Mispriming; PCR Product Clean-up and Detection. Types of PCR Reverse Transcriptase, Real time, Multiplex & Nested PCR. Hybridization Techniques: Southern, Northern, Western and FISH; Markers, Probes and its Clinical Applications.	**15**
	III	**Molecular Biology based Diagnostics** DNA Polymorphism and Identification: RFLP and Parentage Testing; RFLP and Sickle-Cell Anaemia. Molecular Diagnostics for Infectious Diseases Molecular Testing for *Neisseria,* Molecular Diagnosis for HIV-1; Genetic Counselling and Molecular Diagnosis	**15**

		Genetic Testing-Need and Uses; genetic Counselling. Case Studies- Diagnostic Testing for Cystic Fibrosis; Fragile X Diagnostic and Carrier Testing. Ethical, Social and Legal Issues to Molecular - Genetic Testing	

References:

1. Applications Genomics, Proteomics P.Rastogi 3rd edition and Drug discovery

2. Molecular diagnostics- Fundamentals, methods and clinical applications – Buckingham and Flaws F.A. Davis Company Philadelphia.

Course Code: RUSBTKP405

Course Title: PRACTICALS BASED ON RUSBTK405 & RUSBTK406

DETAILED SYLLABUS

Course Code	Title	Credits
RUSBTKP405	1. Familiarization with NCBI, EMBL, DDBJ, PIR, KEGG Databases. 2. Use of NCBI BLAST Tool. 3. Classification of Proteins using CATH/SCOP. 4. Visualization of proteins using Rasmol. 5. Visualization of biomolecular structures – PyMOL, Chimera. 6. Analysis of three-dimensional structures – Similarity, interactions. 7. Handling and Calibration of Micropipette. 8. Isolation and Detection of RNA from Bacteria and Yeast. 9. RFLP- Kit Based. 10. Primer Designing through Open Online Source NCBI-BLAST. 11. DNA Amplification – PCR. 12. Excel based Biostatistics Practicals. 13. Poster of any recently published paper.	**2**

References:

1. Molecular Biotechnology- Glick and Pasterman ASM Press
2. Molecular diagnostics for the clinical laboratorian by Coleman and Tsongalis, Humana press

Course Code: RUSBTK407

Course Title: Entrepreneurship Development

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Develop a systematic and critical thinking attitude for a start-up plan.
CO 2	Select and screen a Business Idea.
CO 3	Design strategies for setting up successful business idea.
CO 4	Creation of unique ideas for business development
CO 5	Analyse the problems encountered by entrepreneurs
CO 6	Devise a suitable method to find out the solution for commonly encountered problems.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK407	**I**	Entrepreneurship Development Concept of Entrepreneur; Entrepreneurship; Need and Importance Factors responsible for shaping an entrepreneur. Entrepreneurship development process	**15**

		Difference between entrepreneur and manager.	
	II	Setting up the Business and Management Aspect Launching of an enterprise. Enterprise selection, analysis of suitable market, feasibility study, SWOT analysis of business Resource mobilization - financial, technological, raw material. Evaluation of project designing business plan. Principles of management, quality circles, MBO, MBW, TQM	**15**
	III	Innovation and entrepreneurship development Innovation and Marketing Management Marketing management and business development Marketing plan, sales promotion, market segmentation - STP analysis Principles of innovation, business diversification Strategies and innovative ideas	**15**

References:

1. Entrepreneurship – Kurup

2. Handbook of Entrepreneurship development- Basotia and Sharma

Modality of Assessment (SEMESTER IV)

1. 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/ Mind maps/ Concept maps/ Info graphs)	20
2	One class Test (multiple choice questions or objective & one sentence)	20
	TOTAL	**40**

B. **External Examination- 60%- 60 Marks**

Semester End Theory Examination:

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

2. Theory question paper pattern:

i. 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.

ii.60% options will be provided.

Paper Pattern:

Question	Options	Marks	Questions Based 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: 40%- 40 Marks**

Particulars	
Journal	10
Experimental tasks	30
Total	**40**

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

B. **External Examination: 60%- 60 Marks**

Semester End Practical Examination:

Particulars	**Paper**
Experimental tasks	RUSBTKP401, RUSBTKP403, RUSBTKP405
Laboratory work 2 major practicals 1 minor practical Viva / Spots	60 40 10 5 + 5
Total	**60**

Overall Examination & Marks Distribution Pattern

SEMESTER I

Course	RUSBTK401			RUSBTK402			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP401						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK403			RUSBTK404			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP403						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK405			RUSBTK406			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP405						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK407			Grand Total
	Internal	External	Total	
Theory	40	60	100	100

SEMESTER V

Course Code: RUSBTK501

Course Title: CELL BIOLOGY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Construct the cell cycle with its components and control system
CO 2	Evaluate the role of apoptosis
CO 3	Differentiate between normal cell and cancerous cell
CO 4	Talk about the principles of cell signalling and apply those principles to different cell types
CO 5	Examine different pathways in cellular signalling and their activation and implication
CO 6	Deduce the role of cellular transporters, cell adhesion molecules and cell junctions. Analyze the permeability of cell membrane

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK501	**I**	**Cell cycle and apoptosis and cancer** Cell cycle and programmed cell death- Overview of cell cycle, Components of cell cycle control system, intracellular control of cell cycle events, Programmed cell death (apoptosis)- intrinsic and extrinsic pathway of apoptosis, extracellular control of cell division, cell growth and apoptosis Mechanics of cell division- overview of M phase, mitosis and cytokinesis Cancer: Characteristics of normal cell and cancerous cell. Cancer as a micro evolutionary process: invasion metastasis, angiogenesis, Tumor- Benign and malignant	**15**

	II	**Cell signaling-I:** Cell signaling and signal transduction: Introduction General Principles of Cell Signaling, Signaling via G-Protein-linked Cell-Surface Receptors Signaling via Enzyme-linked Cell-Surface Receptors – protein tyrosine phosphorylation	**15**
	III	**Cell signaling-II:** Response to multiple extracellular signal molecules, Morphogens, Lifetime of intracellular molecule, Binding reaction and role of Kd, Extracellular messengers and their receptors, Second messengers Role of Calcium and cAMP, Introduction, Calcium binding proteins, Role of Nitric oxide and nuclear receptors, The Logic of Intracellular Signaling: Lessons from Computer-based "Neural networks"	**15**
	IV	**Cell permeability, transport and cell junctions:** Cell permeability, principles of membrane transport, Transporters and channels; Active transport, passive transport, types of transporters, types of ATP driven Pumps, Na+ K+ pump. Cell junctions; cell adhesions and extracellular material, Microvilli tight junctions, gap junctions, cell coat and cell recognition, cellular interactions	**15**

References:

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA
4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA

Course Code: RUSBTK502

Course Title: BIOCHEMISTRY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Analyze the metabolism of carbohydrates and fates of various intermediate and end product. Estimate the amount of starch.
CO 2	Separate and purify protein molecules and estimate their concentration. Construct titration curve for amino acids
CO 3	Evaluate the levels of protein structure. Comment on different types of protein interactions
CO 4	Identify the function of different hormones and their role as cellular messengers
CO 5	Examine and differentiate the mechanisms of Type I and Type II hormones. Discuss the abnormalities associated with hormones
CO 6	Design project proposal for project

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK502	**I**	**Carbohydrate metabolism**: Biochemical pathway for Synthesis and regulation of carbohydrates in Bacteria –Peptidoglycan Plants – starch and sucrose Animals – Glycogen synthesis and breakdown Gluconeogenesis, HMP pathway	**15**
	II	**Protein biochemistry:** Protein structure: Protein Tertiary and Quaternary Structures, Protein Denaturation and Folding, Protein Function: Reversible Binding of a Protein to a Ligand: Oxygen-Binding Proteins	**15**

		Complementary Interactions between Proteins and Ligands: Immunoglobulin's Protein Interactions Modulated by Chemical Energy: Actin, Myosin, and Molecular Motors - Details of Protein purification	
	III	**Endocrinology-I**: Introduction to endocrinology- mechanism of action of group I and group II hormones, coordination of functions by chemical messengers, chemical structure and synthesis of hormones, hormone secretion, transport and clearance from blood Anterior Pituitary hormones and their control by hypothalamus: functions, regulation and abnormalities in growth hormones, Adrenocorticotropin, stimulating hormones	**15**
	IV	**Endocrinology-II**: Posterior pituitary gland and its relation to hypothalamus. Hormones of Posterior pituitary gland their functions, regulation and abnormalities - Oxytocin and vasopressin, thyroid gland functions, regulation and abnormalities - Thyroxine, calcitonin, Parathyroid gland- PTH, Adrenal medulla functions, regulation and abnormalities -epinephrine and nor epinephrine, Adrenal cortex- Glucocortocoids, Pancreas- insulin and glucagon, Female gonads- estrogens and progesterone, Male gonads- testosterone, Placenta- hCG	**15**

References:

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Lehninger, principles of biochemistry, 4th edition (2005), David Nelson and Michael Cox W.H. Freeman and Company, New York.
3. Biochemistry, 4th edition (2010), Voet and Voet, John Wiley and sons, USA
4. Harper's Illustrated Biochemistry, 27th edition, RK Murray, DK Granner, PA Mayes and VW Rodwell, McGraw Hills publication.
5. Biochemistry, 4nd edition (2017), Satyanarayana and Chakrapani, Books & Allied (P) Ltd
6. General Microbiology, 5th edition- Roger Stainer

Course Code: RUSBTKP501

Course Title: Practicals based on RUSBTK501 and RUSBTK502

DETAILED SYLLABUS

Course Code	Title	Credits
RUSBTKP501	1. Cytological identification of cancer cells. 2. Osmosis 3. Lipid Solubility of membrane 4. Production of micelles 5. Study the effect of physical and chemical parameters on cell permeability using beetroot cells 6. Titration curve of amino acids 7. Estimation of starch 8. Protein estimation by Bradford's method 9. Sample preparation and Protein separation by PAGE (native/ SDS) 10. Protein purification by dialysis 11. Estimation of adrenaline 12. Proposal writing for skill-based project	**3**

Course Code: RUSBTK503
Course Title: GENETICS AND MOLECULAR BIOLOGY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Perform and predict genetic maps in bacteria and bacteriophages
CO 2	Analyse the appropriate methods and parameters to be followed for selecting a particular enzyme and genetic vector. Perform restriction digestion and ligation.
CO 3	Apply principles of recombinant DNA technology in extraction of DNA, transformation, expression of genes and construction and screening of genetic libraries
CO 4	Compare different methods of sequencing and examine the importance of these methods in research
CO 5	Examine the importance of human genome project and gene editing and its implications in science and research
CO 6	Inspect the genes involved in cancer

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK503	**I**	**Enzymes and vectors:** Enzymes -Sources, types, mode of action and applications of Restriction endonucleases, DNA polymerases, Ligases, Kinases, Phosphatases, Terminal transferases, Reverse transcriptases and Nucleases Vectors - Features and applications of pBR322, pUC19, cosmids, Phagemids, λ phage, M13	**15**

		bacteriophage vector, Shuttle vector, Expression vector pET YAC	
	II	**Cloning strategies and sequencing:** Methods of gene transfer in prokaryotes and eukaryotes; Recombinant selection and screening methods: genetic, immunochemical, Southern and Western analysis, nucleic acid hybridization, HART,HRT; Expression of cloned DNA molecules and maximization of expression ; Cloning strategies genomic DNA libraries, cDNA libraries, chromosome walking and jumping Sequencing: Maxam Gilbert's method, Sanger's dideoxy method, Automated DNA sequencing, Pyrosequencing	**15**
	III	**Genetic Mapping:** Genetic mapping in bacteria and Bacteriophages: by conjugation, transformation and transduction. Mapping bacteriophage genes, Fine structure analysis of bacteriophage gene	**15**
	IV	**Gene editing and human genome cancer genetics:** Human genome mapping and its implications in health and disease Mechanisms and application: RNAi, ZNF (Zinc finger nucleases), TALENS(Transcription activator like effector nucleases) CRISPR cas system Molecular genetics of cancer, oncogenes and tumor suppressor genes	**15**

References:

1. iGenetics A Molecular Approach 3rd Edition Peter J. Russell.
2. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
3. Principles of Gene Manipulation 7th Edition Primrose S.B., Twyman R.M.
4. Biotechnology – Fundamentals and applications by S.S. Purohit.
5. Genomes 3rd Edition T.A. Brown.
6. Biotechnology B.D. Singh.

7. Gene Cloning and DNA Analysis 6th Edition T.A. Brown.
8. Genomics Cantor C.R., and Smith C.L. John Wiley & Sons. (1999)
9. TALEN and CRISPR/Cas genome editing systems: tools of discovery: A.A.Nemudryi review
10. Molecular diagnostics- Fundamentals, Methods and Clinical applications by Lela Buckingham

Course Code: RUSBTK504
Course Title: INDUSTRIAL BIOTECHNOLOGY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Apply dairy and brewing technology at laboratory scale
CO 2	Suggest specific process parameters to be followed and maintained throughout the process
CO 3	Evaluate various commercial fermentation products and also know their production procedures
CO 4	Plan on setting up of a mini fermentation unit in their laboratories for lab scale fermentation or demonstration purposes
CO 5	Comment on product recovery and suggest appropriate methods to do the same
CO 6	Explore the trends and developments in industrial biotechnology

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK504	**I**	**Dairy Technology:** Milk: Normal flora, changes in raw milk, enumeration. Factors affecting bacteriological quality. Preservation methods, Pasteurisation. Starter Cultures, Fermented products- Production process and spoilage- Cheese: Swiss and Cheddar, Butter, Yogurt and Buttermilk.	**15**
	II	**Brewing technology:**	**15**

		Production and types of: Wine, Beer (Lager and Ale), Vodka, Rum, Whiskey, Tequila Malo-lactic fermentation Production	
	III	**Downstream processing:** Introduction of DSP, Foam separation, Types of Precipitation, Filtration, Centrifugation, Chromatography in DSP, Cell disruption- physical and chemical methods. Solvent recovery, Membrane processes, Drying, Crystallization and Whole broth processing	**15**
	IV	**Trends and developments in industrial productions:** Brewing: Overview, Role of multinational companies, microbreweries and craft breweries, Development of new wine industries, Rise of flavoured alcoholic beverages, Calorie counting and health perception, organic and biodynamic production, Use of GM crops and microorganisms Therapeutic aspect of industrial production: production of Vitamin B12, Case study on production of vaccines Microbiological Assays for pharmaceutical products, Regulatory Microbiological testing in pharmaceuticals	**15**

References:

1. Applied Dairy Microbiology Elmer H Marth and James L Steele Mercel Dekker Inc New York, 2nd edition
2. Microbial Technology Peppler,H.J and Perlman,D 2nd Academic Press Practicals
3. Industrial Microbiology Prescott and Dunn CBS publishers
4. Dairy technology by Yadav and Grower
5. Fermentation technology by Stanbury and Whittkar
6. Handbook of alcoholic beverages- Technical, Analytical and nutritional aspects- Alan J Buglass- Vol I Wiley
7. Fundamentals of Microbiology by Frobisher
8. Industrial Microbiology by A.H. Patel
9. Industrial Microbiology by Casida

Course Code: RUSBTKP502

Course Title: Practicals based on RUSBTK503 and RUSBTK504

DETAILED SYLLABUS

Course Code	Title	Credits
RUSBTKP502	1. Transformation in *E. coli*. 2. Genomic DNA Extraction: Animal cells 3. Restriction enzyme digestion and ligation (Kit may be used). 4. Replica plate technique 5. Gradient plate technique 6. Bacterial gene expression (Kit may be used). 7. Estimation of Milk protein-Pynes method 8. Detection of calcium and phosphorus in milk 9. Production and microbiological analysis of Yoghurt/cheese/butter 10. Production of Wine/Vodka and study of its physico-chemical properties. 11. Bioassay of Vitamin B12	**3**

Course Code: RUSBTK505

Course Title: FORENSIC SCIENCES-I
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Obtain clarity on the functioning of the forensics division and its branches.
CO 2	Elucidate on the use of biotechnological techniques in forensics
CO 3	Talk about the types and nature of impressions and prints and apply the principle in their collection and identification.
CO 4	Understand the importance of collection and preservation of samples.
CO 5	Perform different types of analysis on the various samples.
CO 6	Plan and evaluate a crime scene. Solve case studies related to forensic sciences

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK505	**I**	**Introduction to Forensics:** Introduction to crime, Sociological aspects of crime and criminals in society Types of crime and its causes – property crimes, public order crimes, violent crimes, cybercrimes, juvenile delinquency Introduction to Forensic science – nature, need and function, history of forensic science and scope Criminal behaviour - Theories and literature studies, criminal inheritance and factors responsible, Laws and Principles, branches of Forensic Science (Criminalistics, Forensic Pathology, Forensic Anthropology, Forensic	**12**

		Odontology, Forensic Engineering, Toxicology, Behavioural Sciences, Questioned Documents, Other Specialties)	
	II	**Crime scene investigation**: Types of crime scenes – primary, secondary, crime scenes based on size of evidence Forensic Scientists, Investigating officers and their assigned role and duties, Modus operandi General crime scene procedures and their management, Crime Scene survey, Crime Scene Documentation, collection and preservation of physical evidence, Packaging & Transportation of biological evidences, Blood, semen, urine, faecal matter, vomit, saliva, hair and fibre, explosive evidence (serology, Chemistry), Crime scene reconstruction. Role of forensic biologist (Protection of crime scene, Recognition of biological evidence)	**12**
	III	**Impressions and prints:** Footprints and shoe-prints: Importance, Gait Pattern, casting of footprints in Different medium, Taking Control samples. Tire Marks/prints and Skid marks, taking control samples, Forensic Significance. Lip Prints- Nature, Location, collection and evaluation, taking control samples, Forensic Significance. Bite Marks- Nature, Location, collection and evaluation, taking control samples, Forensic Significance. Ear Prints- Nature, Location, collection and evaluation, taking control samples, Forensic Significance. Tool Marks- Location, collection and evaluation, taking control samples, Forensic Significance. Finger Prints- Nature, Location, collection and evaluation, taking control samples, forensic significance, biometry, poroscopy and edgeoscopy	**12**

	IV	**Forensic DNA biology:** Introduction to and significance of DNA typing DNA typing methods for forensic analysis: SNPs Y chromosome DNA typing, Mitochondrial DNA analysis (mtDNA), X-Chromosome DNA typing, Non-Human DNA Testing, New Technologies, Automation, and Software, Proficiency Testing Lab accreditation, determination of secretor / non-secretor Lewis antigen, Bombay Blood group, Polymorphic enzymes typing – PGM, GLO, ESD, EAP, AK, ADA, etc., and their forensic significance, HLA typing, role Serogenetic markers in individualization, paternity disputes etc., Forensic cases solved using DNA typing	**12**

Course Code: RUSBTKP503

Course Title: Practicals Based on RUSBTK505

DETAILED SYLLABUS

Course Code	Title	Credits
RUSBTKP503	1. Collection and Packaging of Toxicological samples and Petroleum samples 2. Collection and Packaging of biological samples and Homicide case samples 3. To take plain and rolled fingerprints and identify fingerprint pattern. 4. To perform ridge counting and ridge tracing, Lifting and preservation of finger print 5. Collection and Examination of Lip prints and Ear prints 6. To perform electrophoresis for separation of various polymorphic enzymes. 7. Determination of secretor / non-secretor antigen from blood/ saliva. 8. Amylase in saliva (animal and human sources) 9. Luminol/ Phenolphthalein/ precipitin test for blood 10. Acid phosphatase for semen and Barberio test of semen 11. Extraction, isolation and detection of DNA from blood/saliva 12. Fingerprint analysis – powder analysis, ninhydrin spray test, Iodine development, silver nitrate 13. Case studies	**2**

References:

1. https://aboutforensics.co.uk/impression-evidence/
2. https://www.sciencedirect.com/topics/computer-science/sociological-aspect

3. https://saylordotorg.github.io/text_social-problems-continuity-and-change/s11-02-types-of-crime.html; https://www.justia.com/criminal/offenses/sex-crimes/public-indecency/
4. https://law.jrank.org/pages/12004/Causes-Crime.html
5. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/forensic_science/general_forensic/01._introduction_to_forensic_science/et/4761_et_01et.pdf
6. http://www.jpgmonline.com/article.asp?issn=0022-3859;year=2000;volume=46;issue=4;spage=303;epage=8;aulast=Tewari
7. https://sci-hub.tw/https://doi.org/10.1016/B978-0-12-802219-1.00013-4
8. https://pressbooks.bccampus.ca/criminalinvestigation/chapter/chapter-8-crime-scene-management/
9. https://scholarlycommons.law.northwestern.edu/cgi/viewcontent.cgi?article=1392&context=jclc
10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3722715/
11. Analysis and Identification of Bite Marks in Forensic Casework; Sandeep Kaur1 , Kewal Krishan1 , Preetika M Chatterjee1 and Tanuj Kanchan
12. http://www.latent-prints.com/images/Oliver.pdf; http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000690/M011457/ET/1516188816FSC_P3_M35_e-text.pdf
13. https://www.nap.edu/read/1866/chapter/4
14. Forensically relevant SNP classes, Bruce Budwole, Forensic laboratory. DOI: 10.2144/000112806
15. Y chromosome STR typing in crime casework; Lutz Roewer. DOI: 10.1007/s12024-009-9089-5
16. Forensic typing of short tandem repeat markers on the X and Y chromosomes: DOI: 10.1016/j.fsigen.2015.03.013
17. Use of non-human DNA analysis in forensic science: A mini review; Arati Iyengar, Sibte Hadi; https://doi.org/10.1177/0025802413487522
18. Introduction to non-human DNA typing; 10.1016/B978-0-12-382165-2.00049-0
19. Assessment of Lewis Blood group antigens and secretor status in autopsy samples; A. Busuttil, C.C. Blackwell et al.; https://doi.org/10.1016/0379-0738(93)90221-U
20. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_pg.php/692
21. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_pg.php/699
22. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_pg.php/690
23. https://www.ncbi.nlm.nih.gov/pubmed/15570103
24. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5418305/
25. https://juniperpublishers.com/jfsci/pdf/JFSCI.MS.ID.555755.pdf
26. https://www.ncbi.nlm.nih.gov/pubmed/14527299
27. https://www.researchgate.net/publication/288174234_New_Technologies_and_Automation
28. http://www.evidencemagazine.com/index.php?option=com_content&task=view&id=1894&Itemid=9
29. https://link.springer.com/chapter/10.1007/978-3-642-77324-2_126
30. https://www.ncbi.nlm.nih.gov/pubmed/12415830
31. https://www.ijser.org/researchpaper/Determination-of-Serological-Markers-Blood-group-markers-of-Biological.pdf
32. http://www.forensicsciencesimplified.org/fwtt/how.html
33. https://www.sirchie.com/catalog/category/view/id/102/?___store=international_english
34. http://www.tracksceneinvestigation.com/TSI%20PDFs/CASTING.pdf
35. https://emedicine.medscape.com/article/320160-overview
36. Earprints in forensic investigation; Lynn Meijerman, Andrew Thean & George Maat; https://link.springer.com/article/10.1385/FSMP:1:4:247
37. Forensic Examination and Interpetation of tool marks by David Baldwin, John Birkett, Owen Facey and Gilleon Rabey.

Modality of Assessment (SEMESTER V)

Theory Examination Pattern:

A) **Internal Assessment- 40%- 40 Marks**

Sr No	Evaluation type	Marks
1	One Assignment (Case study/Project based/Animation/ Review writing/ Video demonstration/ Pictorial or flow sheet representation, Infographs/ Industrial visit report/Presentations/ Mind-map or concept map etc.)	20
2	One class Test (multiple choice questions / objective)	20
	TOTAL	**40**

B) **External Examination- 60%- 60 Marks**

Semester End Theory Examination:

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

Theory question paper pattern:

1. There shall be 04 questions each of 15 marks. On each unit there will be one question.
2. All questions shall be compulsory with internal choice within the questions (60% options)

Paper Pattern:

Question	Options	Marks	Questions Based on
Q.1) A)	Any 5 out of 8	5	Unit I
Q.1) B)	Any 2 out of 3	10	
Q.2) A)	Any 5 out of 8	5	Unit II
Q.2) B)	Any 2 out of 3	10	
Q.3) A)	Any 5 out of 8	5	Unit III
Q.3) B)	Any 2 out of 3	10	
Q.4) A)	Any 5 out of 8	5	Unit IV
Q.4) B)	Any 2 out of 3	10	

Practical Examination Pattern:

PAPERS: RUSBTKP501, RUSBTKP502, RUSBTKP503

A) **Internal Examination: 40%- 40 Marks**

Particulars	Marks
Journal	10
Experimental tasks	30
Total	40

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

B) **External Examination: 60%- 60 Marks**

Semester End Practical Examination:

Particulars	Marks
Laboratory work *2 Major practicals* *1 Minor practicals* *Viva/ Spots*	*60* *20 & 25 M or 20M each* *10 M* *05 M or 10 M*
Total	60

Overall Examination & Marks Distribution Pattern

Course	RUSBTK501			RUSBTK502			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP501						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK503			RUSBTK504			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP502						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK505		
	Internal	External	Total
Theory	40	60	100
	RUSBTKP503		
Practicals	Internal	External	Total
	40	60	100

SEMESTER VI

Course Code: RUSBTK601

Course Title: IMMUNOLOGY, VIROLOGY AND INSTRUMENTATION

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Discuss the ongoing and future implications of immunology. Prepare vaccine in laboratory and check its sterility
CO 2	Draw the structure of MHC molecules
CO 3	Talk about the host interactions with reference to viral attacks. Demonstrate phage assay.
CO 4	Comment on different types of viruses and their distinguishing characteristics, medical concerns and strategies for dealing with viral attacks on humans as well as other living organisms
CO 5	Apply the basic principles and working of essential instruments to Biotechnological research
CO 6	Examine the different parameters to select a particular chromatography and centrifugation technique. Separate samples using these techniques.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK601	**I**	**Immunology:** MHC class I and II Structure, function, arrangement, interaction with epitopes, polymorphism, role of MHC in diseases, antigen presentation: endogenous antigen , exogenous	**15**

		antigens, TCR, BCR , accessory molecules: structure, function Introduction to CAR-T cell Vaccines and its types	
	II	**Virology:** Introduction to viruses-Position in biological spectrum Virus properties, General structure of viruses Baltimore Classification and Taxonomy (ICTV), Cultivation of viruses, Virulent phages and Lytic cycle - T even phages, One step growth experiment Temperate phages and lysogeny - lambda phage, Reproduction of ds DNA phages Hepatitis/ss RNA(influenza), animal viruses and plant Virus(TMV) Virus purification and assays Cytocidal infections and cell damage Viruses and cancer Viroid and Prions	**15**
	III	**Spectrometry and tracer techniques:** Principle, instrumentation and working of Fluorescence, Luminometry, Infrared, Atomic absorption Isotopes in Biology: Detection Techniques of Radioactivity using GM counter, Scintillation counter, Applications of Tracer techniques in Biology	**15**
	IV	**Chromatography and centrifugation:** Chromatography: Principle, working and application of Affinity, Ion-exchange, Gel permeation, HPLC-Method development and validation, GC. Centrifugation: Types, principle, working and applications of Differential and Density Gradient -Isopycnic, Rate, zonal, Gradient materials, preparation, sample application, recovery, choice of rotors.	**15**

References:

1. Mim's Medical Microbiology 5th edition
2. Microbiology by Prescott Harley and Klein 5th edition Mc Graw Hill
3. Medical Microbiology Jawetz,E., Brooks,G.E, Melnick,J.L., Butel,J.S Adelberg E. A 18th edition
4. Medical Microbiology by Patrick Murray 5th edition
5. Foundations In Microbiology by Talaro and Talaro Third edition W.C Brown
6. Understanding Viruses by Teri Shors
7. Biophysics (2002) Vasantha Pattabhi and N. Gautham, Kluwer Academic Publishers
8. Physical Biochemistry: principles and applications, 2nd edition (2009), David Sheehan , John Wiley & Sons Ltd
9. HPLC method validation for pharmaceuticals: a review (2013), Harshad V. Paithankar, International Journal of Universal Pharmacy and Bio Sciences 2(4): JulyAugust.
10. Lehninger, principles of biochemistry, 4th edition (2005), David Nelson and Michael Cox W.H. Freeman and Company, New York.
11. Biochemistry , 4th edition (2010), Voet and Voet, John Wiley and sons, USA
12. Biochemistry, 4nd edition (2017), Satyanarayana and Chakrapani, Books & Allied (P) Ltd
13. Biophysical Chemistry by Upadhayay and Nath
14. Immunology by Kuby 5^{th} , 7^{th} edition
15. Immunology by Riott
16. Immunology Palan and Pathak

Course Code: RUSBTK602
Course Title: DEVELOPMENTAL BIOLOGY AND TRANSGENESIS
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Summarize the basic functions of gametogenesis, fertilization, post fertilization events
CO 2	Apply the principles of embryology to infertility
CO 3	Deduce and choose appropriate method of ART to be used based on infertility conditions. Analyse the semen sample
CO 4	Examine the methodology used for transgenesis of plants and animals
CO 5	Understand the applications of transgenic organisms in research
CO 6	Select a particular method of transgenesis according to their applications and advantages/limitations

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK602	**I**	**Developmental biology:** Mammalian embryonic development: Reproductive systems, Gametogenesis, Fertilization, Cleavage, Implantation, Gastrulation, cell fate and lineages of three germ layers, fate map Concept of differentiation and embryonic induction	**15**
	II	**Assisted reproductive technology and Stem cell banking:** Infertility, causes of infertility, managing infertility through ART: IVF, ICSI, GIFT and ZIFT, Artificial	**15**

		insemination, test tube baby, Embryo transfer New techniques in ART Stem cells, sources of stem cells, cord blood banking, collection and banking process, public and private banks, applications/uses of stem cell banks	
	III	**Genetic engineering in plants:** Genetic engineering of plants; Methodology. Plant transformation with the Ti plasmid of *A. tumefaciens*, Ti plasmid derived vector system - Transgenic plants: Physical methods of transferring, genes to plants: electroporation, microprojectile bombardment, liposome mediated, protoplast fusion, Vectors for plant cells, Improvement of seed quality protein	**15**
	IV	**Transgenic animals:** Transgenic mice- methodology-retroviral method, DNA microinjection, ES method, genetic manipulation with cre-loxP, Vectors for animal cells, Transgenic animals' recombination system, Cloning live stock by nuclear transfer, Transgenic fish	**15**

References:

1. Principles and techniques in biochemistry and molecular biology (2010), Keith Wilson and John Walker, 7th
2. iGenetics A Molecular Approach 3rd Edition Peter J. Russell.
3. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
4. Principles of Gene Manipulation 7th Edition Primrose S.B., Twyman R.M.
5. Developmental Biology; Scott Gilbert; 9th Edition
6. Langman's medical embryology- T.W. Sadler
7. Development of chordate biology- Verma and Agarwal
8. Review article: Assisted reproductive technology: techniques and limitations- by Mr. Begum
9. Review article: Assisted reproductive technology- Simon M Kelly
10. Umbilical cord blood banking: Consensus statement of the Indian Academy of Pediatrics
11. Umbilical cord blood banking- Royal college of Obstetrician & Gynaecologists
12. Collection, Processing and Banking of Umbilical Cord Blood Stem cells for Clinical use in transplantation and regenerative medicine- David T. Harris
13. Stem cell banking for Regenerative and Personalized medicine: Biomedicines 2014 by David T. Harris

Course Code: RUSBTKP601
Course Title: Practicals Based on RUSBTK601 &RUSBTK602

DETAILED SYLLABUS

Course code	Title	Credits
RUSBTKP601	1. TAB vaccine and Sterility of injectables 2. Phage assay: Demonstration 3. Separation of components from a mixture using Affinity chromatography (Kit may be used) 4. Separation of components from a mixture using ion exchange chromatography (Kit may be used) 5. Separation of components from a mixture using Size exclusion chromatography (Kit may be used) 6. HPLC method validation. 7. TLC of fatty acids/plant pigments 8. Column: chalk chromatography 9. Sucrose density gradient centrifugation 10. Density gradient centrifugation for blood 11. Chick embryo candling and inoculation methods Demonstration experiment. 12. Semen analysis 13. Isolation of Protoplast and fusion 14. Skill based project	**3**

Course Code: RUSBTK603
Course Title: PHARMACOLOGY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Elucidate the concepts of pharmacology and apply the principles in estimation of toxicity of different agents
CO 2	Comment on causes of allergic reactions with response to drug or poison
CO 3	Obtain clarity about mechanism of absorption of drugs from different tissues
CO 4	State the mechanism of action of different antimicrobials. Perform and evaluate different antibiotic sensitivity tests.
CO 5	Predict which antimicrobial agents to be used based on the causative agent
CO 6	Examine the mechanism of different poisons and toxins

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK603	**I**	**Chemotherapeutic agents:** Discovery and Design of antimicrobial, Classification of Antibacterial agents, Selective toxicity, MIC, MLC, Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics: Penicillin, Cephalosporins; Glycopeptides: Vancomycin; Polypeptides: Bacitracin Injury to plasma membrane: Polymyxin, Inhibition of protein	**15**

		synthesis: Aminoglycosides, Tetracyclines, Chloramphenicol, Macrolides Erythromycin, Inhibition of nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole, Antimetabolites: Sulphonamides, Trimethoprim Drug resistance: Mechanism origin, transmission, Use and misuse of antimicrobial agents, Antifungal drugs, Antiviral drugs Cancer: Introduction, Diagnosis & treatment, chemotherapy and preventive measures for cancer	
	II	**General principles of pharmacology:** Mechanism of drug action, drug receptors and biological responses second-messenger systems, the chemistry of drug–receptor binding, dose–response relationship: therapeutic index, ED, LD, Potency and Intrinsic Activity, Drug antagonism	**15**
	III	**Drug Absorption and distribution:** Absorption of drugs from the alimentary tract, factors affecting rate of gastrointestinal absorption, absorption of drugs from lungs and skin, absorption of drugs after parenteral administration factors influencing drug distribution, binding of drugs to plasma proteins, Physiological barriers to drug distribution	**15**
	IV	**Basic and regulatory toxicology:** Background Definitions Causation: degrees of certainty Classification, Causes Allergy in response to drugs, Effects of prolonged administration: chronic organ toxicity, Adverse effects on reproduction Poisons: Deliberate and accidental self-poisoning, Principles of treatment Poison-specific measures General measures , Specific poisonings: cyanide, methanol, ethylene glycol, hydrocarbons, volatile solvents, heavy metals, herbicides and pesticides, biological substances (overdose of medicinal drugs is dealt with under individual agents**)**, Incapacitating	**15**

		agents: drugs used for torture, Nonmedical use of drugs	

References:

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Modern Pharmacology with clinical Applications Craig,C.R, Stitzel,R.E 5th edition
3. Clinical Pharmacology Bennet,PN,Brown,M.J, Sharma,P 11th edition Elsevier
4. Biochemistry Metzler, D.E Elsevier
5. Microbiology by Prescott Harley and Klein 5th edition Mc Graw Hill
6. Medical Microbiology Jawetz,E., Brooks,G.E, Melnick,J.L., Butel,J.S Adelberg E. A 18th edition
7. Medical Microbiology by Patrick Murray 5th edition
8. Foundations In Microbiology by Talaro and Talaro Third edition W.C Brown
9. Understanding Viruses by Teri Shors
10. Mim's Medical Microbiology 5th edition
11. Casarett & Doull's Toxicology- The Basic Science Of Poisons

Course Code: RUSBTK604
Course Title: BIOSAFETY AND PLANT BIOTECHNOLOGY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Identify the potential hazards in laboratory or workplace and suggest first aid and safety methods
CO 2	Prepare/design SOPs of instruments
CO 3	Assess quality assurance and quality control of different products
CO 4	Assess quality assurance and quality control of different products
CO 5	Comment on different advanced techniques and their uses in plant biotechnology
CO 6	Produce biofertilizer/biopesticide in laboratory and study their effects on plant growth

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK604	**I**	**Introduction to Biosafety:** Introduction, Biological Risk Assessment, Hazardous, Genetically modified hazards, Cell cultures, Hazardous Characteristics of Laboratory Procedures, Potential Hazards Associated with Work Practices, Safety Equipment and Facility Safeguards, Pathogenic risk and management Biosafety in biotechnology and rDNA technology	**15**

	II	**GLP, GMP and QA-QC:** Concept of GLP and GMP**,** Requirements and implementation of GMP, Practicing GLP, Guidelines to GLP Documentation of Laboratory work, Documentation of GMP practices , Preparation of SOPs Calibration records , Validation of methods, Regulatory certification, Quality assurance and Quality control and: concept of QA & QC, Requirements for implementing QA & QC	**15**
	III	**Introduction to plant biotechnology:** Introduction, Micropropagation, Somaclonal Variations, Haploid Plants, Embryo Rescue, Somatic Hybrids And Cybrids, Germplasm Conservation, Molecular Markers And Maps	**15**
	IV	**Biofertilizers and biopesticide:** Biofertilizer: Nitrogen-fixing Rhizobacteria – Symbiotic Nitrogen Fixers, Nonsymbiotic Nitrogen Fixers, Plant Growth Promoting Microorganisms-Phosphate- Solubilizing Microbes (PSM), Phytohormones and Cytokinins, Induced Systemic Resistance Plant Growth Promotion by Fungi-Mycorrhizae, Arbuscular Mycorrhizae, Ectomycorrhizae Microbial Inoculants-Inocula,Carriers,andApplications,MonocultureandCo-cultureInoculantFormulations Biocontrol,Polymicrobial Inoculant Formulations Biopesticides - types, Bacillus thuringiensis, insect viruses and entomopathogenic fungi(characteristics, physiology, mechanism of action and application)	**15**

References:

1. Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.
2. Biosafety in Microbiological and Biomedical Laboratories - 5th Edition, L. Casey Chosewood Deborah E. Wilson U.S. Department of Health and Human Services Centers for Disease Control and Prevention National Institutes of Health.
3. WHO handbook on GLP
4. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
5. Plant tissue culture by K.G.Ramawat
6. Plant tissue culture by KK Dey

7. Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur IK International
8. Biotechnology- expanding horizons: B D Singh
9. Microbial Technology Peppler,H.J and Perlman,D 2nd Academic Press Practicals
10. Environmental Biotechnology by M.H. Fulekar
11. Advances in Biotechnology by S.N. Jogdand

Course Code: RUSBTKP602

Course Title: Practicals Based on RUSBTK603 &RUSBTK604

DETAILED SYLLABUS

Course code	Title	Credits
RUSBTKP602	1. Antibiotic sensitivity test using agar cup method 2. Antibiotic sensitivity test using paper disc method 3. Antibiotic sensitivity test using ditch method. 4. Synergistic action of two drugs 5. LD 50, ED 50 evaluation using suitable models 6. First aid methods and safety in laboratory/ workplace 7. Biosafety: Signs and Symbols 8. Validation of measuring cylinders, colorimeters 9. Calibration of pH meter and weighing balance 10. Isolation of phosphate solubilising organism 11. Quantitative measurement of phosphate solubilisation 12. Isolation of Rhizobium and Azatobacter 13. Study the effect of plant growth using them as microbial inoculants 14. Extraction of biopolymer from Azatobacter	**3**

Course Code: RUSBTK605
Course Title: FORENSIC SCIENCES-II
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Obtain clarity on the variety of instruments that can be used for evidence analysis
CO 2	Apply the different instrumentation techniques for different samples/evidences
CO 3	Elucidate on the importance of the different branches of forensic laboratories
CO 4	Talk about the significance of evidence in analysis and perform the analysis for different samples.
CO 5	Comprehend the role of explosives and ballistics.
CO 6	Solve case studies related to forensic biology

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK605	**I**	**Analytical techniques in forensic sciences:** Instrumentation in Forensic Analysis (2 – 3 examples of each) Applications of Microscopy, spectroscopy (Atomic absorption, Flame spectrometry, inductive coupled plasma spectrometry), electrophoresis, chromatography (GC, HPLC), gravimetric analysis and Volumetric analysis, Thermal methods (TGA, DTA, DSC), NMR, Neutron Activation Analysis Serological Techniques	**12**

		Electrophoretic methods: Agarose gel, SDS Natured /Denatured. DNA Quantification: Slot Blot Assay, Southern Northern Western blotting Various methods of development of fingerprints: conventional methods, physical and chemical methods, florescent method, Magnetic Powder method, fuming method, laser method. PCR in forensic science	
	II	**Evidence analysis:** Determination of human and animal origin from bones, hairs, nails, skin, body tissue, and fluids strains viz. blood, menstrual blood, semen, saliva, sweat, pus, vomit, etc., through immune diffusion and immune – electrophoresis. Identification of blood: Properties Blood Grouping History of Bloodstain Pattern interpretation Target surface considerations, Size, Shape and Directionality of bloodstains Spattered blood, other Bloodstain Patterns Interpretation of Bloodstain on clothing and footwear	**12**
	III	**Forensic science and its branches:** Analysis of Skeletal Remains Forensic Anthropology (Skeletal system & bone formation, Skeletal indicators of health & injuries, Identification of joint wear & deterioration, Estimation of Age, Sex & race, Estimation of time since death, Human v/s animal bone morphology) Facial Reconstruction Forensic Odontology (Development of dental structure, Estimation of Age, Sex & race) Forensic Pathology (Decomposition Muscular Physiology, causes of death – Asphyxia, drowning, Post mortem Examination - Wounds, injuries	**12**

		Digestive System & Digestive paths of macromolecules, enzymes & end products, Undigested stomach contents post mortem, Role of a Forensic Pathologist) Forensic Entomology (Basic principle of insect biology, Life cycle, Estimation of time since death, Dipterans Larval Development, Successional Colonization of Body, Determination of displacement and disturbance of the body)	
	IV	**Ballistics and forensic laboratories:** Introduction of Fire arms. Proof marks Introduction to and types of Ballistics (internal, external and terminal ballistics) Role of forensic sciences in explosives Petroleum – Introduction and its forensic examination for adulteration Growth of Forensic Science Laboratories in India – Central and State level laboratories, Educational setup in Forensic Science in India Services and functionalities provided by various FSLs, Various divisions in the FSL – Ballistics, Biology, Chemistry Documents, Physics, Psychology, Serology, Toxicology	**12**

Course Code: RUSBTKP603

Course Title: Practicals Based on RUSBTK605

DETAILED SYLLABUS

Course code	Title	Credits
RUSBTKP603	1. Microscopic examination of hair of different animals such as Dogs, Cats, Cow, Horse, Goats, humans etc. (M-18) 2. Separation & detection of biological fluid by using HPLC. 3. Cement analysis by volumetric and gravimetric method. 4. Detection of Blood Alcohol Content. 5. Blood spatter analysis. 6. PCR analysis of given sample. 7. TLC of analgesics/ semen (M-08 Serology) 8. TLC of ink and dyes. 9. Capillary electrophoresis 10. Detection of saliva by gel-based starch-iodide test. 11. Reinsch's test for detection of arsenic in forensic sample 12. Copper-sulphate pyridine test for detection of cyanate 13. Prussian blue test for detection of cyanide in the sample. 14. Zwikker's test for Thiobarbiturates in sample. 15. McNally's test for presence of salicylates and salicylic acid in sample. 16. Lieberman's test for detection of phenols, resorcinols as well as alpha- & beta-naphthol. 17. Ammonium Molybdate test for detection of arsenites and phosphates. 18. Case studies	**2**

References

1. Forensic analytical technique- Barbara Stuart
2. Latent print development- Brian Yamashita and Mike French
3. Forensic Analysis of Biological Evidence- R.E. Gaensslen
4. Handbook of Firearms and Ballistics: Examining and Interpreting Forensic Evidence- Second Edition- Brian J. Heard

Modality of Assessment (SEMESTER VI)

Theory Examination Pattern:

A) **Internal Assessment- 40%- 40 Marks**

Sr No	Evaluation type	Marks
1	One Assignment (Case study/Project based/Animation/ Review writing/ Video demonstration/ Pictorial or flow sheet representation or Infograph/ Mind map or concept map / Industrial visit report/Presentations etc.)	20
2	One class Test (multiple choice questions / objective)	20
	TOTAL	**40**

B) **External Examination- 60%- 60 Marks**

Semester End Theory Examination:

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

Theory question paper pattern:

1. There shall be 04 questions each of 15 marks. On each unit there will be one question.
2. All questions shall be compulsory with internal choice within the questions (60% options)

Paper Pattern:

Question	Options	Marks	Questions Based on
Q.1)A)	*Any 5 out of 8*	*5*	*Unit I*
Q.1)B)	*Any 2 out of 3*	*10*	
Q.2)A)	*Any 5 out of 8*	*5*	*Unit II*
Q.2)B)	*Any 2 out of 3*	*10*	
Q.3)A)	*Any 5 out of 8*	*5*	*Unit III*
Q.3)B)	*Any 2 out of 3*	*10*	
Q.4)A)	*Any 5 out of 8*	*5*	*Unit IV*
Q.4)B)	*Any 2 out of 3*	*10*	

Practical Examination Pattern:

PAPERS: RUSBTKP601, RUSBTKP602, RUSBTKP603

A) **Internal Examination: 40%- 40 Marks**

Particulars	Marks
Journal	10
*Experimental tasks	30
Total	40

***Project work for semester VI in RUSBTKP601 (Internal project evaluation- 25 M)**

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

B) **External Examination: 60%- 60 Marks**

Semester End Practical Examination:

Particulars	Marks
Laboratory work *2 Major practicals** *1 Minor practicals* *Viva/ Spots*	*60* *20 & 25 M or 20M each* *10 M* *05 M or 10 M*
Total	60

***Skill based project in Semester VI (RUSBTKP601) - 50M**

Overall Examination & Marks Distribution Pattern

Course	RUSBTK601			RUSBTK602			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP601						
	Internal			External			

Practicals	**40**	**60**	**100**

Course	**RUSBTK603**			**RUSBTK604**			**Grand Total**
	Internal	**External**	**Total**	**Internal**	**External**	**Total**	
Theory	**40**	**60**	**100**	**40**	**60**	**100**	**200**
Course	**RUSBTKP602**						
	Internal			**External**			
Practicals	**40**			**60**			**100**

Course	**RUSBTK605**		
	Internal	**External**	**Total**
Theory	**40**	**60**	**100**
	RUSBTKP603		
Practicals	**Internal**	**External**	**Total**
	40	**60**	**100**
