Resolution No. AC/I(19-20).2.RPS2

S.P.Mandali's

Ramnarain Ruia Autonomous College

Syllabus for *M.Sc. I*

Program: *M.Sc.*

Course: *Biochemistry (RPSBCH)*

(Credit Based Semester and Grading System with effect from the academic year 2019–2020)

Semester I

Course Code	Unit	Topics	Credits	Lectures
Paper I – Basics of Biochemistry				
RPSBCH101	I	Membrane Biochemistry	4	15
	II	Bioenergetics & Protein chemistry		15
	III	Enzymology		15
	IV	Neurophysiology & Cardiac Physiology		15
Paper II - Instrumentation & Analytical Techniques - I				
RPSBCH102	I	Colligative properties and Acids, Bases & Buffers	4	15
	II	Centrifugation & Electrophysiological Methods		15
	III	Chromatography		15
	IV	Spectroscopic Techniques I		15
Paper III - Industrial Biotechnology & Bioinformatics				
RPSBCH103	I	Bioprocess Technology & Fermentation	4	15
	II	PTC, ATC & MTC		15
	III	Food Quality		15
	IV	Bioinformatics		15
Paper IV - Research Methodology, Developmental Biology & Soft Skills Development				
RPSBCH104	I	Research and Research Design	4	15
	II	Report Writing and Presentation		15
	III	Developmental biology in animals & plants		15
	IV	Soft Skills Development		15
RPSBCHP101	Enzymology & Serological Estimations		2	
RPSBCHP102	Chromatography, Colorimetry		2	
RPSBCHP103	Bioinformatics & Tissue culture		2	
RPSBCHP104	Research Methodology & Microscopy		2	

Semester II

Course Code	Unit	Topics	Credits	Lectures
Paper I - Advanced Biochemistry				
RPSBCH201	I	Plant Biochemistry	4	15
	II	Endocrinology		15
	III	Biochemistry of Tissues		15
	IV	Cell Signalling & Bioluminescence		15
Paper II - Instrumentation and Analytical Techniques - II				
RPSBCH202	I	Electrophoresis	4	15
	II	Special Instrumental Methods of Analysis		15
	III	Techniques in Genetics & Sequencing Techniques		15
	IV	Spectroscopic Techniques II		15
Paper III - Industrial & Environmental Biotechnology				
RPSBCH203	I	Industrial Importance of Carbohydrates, Proteins & Lipids	4	15
	II	Immobilization, Biosensors & Production of vaccines, hormones and industrial proteins		15
	III	Environmental Biotechnology		15
	IV	Nanotechnology & other topics		15
Paper IV – Biostatistics				
RPSBCH204	I	Introduction to Biostatistics	4	15
	II	Hypothesis Testing of Means & ANOVA		15
	III	Hypothesis Testing of Difference Between Means & Chi-square Test		15
	IV	Normal Distribution, Probability and Correlation & Regression		15
RPSBCHP201	Enzymology & Isolations		2	
RPSBCHP202	Chromatography & Colorimetry		2	
RPSBCHP203	Isolations & Environmental Biochemistry		2	
RPSBCHP204	Bioinformatics, Isolations & Microscopy		2	

Course Code: RPSBCH

Course Title: Biochemistry

Academic year 2019-20

Learning Objectives:

The overall goal of this MSc I course is to introduce the students to the basics & advances of biochemistry, instrumentation, analytical techniques, industrial & environmental biotechnology, bioinformatics, research methodology, developmental biology, biostatistics, and soft skills development.

Learning Outcomes:

Upon completion of the MSc Part I course, the students would learnand understand the following:

1) The basics of Biochemistry to make them understand advanced concepts easily. Also, the basics of Biochemistry unit was included purposely in the syllabus to introduce 6 units Chemistry students to the subject of Biochemistry.
2) Theoretical and practical knowledge of different tools used for various Biochemical estimations which will improve their analytical skills and handling of instruments.
3) The applied aspects of Biochemistry through Biotechnology, Microbiology, Industrial synthesis and environmental biotechnology.
4) Bioinformatics which will enable them to understand the computational application of biology. It is an important topic in modern sciences which will help them to understand protein engineering and drug designing in a better way.
5) Research methodology which will help them to develop research aptitude through research projects.
6) Soft skills development which will create awareness and develop competence in personality development, communication skills, academic and professional skills. Empower the students with leadership qualities, entrepreneurship and start-ups for employment, stress & time management.
7) Biostatistics which will help them to interpret results and draw conclusions of the experimental data generated during their dissertation work and experiments.
8) All the practicals have been rearranged in accordance with the theory of each paper at each semester.

Detailed Syllabus

SEMESTER I		
Course Code	**Title**	**Credits**
RPSBCH101	**Basics of Biochemistry**	**04**
Unit I	**Membrane Biochemistry**	**15 lectures**
1.1	**Membrane Biochemistry**	
1.1.1	Biological membrane; structure and assembly: constituents, bacterial cell envelop, asymmetry flip flop, protein lipid interaction, factors affecting physical properties of membranes.	
1.1.2	Biological and physical membrane models. Specialized features like lipid rafts, caveolae and tight junctions	
1.1.3	Principles and Mechanism of Diffusion and Passive, Active & facilitated Transport. Endocytosis, exocytosis.	
1.1.4	Specialized mechanism for transport of macromolecules, gap junctions, nuclear pores, toxins, control of transport processes, binding proteins, hormone effects	
1.1.5	Role of Na, K ATPase and the passive permeability of the plasma membrane to Na, K and Cl, voltage and ligand gated ion channels, ATP-ADP exchanger.	
1.1.6	Molecular mechanisms, ion translocating antibiotics, valinomycin, gramicidin, ouabain, group translocation, ionophores, electrical gradient, energy coupling mechanism.	
Unit II	**Bioenergetics & Protein Chemistry**	**15 lectures**
2.1	**Bioenergetics**	
2.1.1	Introduction to Bioenergetics, Concepts of free energy	
2.1.2	Respiratory Electron Transport Chain (ETC), Carriers, Q cycle in complex III, Inhibitors of ETC	
2.1.3	Malate–Aspartate shuttle, Glycerol phosphate shuttle	
2.1.4	Proton Motive Force, Chemiosmotic theory	
2.1.5	ATP synthase, ATP synthesis	
2.1.6	Uncouplers of ETC and oxidative phosphorylation	
2.2	**Protein Chemistry**	
2.2.1	Polypeptide backbone, covalent and non-covalent interactions, end-group analysis by chemical and enzymatic methods, Conformation, Configuration	
2.2.2	Details of 1°, 2°, 3° and 4° structures, problems based on determination of 1° structure, Ramachandran Plot, Motifs, and folds in protein structure, Zinc finger, Leucine zipper, Domains.	
2.2.3	Structure-function relation of protein, Protein-Protein interaction (actin, tubulin), cross-linking in proteins.	
2.2.4	Dynamic properties and mechanisms of protein folding.	
2.2.5	Prion proteins, prion domains. Their role in neurodegenerative disease.	
Unit III	**Enzymology**	**15 lectures**
3.1	**Enzymology**	
3.1.1	IUB/EC Enzymes classification	
3.1.2	Michaelis-Menten Kinetics of monosubstrate enzyme reaction, LB Plot, Einsethal Cornish Bowden Plots	

3.1.3 3.1.4 3.1.5 3.1.6	Mechanism of enzyme action Importance of transition state in enzyme activity Mechanism of Enzyme Action for Acid –Base Electrostatic and Covalent Catalysis (Ex. Chymotrypsin, Carboxypeptidase, Hexokinase), factors affecting catalysis. Metal, co-factor, and co-enzyme requirements Enzyme Inhibition-Reversible competitive, non-competitive, uncompetitive, Partial, Mixed, Allosteric Irreversible and Feedback Inhibition. Enzyme inhibitors as drugs Regulatory enzymes Allosteric enzymes-Conformational Changes in Response to Modulator Binding	
Unit IV	**Neurophysiology & Cardiac Physiology**	**15 lectures**
4.1 4.1.1 4.1.2 **4.2** 4.2.1 4.2.2 4.2.3 4.2.4 4.2.5 4.2.6 4.2.7	**Neurophysiology** Nerves- Structure of Neuron, chemistry of nerve tissue, mechanism of nerve impulse transmission, synapse (Chemical & Electrical) and synaptic transmission, Synthesis and actions of neurotransmitters (GABA, Acetylcholine, Glycine, Aspartic acid, Catecholamines), disorders related to defects in neurotransmission– (Parkinson's disease, stroke, Alzheimer's disease) **Cardiac Physiology** Conductive system of the heart – SA node (Mechanism & Self excitation) Internodal pathways AV node (Mechanism & Conduction) Purkinje fiber Regulation of conduction of the heart Normal ECG & its characteristics	
	PRACTICALS	
RPSBCHP101	**Enzymology & Serological Estimations**	**Credits 02**
	1) Determination of optimum pH of β-amylase 2) Determination of optimum temperature of β-amylase 3) Determination of Km value of β-amylase 4) Study of effect of inhibitor on the Km value of β-amylase 5) Determination of Km value of pectinesterase 6) Estimation of plasma glucose by GOD-POD method 7) Estimation of serum calcium by Trinder's method 8) Estimation of serum iron by dipyridyl method 9) Estimation of serum copper by Dithiocarbamate method 10) Estimation of serum phosphorus by Fiske-Subbarow method	

SEMESTER I		
Course Code	**Title**	**Credits**
RPSBCH102	**Instrumentation and Analytical Techniques - I**	**04**
Unit I	**Colligative Properties & Acid, Bases and Buffers**	**15 lectures**
1.1 1.1.1 1.1.2 **1.2** 1.2.1 1.2.2 1.2.3	**Colligative Properties** Definitions, Factors affecting and Physiological Applications of Osmosis, Measurement of osmotic pressure, Osmoregulation, Adsorption, Colloids, Surface Tension and Viscosity Numerical Problems based on above concepts **Acid, Bases and Buffers** Ionization, Dissociation, Acidity, Basicity theories of Acid and Bases, Strength of Acids and Bases, Acid-Base Equilibrium in Aqueous and Non-aqueous media. pH, pH-dependent functions and structures off bio-molecules, Henderson – Hasselbach Equation, Different methods for measurement of pH. Use of Indicators, Buffers, Amino Acid titrations. Biologically important buffers, Buffering of blood. Numerical Problems based on above concepts	
Unit II	**Centrifugation & Electrophysiological Methods**	**15 lectures**
2.1 2.1.1 2.1.2 2.1.2 **2.2** 2.2.1 2.2.2	**Centrifugation** Basic principles of sedimentation, relation between g and rpm Classification of centrifuges based on level of sophistication: Bench top, High speed and ultracentrifuges Types, Principles, Instrumentation, Working and Applications of: Preparative and Analytical Ultracentrifugation **Electrophysiological Methods** Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion & stimulation of brain, PET, MRI, fMRI, CAT Medical imaging – Radiography (Projection radiographs & Fluoroscopy), Ultrasound (medical ultrasonography), Elastography, Tactile imaging, Tomography, Echocardiography	
Unit III	**Chromatography**	**15 lectures**
3.1 3.1.1 3.2 3.2.1 3.2.2 3.2.3 3.2.4 3.2.5 3.2.6	**Chromatography** Introduction, Concept of partition coefficient, retention time, retention factor Principle, Technique and Applications of the following kinds of chromatography: Partition chromatography (Paper, GLC, GSC) Adsorption Chromatography (TLC and Column) Ion exchange chromatography Gel filtration Affinity chromatography Advanced Chromatographic techniques – HPLC, HPTLC, LC-MS	

Unit IV	**Spectroscopic Techniques – I**	**15 lectures**
4.1 4.1.1 4.1.2 4.1.3 4.1.4 4.1.5	**Spectroscopic Techniques – I** Beer-Lamberts Law, Its verifications and Deviations, Concept of Absorptions, Transmission, Scattering, Phosphorescence, Fluorescence, Luminescence, Diffraction Spectra and interpretation. The Chromophore concept – Auxochrome, Infrared Spectra of common functional groups. Principle, Instrumentation, working and application of – UV- Visible and IR Spectroscopy Double beam operation, dual wavelength spectrophotometer, Disadvantages of IR spectroscopy. Turbidometry and Nephlometry. Principle, instrumentation, working and application of – Spectrofluorometric, Flame Spectrophotometry, Fluorescence spectra and the study of protein structure.	
	PRACTICALS	
RPSBCHP102	**Chromatography, Colorimetry**	**Credits 02**
	1) Estimation of proteins by Biuret method 2) Estimation of amino acids by Ninhydrin method 3) Estimation of glucose by Folin – Wu method 4) Separation of plant pigments by adsorption column chromatography 5) Separation of sugars by ascending paper chromatography 6) Separation of sugars by circular paper chromatography 7) Separation of a mixture of glucose and starch by gel filtration chromatography 8) Determination of pKa values of alanine/ glycine by titration curve	

SEMESTER I		
Course Code	**Title**	**Credits**
RPSBCH103	**Industrial Biotechnology and Bioinformatics**	**04**
Unit I	**Bio Process Technology & Fermentation**	**15 lectures**
1.1	**Bio Process Technology**	
1.1.1	Types of Bioreactors- Batch, continuous stirred Tank, Recycle reactors, fluidized bed reactor, Semi-continues	
1.1.2	Parameters for Bio process – Bio mass, Substrates, product, O_2 and CO_2, Temperature, agitation.	
1.1.3	Bio process monitoring with respect to O_2 transfer, energy transfer, rate of utilization, efficiency.	
1.1.4	Downstream processing, process for product recovery, recycling of residual raw, by product recovery.	
1.2	**Fermentation**	
1.2.1	Primary and secondary of microbes, inoculums preparation, fermentation media, industrial sterilization, strain improvement, metabolic and genetic regulations during fermentations, pure and mix culture fermentations.	
1.2.2	Products from microorganisms (Flowsheets)– enzymes (Pectinases), Primary metabolites (Glucose), Antibiotics (Penicillin), Beverages (wine, Beer)	
1.2.3	Fuels from microbes, microbial polymers and microbial steroid biotransformations	
Unit II	**PTC, ATC & MTC**	**15 lectures**
2.1	**Plant Tissue Culture (PTC)**	
2.1.1	Principles, Techniques, Methodology and Application of PTC	
2.1.2	Micropropogation and Protoplast fusion	
2.1.3	Suspension Cultures for production and secondary metabolites	
2.1.4	Use of PTC in production of transgenics	
2.2	**Animal Tissue Culture (ATC)**	
2.2.1	Principles, Techniques, Methodology and Application of ATC	
2.2.2	Transfection using eggs, cultured stem cells and nuclei in development of transgenic animals	
2.2.3	Frontiers of contraceptive research, cryopreservation of sex gametes & embryos, Ethical issues in embryo research	
2.3	**Microbial Tissue Culture (MTC)**	
2.3.1	Principles, Techniques, Methodology and Application of MTC.	
2.3.2	Commercial production of industrially important microbial strains, role of ATCC and microbial cell banks.	
2.3.3	Microbes as products, Single Cell Protein (SCP) and Yeast (nutrient).	
Unit III	**Food Quality**	**15 lectures**
3.1	**Bio Chemistry of Food Spoilage**	
3.1.1	Factors causing food spoilage during food ripening, vegetable maturation and their control.	
3.1.2	Post mortem changes in meat and their control.	

3.2 3.2.1 3.2.2 **3.3** 3.3.1 3.3.2 3.3.3	**Food Preservation** General principles of food preservation Preservation by use of high and low temperatures, drying, radiations, chemical preservatives, inert gases, mechanical preservation techniques (vacuum packaging, tetra packs). **Adulteration & Other topics** Determination of shelf – life of food products, transport of perishable food items. Food Adulteration – Common food adulterants, their harmful effects and physical and chemical methods for their detection. Role of ISI, Agmark, FDA & Food Safety and Standards Authority of India (FSSAI), Food and Agricultural Organization (FAO) in food industry.	
Unit IV	**Bioinformatics**	**15 lectures**
4.1 4.1.1 4.1.2 4.1.3 4.1.4 **4.2** 4.2.1 4.2.2 4.2.3 4.2.4 4.2.5 4.2.6	**Introduction to Bioinformatics** Bioinformatics- Need and applications on various fields of Biology Introduction to Databases- Classification and Categories Nucleotide and Protein sequence analysis using BLAST and variants, working of BLAST Introduction to multiple sequence alignment- Progressive algorithms- CLUSTAL programs, working of CLUSTAL **Biological Databases and retrieval techniques** Nucleotide Databases- Genbank, Unigene Literature Database- Pubmed, Medline Protein Sequence Databases- Swissprot, PIR Protein Structural Databases- PDB, SCOP, CATH Metabolic pathway database- KEGG, Metacyc Other databases- OMIM, Taxonomy	
	PRACTICALS	
RPSBCHP103	**Bioinformatics & Tissue culture**	**Credits 02**
	1) Searches on Medline, PubMed,BioMed central 2) Use of clustal x/w for alignment of protein and nucleic acid sequence 3) Use of TAXON to classify microbes and viruses 4) Methods for searching BLAST and FASTA 5) Tests for adulteration 6) Estimation of proteins by Pyne's method 7) Detection of antimicrobial activity 8) Estimation of carbon dioxide generated during fermentation by yeast	

SEMESTER I		
Course Code	**Title**	**Credits**
RPSBCH104	**Research Methodology, Developmental Biology & Soft Skills Development**	**04**
Unit I	**Research & Research Design**	**15 lectures**
1.1 1.1.1 1.1.2 1.1.3 **1.2** 1.2.1 1.2.2 1.2.3	**Research** Meaning of research, Research Process, Types of research Formulating research problem Criteria for good research. Significance of research. **Research Design** Meaning, features of good research design, types of research designs. Basic principles of experimental designs. Prospective, retrospective, prospective & retrospective, observational, experimental, clinical trials, RCT, Cohort, cross sectional and case controlled studies.	
Unit II	**Report Writing & Presentation**	**15 lectures**
2.1 2.1.1 2.1.2 2.1.3 **2.2** 2.2.1 2.2.2 2.2.3 2.2.4	**Report Writing** Significance of report writing, different steps in report writing, typesof report. Mechanics and precautions of writing research reports for scientific journals, popular magazines, seminars/symposia/ conferences/workshops Layout of research paper, Layout for poster **Presentation** Presentation – Oral & Written. Use of digital media. Preparing for oral presentation, Structure of oral presentation, Giving the oral presentation Presentations in classrooms, scientific meets & public audience. Defense of research thesis.	
Unit III	**Developmental Biology in animals & plants**	**15 lectures**
3.1 3.1.1 3.1.2 3.1.3 3.1.4 3.1.5 3.1.6 3.1.7 3.1.8	**Developmental Biology in animals & plants** Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation Morphogenetic gradients; cell fate and cell lineages; genomic equivalence and the cytoplasmic determinants Gametogenesis, fertilization (in humans & sea urchin) Early development, cell surface molecules in sperm-egg recognition in animals; Embryonic cleavage Metamorphosis of caterpillar Formation of germ layers in animals Sexual reproduction in plants - Gametogenesis, double fertilization in plants	

Unit IV	**Soft Skills Development**	**15 lectures**
4.1 4.1.1 4.1.2 **4.2** 4.2.1 4.2.2 4.2.3 **4.3** 4.3.1 **4.4** 4.4.1 4.4.2 4.4.3	**Personal skills** Personality Development – Self Esteem, Positive Thinking, Johari Window, Physical Fitness Communication Skills – Process & Significance of Communication, Verbal, Non- verbal, formal & informal communication & Digital Communication. **Interpersonal skills and Entrepreneurship** Leadership & Team Building, Decision Making Stress & Time Management. Entrepreneurship skills **Professional Skills** Ethical Values **Academic Skills** Employment Communication – CV & Resume Building, Scan able CV, Formats of CV/ Resume/ Job Application/ Covering Letter, Professional presentations Job Interviews – Background information, Types & preparatory steps for interviews, developing interview skills, mock interviews Group Discussion – Importance & significance of GD, GD/ Panel Discussion/ Debate, Types of GD (Topics – based & Case- based)	
	PRACTICALS	
RPSBCHP104	**Research Methodology & Microscopy**	**Credits 02**
	1) Preparation of research proposal for minor/ major research projects to be submitted to the funding agencies. 2) Review of research work carried out of any 5 national or international research centers or institutes. 3) Presentation – Oral & Written 4) Poster making 5) Use of digital media 6) Group Discussion 7) Resume writing 8) Gram Staining 9) Spore staining	

SEMESTER II		
Course Code	**Title**	**Credits**
RPSBCH201	**Advanced Biochemistry**	**04**
Unit I	**Plant Biochemistry**	**15 lectures**
1.1 1.1.1 1.1.2 1.1.3 1.1.4	**Plant Biochemistry** Plant Growth Substances- Structure and Function of- Auxins, Gibberllins, Cytokininis, Ethylene and Abscissic Acid Photosynthesis - Light and dark reactions, Z scheme and electron carriers, photophosphorylation [linear and cyclic]; Photorespiration, Photoperiodism Calvin cycle – schematic with enzymes, C_4 and CAM pathway Secondary metabolites of plants – Nitrogen containing compounds (Alkaloids), Terpenes & Phenolic compounds - Shikimic acid pathway, Mevalonic acid pathway, MEP Pathway	
Unit II	**Endocrinology**	**15 lectures**
2.1 2.1 2.2 2.3 2.4 2.5 2.6	**Endocrinology** Definition of Hormones, hormone receptor, endocrine & exocrine glands Classification of hormones on the basis of: i)Distance of target tissue- autocrine, paracrine, endocrine ii) Chemistry - One example for each sub class. Hierarchal organization of the mammalian endocrine system Chemistry, synthesis, secretion & physiological role of thyroxine and insulin (Synthesis from preproinsulin), Diabetes mellitus, Hypothyroidism (cretinism and myxedema), Hyperthyroidism (goiter – simple & toxic) Physiological role of glucocorticoids, oxytocin & vasopressin, FSH, LH, Estrogen, Progesterone (Reproductive cycle) Mode of action of steroid hormones and epinephrine. (amplification cascade with G proteins, cAMP, adenylate cyclase, kinases)	
Unit III	**Biochemistry of Tissues**	**15 lectures**
3.1 3.1.1 3.1.2 3.1.3 3.1.4	**Biochemistry of Tissues** Muscles- Structure and composition of muscle fibres, mechanism of muscle contraction and relaxation, mechanism of twitch, energy source for muscular work, muscular dystrophies Bones- Composition, formulation, Structure and functions, factors affecting bone metabolism, bone remodelling, osteoporosis, osteomalacia Connective Tissue- Biosynthesis, composition, structure and metabolism of Collagen and its Disorders-Ehler's Syndrome (Type I to VII), Osteogenesis Imperfecta (Type I to IV), Paget's disease **Cytoskeleton** Introduction, Structure & Function Microtubule (α, β tubulin), Intermediate filament, Microfilament	

Unit IV	Cell Signaling & Bioluminescence	15 lectures
4.1	**Cell Signaling**	
4.1.1	Classes of Cell Receptors,	
4.1.2	Molecular Mechanism of Cell Signalling via G-protein linked Cell Surface Receptors. Signaling molecules and their receptors Modes of cell-cell signaling (endocrine, paracrine and autocrine)	
4.1.3	Steroid superfamily receptors and their functions.	
4.1.4	Role of Ca^{++} as an intracellular signal, Ca^{++} / Calmodulin dependent protein kinase, cAMP- Ca^{++} Pathway	
4.1.5	Pathways of intracellular signal transduction cAMP, cGMP, Phospholipid and Ca, Ras, Raf and MAP kinase pathways JAK/STAT pathway	
4.1.6	Signal transduction and cytoskeleton Integrin and signal transduction	
4.1.7	Cytoskeleton Signaling in development and differentiation using following examples Mesoderm, induction in xenopus and Eye development in Drosophila	
4.2	**Bioluminescence**	
4.2.1	History, Source of Bioluminescence material, examples of bioluminescence organism	
4.2.2	Mechanism of Bio-luminescence in specific organisms, Evolution & Bioluminescence.	
4.2.3	Use and applications of bioluminescence	
	PRACTICALS	
RPSBCHP201	**Enzymology & Isolations**	**Credits 02**
	1) Qualitative tests for phytochemicals 2) Extraction of Curcumin from turmeric 3) Extraction of Carotenes from carrot 4) Isolation and Estimation of Oxalates from spinach 5) Isolation and Estimation of Lycopene from tomatoes 6) Km of immobilized enzyme 7) Estimation if Vitamin C from food sample by Dichlorophenol indophenols Dye method 8) Estimation of serum creatinine by Jaffes method 9) Estimation of Blood Urea Nitrogen by diacetyl monoxime method 10) Estimation of serum uric acid by phosphotungstic acid method (Caraways method)	

SEMESTER II		
Course Code	**Title**	**Credits**
RPSBCH202	**Instrumentation and Analytical Techniques - II**	**04**
Unit I	**Electrophoresis**	**15 lectures**
1.1 1.1.1 1.1.2 1.1.3 1.1.4 1.1.5 1.1.6	**Electrophoresis** Basic principle of electrophoresis, factors affecting rate of electrophoresis, concept of electro-osmotic flow Electrophoresis of proteins – Concept of discontinuous buffer system, SDS PAGE, Native PAGE, Gradient gel, Isoelectric focusing of gel, 2D gel Detection of protein in gel- CBB, Silver staining, Zinc staining Electrophoresis of Nucleic acid (DNA & RNA) -AGE, PFGE Detection of Nucleic acid in gel- Ethidium bromide, syber green Advanced electrophoresis – immune-electrophoresis, microchip electrophoresis, preparative electrophoresis Gel Documentation System	
Unit II	**Special Instrumental Methods of Analysis**	**15 lectures**
2.1 2.1.1 2.2 2.2.1 2.2.2 2.2.3 2.2.4	**Special Instrumental Methods of Analysis** Basic Principles, Instrumentation, working and applications of experimental techniques in Flow Cytometry, FRAP, FRET, FLIM Basic Principles, Instrumentation, working and application of instrumental methods of analysis in environmental methods of analysis in environmental biochemistry – Conductometry, Potentiometry, Selective Ion Meters, High Frequency Titrations, Polarography, Anode Stripping Voltammetry, Neutron Activation Analysis, Inductively Coupled Plasma Emission Spectrometry	
Unit III	**Techniques in Genetics & Sequencing Techniques**	**15 lectures**
3.1 3.1.1 3.1.2 3.1.3 3.1.4	**Techniques in Genetics & Sequencing Techniques** Basic Principles and Instrumentation, working and applications of- Purification of Proteins/ Enzymes- Difference in the extraction of intracellular and extracellular proteins, salting out, dialysis, use of chromatography, immunoblotting and electrophoresis. Protein Sequencing Techniques – End group analysis (N terminal, C-terminal), Specific peptide cleavage reactions, Peptide mapping DNA Sequencing Techniques –First generation, second generation and Next generation sequencing methods Blotting Techniques – Southern, Northern, Western and dot blot	
Unit IV	**Spectroscopic Techniques – II**	**15 lectures**
4.1	**Spectroscopic Techniques – II**	

4.1.1 4.1.2 4.1.3 4.1.4 4.1.5	Principle, instrumentation, working and application of- Atomic Absorption Spectrometry, Luminometry. Nuclear Magnetic Resonance(NMR), Electron Spin Resonance (ESR), Mossbauer Spectroscopy, Matrix Assisted LASER Desorption, ionization, Time of Flight-Mass Spectroscopy (MALDI-TOF-MS), X-Ray Diffraction Spectra, Optical Rotatory Dispersion, (ORD), Circular Dichroism, LASER-Principle, applications in Medicine & Biology	
	PRACTICALS	
RPSBCHP202	**Chromatography & Colorimetry**	**Credits 02**
	1) Estimation of proteins by Bradford method 2) Estimation of proteins by Folin – Lowry method 3) Estimation of glucose by anthrone 4) Separation of amino acids by ascending paper chromatography 5) Separation of amino acids by circular paper chromatography 6) Separation of plant pigments/oils by thin layer chromatography 7) Separation of a mixture of lactose and casein by gel filtration chromatography 8) Serum proteins electrophoresis 9) Detection of proteins by silver staining method	

SEMESTER II			
Course Code		**Title**	**Credits**
RPSBCH203		**Industrial & Environmental Biotechnology**	**04**
Unit I	**Industrial Importance of Carbohydrates, proteins and lipids**		**15 lectures**
1.1 1.1.1 1.1.2 **1.2** 1.2.1 1.2.2 **1.3** 1.3.1	**Carbohydrates of industrial importance** Manufacturing and refining of cane sugar, pectin & cellulose Manufacturing of polysaccharides. Plant polysaccharide (Gum Arabic), microbial polysaccharides, modified carbohydrates – modified starches, modified celluloses **Lipids of industrial importance** Extraction and refining of vegetable oils and animal fats in general. Extraction and applications of chlorophyll, carotene, lycopene Turmeric, and essential oils. **Proteins of industrial importance** Isolation and purification of Proteins & Enzymes – Source identification, isolation, recovery, concentration.		
Unit II	**Immobilization, Biosensors & Production of vaccines, hormones and industrial proteins**		**15 lectures**
2.1 2.1.1 2.1.2 **2.2** 2.2.1 **2.3** 2.3.1 2.3.2 2.3.3	**Enzyme Immobilization** Methods of immobilization Applications in industry and medicine **Biosensors** Biosensors: Features of biosensors; Types: Electrochemical, Thermometric, Optical, Piezoelectric, Whole cell, Immunobiosensor; Construction and development, Applications **Production of vaccines, hormones and industrial proteins** Vaccines & Anti – toxoid Technology for measles, poliomyelitis, typhoid, Hepatitis B, AIDS, anti –tetanus. Hormones – conventional & engineered Insulin, Erythropoietin, Growth hormones Non – catalytic industrial proteins – casein, whey proteins, Egg proteins, wheat germ proteins.		
Unit III	**Environmental Biotechnology**		**15 lectures**
3.1 3.1.1 3.1.2 3.1.3 **3.2** 3.2.1 3.2.2	**Air Pollution** Air pollution – classification & effects of air pollutants on human health - Gases containing the oxides of carbon, sulphur and nitrogen, ozone, suspended particulate matters in air and CFC. Measures to control air pollution and. Greenhouse effect & Global warming – sources, consequences & remedial measures. **Water Pollution** Sources and effects of water pollutants on human health, quality standards for drinking water, waste water treatment and recycling. Concept and significance of BOD, COD and dissolved oxygen		

3.3	Emerging eco-friendly alternatives for chemical industry –Green chemistry and Green Technology. Bioremediation.	
Unit IV	**Nanotechnology and other topics**	**15 lectures**
4.1 4.1.1 4.1.2 **4.2** 4.2.1 4.2.2 4.2.3	**Nano biotechnology** Definition and methods of preparation of nano-bioparticles. Applications in drug designing, drug delivery & protein engineering. **Other Topics** Clinical diagnostics – Diagnostic Kits and their applications. Concept and significance of Bio safety, Bio Hazards and Bio ethics. Concept of QC, QA GMP, GLP in labs & production processes. Lab/process validation & Accreditation. Maintenance & Management of Lab/Experimental animals and Animal House CPCEA guidelines.	
	PRACTICALS	
RPSBCHP203	**Isolations & Environmental Biochemistry**	**Credits 02**
	1) Extraction of casein from milk 2) Extraction of albumins and globulins from egg white 3) Extraction of proteins from germinating seeds 4) Isolation of lecithin and cholesterol from egg yolk 5) Total alkalinity of water effluent 6) COD of waste water 7) Total hardness of well water 8) Chlorides from water sample by Schales and Schales method 9) Immobilization of enzymes and its activity	

SEMESTER II		
Course Code	**Title**	**Credits**
RPSBCH204	**Biostatistics**	**04**
Unit I	**Introduction to Biostatistics**	**15 lectures**
1.1 1.1.1 1.1.2 1.1.3 1.1.4	**Introduction to Biostatistics** Introduction: scope and applications of biostatistics Common statistical terms: Sources, nature and presentation of data; Measurement and scales of measurement Descriptive statistics: Measures of central tendency- Mean, Median and mode Measures of dispersion- Range, percentiles, variance, SD, Mean deviation	
Unit II	**Hypothesis Testing Of Means & ANOVA**	**15 lectures**
2.1 2.1.1 2.1.2 2.1.3 **2.2** 2.2.1	**Hypothesis Testing Of Means** Introduction – Hypothesis, Type I and Type II errors, One-tailed and two tailed tests, Hypothesis testing of mean - Z-test, t-test Standard error **ANOVA** Introduction, Types of ANOVA	
Unit III	**Hypothesis Testing Of Difference Between Means & Chi-square Test**	**15 lectures**
3.1 3.1.1 **3.2** 3.2.1	**Hypothesis Testing Of Difference Between Means** Hypothesis testing of difference between population means - Z-test, t-test (Paired and unpaired) **Chi-square Test** Chi-square (Test of population variance, Test of goodness of fit, Test of association), 2 x 2 Table, Yates' correction	
Unit IV	**Normal Distribution, Probability and Correlation & Regression**	**15 lectures**
4.1 4.1.1 4.1.2 **4.2** 4.2.1 **4.3** 4.3.1 4.3.2	**Normal Distribution** Normal distribution and normal curve, Asymmetric distribution **Probability** Concept of probability: definition, Addition & Multiplication laws **Correlation & Regression** Correlation, Bivariate & multivariate distributions, Types of correlation, Measure of correlation Regression, Types of regression, Regression coefficient	

	PRACTICALS	
RPSBCHP204	**Bioinformatics, Isolations & Microscopy**	**Credits 02**
	1) Isolation of starch from potato 2) Isolation of pectin from oranges 3) Estimation of alkaline phosphatase from moong seeds 4) Determination of density of sugar syrup 5) Capsule staining 6) One numerical problem each on – a. Measures of central tendency – Mean, Median and Mode b. Measures of dispersion/variability – Mean Deviation, Standard Deviation and Coefficient of Variation c. Z-test and t-test d. Chi-square test e. Simple and multiple regression	

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Suggested Readings for Paper 101,201 and Practical 101,201.

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2) Fundamentals of Enzymology, Price.NC. And Stevens. L., Oxford University Press
3) Enzymes- Biochemistry, Biotechnology, Clinical chemistry- Palmer, T., Affiliated East-West press
4) Fundamentals of Enzyme Kinetics, Segel I H; Wiley Interscience,
5) Biochemical calculations, 2nd Edition by Irwin H. Segel. John Wiley & Sons,
6) Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman
7) Enzymology by Dixon and Webb
8) Enzymes by Palmer
9) Biochemistry. Jeremy M. Berg, John L. Tymoczco, and LubertStryer: W.H. Freeman
10) Biochemistry. (4th Ed.). Donald Voet, Judith G. Voet – Publisher John Wiley & Sons.
11) Membranes and their cellular functions- IB Filnean, R. Coleman and R.H. Mitchell,1984, Blackwell Scientific Publishers, Oxford, 3rd ed.
12) The Cell, 2nd edition A Molecular Approach Geoffrey M Cooper.Boston University Sunderland (MA): Sinauer Associates 2000.ISBN-10: 0-87893-106-6
13) Cell and Molecular Biology. D. P. De Robertis. Lippincott Williams & Wilkins ISBN: 9788184734508, 8184734506 Edition: 8th Edition, 2010
14) Harpers Illustrated Biochemistry 30th Edition that complies with legal requirement
15) Jan 2015 by Victor W. Rodwell, David Bender , Kathleen M. Botham , Peter J. Kennelly.
16) Cell and molecular biology by Lippincott's illustrated Reviews
17) Williams Textbook of Endocrinology –Larsen, R.P. Korenberg, H.N. Melmed, S. and Polensky, K.S. Saunders.
18) Human Physiology –Chatterjee.C.C, Medical Allied Agency
19) Principles of Biochemistry: Mammalian Biochemistry: Smith EL, Hill RL, White A, McGraw Hill
20) The metabolic basis of Inherited diseases (Vol I & II) Scriver CR..Valle D,
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23) Biochemistry. Zubay (1983) Addison, Wesley publ. Co.
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26) Handbook of Pharmaceutical Natural Products by G Brahamachari, Wiley-VCH (2010) (ISBN 978-3-52732148-3)
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28) Natural Products from Plants by PB Kaufman, CR press (1999) (ISBN 0-8493-3134-X)
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47) Enzymes- Biochemistry, Biotechnology, Clinical chemistry- Palmer, T., Affiliated East-West press
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51) Enzymes by Palmer
52) Membranes and their cellular functions- IB Filnean, R.Coleman and RH Michell, 1984,Blackwell scientific publishers, Oxford, 3rd ed.
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57) Medicinal Chemistry of Bioactive Natural Products by X T Liang, WS Fang (Eds), Wiley Interscience (2006) (ISBN 0471-73933-2)

Suggested Readings for Paper 102,202 and Practical 102,202

1) Van Holde KE – Principles of Physical Biochemistry, Prentice Hall, 1998
2) Wilson K & Walker J – Principles and Techniques of Practical Biochemistry. Cambridge Low Price Edition
3) Frelfelder D- Physical Biochemistry
4) Skoog Douglas A – Principles of Instrumental Analysis Harcourt Brace publishers, London
5) Harvey David – Modern Analytical Chemistry, International edition, McGraw, Hill, Boston
6) Srivastava VK and Kishore K – Introduction to chromatography: Theory & Practice, S Chand & Co, New Delhi
7) Holme David J – Problem solving in analytical biochemistry, H & Longman Sc. And Tech, Essex
8) Brave Robert D – Introduction to Instrumental Analysis, McGraw Hill Book Co, New York
9) Ninfa Alexander J and Ballou David P – Fundamental Laboratory Approaches for Biochemistry and Biotechnology, Fitzgerald Science Press, Bethesda
10) Upadhyaya et al – Biophysical Chemistry, Himalaya Publishing Home, New Delhi
11) Rodney Boyer Experimental Biochemistry Pearson Publ. Sawheny and Singh
12) Practical Biochemistry by David Plummer
13) Physics of Diagnostic images by Dowsett.
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15) Greenberg David M – Metabolic Pathways. Vols. 2 and 3, 3rd editions. Academic Press, New York
16) Henry Richard et al – Clinical Chemistry, Principles and Techniques, 2nd edition, Harper and Row, New York
17) Kamal SH – Clinical Biochemistry for Medical Technologies, Churchill Livingston, London
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19) Stokes Joan et al – Clinical Microbiology, Edward Arnold, London
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29) Vasudevan Text Book of Medical Biochemistry
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Suggested Reading for Paper 103,203 and Practical 103,203:

1) Industrial Microbiology – AH Patel, McMillan India Ltd, 1st Edition
2) Food Microbiology – Frazier &Westhoff, Tata McGraw Hill Publishers, New Delhi
3) Total synthesis of natural products, Vol I-John Apsinon
4) Chemical Process Industries – Norris Shreeve& Joseph Brink
5) Roger's Industrial Chemistry Vol I & II – Edited by CC Furnas

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7) Encyclopedia of chemical technology, 3rd Edition
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10) Essential Oils, Vol I – Ernst Guenther
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12) EncyclopediaBritannica, Vol IV & V
13) Principles of Environmental Chemistry – Kothandaram&Swaminathan, BI Publishers, Chennai
14) Environmental Chemistry – AK De, New Age International Publishers, 4th Edition
15) Molecular Biology and Biotechnology – Edited by JM Walker & EB Gingdd, Panima Educational Book Agency, New Delhi, 2nd Edition
16) GMP for pharmaceuticals, A plan for TQC – SH Wiling & JR Stoker, Marul Dekker Inc., New York, 4th Edition, 1997
17) Total Quality Assurance for the Food Industries – WA Gould & RW Gould. CTI Publications Inc., USA 1988
18) Current Good Manufacturing Practices for Food Plan Sanitation – WA Gould, CTI Publications Inc. USA 1980
19) Fundamental Concepts of Environmental Chemistry – Sodhi, Narosa Publishing House, 2002
20) Introduction to plant Biotechnology – HS Chawla, oxford & IBH Publishing Co, New Delhi, 2nd Edition.
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22) Animal Biotechnology – Edited by AK Srivastava, oxford & IBH publishing Co, New Delhi, 2005
23) Proteins, Biochemistry & Biotechnology – Gary Walsh, John Wiley & Sons, 2002
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25) Enzymes, Biochemistry, Biotechnology, Clinical Biochemistry – Trevor Palmer, First East-West Press Ed. 2004
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29) Fundamental Concepts of Bioinformatics - Dan E. Krane, Michael L. Raymer, Pearson education (2004)
30) Bioinformatics: Sequence and Genome analysis by David W. Mount CBS Publishers & Distributors, 2004 reprint
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35) Sequence and Genome Analysis by David W. Mount - Cold Spring Harbor Laboratory 1stedition ; 2004
36) Bioinformatics and Functional Genomics; by Jonathan Pevsner; Wiley-Liss 1st edition, 2003

Suggested Readings for paper 104,204 and Practical 104,204:

1) Lemeshow S, Homer DW, Klar J and Lwanga SK, (1996) Adequacy o sample size in health studies. John Wiley and Sons, Chichester.
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4) Statistical methods for research workers – RA Fisher, 14th edition, Oliver Boyd publication
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6) Methods in biostatistics for medical students and research workers – BK Mahajan, Jaypee Brothers, New Delhi
7) Research methodology, Methods and techniques – CR Kothari Willey Eastern Ltd, Mumbai
8) Research methods – Ram Ahuja, Rawat Publications, New Delhi
9) Genetics and Biostatistics – MeyyanPillai, Saras Publication, Kanyakumari
10) Papers in Biochemistry – Jon Herriott Gary Jacobson, Julius Marmur and William parson, Addison-wesley publication Co, California
11) Experimental Biochemistry, Theory and exercises in fundamental methods – Robert Switzer and Liam Garrity, 3rd edition, WH Freeman & Co. NY
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19) Cornerstone : Developing Soft Skills by Sheffield, Person India
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21) Communication Skills by Dr. Nageshwar Rao and Dr. Ranjendra P Das,
22) Fred Luthans " OrganisationalBehaviour", Mc Graw Hill edition
23) Wallace and Masterss, " Personal Development for Life and Work"
24) Bell, Smith, " Management Communication" Wiley India Edition
25) Dr.K. Alex, " Soft Skills " , S. Chand and Company.
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MODALITY OF ASSESSMENT

Theory Examination Pattern:

A) Internal Assessment - 40% (40 marks.)

Sr No	Evaluation type	Marks
1	One test/assignment/quiz/presentation	20
2	One class Test (multiple choice questions / objective)	20

B) External examination - 60 % (60 marks)

Semester End Theory Assessment - 60 marks

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

ii. Paper Pattern:

1. There shall be **05** questions each of **12** marks. On each unit there will be one question & first question will be based on all the 4 units.
2. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1)	Any 6 out of 8	12	Unit I, II, III, IV
Q.2)A)	Any 2 out of 3	06	Unit I
Q.2)B)	Any 1 out of 2	06	
Q.3)A)	Any 2 out of 3	06	Unit II
Q.3)B)	Any 1 out of 2	06	
Q.4)A)	Any 2 out of 3	06	Unit III
Q.4)B)	Any 1 out of 2	06	
Q.5)A)	Any 2 out of 3	06	Unit IV
Q.5)B)	Any 1 out of 2	06	

Practical Examination Pattern:

(A)Internal Examination:

Heading	**Practical I, II, III & IV**
Journal	05
Test	15
Total	**20**

(B) External (Semester end practical examination):

Particulars	**Practical I, II, III & IV**
Laboratory work	25
Viva	5
Total	**30**

PRACTICAL BOOK/JOURNAL

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

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

Overall Examination and Marks Distribution Pattern

Semester – I

Course	RPSBCH101			RPSBCH102			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	**200**
Practicals	20	30	50	20	30	50	**100**

Course	RPSBCH103			RPSBCH104			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	**200**
Practicals	20	30	50	20	30	50	**100**

Semester – II

Course	RPSBCH201			RPSBCH202			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	**200**
Practicals	20	30	50	20	30	50	**100**

Course	RPSBCH203			RPSBCH204			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	**200**
Practicals	20	30	50	20	30	50	**100**