

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 learn and 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	Mechanism of enzyme action Importance of transition state in enzyme activity	
3.1.4	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	
3.1.5	Enzyme Inhibition-Reversible competitive, non-competitive, uncompetitive, Partial, Mixed, Allosteric Irreversible and Feedback Inhibition. Enzyme inhibitors as drugs	
3.1.6	Regulatory enzymes Allosteric enzymes-Conformational Changes in Response to Modulator Binding	
Unit IV	Neurophysiology & Cardiac Physiology	15 lectures
4.1	Neurophysiology	
4.1.1	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)	
4.1.2		
4.2	Cardiac Physiology	
4.2.1	Conductive system of the heart –	
4.2.2	SA node (Mechanism & Self excitation)	
4.2.3	Internodal pathways	
4.2.4	AV node (Mechanism & Conduction)	
4.2.5	Purkinje fiber	
4.2.6	Regulation of conduction of the heart	
4.2.7	Normal ECG & its characteristics	
	PRACTICALS	
RPSBCHP101	Enzymology & Serological Estimations	Credits 02
	<ol style="list-style-type: none"> 1) Determination of optimum pH of β-amylase 2) Determination of optimum temperature of β-amylase 3) Determination of K_m value of β-amylase 4) Study of effect of inhibitor on the K_m value of β-amylase 5) Determination of K_m 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 dipyrindyl 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	Colligative Properties	
1.1.1	Definitions, Factors affecting and Physiological Applications of Osmosis, Measurement of osmotic pressure, Osmoregulation, Adsorption, Colloids, Surface Tension and Viscosity	
1.1.2	Numerical Problems based on above concepts	
1.2	Acid, Bases and Buffers	
1.2.1	Ionization, Dissociation, Acidity, Basicity theories of Acid and Bases, Strength of Acids and Bases, Acid-Base Equilibrium in Aqueous and Non-aqueous media.	
1.2.2	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.	
1.2.3	Numerical Problems based on above concepts	
Unit II	Centrifugation & Electrophysiological Methods	15 lectures
2.1	Centrifugation	
2.1.1	Basic principles of sedimentation, relation between g and rpm	
2.1.2	Classification of centrifuges based on level of sophistication: Bench top, High speed and ultracentrifuges	
2.1.2	Types, Principles, Instrumentation, Working and Applications of: Preparative and Analytical Ultracentrifugation	
2.2	Electrophysiological Methods	
2.2.1	Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion & stimulation of brain, PET, MRI, fMRI, CAT	
2.2.2	Medical imaging – Radiography (Projection radiographs & Fluoroscopy), Ultrasound (medical ultrasonography), Elastography, Tactile imaging, Tomography, Echocardiography	
Unit III	Chromatography	15 lectures
3.1	Chromatography	
3.1.1	Introduction, Concept of partition coefficient, retention time, retention factor	
3.2	Principle, Technique and Applications of the following kinds of chromatography :	
3.2.1	Partition chromatography (Paper, GLC, GSC)	
3.2.2	Adsorption Chromatography (TLC and Column)	
3.2.3	Ion exchange chromatography	
3.2.4	Gel filtration	
3.2.5	Affinity chromatography	
3.2.6	Advanced Chromatographic techniques – HPLC, HPTLC, LC-MS	

Unit IV	Spectroscopic Techniques – I	15 lectures
4.1	Spectroscopic Techniques – I	
4.1.1	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.	
4.1.2	Principle, Instrumentation, working and application of – UV- Visible and IR Spectroscopy	
4.1.3	Double beam operation, dual wavelength spectrophotometer, Disadvantages of IR spectroscopy. Turbidometry and Nephelometry.	
4.1.4	Principle, instrumentation, working and application of – Spectrofluorometric, Flame Spectrophotometry,	
4.1.5	Fluorescence spectra and the study of protein structure.	
	PRACTICALS	
RPSBCHP102	Chromatography, Colorimetry	Credits 02
	<ol style="list-style-type: none"> 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	Micropropagation 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	Food Preservation	
3.2.1	General principles of food preservation	
3.2.2	Preservation by use of high and low temperatures, drying, radiations, chemical preservatives, inert gases, mechanical preservation techniques (vacuum packaging, tetra packs).	
3.3	Adulteration & Other topics	
3.3.1	Determination of shelf – life of food products, transport of perishable food items.	
3.3.2	Food Adulteration – Common food adulterants, their harmful effects and physical and chemical methods for their detection.	
3.3.3	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	Introduction to Bioinformatics	
4.1.1	Bioinformatics- Need and applications on various fields of Biology	
4.1.2	Introduction to Databases- Classification and Categories	
4.1.3	Nucleotide and Protein sequence analysis using BLAST and variants, working of BLAST	
4.1.4	Introduction to multiple sequence alignment- Progressive algorithms- CLUSTAL programs, working of CLUSTAL	
4.2	Biological Databases and retrieval techniques	
4.2.1	Nucleotide Databases- Genbank, Unigene	
4.2.2	Literature Database- Pubmed, Medline	
4.2.3	Protein Sequence Databases- Swissprot, PIR	
4.2.4	Protein Structural Databases- PDB, SCOP, CATH	
4.2.5	Metabolic pathway database- KEGG, Metacyc	
4.2.6	Other databases- OMIM, Taxonomy	
	PRACTICALS	
RPSBCHP103	Bioinformatics & Tissue culture	Credits 02
	<ol style="list-style-type: none"> 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	Research	
1.1.1	Meaning of research, Research Process, Types of research	
1.1.2	Formulating research problem	
1.1.3	Criteria for good research. Significance of research.	
1.2	Research Design	
1.2.1	Meaning, features of good research design, types of research designs.	
1.2.2	Basic principles of experimental designs.	
1.2.3	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	Report Writing	
2.1.1	Significance of report writing, different steps in report writing, types of report.	
2.1.2	Mechanics and precautions of writing research reports for scientific journals, popular magazines, seminars/symposia/ conferences/workshops	
2.1.3	Layout of research paper, Layout for poster	
2.2	Presentation	
2.2.1	Presentation – Oral & Written. Use of digital media.	
2.2.2	Preparing for oral presentation, Structure of oral presentation, Giving the oral presentation	
2.2.3	Presentations in classrooms, scientific meets & public audience.	
2.2.4	Defense of research thesis.	
Unit III	Developmental Biology in animals & plants	15 lectures
3.1	Developmental Biology in animals & plants	
3.1.1	Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation	
3.1.2	Morphogenetic gradients; cell fate and cell lineages; genomic equivalence and the cytoplasmic determinants	
3.1.3	Gametogenesis, fertilization (in humans & sea urchin)	
3.1.4	Early development, cell surface molecules in sperm-egg recognition in animals;	
3.1.5	Embryonic cleavage	

3.1.6	Metamorphosis of caterpillar	
3.1.7	Formation of germ layers in animals	
3.1.8	Sexual reproduction in plants - Gametogenesis, double fertilization in plants	
Unit IV	Soft Skills Development	15 lectures
4.1	Personal skills	
4.1.1	Personality Development – Self Esteem, Positive Thinking, Johari Window, Physical Fitness	
4.1.2	Communication Skills – Process & Significance of Communication, Verbal, Non-verbal, formal & informal communication & Digital Communication.	
4.2	Interpersonal skills and Entrepreneurship	
4.2.1	Leadership & Team Building, Decision Making	
4.2.2	Stress & Time Management.	
4.2.3	Entrepreneurship skills	
4.3	Professional Skills	
4.3.1	Ethical Values	
4.4	Academic Skills	
4.4.1	Employment Communication – CV & Resume Building, Scan able CV, Formats of CV/ Resume/ Job Application/ Covering Letter, Professional presentations	
4.4.2	Job Interviews – Background information, Types & preparatory steps for interviews, developing interview skills, mock interviews	
4.4.3	Group Discussion – Importance & significance of GD, GD/ Panel Discussion/ Debate, Types of GD (Topics – based & Case- based)	
	PRACTICALS	
RPSBCHP104	Research Methodology & Microscopy	Credits 02
	<ol style="list-style-type: none"> 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	Plant Biochemistry	
1.1.1	Plant Growth Substances- Structure and Function of- Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic Acid	
1.1.2	Photosynthesis - Light and dark reactions, Z scheme and electron carriers, photophosphorylation [linear and cyclic]; Photorespiration, Photoperiodism	
1.1.3	Calvin cycle – schematic with enzymes, C ₄ and CAM pathway	
1.1.4	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	Endocrinology	
2.1	Definition of Hormones, hormone receptor, endocrine & exocrine glands	
2.2	Classification of hormones on the basis of: i) Distance of target tissue- autocrine, paracrine, endocrine ii) Chemistry - One example for each sub class.	
2.3	Hierarchical organization of the mammalian endocrine system	
2.4	Chemistry, synthesis, secretion & physiological role of thyroxine and insulin (Synthesis from preproinsulin), Diabetes mellitus, Hypothyroidism (cretinism and myxedema), Hyperthyroidism (goiter – simple & toxic)	
2.5	Physiological role of glucocorticoids, oxytocin & vasopressin, FSH, LH, Estrogen, Progesterone (Reproductive cycle)	
2.6	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	Biochemistry of Tissues	
3.1.1	Muscles- Structure and composition of muscle fibres, mechanism of muscle contraction and relaxation, mechanism of twitch, energy source for muscular work, muscular dystrophies	
3.1.2	Bones- Composition, formulation, Structure and functions, factors affecting bone metabolism, bone remodelling, osteoporosis, osteomalacia	

3.1.3	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	
3.1.4	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
	<ol style="list-style-type: none"> 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 of 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	Electrophoresis	
1.1.1	Basic principle of electrophoresis, factors affecting rate of electrophoresis, concept of electro-osmotic flow	
1.1.2	Electrophoresis of proteins – Concept of discontinuous buffer system, SDS PAGE, Native PAGE, Gradient gel, Isoelectric focusing of gel, 2D gel	
1.1.3	Detection of protein in gel- CBB, Silver staining, Zinc staining	
1.1.4	Electrophoresis of Nucleic acid (DNA & RNA) -AGE, PFGE	
1.1.5	Detection of Nucleic acid in gel- Ethidium bromide, syber green	
1.1.6	Advanced electrophoresis – immune-electrophoresis, microchip electrophoresis, preparative electrophoresis	
	Gel Documentation System	
Unit II	Special Instrumental Methods of Analysis	15 lectures
2.1	Special Instrumental Methods of Analysis	
2.1.1	Basic Principles, Instrumentation, working and applications of experimental techniques in Flow Cytometry, FRAP, FRET, FLIM	
2.2	Basic Principles, Instrumentation, working and application of instrumental methods of analysis in environmental methods of analysis in environmental biochemistry –	
2.2.1	Conductometry, Potentiometry,	
2.2.2	Selective Ion Meters, High Frequency Titrations, Polarography,	
2.2.3	Anode Stripping Voltammetry, Neutron Activation Analysis,	
2.2.4	Inductively Coupled Plasma Emission Spectrometry	
Unit III	Techniques in Genetics & Sequencing Techniques	15 lectures
3.1	Techniques in Genetics & Sequencing Techniques	
3.1.1	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.	

3.1.2	Protein Sequencing Techniques – End group analysis (N terminal, C-terminal), Specific peptide cleavage reactions, Peptide mapping	
3.1.3	DNA Sequencing Techniques –First generation, second generation and Next generation sequencing methods	
3.1.4	Blotting Techniques – Southern, Northern, Western and dot blot	
Unit IV	Spectroscopic Techniques – II	15 lectures
4.1	Spectroscopic Techniques – II	
4.1.1	Principle, instrumentation, working and application of-	
4.1.2	Atomic Absorption Spectrometry, Luminometry.	
4.1.3	Nuclear Magnetic Resonance(NMR), Electron Spin Resonance (ESR), Mossbauer Spectroscopy,	
4.1.4	Matrix Assisted LASER Desorption, ionization, Time of Flight-Mass Spectroscopy (MALDI-TOF-MS),	
4.1.5	X-Ray Diffraction Spectra, Optical Rotatory Dispersion, (ORD), Circular Dichroism, LASER-Principle, applications in Medicine & Biology	
	PRACTICALS	
RPSBCHP202	Chromatography & Colorimetry	Credits 02
	<ol style="list-style-type: none"> 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	Carbohydrates of industrial importance	
1.1.1	Manufacturing and refining of cane sugar, pectin & cellulose	
1.1.2	Manufacturing of polysaccharides. Plant polysaccharide (Gum Arabic), microbial polysaccharides, modified carbohydrates – modified starches, modified celluloses	
1.2	Lipids of industrial importance	
1.2.1	Extraction and refining of vegetable oils and animal fats in general.	
1.2.2	Extraction and applications of chlorophyll, carotene, lycopene Turmeric, and essential oils.	
1.3	Proteins of industrial importance	
1.3.1	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	Enzyme Immobilization	
2.1.1	Methods of immobilization	
2.1.2	Applications in industry and medicine	
2.2	Biosensors	
2.2.1	Biosensors: Features of biosensors; Types: Electrochemical, Thermometric, Optical, Piezoelectric, Whole cell, Immunobiosensor; Construction and development, Applications	
2.3	Production of vaccines, hormones and industrial proteins	
2.3.1	Vaccines & Anti – toxoid Technology for measles, poliomyelitis, typhoid, Hepatitis B, AIDS, anti –tetanus.	
2.3.2	Hormones – conventional & engineered Insulin, Erythropoietin, Growth hormones	
2.3.3	Non – catalytic industrial proteins – casein, whey proteins, Egg proteins, wheat germ proteins.	
Unit III	Environmental Biotechnology	15 lectures

3.1	Air Pollution	
3.1.1	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.	
3.1.2	Measures to control air pollution and.	
3.1.3	Greenhouse effect & Global warming – sources, consequences & remedial measures.	
3.2	Water Pollution	
3.2.1	Sources and effects of water pollutants on human health, quality standards for drinking water, waste water treatment and recycling.	
3.2.2	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	Nano biotechnology	
4.1.1	Definition and methods of preparation of nano-bioparticles.	
4.1.2	Applications in drug designing, drug delivery & protein engineering.	
4.2	Other Topics	
4.2.1	Clinical diagnostics – Diagnostic Kits and their applications. Concept and significance of Bio safety, Bio Hazards and Bio ethics.	
4.2.2	Concept of QC, QA GMP, GLP in labs & production processes. Lab/process validation & Accreditation.	
4.2.3	Maintenance & Management of Lab/Experimental animals and Animal House CPCEA guidelines.	
	PRACTICALS	
RPSBCHP203	Isolations & Environmental Biochemistry	Credits 02
	<ol style="list-style-type: none"> 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	Introduction to Biostatistics	
1.1.1	Introduction: scope and applications of biostatistics	
1.1.2	Common statistical terms: Sources, nature and presentation of data; Measurement and scales of measurement	
1.1.3	Descriptive statistics: Measures of central tendency- Mean, Median and mode	
1.1.4	Measures of dispersion- Range, percentiles, variance, SD, Mean deviation	
Unit II	Hypothesis Testing Of Means & ANOVA	15 lectures
2.1	Hypothesis Testing Of Means	
2.1.1	Introduction – Hypothesis, Type I and Type II errors, One-tailed and two tailed tests,	
2.1.2		
2.1.3	Hypothesis testing of mean - Z-test, t-test	
	Standard error	
2.2	ANOVA	
2.2.1	Introduction, Types of ANOVA	
Unit III	Hypothesis Testing Of Difference Between Means & Chi-square Test	15 lectures
3.1	Hypothesis Testing Of Difference Between Means	
3.1.1	Hypothesis testing of difference between population means - Z-test, t-test (Paired and unpaired)	
3.2	Chi-square Test	
3.2.1	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	Normal Distribution	

4.1.1	Normal distribution and normal curve,	
4.1.2	Asymmetric distribution	
4.2	Probability	
4.2.1	Concept of probability: definition, Addition & Multiplication laws	
4.3	Correlation & Regression	
4.3.1	Correlation , Bivariate & multivariate distributions, Types of correlation, Measure of correlation	
4.3.2	Regression, Types of regression, Regression coefficient	
	PRACTICALS	
RPSBCHP204	Bioinformatics, Isolations & Microscopy	Credits 02
	<ol style="list-style-type: none"> 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 – <ol style="list-style-type: none"> 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 	

References:

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

- 1) Bioenergetics (Fourth Edition), David G. Nicholls and Stuart Ferguson, Academic Press, 2013.
- 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. Tymoczko, and Lubert Stryer: 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,

- 21) Vertebrate endocrinology. Norris DO (1985) 2nd Edition.
- 22) Endocrine Physiology- Martin C.R., (1985). Oxford University Press) N.Y.
- 23) Biochemistry. Zubay (1983) Addison, Wesley publ. Co.
- 24) Biochemical Endocrinology. E. Frieden (1983)
- 25) Chemistry of Natural products by SV Bhat, BA Nagasampagi & M Sivakumar, Berlin Springer (2005) (ISBN 3-540-40669-7)
- 26) Handbook of Pharmaceutical Natural Products by G Brahamachari, Wiley-VCH (2010) (ISBN 978-3-52732148-3)
- 27) The secondary Metabolites Natural Products by JR Hansen, Royal Society of Chemistry (2003) (ISBN 0-85404-490-6)
- 28) Natural Products from Plants by PB Kaufman, CR press (1999) (ISBN 0-8493-3134-X)
- 29) Medicinal Chemistry of Bioactive Natural Products by X T Liang, WS Fang (Eds), Wiley Interscience (2006) (ISBN 0471-73933-2)
- 30) Brocchieri L, Karlin S (2005-06-10). "Protein length in eukaryotic and prokaryotic proteomes". *Nucleic Acids Research*. 33 (10): 3390–3400. doi:10.1093/nar/gki615. PMC 1150220. PMID 15951512.
- 31) Sanger, F. (1959-05-15). "Chemistry of Insulin". *Science*. 129 (3359): 1340–1344. doi:10.1126/science.129.3359.1340. ISSN 0036-8075. PMID 13658959.
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- 33) Chiang YS, Gelfand TI, Kister AE, Gelfand IM (2007). "New classification of supersecondary structures of sandwich-like proteins uncovers strict patterns of strand assemblage.". *Proteins*. 68 (4): 915–921. doi:10.1002/prot.21473. PMID 17557333.
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- 42) Population species and evolution (1973), E Mayer Press Pub.
- 43) Biochemistry ,Lehninger (1975) Worth pub 4) Origin of Eukaryotic cells, Margulis L.(1977)
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- 45) Bioenergetics (Fourth Edition), David G. Nicholls and Stuart Ferguson,Academic Press, 2013
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- 56) Natural Products from Plants by PB Kaufman, CR press (1999)(ISBN 0-8493-3134-X)
- 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.

- 14) Medical imaging by Christenson.
- 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 Livingstone, London
- 18) Todd et al – Clinical Diagnosis and Management, 17th edition, WB Saunders, Philadelphia
- 19) Stokes Joan et al – Clinical Microbiology, Edward Arnold, London
- 20) Gill CV – Short cases in clinical biochemistry, Churchill Livingstone, Edinburgh, 1984
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- 23) BayensDominiezak – Medical biochemistry, Mosby Publishers, Harcourt, 1999
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- 28) Satyanarayanan – Biochemistry
- 29) Vasudevan Text Book of Medical Biochemistry
- 30) Voet&Voet – Biochemistry, 2nd edition
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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
- 6) Merck Index, 10th Edition
- 7) Encyclopedia of chemical technology, 3rd Edition
- 8) Chemistry of Natural Products – Agarwal& Sharma
- 9) Industry chemistry of Fats and Waxes – JP Hilditch
- 10) Essential Oils, Vol I – Ernst Guenther
- 11) Natural and Synthetic colouring matter and related fields – JS Gore, Joshi
- 12) Encyclopedia Britannica, 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
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- 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.
- 21) Nanotechnology, A Genetic Introduction to the next big idea – Mark Ratner & Daniel Ratner, Pearson Education
- 22) Animal Biotechnology – Edited by AK Srivastava, oxford & IBH publishing Co, New Delhi, 2005
- 23) Proteins, Biochemistry & Biotechnology – Gary Walsh, John Wiley & Sons, 2002
- 24) Biotechnology, An Introduction – Susan R Barnum, Vikas Publishing House, International Student Edition
- 25) Enzymes, Biochemistry, Biotechnology, Clinical Biochemistry – Trevor Palmer, First East-West Press Ed. 2004
- 26) Essential Bioinformatics, JinXiong, Cambridge University Press, 2006
- 27) Introduction to Bioinformatics – Teresa Atwood and David J.Parry, Pearson smith publication (2003)
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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
- 31) Bioinformatics and Functional Genomics; by Jonathan Pevsner; Wiley-Liss 1st edition, 2003
- 32) Essential Bioinformatics, JinXiong, Cambridge University Press, 2006
- 33) Fundamental Concepts of Bioinformatics - Dan E. Krane, Michael L. Raymer, Pearson education First edition (2004)
- 34) Sequence structure and Database – Des Higgins, Willice Taylor, oxford press 1st edition (2003)
- 35) Sequence and Genome Analysis by David W. Mount - Cold Spring Harbor Laboratory 1st edition ; 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.
- 2) Machin, D., Campbell MJ, Fayers P, Pinol A., (1998) Statistical Tables for the design of Clinical Studies, Second Edition, Blackwell Oxford.
- 3) Quinn & Keough, Experimental Design and Data Analysis for Biologists, Cambridge University Press. <http://www.lacbiosafety.org/wp->

- 4) Statistical methods for research workers – RA Fisher, 14th edition, Oliver Boyd publication
- 5) Statistical methods in research and production – Davelr OL & Goldsmith PL, Longman
- 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 – Meyyan Pillai, 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
- 12) Statistical methods in biological array – Davids J Finney, 3rd edition charles Griffin & co, London
- 13) Research Methodology – SM Israney, universal Publishing Corporation
- 14) Statistics for Biology – Bishop ON, 1983, Longman
- 15) A Textbook of Biostatistics by A Annadurai, New Age Publication
- 16) Soft Skills- An Integrated Approach to Maximize Personality Development by Gajandra S Chavan& Sangeeta Sharma, Wiley India
- 17) Personality Development and Soft Skills by Barun K Mitra, Oxford.
- 18) Soft Skills- Enhancing Employability by M S Rao, I K International
- 19) Cornerstone : Developing Soft Skills by Sheffield, Person India
- 20) Business Communication by ShaliniKalia and Shailaja Agrawal, Wiley India.
- 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.
- 26) Rhoda A. Doctor, Aspi H. Doctor, " Business Communication " Sheth Publishes pvt.ltd.

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

Resolution No. AC/II(18-19).2.RPS2

S.P.Mandali's
Ramnarain Ruia Autonomous College



Syllabus for M.Sc. II

Program: M.Sc.

Course: Biochemistry (RPSBCH)

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

Semester III

Course Code	Unit	Topics	Credits	Lectures
Paper I – Physiology & Metabolism – I				
RPSBCH301	I	Carbohydrate metabolism	4	15
	II	Protein metabolism		15
	III	Enzymes and isoenzymes of clinical importance		15
	IV	Haematopoiesis & related disorders		15
Paper II – Nutrition & Pharmacology				
RPSBCH302	I	Nutrition	4	15
	II	Diet in Health & Disease		15
	III	General Pharmacology		15
	IV	Pharmacodynamics & ADRs		15
Paper III – Basics of Genetics				
RPSBCH303	I	Genetics I	4	15
	II	Genetics II		15
	III	Regulation of Gene Expression		15
	IV	Chromosomal Abnormalities & Mutations		15
Paper IV – Basics of Immunology				
RPSBCH304	I	Introduction to immune system	4	15
	II	Antigen & Antibody		15
	III	Antigen- Antibody interactions & Complement system		15
	IV	Tumour Immunology, & Immunodeficiencies		15
RPSBCHP301	Haematology		2	
RPSBCHP302	Clinical Biochemistry		2	
RPSBCHP303	Genetics		2	

RPSBCHP304	Immunology & Serology	2	
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Semester IV

Course Code	Unit	Topics	Credits	Lectures
Paper I – Physiology & Metabolism – II				
RPSBCH401	I	Lipid Metabolism	4	15
	II	Nucleotide Metabolism & Interrelationship of Metabolisms		15
	III	Disorders of Metabolism		15
	IV	Stem Cell & Apoptosis		15
Paper II – Clinical Biochemistry & Pharmacology				
RPSBCH402	I	Body Fluids	4	15
	II	Organ Function		15
	III	Pharmacokinetics & Bioassay		15
	IV	Therapeutic drugs & Drugs acting on Haematopoietic System		15
Paper III – Advanced Genetics				
RPSBCH403	I	Cell Cycle and its regulation & DNA Replication	4	15
	II	Transcription		15
	III	Translation		15
	IV	Recombinant DNA Technology		15
Paper IV - Advanced Immunology				
RPSBCH404	I	Cytokines	4	15
	II	TCR, Major Histocompatibility complex & Transplant immunology		15
	III	Immunological Tolerance & Autoimmunity		15
	IV	Immune response to infectious diseases & Vaccines		15

RPSBCHP401	Project work	2	
RPSBCHP402	Clinical Biochemistry	2	
RPSBCHP403	Genetics	2	
RPSBCHP404	Immunology, Serology & Colorimetry	2	

Course Code: RPSBCH
Course Title: Biochemistry
Academic year 2019-20

Learning Objectives:

The overall goal of this MSc II course is to familiarize the students to the fields of physiology, metabolism, genetics, immunology, nutrition, clinical biochemistry and pharmacology.

Learning Outcomes:

Upon completion of the MSc Part II course, the students would learn and understand the following:

- 1) The metabolic processes which are essential part of Biochemistry and will further help them to understand the physiology of the human body.
- 2) The important physiological concepts like Hematopoiesis, water electrolyte balance introduced along with in-depth concepts of metabolism which forms the basis of Biochemistry.

- 3) Nutritional biochemistry and pharmacology which will enable them to explore various career opportunities in the fields of nutrition, dietetics, nutraceuticals, health & wellness, pharmaceuticals, etc.
- 4) The important genetic processes namely, DNA replication, transcription, translation & Recombinant DNA Technology increasing their knowledge of molecular biology.
- 5) Basics of human immune system, detailed study of various cells and organs involved.
- 6) Tumour immunology, immunodeficiencies, immunological tolerance, autoimmunity, transplant immunology and vaccines which will further increase their understanding of Human immune system in a better way.
- 7) All the practicals have been rearranged in accordance with the theory of each paper at each semester.

The over-all syllabus at the Post-Graduation level has been designed such that the student is well prepared to appear for competitive examinations held all over.

Detailed Syllabus

SEMESTER III		
Course Code	Title	Credits
RPSBCH301	Physiology & Metabolism – I	04
Unit I	Carbohydrate Metabolism	15 lectures
1.1.1	Schematic representation of Glycolysis & Krebs's cycle	
1.1.2	Glycogen Metabolism: Synthesis, breakdown, mechanisms of control of glycogen metabolism - Direct Allosteric Control of Glycogen Phosphorylase and Glycogen Synthase, Covalent Modification of Enzymes by Cyclic Cascades, Hormonal regulation, Maintenance of Blood Glucose Levels	
1.1.3	Gluconeogenesis: Pathway and its Regulation,	
1.1.4	Futile cycle, Rapoport Luebering cycle, Cori cycle, Glucose-Alanine cycle & their significance	
1.1.5	Shuttles-Malate-Aspartate shuttle & Glycerol phosphate shuttle.	
1.1.6	Uronic acid pathway (biosynthesis, degradation & its significance), Galactose and fructose metabolism; Sorbitol pathway, Glyoxylate pathway.	
1.1.7	Biosynthesis of oligosaccharides and glycoproteins	
1.1.8	Mucopolysaccharides; Structure, function and disorders	
Unit II	Protein metabolism	15 lectures
2.1.1	Reactions of amino acids: Deamination, Transamination, Decarboxylation, Transmethylation, Transdeamination,	

2.1.2	Ammonia formation, transport and detoxification in brain and liver. Urea cycle-regulation	
2.1.3	Metabolism of significant amino acids– Glycine, Phenylalanine, Tyrosine, Tryptophan Alanine, Sulphur containing amino acids	
2.1.4	Formation of specialized products from amino acids and their functions- glutathione, creatine, creatinine, biogenic amines (dopamine, norepinephrine, tyramine, serotonin, melatonin, GABA, Histamine) polyamines (Putrescine, Spermodine, Spermine)	
Unit III	Enzymes and isoenzymes of clinical importance	15 lectures
3.1.1	Introduction, Possible mechanisms for abnormal enzyme levels	
3.1.2	Clinical significance of enzyme assay – serum enzymes in heart diseases, liver diseases, GIT diseases, Muscle diseases, Bone diseases	
3.1.3	Value of enzymes in malignancies	
3.1.4	Isoenzymes & their clinical significance – LDH, CPK, Alkaline phosphatase	
Unit IV	Haematopoiesis & related disorders	15 lectures
4.1.1	Haematopoiesis, Hemoglobin Metabolism,	
4.1.2	Hb derivatives: Oxy, Reduced, Met, Carboxy, Carbamino	
4.1.3	Hemoglobinopathies: 1) Haemolytic Anemia- Unstable Hb, 2) Hb with abnormal O ₂ affinity-High affinity (Polycythemia) Low affinity (Cyanosis) 3) Hb with structural and synthetic Variation in globin chains : Sickle cell Anemia (Structural) Alpha and Beta Thalassemia (Synthetic), Porphyrias	
4.1.4	Acidosis & Alkalosis	
4.1.5	Blood Gas Analysis (pH, pO ₂ , pCO ₂ , Bicarbonate) and interpretation	
	PRACTICALS	
RPSBCHP301	Haematology	Credits 02
	<p style="text-align: center;">Haematological tests –</p> <ol style="list-style-type: none"> 1) Bleeding time 2) Clotting Time 3) Packed Cell Volume 4) Erythrocyte Sedimentation Rate 5) Estimation of haemoglobin using Sahli's Haemoglobinometer 6) WBC Count 7) Total and differential WBC count 8) RBC Count 	

SEMESTER III		
Course Code	Title	Credits
RPSBCH302	Nutrition & Pharmacology	04
Unit I	Nutrition	15 lectures
1.1	Macronutrients of Nutritional significance	
1.1.1	Carbohydrates: Role of Oligosaccharides, Dietary Fibre, Non-starch, polysaccharides, Prebiotics and Probiotics, Sugar alcohols in human nutrition, Glycemic Index, Sweeteners	
1.1.2	Lipids: SFA, MCT, MUFA, PUFA, Trans fatty acids, Omega 3, 6 Fatty Acids and their implications on health, Biochemical functions and deficiency disorders of essential fatty acids, fat replacers	
1.1.3	Proteins: Nitrogen Balance, Protein Energy Malnutrition-Clinical features, Biochemical and Metabolic Changes, Nutritional Requirements. Anti-nutritional Factors-Trypsin Inhibitors, Pressor Amines, Phytates, Oxalates. Quality of Protein scoring system, Complementary value of Protein	
Unit II	Diet in Health & Disease	15 lectures
2.1.1	Nutrition during pregnancy, lactation, infancy, childhood, adolescence, adulthood, ageing.	
2.1.2	Nutrition for health & weight management.	
2.1.3	Nutrition for Exercise and Sport performance.	
2.1.4	Nutrition for bone health.	
2.1.5	Nutrition for therapeutic condition: Hypertension, CVD, GI disorders, (peptic ulcer. H. Pylori), Diabetes mellitus, anemia, Renal disorders, CRF,	

	ARF, Jaundice	
Unit III	General Pharmacology	15 lectures
3.1.1	Scope of pharmacology	
3.1.2	Sources, Classification and Nomenclature of drugs	
3.1.3	Dosage forms and routes of drug administration; Factors affecting dosage and drug delivery	
3.1.4	Pharmacokinetics : LD 50 , ED 50 Half Life, Loading dose, Maintenance dose (Explanation of terms only), Therapeutic dose, Therapeutic Index, Drug plasma concentration, Volume of distribution, Clearance	
Unit IV	Pharmacodynamics & ADRs	15 lectures
4.1	Pharmacodynamics	15 lect
4.1.1	Basis of Drug Action	
4.1.2	Drug Receptor Interaction – Receptor Theory of Drug Action, Location of 4.1.3	
4.1.3	Drug Receptor-G-Coupled Protein receptors	
4.1.4	Drug Acting on enzymes	
4.1.5	Non receptor mechanism	
4.1.6	Placebo effect	
4.1.7	Affinity and Intrinsic Activity	
4.1.8	Intensity of Drug Response – Potency and Efficacy	
4.1.9	Combined Effects of Drug – Synergism, Antagonism	
4.2	Adverse Drug Reactions (ADR)	
4.2.1	Definition and Types and Classification of ADR (Pharmacological, Non-pharmacological, Disease related, Multiple drug reactions)	
4.2.2	Repeated Dosage, Drug dependence, Over dosage, Acute poisoning	
4.2.3	General Principles of Management of Poisoning	
PRACTICALS		
RPSBCHP302	Clinical Biochemistry	Credits 02
	<ol style="list-style-type: none"> 1) Estimation of total and free gastric juice acidity 2) Lipid Profile – <ol style="list-style-type: none"> a. Estimation of total cholesterol and HDL b. Estimation of Triglycerides c. Estimation of LDL by calculation 3) Estimation of serum acid phosphatase 4) Estimation of serum electrolytes sodium and potassium by Flame Photometry 5) Monograph of Aspirin 6) Estimation of Thiamine by Thiochrome method 7) Estimation of Riboflavin by Slater method 	

SEMESTER III			
Course Code	Title	Credits	
RPSBCH303	Basics of Genetics	04	
Unit I	Genetics I	15 lectures	
1.1.1	Mendelian genetics: Mendel's experiments & Laws	15 lect	
1.1.2	Variations over Mendelian Genetics - Incomplete Dominance, Co-Dominance, Multiple Alleles, Pleiotropy, Polygenics, Epistasis, Linked Genes, Sex-linked		
1.1.3	Genes, Environmental influences on Gene Expression (Hormones, Sex-limited &		
1.1.4	Sex-influenced), Maternal Gene Effects		
1.1.5	Pedigree analysis, Problems based on these concept		
1.2.1	Structure and characteristic of DNA & RNA - double helical structure		
1.2.2	A, B & Z DNA, liner and circular DNA.		
1.2.3	T _m of DNA, its relation to GC content,		
1.2.4	Types of RNA, structure & functions		
1.2.5	Cot curves and its significance, C-value paradox		
Unit II	Genetics II		15 lectures
2.1	Organization of DNA in genome		
2.1.1	Histones, nucleosomes, structure of chromatin		
2.1.2	Eukaryotic chromosomes, Unique and repetitive sequences of DNA		
2.2	Histone acetylation and deacetylation, DNA methylation		
	Lampbrush & polytene chromosomes		

2.3	Genetic recombinations: Holliday models	
2.4.1	Gene mapping – Genome mapping (genetic mapping, Physical mapping)	
2.4.2	Tetrad analysis	
2.4.3	Problems based on above concept	
Unit III	Regulation of Gene Expression	15 lectures
3.1.1	Regulation of gene expression in prokaryotes	
3.1.2	Introduction, Conditions affecting gene expression (positive and negative control, induction and repression)	
3.1.3	Operon Model and its regulation Lac operon and its regulation (Catabolite repression) , Lac I mutation- formation of merozygotes, cis-trans acting elements in gene expression Trp operon and its regulation (attenuation)	
3.2	Riboswitches	
3.2.1	Regulation of gene expression in eukaryotes	
3.2.2	Regulatory transcription factors	
Unit IV	Chromosomal Abnormalities & Mutations	15 lectures
4.1.1	Chromosomal aberration	
4.1.2	Structural and numerical abnormalities	
4.1.3	Euploidy and aneuploidy (Autosomal and Sex chromosomes)	
4.1.4	Monosomies (Turner syndrome) Disomies and trisomies (Down Syndrome) and their causes	
4.2	Mutations	
4.2.1	Types of mutations	
4.2.2	Physical, chemical and Biological agents causing mutations	
4.2.3	Reverse mutations, Mutagenesis, Site directed mutagenesis, Ames test.	
4.3	DNA repair Mechanism	
4.3.1	Photoreactivation, base & nucleotide excision, mismatch repair SOS repair, recombinational repair	
	PRACTICALS	
RPSBCHP303	Genetics	Credits 02
	<ol style="list-style-type: none"> 1) Qualitative tests for nucleic acids 2) Staining of nucleic acid 3) Study of Karyotypes 4) Isolation of DNA from germinating moong/onion/strawberry 5) Study of viscosity of DNA solution 6) Estimation of DNA by DPA method 7) Staining and visualization of mitochondria by Janus Green Stain 	

SEMESTER III

Course Code	Title	Credits
RPSBCH304	Basics of Immunology	04
Unit I	Unit I Human immune system	15 lectures
1.1	Cells of the immune system:	
1.1.1	Lymphocytes – B cells and T cells, Natural killer cells – Mononuclear	
1.1.2	phagocytes, Granulocytes, Antigen presenting cells.	
1.2	Organs of the immune system	
1.2.1	Primary lymphoid organs: Thymus, Bone marrow	
1.2.2	Secondary lymphoid organs: Lymphatic system, Lymph nodes, Spleen, MALT.	
1.3	Classification of immunity based on mode of acquisition and based on types of cells involved –	
1.3.1	Active & Passive	
1.3.2	Humoral & Cell mediated immunity	
1.4	Antigen processing and presentation: Pathways for Antigen Processing, Cytosolic and endocytic pathway	
1.5.1	Overview of T cell development - maturation, differentiation and activation	
1.5.2	Overview of B cell development - maturation, differentiation and activation; Regulation of B cell development	
1.5.3	Clonal selection & immunologic memory.	

Unit II	Unit II Antigen- Antibody	15 lectures
2.1	Antigens: Antigenicity, immunogenicity, epitope, factors determining immunogenicity, Haptens, adjuvants.	
2.2	Antibodies: Fine structure of immunoglobulin, Antibody mediated functions, Antibody classes, Monoclonal antibodies (Production & applications).	
2.3	Antibody diversity: Multigene organization of immunoglobulin genes – Lambda , kappa & heavy chain	
2.3.1	Light chain DNA – VJ rearrangements	
2.3.2	Heavy chain DNA - VDJ rearrangements	
Unit III	Unit III Antigen- Antibody interactions & Complement system	15 lectures
3.1	Antigen- Antibody interactions	
3.1.1	Forces involved, antibody affinity, antibody avidity.	
3.1.2	Precipitation reactions – Oudins, Ouchterlony	
3.1.3	Agglutination reactions : Blood typing, bacterial agglutination,	
3.1.4	Passive agglutination, agglutination inhibition, Coomb's test.	
3.1.5	Immunoelectrophoresis : Principles of Radioimmunoassay, ELISA, Immunofluorescence, Western Blotting	
3.2	Complement system	
3.2.1	Components of complement;	
3.2.2	Complement activation – Classical, Alternate & Lectin pathway; formation of membrane attack complex.	
3.2.3	Biological consequences of complement activation.[in brief]	
Unit IV	Unit IV Tumour immunology & Immunodeficiencies	15 lectures
4.1.1	Physiology of Tumourous cells	
4.1.2	Carcinogens: Types (Physical, Chemical and Biological); Environmental Factor.	
4.1.3	Role of p53, oncogenes and Tumour suppressor genes	
4.1.4	Conversion of proto-oncogenes to oncogenes	
4.1.5	Cancer therapy (Chemo – purine, pyrimidine and folate analogs)	
4.2	Immunodeficiencies	
4.2.1	Classification of immunodeficiencies: primary and secondary	
4.3	Immunology of HIV/AIDS :	
4.3.1	Structure and genetics basis of AIDS virus.	
4.3.2	Replication of AIDS Virus, destruction of CD4 T cells	
4.3.3	AIDS Therapy	
PRACTICALS		
RPSBCHP304	Immunology & Serology	Credits 02
	Serological tests – 1) Rheumatoid arthritis factor 2) C-reactive protein test 3) Widal Qualitative test 4) Widal Quantitative test 5) Immunodiffusion by Ouchterlony double diffusion method Demonstration Experiments – 1) RIA	

	2) ELISA	
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SEMESTER IV		
Course Code	Title	Credits
RPSBCH401	Physiology & Metabolism – II	04
Unit I	Lipid Metabolism & related disorders	15 lectures
1.1.1	Schematic representation (*only) of Fatty acid oxidation of unsaturated fatty acids and odd carbon chain fatty acid oxidation (saturated, unsaturated, odd chain, even chain, peroxisomal minor pathways of fatty acids oxidation)	
1.1.2	Schematic representation (*only) of Fatty acid biosynthesis, Elongases & desaturases, synthesis of Triacylglycerol.	
1.2	Cholesterol: Biosynthesis, control, transport, utilization	
1.3	Arachidonate metabolism: Prostaglandins, Prostacyclins, thromboxanes and leukotrienes, the cyclic pathway of prostaglandins, Prostacyclins, thromboxanes' the linear pathway of leucotrienes.	
1.4	Phospholipid, glycolipid and lipoprotein: metabolism of glycerophospholipids, sphingolipids, sphingophospholipids, sphingoglycolipids.	
1.5	Lipoprotein Metabolism : Metabolism of chylomicrons, VLDL, LDL, HDL, transport lipoproteins and membrane lipoproteins	
1.6	Adipose tissue Metabolism, fatty liver, ketone bodies-formation, utilization, ketosis, metabolism of alcohol (ethanol),	
Unit II	Nucleic Acid Metabolism & Integration of Metabolism	15 lectures

2.1.1	Metabolism of Purine and pyrimidine	
2.1.2	Biosynthesis and degradation	
2.1.3	Regulation of purine metabolism	
2.1.4	Salvage pathway	
2.1.5	Inhibitors	
2.2	Integration of metabolism	
2.2.1	Integration of major metabolic pathways of energy metabolism	
2.2.2	Organ specialization and metabolic integration –Liver, Adipose tissues, Skeletal muscle, Brain, Kidney	
2.2.3	Metabolism of Well-fed state and starvation - Liver, Adipose tissues, Skeletal muscle, Brain	
2.2.4	Metabolic homeostasis: Regulation of appetite, energy expenditure and body weight	
Unit III	Metabolic disorders	15 lectures
3.1	Inborn errors of metabolism - Introduction	
3.2	Disorders related to Carbohydrate Metabolism: Glycogen storage diseases and its types, Glucose-6-phosphate dehydrogenase deficiency disease, Wernicke-Korsakoff syndrome, Fabry's disease Classical galactosemia, essential fructosuria	
3.3	Disorders related to Protein Metabolism: Hyperammonemia, Glycinuria, Primary Hyperoxaluria, Phenyl ketonuria, Tyrosinemia & its types, Alkaptonuria, Albinism, Metabolic disorders of urea cycle, Hartnup's disease, Cystinuria, Cystinosis, Homocystinuria & its types, Maple syrup disease	
3.4	Disorders related to Lipid Metabolism: Wolman disease Disorders of Fatty acid oxidation – Genetic deficiencies in carnitine transport and Acyl CoA dehydrogenase (Jamaican vomiting sickness, SIDS), Refsum's disease Disorders of Sphingolipids – Neimann-Pick, Farber's disease, Tay-Sach's and Sphingolipidoses Disorders of lipoprotein metabolism – Hypo and hyper lipoproteinemias, Deficiency of LDL receptors Disorders of glycolipids – Gaucher & Krabbe's disease	
3.5	Disorders related to Nucleic acid Metabolism: Purine metabolism disorders (Gout and its types, Lesch-Nyhan syndrome), Pyrimidine metabolism disorders (Orotic aciduria, Reye's syndrome)	
Unit IV	Stem Cell & Apoptosis	15 lectures
4.1.1	Types of stem cells and their properties. Unipotent, totipotent, multipotent, pluripotent, oligopotent stem cells. Sources of stem cells with advantages and disadvantages – Embryonic stem cells, adult stem cells, induced pluripotent stem cell	
4.1.2	Characterization, microarray analysis and differentiation of stem cells	
4.1.3	Stem Cell Research	

4.1.4	Therapeutic applications of stem cells.	
4.2	Apoptosis –	
4.2.1	Properties of apoptotic cells	
4.2.2	Role of caspases in apoptosis	
4.2.3	Mechanism (Intrinsic & Extrinsic pathway)	
	PRACTICALS	
RPSBCHP401	Project Work	Credits 02
	<p>GUIDELINE TO CARRY OUT PROJECTWORK</p> <ol style="list-style-type: none"> 1. The main purpose of introduction of Project Work at MSc II is to inculcate research culture at Post-graduation level. It will also make the students familiar with Research Methodology i.e. reference work, experimental work, data analysis of experimental data, interpretation of results obtained, writing of project work and compilation of bibliography in proper order. 2. Each student shall complete a small research project during their academic year of MSc II. However, the initial reference work for the project can be started after the conclusion of MSc I Semester II examination and summer vacation to MSc II. 3. Nature of Research Project:-Experimental-based or literature survey involving laboratory analytical work will be considered as the Research Project. 4. Duration of Project work:-Using the infrastructure available in the Biochemistry Department, RamnarainRuia Autonomous College, the duration to complete the project work will be from the commencement of the project work till the end of January of MSc II (Sem IV) academic year. 5. Schedule for Submission of project Work:-Experimental work or literature survey must be completed and the report on the same (2 Copies) will have to be submitted by the end of January of MSc II (Sem IV) academic year. 6. The project should be divided into the following parts:- <ol style="list-style-type: none"> a) Certification of completion of Project Work b) Acknowledgement c) Introduction d) Review of Related Literature e) Aims and Objectives f) Plan of work g) Material and Methods h) Results i) Discussion & Conclusion j) Future Prospects k) Bibliography 7. The project will be assessed. <p>GUIDELINE FOR THE ASSESMENT OF PROJECT WORK</p> <ol style="list-style-type: none"> 1. The practical 401 of Sem IV (Course Code No. RPSBCHP401) shall be exclusively devoted for the project. 	

2. Each student will complete the project (2 copies) and get both the copies certified by the guiding teacher and the Head of Dept. (HOD) by January of MSc II (Sem IV) academic year.
3. One copy of the certified project will be submitted to the Department; while the other copy will be retained by the students for his/ her personal record.
4. The candidate is required to present the Research Project to the examiner followed by Viva- Voce examination based on the project work by the examiner.
- 9) The following Marking Scheme shall be considered while assessing the project work

Particular		Marks
a)	Project Work (Contents Submitted in the bound form)	30
b)	Presentation of Project Work to Examiner	10
c)	Viva- voce Exam based in Project Work	10
TOTAL		50

SEMESTER IV

Course Code	Title	Credits
RPSBCH402	Clinical Biochemistry & Pharmacology	04
Unit I	Body Fluids	15 lectures
1.1	Composition and Functions of Body Fluids in Health and Disease	
1.1.1	Plasma, lymph, urine, cerebrospinal fluid, gastric juice, pleural fluid, saliva, sweat and tears, synovial fluid, bile	
1.1.2	Blood Coagulation	
1.1.3	Hyperbilirubinemia	
Unit II	Organ Function	15 lectures
2.1	Organ Function Tests. Biochemical Assessments and Changes in Endocrine Disorders	
2.1.1	Liver Function test	
2.1.2	Renal Function test including mechanism of urine formation	
2.1.3	Gastric and Pancreatic Function test	
2.1.4	Thyroid Function test	
2.1.5	Cardiac Profile	

2.1.6	Biochemical assessment and changes in Endocrine disorder(Pituitary, Thyroid, Adrenal Medulla, Adrenal Cortex, Ovaries , testes)	
Unit III	Pharmacokinetics & Bioassay	15 lectures
3.1.1 3.1.2 3.1.3 3.1.4 3.2.1 3.2.2	Pharmacodynamics, Physicochemical properties of drugs, Drug absorption : through-GIT, pulmonary, renal, placental and blood-brain barrier Bioavailability and Bioequivalence Drug Distribution, Metabolism and Excretion Bioassays : Need for bioassay, Principles and methods of bioassay, Applications of bioassay Preclinical and clinical evaluation, Therapeutic drug monitoring	
Unit IV	Therapeutic drugs & Drugs acting on Haematopoietic System	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 4.2.7 4.2.8	Therapeutic drugs : (Mechanism of action and adverse effects) Anti inflammatory – non steroid anti inflammatory NSAID [Ibuprofen], Salicylates – [Aspirins] Cardiovascular drugs- CVS [Ca channel blocker-Amlodipine, and Beta blocker – Propranolol] Antibiotic – Penicillin and Sulphonamide Antacid- Proton pump blocker –Omeprazole Drugs acting on Haemopoietic System Metabolism of iron Iron therapy: Oral Iron preparations, Parental Iron preparations, Toxicity of Iron: Desferrioxamine Mesylate Folic Acid (Pteroylglutamic acid) : Mode of Action, Therapeutic Uses Vitamin B12 (Cyanocobalamin): Mode of Action, Therapeutic Uses Hydroxycobalamin Erythropoietin Colony Stimulating Factors: Filigrastim, Lenograstim, Molgramostim Anti-coagulants – Mechanism of Haemostasis Intravenous anticoagulants – Heparin Oral anticoagulants – Coumarin derivatives & Indanedione derivatives	
	PRACTICALS	
RPSBCHP402	Clinical Biochemistry	Credits 02
	1) Liver Function Tests – <ol style="list-style-type: none"> a. Estimation of serum ALT and AST b. Estimation of total and direct bilirubin c. Estimation of serum alkaline phosphatase d. Estimation of total proteins, albumin and determination of A/G ratio e. Estimation of serum albumin by Bromocresol Green (BCG) binding method 2) Renal Function tests – <ol style="list-style-type: none"> a. Creatinine clearance test b. Urea clearance test 	

	3) Pancreatic Function Test <ol style="list-style-type: none"> a. Estimation of serum amylase activity b. Glucose Tolerance Test 4) Urine report –Abnormal constituents 5) Clinical analysis of CSF – <ol style="list-style-type: none"> a. Estimation of glucose in CSF b. Estimation of proteins in CSF c. Estimation of chlorides in CSF Demonstration Experiments – <ol style="list-style-type: none"> 1) Estimation of serum glycosylated haemoglobin 2) Separation of LDH isoenzymes by PAGE 	
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SEMESTER IV		
Course Code	Title	Credits
RPSBCH403	Advanced Genetics	04
Unit I	Cell Cycle and its regulation & DNA Replication	15 lectures
1.1	Cell cycle and its regulation	
1.1.1	Phases of cell cycle and its regulation (Cyclins & CDKs)	
1.1.2	State of DNA in different phases of cell cycle	
1.2	Replication of DNA	
1.2.1	Replication of DNA (in prokaryotes)	
1.2.2	Modes of DNA replication: Theta & rolling circle	
1.2.3	Enzymes (pol I, II and III) and accessory proteins	
1.2.4	Mechanism of semi-conservative replication (Initiation, elongation & termination)	
1.3	Replication of DNA (in eukaryotes)	
1.3.1	Enzymes (pol α , β , γ , δ , ϵ) and accessory proteins	
1.3.2	Mechanism (Pre-RC assembly, Initiation, elongation & termination)	
1.3.3	Role of telomerase (End replication problem)	

Unit II	Transcription	15 lectures
2.1.1	Transcription in prokaryotes	
2.1.2	Prokaryotic RNA polymerase and promoter; Transcription unit, Upstream regulatory sequences,	
2.1.3	Mechanism of RNA transcription: Initiation, elongation and termination (Type I & II)	
2.1.4	Mechanism of RNA transcription by RNAP I, II & III	
2.1.5	Comparative overview of transcription in prokaryotes & eukaryotes	
2.1.6	Processing of tRNA , rRNA, mRNA (prokaryotes and eukaryotes)	
2.1.7	Concept of split genes, reverse transcription.	
2.1.8	Role of Inhibitor-Rifampicin, Actinomycin D	
Unit III	Translation	15 lectures
3.1.1	Translation (protein biosynthesis) in prokaryotes	
3.1.2	Genetic code, mechanism of translation: Activation of amino acids, chain initiation, elongation & termination	
3.1.3	Comparative overview of translation in prokaryotes & eukaryotes	
3.1.4	Signal hypothesis	
3.1.5	Post translational modifications of proteins (proteolytic cleavage, acylation, phosphorylation, methylation, glycosylation), Protein targeting	
3.1.6	Inhibitors of translation	
Unit IV	Recombinant DNA Technology	15 lectures
4.1.1	Introduction of RDT	
4.1.2	Tools for RDT - (a) Enzymes- Restriction endonucleases, ligases, terminal transferases, reverse transcriptase: (b) Cloning and Expression Vectors- Plasmid, pBR 322, PUC-19, Bacteriophage – Lambda phage; Cosmid; Artificial Chromosomes(BAC and YAC); Shuttle vectors; (c) Probes- DNA probes	
4.1.3	Applications of RDT- Agriculture (Bt Cotton); Medicine (Insulin); GM food	
4.1.4	Isolation of gene: Gene library and c-DNA library; Southern blot; Northern blot;	
4.1.5	Gene Transfer: Transformation, Transfection, Electroporation, Microinjection, Liposome, Microprojectile (in brief)	
4.1.6	Selection and screening- Antibiotic and colony hybridization	
4.1.7	DNA Amplification by PCR	
	PRACTICALS	
RPSBCHP403	Genetics	Credits 02
	<ol style="list-style-type: none"> 1) Study of stages of mitosis using plant root tip 2) Isolation of RNA from Baker's dry yeast 3) Estimation of RNA by Orcinol method 4) Estimation of UV absorption of nucleic acids 5) Smear technique to demonstrate sex chromatin in buccal epithelial cells 6) PCR <p>Demonstration Experiments –</p> <ol style="list-style-type: none"> 1) Ames test 	

	2) DNA sequencing – Maxam Gilbert Method and Sanger’s Method 3) Blotting Techniques – Southern, Northern and Western	
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SEMESTER IV		
Course Code	Title	Credits
RPSBCH404	Advanced Immunology	04
Unit I	Cytokines	15 lectures
1.1.1	Cytokines & its Properties	
1.1.2	Structural families of cytokines and biological functions	
1.1.3	Cytokine receptors & its classification	
1.1.4	Cytokine antagonists	
1.1.5	Cytokine secretion by TH1 and TH2 subsets	
1.1.6	Cytokine related disorders (Bacterial Septic shock, Bacterial Toxic shock, Cancers, Chagas Disease), Therapeutic uses of cytokines	
1.1.7	Hypersensitivity Gell and Coomb’s classification types I to IV with mechanisms	
Unit II	TCR, Major Histocompatibility complex & Transplant immunology	15 lectures

2.1.1	Structure of T cell receptor, multi-gene family, DNA gene rearrangement	
2.1.2	T cell receptor complex, accessory molecules, self MHC restriction of T cell receptor	
2.2.1	General organization and inheritance of MHC.	
2.2.2	Structure of Class I and Class II HLA Molecules and organization of Class I and Class II HLA Genes. Cellular distribution of MHC Molecules	
2.2.3	Regulation of MHC Expression- Determinant Selection Model, Holes in the Repertoire Model	
2.2.4	MHC and susceptibility to disease	
2.2.5	Antigen processing and presentation: Pathways for Antigen Processing, Cytosolic and endocytic pathway & Self MHC Restriction of T Cell	
2.3.1	Immunological basis of graft rejection	
2.3.2	Mechanism of graft rejection: Sensitization and effector stage	
2.3.3	Clinical manifestation of graft rejection	
2.3.4	Allograft rejection displays specificity and memory	
2.3.5	Tissue typing and laboratory investigations- microcytotoxicity test, mixed lymphocyte reaction (HLA Typing)	
2.3.6	General and specific immunosuppressive therapy	
Unit III	Immunological Tolerance & Autoimmunity	15 lectures
3.1	Immunological Tolerance	
3.1.1	Pathways to B and T cell tolerance	
3.1.2	General characteristics of B and T cell tolerance	
3.1.3	Mechanisms of tolerance inductions self tolerance	
3.1.4	Potential therapeutic applications of tolerance	
3.2	Autoimmunity and autoimmune Diseases their etiology	
3.2.1	Organ specific autoimmune diseases (Hashimoto's thyroiditis, Myasthenia gravis and Insulin dependent diabetes mellitus)	
3.2.2	Systemic Autoimmune diseases (Systemic lupus erythomatous, Rheumatoid arthritis, Multiple sclerosis)	
3.2.3	Diagnostic & prognostic value of auto antibodies- Treatment of autoimmune diseases	
3.2.4	Role of CD4, T cell, MHC and TCR in autoimmunity	
3.2.5	Proposed mechanisms for induction of auto immunity	
Unit IV	Immune response to infectious diseases & Vaccines	15 lectures
4.1.1	Immune Response & effector mechanism towards infectious diseases - Viral, Bacterial, Fungal and Protozoal diseases & Helminthes infections	
4.2	Vaccines	
4.2.1	Active & Passive immunization, Designing vaccines (factors)	
4.2.2	Types of vaccine – Live, attenuated vaccine; Inactivated or killed vaccine; Subunit vaccine – Toxoids (Antivenins), Triple antigen (DTP), Bacterial polysaccharide capsules, outer membrane proteins, viral glycoproteins, pathogen proteins, synthetic peptides (multivalent subunit vaccines) as vaccines Conjugate vaccine; Anti-idiotypic vaccines; DNA vaccines; Recombinant vector vaccines	

PRACTICALS		
RPSBCHP404	Immunology & Serology	Credits 02
	1) Blood Grouping by ABO and Rh Method 2) VDRL Qualitative test 3) VDRL Quantitative test 4) Pregnancy test 5) Immunodiffusion by radial method 6) Spectroscopic estimation of aspirin hydrolysate	

References:

Suggested Readings for paper 301 and 401 and Practical 301 and 401

- 1) Lewin Benjamin, Genes (Latest edition) Oxford Univ. Press
- 2) Jha A.P. Genes and Evolution 1993, Macmillan, Delhi.
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- 5) Fisher R.A. Genetic Theory of Natural Selection, RESTE, New Delhi.
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- 9) Bain Bridge Brian W, Genetics of Microbes, 1980, Blackie and Son, London
- 10) Winchester A.M. Genetics: A Survey of Principles of Heredity, Oxford IBH Public Co.

Suggested Readings for paper 302 and 402 and Practical 302 and 402

- 1) Weir D.M., immunology, 5th ed., ELBS and Churchill Livingston.
- 2) Chakravarthy A.K. Immunology, Tata McGraw Hill, New Delhi.
- 3) Callaghan Richard B. Immunology, Academic Press
- 4) Weir D.M., Immunology: Student's Notes, ELBS- Oxford.
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- 9) Hood Leroy E., Immunology, 2nd Ed., 1976, Benjamin Cummings Publication
- 10) Topley Wilson, Topley and Wilson's Principle of Bacteriology, Virology and immunity Edward Arnold Ltd., London

Suggested Readings for paper 303 and 403 and Practical 303 and 403

- 1) Greenberg David M – Metabolic Pathways. Vols 2 and 3, 3rd editions. Academic Press, New York
- 2) Henry Richard et al – Clinical Chemistry, Principles and Techniques, 2nd edition, Harper and Row, New York
- 3) Kamal SH – Clinical Biochemistry for Medical Technologies, Churchill Livingston, London
- 4) Todd et al – Clinical Diagnosis and Management, 17th edition, WB Saunders, Philadelphia
- 5) Stokes Joan et al – Clinical Microbiology, Edward Arnold, London
- 6) Gill CV – Short cases in clinical biochemistry, Churchill Livingston, Edinburgh, 1984
- 7) Rao Ranganathan – Text book of biochemistry 3rd edition, Prentice Hall, New Delhi
- 8) Rodrigues Fred K Carbohydrate chemistry with clinical correlations, New Age International, New Delhi
- 9) Bayens Dominezak – Medical biochemistry, Mosby Publishers, Harcourt, 1999

Suggested Readings for paper 304 and 404 and Practical 304 and 404

- 1) Anderson I et al. Nutrition in Health and Disease, 17th ed., 1982, J.B. Lippincott Co.,
- 2) Anita F.P., Clinical Dietetics and Nutrition's, 4th ed., 1997 Oxford University Press, New Delhi.
- 3) Bennion H., Clinical Nutrition, 1979, Harper Row, New York.
- 4) Carolyn E., et al, Nutrition and Diet Therapy, 7th Ed., 2000, Delmer Publishers
- 5) Gopalan C et al, Dietary Allowances for Indians, NIH, Hyderabad.
- 6) Gopalan C et al, Nutritive Value of Indian Foods, 1988, NIH, Hyderabad.
- 7) Halpern S.L., Quick reference to Clinical nutrition, 2nd Ed., 1987, J.B. Lippincott Co.
- 8) Kinney J.M. et.al, Nutrition and Metabolism in Patient Care, 19th ed., 1999, W.B. Saunders and Co.
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- 11) Shils M.E. et al, Modern Nutrition in Health and Disease, 1998, Lea and Febiger, Philadelphia.
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- 13) Williams S., Nutrition and Diet Therapy, 4th Ed., The C.V. Mosby Co., Missouri.
- 14) Essentials of Pharmacotherapeutics, 3rd Ed., By F.S.K. Barar, S chand & Company Ltd. 2005.
- 15) Pharmaceutical chemistry, G Melentyeva L L Antonova Mir Publishers, Moscow
- 16) Chemical Pharmacology, R B Barlow, 2nd Ed, Methven and CO. New Fettes Lane
- 17) Medicinal Chemistry, Vol I, 3rd Ed, Alfred Burga, Wiley Inter sciences
- 18) Textbook of paramedical chemistry, Jayshree Ghosh, S chand and company, New Delhi
- 19) Pharmacology, B Suresh, 1st Ed. Shanti, Publication.

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MODALITY OF ASSESSMENT

Theory Examination Pattern:

B) 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 %

Semester End Theory Assessment - 60 marks

- iii. Duration - These examinations shall be of **2 hours** duration.
- iv. Paper Pattern:
 3. 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.
 4. 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
Journal	05
Test	15
Total	20

(B) External (Semester end practical examination):

Particulars	Practical 1
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 – III

Course	RPSBCH301			RPSBCH302			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	RPSBCH303			RPSBCH5P304			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 – IV

Course	RPSBCH401			RPSBCH402			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	RPSBCH403			RPSBCH5P404			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

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