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

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 1.1.2 1.1.3 1.1.4 1.1.5 1.1.6 1.1.7 1.1.8	Schematic representation of Glycosis & Kreb's cycle 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 Gluconeogenesis: Pathway and its Regulation, Futile cycle, Rapoport Luebering cycle, Cori cycle, Glucose-Alanine cycle& their significance Shuttles-Malate-Aspartate shuttle & Glycerol phosphate shuttle. Uronic acid pathway (biosynthesis, degradation & its significance), Galactose and fructose metabolism; Sorbitol pathway, Glyoxylate pathway. Biosynthesis of oligosaccharides and glycoproteins Mucopolysaccharides; Stucture,function and disorders	
Unit II	**Protein metabolism**	**15 lectures**
2.1.1 2.1.2 2.1.3 2.1.4	Reactions of amino acids: Deamination, Transamination, Decarboxylation, Transmethylation, Transdeamination, Ammonia formation, transport and detoxification in brain and liver. Urea cycle-regulation Metabolism of significant amino acids– Glycine, Phenylalanine, Tyrosine, Tryptophan Alanine, Sulphur containing amino acids 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 3.1.2 3.1.3 3.1.4	Introduction, Possible mechanisms for abnormal enzyme levels Clinical significance of enzyme assay – serum enzymes in heart diseases, liver diseases, GIT diseases, Muscle diseases, Bone diseases Value of enzymes in malignancies Isoenzymes & their clinical significance – LDH, CPK, Alkaline phosphatase	
Unit IV	**Haematopoiesis & related disorders**	**15 lectures**
4.1.1	Haematopoiesis, Hemoglobin Metabolism,	

4.1.2 4.1.3 4.1.4 4.1.5	Hb derivatives: Oxy, Reduced, Met, Carboxy, Carbamino 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 Acidosis & Alkalosis Blood Gas Analysis (pH, pO_2, pCO_2, Bicarbonate) and interpretation	
	PRACTICALS	
RPSBCHP301	**Haematology**	**Credits 02**
	Haematological tests – 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 1.1.1 1.1.2 1.1.3	Macronutrients of Nutritional significance Carbohydrates: Role of Oligosaccharides, Dietary Fibre, Non-starch, polysaccharides, Prebiotics and Probiotics, Sugar alcohols in human nutrition, Glycemic Index, Sweeteners 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 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 2.1.2 2.1.3 2.1.4 2.1.5	Nutrition during pregnancy, lactation, infancy, childhood, adolescence, adulthood, ageing. Nutrition for health & weight management. Nutrition for Exercise and Sport performance. Nutrition for bone health. 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 3.1.2 3.1.3 3.1.4	Scope of pharmacology Sources, Classification and Nomenclature of drugs Dosage forms and routes of drug administration; Factors affecting dosage and drug delivery 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 4.1.1 4.1.2 4.1.3 4.1.4 4.1.5	Pharmacodynamics Basis of Drug Action Drug Receptor Interaction – Receptor Theory of Drug Action, Location of 4.1.3 Drug Receptor-G-Coupled Protein receptors Drug Acting on enzymes Non receptor mechanism		**15 lect**

4.1.6 4.1.7 4.1.8 4.1.9 4.2 4.2.1 4.2.2 4.2.3	Placebo effect Affinity and Intrinsic Activity Intensity of Drug Response – Potency and Efficacy Combined Effects of Drug – Synergism, Antagonism Adverse Drug Reactions (ADR) Definition and Types and Classification of ADR (Pharmacological, Non-pharmacological, Disease related, Multiple drug reactions) Repeated Dosage, Drug dependence, Over dosage, Acute poisoning General Principles of Management of Poisoning	
	PRACTICALS	
RPSBCHP302	**Clinical Biochemistry**	**Credits 02**
	1) Estimation of total and free gastric juice acidity 2) Lipid Profile – 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 1.1.2 1.1.3 1.1.4 1.1.5 1.2.1 1.2.2 1.2.3 1.2.4 1.2.5	Mendelian genetics: Mendel's experiments & Laws Variations over Mendelian Genetics - Incomplete Dominance, Co-Dominance, Multiple Alleles, Pleiotropy, Polygenics, Epistasis, Linked Genes, Sex-linked Genes, Environmental influences on Gene Expression (Hormones, Sex-limited & Sex-influenced), Maternal Gene Effects Pedigree analysis, Problems based on these concepts Structure and characteristic of DNA & RNA - double helical structure A, B & Z DNA, liner and circular DNA. Tm of DNA, its relation to GC content, Types of RNA, structure & functions Cot curves and its significance, C-value paradox		**15 lect**
Unit II	**Genetics II**		**15 lectures**
2.1 2.1.1 2.1.2 2.2 2.3 2.4.1 2.4.2 2.4.3	Organization of DNA in genome Histones, nucleosomes, structure of chromatin Eukaryotic chromosomes, Unique and repetitive sequences of DNA Histone acetylation and deacetylation, DNA methylation Lampbrush & polytene chromosomes Genetic recombinations: Holliday models Gene mapping – Genome mapping (genetic mapping, Physical mapping) Tetrad analysis Problems based on above concept		
Unit III	**Regulation of Gene Expression**		**15 lectures**
3.1.1 3.1.2 3.1.3 3.2 3.2.1 3.2.2	Regulation of gene expression in prokaryotes Introduction, Conditions affecting gene expression (positive and negative control, induction and repression) 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) Riboswitches Regulation of gene expression in eukaryotes Regulatory transcription factors		
Unit IV	**Chromosomal Abnormalities & Mutations**		**15 lectures**
4.1.1 4.1.2	Chromosomal aberration Stuctural and numerical abnormalities		

4.1.3 4.1.4 4.2 4.2.1 4.2.2 4.2.3 4.3 4.3.1	Euploidy and aneuploidy (Autosomal and Sex chromosomes) Monosomies (Turner syndrome) Disomies and trisomies (Down Syndrome) and their causes Mutations Types of mutations Physical, chemical and Biological agents causing mutations Reverse mutations, Mutagenesis, Site directed mutagenesis, Ames test. DNA repair Mechanism Photoreactivation, base & nucleotide excision, mismatch repair SOS repair, recombinational repair	
	PRACTICALS	
RPSBCHP303	**Genetics**	**Credits 02**
	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 1.1.1 1.1.2 1.2 1.2.1 1.2.2 1.3 1.3.1 1.3.2 1.4 1.5.1 1.5.2 1.5.3	Cells of the immune system: Lymphocytes – B cells and T cells, Natural killer cells – Mononuclear phagocytes, Granulocytes, Antigen presenting cells. Organs of the immune system Primary lymphoid organs: Thymus, Bone marrow Secondary lymphoid organs: Lymphatic system, Lymph nodes, Spleen, MALT. Classification of immunity based on mode of acquisition and based on types of cells involved – Active & Passive Humoral & Cell mediated immunity Antigen processing and presentation: Pathways for Antigen Processing, Cytosolic and endocytic pathway Overview of T cell development - maturation, differentiation and activation Overview of B cell development - maturation, differentiation and activation; Regulation of B cell development Clonal selection & immunologic memory.		
Unit II	**Unit II Antigen- Antibody**		**15 lectures**
2.1 2.2 2.3 2.3.1 2.3.2	Antigens: Antigenecity, immunogenecity, epitope, factors determining immunogenecity, Haptens, adjuvants. Antibodies: Fine structure of immunoglobulin, Antibody mediated functions, Antibody classes, Monoclonal antibodies (Production & applications). Antibody diversity: Multigene organization of immunoglobulin genes – Lambda, kappa & heavy chain Light chain DNA – VJ rearrangements Heavy chain DNA - VDJ rearrangements		
Unit III	**Unit III Antigen- Antibody interactions & Complement system**		**15 lectures**
3.1 3.1.1 3.1.2 3.1.3 3.1.4 3.1.5 3.2 3.2.1 3.2.2 3.2.3	Antigen- Antibody interactions Forces involved, antibody affinity, antibody avidity. Precipitation reactions – Oudins, Ouchterlony Agglutination reactions: Blood typing, bacterial agglutination, Passive agglutination, agglutination inhibition, Coomb's test. Immunoelectrophoresis: Principles of Radioimmunoassay, ELISA, Immunofluorescence, Western Blotting Complement system Components of complement; Complement activation – Classical, Alternate & Lectin pathway; formation of membrane attack complex. Biological consequences of complement activation.[in brief]		

Unit IV	**Unit IV Tumour immunology & Immunodeficiencies**	**15 lectures**
4.1.1 4.1.2 4.1.3 4.1.4 4.1.5 4.2 4.2.1 4.3 4.3.1 4.3.2 4.3.3	Physiology of Tumourous cells Carcinogens: Types (Physical, Chemical and Biological); Environmental Factor. Role of p53, oncogenes and Tumour suppressor genes Conversion of proto-oncogenes to oncogenes Cancer therapy (Chemo – purine, pyrimidine and folate analogs) Immunodeficiencies Classification of immunodeficiencies: primary and secondary Immunology of HIV/AIDS : Structure and genetics basis of AIDS virus. Replication of AIDS Virus, destruction of CD4 T cells 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	

SEMESTER IV			
Course Code		**Title**	**Credits**
RPSBCH401		**Physiology & Metabolism – II**	**04**
Unit I	**Lipid Metabolism& related disorders**		**15 lectures**
1.1.1 1.1.2 1.2 1.3 1.4 1.5 1.6	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) Schematic representation (*only) of Fatty acid biosynthesis, Elongases & desaturases, synthesis of Triacylglcerol. Cholesterol: Biosynthesis, control, transport, utilization Arachidonate metabolism: Prostaglandins, Prostacyclins, thromboxanes and leukotrienes, the cyclic pathway of prostaglandins, Prostacyclins, thromboxanes' the linear pathway of leucotrienes. Phospholipid, glycolipid and lipoprotein: metabolism of glycerophospholipids, sphingolipids, sphingophospholipids, sphingoglycolipids. Lipoprotein Metabolism: Metabolisam of chylomicrons, VLDL, LDL, HDL, transport lipoproteins and membrane lipoproteins 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 2.1.2 2.1.3 2.1.4 2.1.5 2.2 2.2.1 2.2.2 2.2.3 2.2.4	Metabolism of Purine and pyrimidine Biosynthesis and degradation Regulation of purine metabolism Salvage pathway Inhibitors Integration of metabolism Integration of major metabolic pathways of energy metabolism Organ specialization and metabolic integration –Liver, Adipose tissues, Skeletal muscle, Brain, Kidney Metabolism of Well-fed state and starvation - Liver, Adipose tissues, Skeletal muscle, Brain Metabolic homeostasis: Regulation of appetite, energy expenditure and body weight		
Unit III	**Metabolic disorders**		**15 lectures**
3.1 3.2 3.3	Inborn errors of metabolism - Introduction 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 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, Deficicency 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**
	GUIDELINE TO CARRY OUT PROJECTWORK 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:-
   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.

GUIDELINE FOR THE ASSESMENT OF PROJECT WORK

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 1.1.1 1.1.2 1.1.3	Composition and Functions of Body Fluids in Health and Disease Plasma, lymph, urine, cerebrospinal fluid, gastric juice , pleural fluid, saliva, sweat and tears ,synovial fluid, bile Blood Coagulation Hyperbilirubinemia	
Unit II	**Organ Function**	**15 lectures**
2.1 2.1.1 2.1.2 2.1.3 2.1.4 2.1.5 2.1.6	Organ Function Tests. Biochemical Assessments and Changes in Endocrine Disorders Liver Function test Renal Function test including mechanism of urine formation Gastric and Pancreatic Function test Thyroid Function test Cardiac Profile Biochemical assessment and changes in Endocrine disorder(Pituitary, Thyroid, Adrenal Medulla, Adrenal Cortex, Ovaries , tastes)	
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	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 – Proprenolol] Antibiotic – Penicillin and Sulphonamide Antacid- Proton pump blocker –Omeprazole **Drugs acting on Haemopoietic System**	

4.2.1 4.2.2 4.2.3 4.2.4 4.2.5 4.2.6 4.2.7 4.2.8	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 – 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 – a. Creatinine clearance test b. Urea clearance test 3) Pancreatic Function Test a. Estimation of serum amylase activity b. Glucose Tolerance Test 4) Urine report –Abnormal constituents 5) Clinical analysis of CSF – a. Estimation of glucose in CSF b. Estimation of proteins in CSF c. Estimation of chlorides in CSF **Demonstration Experiments –** 1) Estimation of serum glycosylated haemoglobin 2) Separation of LDH isoenzymes by PAGE	

SEMESTER IV			
Course Code		**Title**	**Credits**
RPSBCH403		**Advanced Genetics**	**04**
Unit I	**Cell Cycle and its regulation & DNA Replication**		**15 lectures**
1.1 1.1.1 1.1.2 1.2 1.2.1 1.2.2 1.2.3 1.2.4 1.3 1.3.1 1.3.2 1.3.3	Cell cycle and its regulation Phases of cell cycle and its regulation (Cyclins & CDKs) State of DNA in different phases of cell cycle Replication of DNA Replication of DNA (in prokaryotes) Modes of DNA replication: Theta & rolling circle Enzymes (pol I, II and III) and accessory proteins Mechanism of semi-conservative replication (Initiation, elongation & termination) Replication of DNA (in eukaryotes) Enzymes (pol α, β, γ, δ, ε) and accessory proteins Mechanism (Pre-RC assembly, Initiation, elongation & termination) Role of telomerase (End replication problem)		
Unit II	**Transcription**		**15 lectures**
2.1.1 2.1.2 2.1.3 2.1.4 2.1.5 2.1.6 2.1.7 2.1.8	Transcription in prokaryotes Prokaryotic RNA polymerase and promoter; Transcription unit, Upstream regulatory sequences, Mechanism of RNA transcription: Initiation, elongation and termination (Type I & II) Mechanism of RNA transcription by RNAP I, II & III Comparative overview of transcription in prokaryotes & eukaryotes Processing of tRNA, rRNA, mRNA (prokaryotes and eukaryotes) Concept of split genes, reverse transcription. Role of Inhibitor-Rifampicin, Actinomycin D		
Unit III	**Translation**		**15 lectures**
3.1.1 3.1.2 3.1.3 3.1.4 3.1.5 3.1.6	Translation (protein biosynthesis) in prokaryotes Genetic code, mechanism of translation: Activation of amino acids, chain initiation, elongation & termination Comparative overview of translation in prokaryotes & eukaryotes Signal hypothesis Post translational modifications of proteins (proteolytic cleavage, acylation, phosphorylation, methylation, glycosylation), Protein targeting Inhibitors of translation		
Unit IV	**Recombinant DNA Technology**		**15 lectures**
4.1.1	Introduction of RDT		

4.1.2 4.1.3 4.1.4 4.1.5 4.1.6 4.1.7	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 Applications of RDT- Agriculture (Bt Cotton); Medicine (Insulin); GM food Isolation of gene: Gene library and c-DNA library; Southern blot; Northern blot; Gene Transfer: Transformation, Transfection, Electroporation, Microinjection, Liposome, Microprojectile (in brief) Selection and screening- Antibiotic and colony hybridization DNA Amplification by PCR	
	PRACTICALS	
RPSBCHP403	**Genetics**	**Credits 02**
	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 **Demonstration Experiments –** 1) Ames test 2) DNA sequencing – Maxam Gilbert Method and Sanger's Method 3) Blotting Techniques – Southern, Northern and Western	

SEMESTER IV			
Course Code		**Title**	**Credits**
RPSBCH404		**Advanced Immunology**	**04**
Unit I	**Cytokines**		**15 lectures**
1.1.1 1.1.2 1.1.3 1.1.4 1.1.5 1.1.6 1.1.7	Cytokines & its Properties Structural families of cytokines and biological functions Cytokine receptors & its classification Cytokine antagonists Cytokine secretion by TH1 and TH2 subsets Cytokine related disorders (Bacterial Septic shock, Bacterial Toxic shock, Cancers, Chagas Disease), Therapeutic uses of cytokines 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 2.1.2 2.2.1 2.2.2 2.2.3 2.2.4 2.2.5 2.3.1 2.3.2 2.3.3 2.3.4 2.3.5 2.3.6	Structure of T cell receptor, multi-gene family, DNA gene rearrangement T cell receptor complex, accessory molecules, self MHC restriction of T cell receptor General organization and inheritance of MHC. Structure of Class I and Class II HLA Molecules and organization of Class I and Class II HLA Genes. Cellular distribution of MHC Molecules Regulation of MHC Expression- Determinant Selection Model, Holes in the Repertoire Model MHC and susceptibility to disease Antigen processing and presentation: Pathways for Antigen Processing, Cytosolic and endocytic pathway & Self MHC Restriction of T Cell Immunological basis of graft rejection Mechanism of graft rejection: Sensitization and effector stage Clinical manifestation of graft rejection Allograft rejection displays specificity and memory Tissue typing and laboratory investigations- microcytotoxicity test, mixed lymphocyte reaction (HLA Typing) General and specific immunosuppressive therapy		
Unit III	**Immunological Tolerance & Autoimmunity**		**15 lectures**
3.1 3.1.1 3.1.2 3.1.3 3.1.4 3.2 3.2.1 3.2.2 3.2.3	Immunological Tolerance Pathways to B and T cell tolerance General characteristics of B and T cell tolerance Mechanisms of tolerance inductions self tolerance Potential therapeutic applications of tolerance Autoimmunity and autoimmune Diseases their etiology Organ specific autoimmune diseases (Hashimoto's thyroiditis, Myasthenia gravis and Insulin dependent diabetes mellitus) Systemic Autoimmune diseases (Systemic lupus erythomatous, Rheumatoid arthritis, Multiple sclerosis) Diagnostic & prognostic value of auto antibodies- Treatment of autoimmune		

3.2.4 3.2.5	diseases Role of CD4, T cell, MHC and TCR in autoimmunity Proposed mechanisms for induction of auto immunity	
Unit IV	**Immune response to infectious diseases & Vaccines**	**15 lectures**
4.1.1 4.2 4.2.1 4.2.2	Immune Response & effector mechanism towards infectious diseases - Viral, Bacterial, Fungal and Protozoal diseases &Helminthes infections Vaccines Active & Passive immunization, Designing vaccines (factors) 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-idiotype 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.
3) Williamson Robert, Genetic Engineering I, Academic Press
4) Williamson Robert, Genetic Engineering 2, Academic Pres
5) Fisher R.A. Genetic Theory of Natural Selection, RESTE, New Delhi.
6) Mitra Snadhya, Genetic Engineering: Principles and Practice, Macmillan India Pvt. Ltd.
7) Sang J. H, Genetics, 1984, Longman, London, 1984.
8) Hayes, William, Genetics of Bacteria and Viruses, CBS Publisher, New Delhi.
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.
5) Bowry T.R., Immunology Simplified, 2nd Ed., ELBS and Oxford.
6) Ivan, Immunology Method Manual, Vol. 4 1997, Academic Press, Sani Diego.
7) Roitt Ivan and others, Immunology, 6th Ed., Mosby, Edinburg.
8) Kuby, Janis, Immunology. 3rd Ed., 1997, W.H. Freeman Co.
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 Dominiezak – 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, Hyderbad.
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.
9) Pike R.L. and Brown M.L., Nutrition: An Integrated Approach, 1987, John Wiley and Sons.
10) Robinson C.et al, Normal and Therapeutic Nutrition, 16th Ed., 1982, Macmillan Publishing Co.
11) Shils M.E.et al, Modern Nutrition in Health and Disease, 1998, Lea and Febiger, Philadelphia.
12) Swaminathan M., Essentials of food and Nutrition, 2nd Ed., 1985, Ganesh and Co.
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 LAntonova Mir Publishers, Moscow
16) Chemical Pharmacology, R B Barlow, 2nd Ed, Methven and CO. New Fetters 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.

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 %

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**
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**