Resolution No. AC/I(19-20).2.RUS2

S.P. Mandali's

Ramnarain Ruia Autonomous College

Syllabus for *T.Y.BSc.*

Program: *B.Sc.*

Course: *Biochemistry (RUSBCH)*

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

Semester V

Course Code	Unit	Topics	Credits	Lectures
Paper I - Metabolism & Analytical Techniques - I				
RUSBCH501	I	Carbohydrate Metabolism	3	15
	II	Amino acid and protein metabolism & Biochemistry of senses		15
	III	Bioenergetics & Oxidative Phosphorylation		15
	IV	Chromatography		15
Paper II – Environmental Science & Cell Biology				
RUSBCH502	I	Air	3	15
	II	Water & Water Treatment		15
	III	Soil & Noise & Environmental Monitoring		15
	IV	Cell – Cell Communication		15
Paper III –Advanced Genetics & RDT				
RUSBCH503	I	DNA Replication & Repair	3	15
	II	Transcription		15
	III	Translation		15
	IV	Recombinant DNA Technology (RDT)		15
Paper IV – Immunology & Pathophysiology - I				
RUSBCH504	I	Human immune system	3	15
	II	Antigen & Antibody		15
	III	Antigen- Antibody interactions & Complement system		15
	IV	Tumour immunology & Apoptosis		15
RUSBCHP501	Practicals based on course in theory –RUSBCH501		4	
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Semester VI

Course Code	Unit	Topics	Credits	Lectures
Paper I - Metabolism & Analytical Techniques - II				
RUSBCH601	I	Lipid metabolism	3	15
	II	Nucleic Acid Metabolism & Integration of Metabolism		15
	III	Centrifugation & Protein Purification techniques		15
	IV	Electrophoresis		15
Paper II – Nutrition & Pharmacology				
RUSBCH602	I	Nutrition & Diet Management	3	15
	II	Vitamins and Co-enzymes & their deficiency disorders		15
	III	Pharmacokinetics and Bioassay		15
	IV	Therapeutic drugs & Drugs acting on the Haemopoietic system		15
Paper III – Biostatistics & Bioinformatics				
RUSBCH603	I	Biostatistics & descriptive statistics	3	15
	II	Probability & Normal distribution and Bioinformatics		15
	III	Hypothesis testing of means & ANOVA		15
	IV	Hypothesis testing of difference between means & Chi-square test		15
Paper IV – Immunology & Pathophysiology - II				
RUSBCH604	I	Metabolic disorders	3	15
	II	TCR, Major Histocompatibility complex &Transplant immunology		15
	III	Virology & AIDS		15
	IV	Ageing, Alzheimer's and Vaccines		15
RUSBCHP601	Practicals based on course in theory – RUSBCH601		4	
RUSBCHP602	Practicals based on course in theory –RUSBCH602			
RUSBCHP603	Practicals based on course in theory –RUSBCH603		4	
RUSBCHP604	Practicals based on course in theory –RUSBCH604			

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

Learning Objectives:
The overall goal of this TYBSc course is to familiarize the students to the fields of physiology, metabolism, instrumentation, environmental science, genetics, immunology, nutritional biochemistry, biostatistics, pharmacology and bioinformatics.

Learning Outcomes:
Upon completion of the TYBSc course, the students would understand the following:

1) Metabolism (Carbohydrates, amino acids & proteins, lipids, nucleic acids) & integration of metabolisms. Bioenergetics & oxidative Phosphorylation which will enable them to understand the energetics of various metabolisms.
2) Biochemistry of senses topic which includes the study of sensory system of humans.
3) Analytical techniques like chromatography, centrifugation, electrophoresis, protein purification techniques, etc
4) Environmental Science which include topics like air pollution; water pollution; soil & noise pollution; and Energy, Industrial Pollutants & Environmental Monitoring.
5) Nutritional Biochemistry comprising of topics like Nutrition & Diet Management; Vitamins and Co-enzymes & their deficiency disorders.
6) Pharmacokinetics and Bioassay; Therapeutic drugs & Drugs acting on haemopoietic system will help them to understand pharmacology in more depth.
7) The important genetic processes namely, DNA replication, transcription, translation & Recombinant DNA Technology increasing their knowledge of molecular biology.
8) Biostatistics which will help them to interpret results and draw conclusions in the research.
9) Bio-informatics and applications of computers in Bio-chemistry.
10) Basics of human immune system, detailed study of various cells and organs involved.
11) Tumour immunology, apoptosis, virology, AIDS, Ageing, Alzheimers, transplant immunology and vaccines which will further increase their understanding of Human immune system in a better way.
12) All the practicals have been rearranged in accordance with the theory of each paper at each semester.

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

Detailed Syllabus

SEMESTER V		
Course Code	**Title**	**Credits**
RUSBCH501	**Metabolism & Analytical Techniques - I**	**3**
Unit I Carbohydrate metabolism		
1.1	Catabolism – Cellular location, sequence of reactions, labelling of carbon atoms, and energetics of:	15 Lectures
1.1.1	Glycolysis (aerobic and anaerobic) - Mechanisms of regulation of glycolysis - Homeostasis and Metabolic Control, Metabolic Flux, Metabolic Control Analysis, Supply–Demand Analysis, Mechanisms of Flux Control	
1.1.2	Oxidation of pyruvate,	
1.1.3	Krebs cycle; Glyoxylate pathway;	
1.1.4	Glycogenolysis – [schematic – no structures, but with enzymes and coenzymes]	
1.2	Anabolism – HMP shunt (Cellular location, sequence of reactions, multifunctional nature); Gluconeogenesis, Glycogenesis – [schematic – no structures, but with enzymes and coenzymes]	
Unit II Amino acid and protein metabolism & Biochemistry of Senses		
2.1	Amino acid and protein metabolism	15 Lectures
2.1.1	Reactions of amino acids – Transamination [GOT/GPT and mechanism of transamination]; Decarboxylation [His, Trp, Glu, and mechanism of decarboxylation], Deamination [oxidative – NAD(P) linked dehydrogenases and D & L - Amino acid oxidases, Non oxidative – Asp, Cys, Ser]	
2.1.2	Definition – ketogenic and glucogenic amino acids	
2.1.3	Urea cycle – Cellular location, sequence of reactions, Labeling of N atom, transport of NH_3	
2.2	Biochemistry of Senses –	
2.2.1	Sensory systems, Senses and receptors	
2.2.2	Classification of receptors based on location – Exteroceptors, Interoceptors & Proprioceptors	
2.2.3	Classification of receptors based on type of stimulus detected – Mechanoreceptors, Photoreceptors, Thermoreceptors, Nociceptors, Chemoreceptors (Gustatory & Olfactory), Osmoreceptors	
2.2.4	Auditory system	
2.2.5	Vision	
2.2.6	Somatosensory	
Unit III Bioenergetics & Oxidative Phosphorylation		
3.1	Bioenergetics	15 Lectures
3.1.1	Concept of free energy; Respiratory electron transport chain – Carriers [basic chemistry, redox potentials, orientation on the membrane, sequence}; Complexes I to IV; Q cycle in Complex III; Inhibitors of electron transport – Antimycin A, Amytal, Rotenone, CN, Azide, CO	
3.1.2	Malate-Aspartate shuttle and Glycerol phosphate shuttle	
3.2	Oxidative phosphorylation Chemiosmotic hypothesis, Proton motive force; Structure of ATP synthase , Uncoupler- of ETC and Oxidative phosphorylation [DNP]	
Unit IV Chromatography		
4.1	Chromatography	15 Lectures
4.2	Introduction, Concept of partition coefficient, retention time, retention factor	

	Principle, Technique and Applications of the following kinds of chromatography: Partition chromatography (Paper, GLC) Adsorption Chromatography (TLC and Column) Ion exchange chromatography Gel filtration Affinity chromatography Advanced Chromatographic techniques – HPLC, HPTLC	
	PRACTICALS	
RUSBCHP501	Practicals based on course in theory –RUSBCH501	**2**
	1) Identification of biomolecules 2) Determination of the optimum pH of β-Amylase 3) Determination of Km value of β-Amylase 4) Study the effect of inhibitor on β-Amylase 5) Determination of the activity and specific activity of β-Amylase from sweet potato 6) Estimation of glucose by Benedict's method 7) Separation of sugars by circular paper chromatography 8) Separation of plant pigments by Adsorption Column Chromatography	

SEMESTER V		
Course Code	**Title**	**Credits**
RUSBCH502	**Environmental Science & Cell Biology**	**3**
Unit I Air		
1.1 1.1.1 1.1.2 1.1.3 1.2	Atmosphere Composition and structure of atmosphere Particles, ions and radicals in the atmosphere Chemical and photochemical reactions in the atmosphere [reactions of oxygen, ozone, sulphur dioxide, nitrogen oxide and organic compounds] Air Pollutants – CO, Oxides of Nitrogen, SO_2, hydrocarbons and photochemical smog, Greenhouse gases, suspended particulate matter[sources and effect of] , depletion of ozone	15 Lectures
Unit II Water & Water Treatment		
2.1 2.1.1 2.2 2.2.1 2.2.2 2.3 2.3.1	Water Hydrosphere- characteristics and the water cycle Water Pollution Organic pollutants [pesticides, insecticides, detergents, oil spills, toxic organic chemicals] Inorganic pollutants [heavy metals – Hg, Pb, As, Cd] Thermal pollution of water Water treatment Criteria for water purity, Water purification [preliminary, primary, secondary, tertiary- chlorination, ion exchange]	15 Lectures
Unit III Soil, Noise & Environmental monitoring		
3.1 3.1.1 3.1.2 3.1.3 3.2 3.2.1 3.2.2 3.3 3.3.1 3.3.2	Soil Composition of soil, Nitrogen cycle Types of soil pollution – acidification, agrochemical pollution, salinization, and contamination by metalliferous wastes Noise and its measurement Classification of Noise Causes and consequences of Noise pollution Environmental monitoring Approaches used to monitor the environment-air, water and soil. [Principles and Significance only. Protocols for each factor – not required] Remote Sensing	15 Lectures
Unit IV Cell – Cell Communication		
4.1 4.2 4.2.1 4.2.2 4.2.3 4.3 4.3.1 4.3.2	Introduction, Significance of cell communication Cell Junctions & its classification – Occluding junction (tight junctions, septate junctions) Anchoring junction (Actin filament attachment sites & Intermediate filament attachment sites), Communicating junction (Gap junction, Chemical synapses, Plasmodesmata) Cell – Cell Adhesion Mechanism of Adhesion – Junctional & Non-junctional Cadherins mediated Ca^{2+}-dependent Cell - Cell Adhesion	15 Lectures

	PRACTICALS	
RUSBCHP502	Practicals based on course in theory –RUSBCH502	**2**
	1) Determination of the pH of water/ Effluent/ soil using a pH meter 2) Determination of the conductance of water/Effluent 3) Estimation of Organic content of soil by Diphenylamine method 4) Estimation of lead by the EDTA method 5) Estimation of copper by the Isoamyl alcohol method 6) Determination of salinity / chlorides in water by Silver nitrate method 7) Determination of the Chemical Oxygen Demand of water/ Effluent by the Potassium Dichromate method 8) Determination of potability of water by conducting a coliform count	

SEMESTER V		
Course Code	**Title**	**Credits**
RUSBCH503	**Advanced Genetics & RDT**	**3**
Unit I DNA Replication & Repair		
1.1.1 1.1.2 1.1.3 1.1.4 1.1.5 1.1.6 1.2	Replication of DNA (in prokaryotes) Models of DNA replication: Semi-conservative, Dispersive & Conservative Modes of DNA replication: Theta & rolling circle Enzymes (pol I, II and III) and accessory proteins Mechanism of semi-conservative replication (Initiation, elongation & termination) DNA Mutations, mutagens DNA repair: Direct, Photoreactivation,O6 methyl guanine DNA methyl transferase, Excision repair, Mismatch repair, Recombination repair, SOS-error prone repair	15 Lectures
Unit II Transcription		
2.1 2.1.1 2.1.2 2.2 2.3 2.4 2.5	Transcription in prokaryotes Prokaryotic RNA polymerase and promoter; Transcription unit, Upstream regulatory sequences, Mechanism of RNA transcription: Initiation, elongation and termination (Type I & II) 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	15 Lectures
Unit III Translation		
3.1 3.1.1 3.2 3.3 3.4	Translation (protein biosynthesis) in prokaryotes Genetic code, mechanism of translation: Activation of amino acids, chain initiation, elongation & termination Signal hypothesis Post translational modifications of proteins (proteolytic cleavage, acylation, phosphorylation, methylation, glycosylation), Protein targeting Inhibitors of translation	15 Lectures
Unit IV Recombinant DNA Technology (RDT)		
4.1 4.2 4.3 4.4 4.5 4.6 4.7	Introduction of RDT 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: Transfection, Electroporation, Microinjection, Liposome, Microprojectile (in brief) Selection and screening- Antibiotic and colony hybridization DNA Amplification by PCR	15 Lectures

	PRACTICALS	
RUSBCHP503	Practicals based on course in theory –RUSBCH503	**2**
	1) Estimation of glucose by the Folin-Wu method 2) Estimation of glucose by the GOD-POD method 3) Estimation of Calcium by the Erichrome Black T- EDTA method 4) Estimation of Magnesium by the Erichrome Black T- EDTA method 5) Estimation of phosphorus by Fiske Subbarow method 6) Estimation of DNA by the Diphenylamine method 7) Isolation and spooling of DNA from onion/moong 8) Estimation of UV absorption of nucleic acids& proteins	

SEMESTER V		
Course Code	**Title**	**Credits**
RUSBCH504	**Immunology & Pathophysiology - I**	**3**
Unit I Human immune system		
1.1	Types of Immunity	15 Lectures
1.1.1	Innate immunity – Anatomical barriers, physiological barriers,	
1.1.2	Characteristics of Inflammation, phagocytosis [no mechanism]	
1.1.3	Adaptive immunity – Active & Passive	
1.1.4	Humoral& Cell mediated immunity	
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	Cells of the immune system:	
1.3.1	Lymphocytes – B cells and T cells, Natural killer cells – Mononuclear phagocytes, Granulocytes, Antigen presenting cells.	
1.3.2	Clonal selection & immunologic memory.	
1.3.3	Cytokines: biological functions of IL1, tumor necrosis factor alpha, interferon – alpha, IL2, interferon-gamma.	
Unit II Antigen- Antibody		
2.1	Antigens: Antigenecity, immunogenecity, epitope, factors determining immunogenecity, Haptens, adjuvants.	15 Lectures
2.2	Antibodies: Fine structure of immunoglobulin, Antibody mediated functions, Antibody classes, Monoclonal antibodies.	
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 Antigen- Antibody interactions & Complement system		
3.1	Antigen- Antibody interactions	15 Lectures
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 Tumour immunology & Apoptosis		
4.1	Physiology of Tumourous cells	15 Lectures
4.2	Carcinogens: Types (Physical, Chemical and Biological); Environmental Factor.	
4.3	Role of p53, oncogenes and Tumour suppressor genes	
4.3.1	Conversion of proto-oncogenes to oncogenes	
4.4	Cancer therapy (Chemo – purine, pyrimidine and folate analogs)	
4.5	Apoptosis –	
4.5.1	Properties of apoptotic cells	
4.5.2	Role of caspases in apoptosis	

4.5.3	Mechanism (Intrinsic & Extrinsic pathway)	
	PRACTICALS	
RUSBCHP504	Practicals based on course in theory –RUSBCH504	**2**
	1) Isolation of starch from potato 2) Estimation of percentage purity of starch hydrolysate by Willstatter's method 3) Extraction of lipid from oil seeds by the Cold Percolation Method 4) Determination of Blood groups 5) Determination of the Haemoglobin content by the Sahli'shaemoglobinometer 6) Making of pH paper using anthocyanin extracted from vegetables 7) Use of anthocyanin as pH indicator	

SEMESTER VI		
Course Code	**Title**	**Credits**
RUSBCH601	**Metabolism & Analytical Techniques - II**	**3**
Unit I Lipid metabolism		
1.1	Lipid metabolism	15 Lectures
1.1.1	Catabolism - Knoop's experiment; Beta oxidation of even carbon saturated fatty acids (C4 to C20) Energetics of fatty acid oxidation	
1.2	Anabolism – Fatty acid biosynthesis (palmitic acid), Ketone body formation, utilization, and the physiological significance of Ketone bodies in Diabetes mellitus, Starvation, Pregnancy and Alcoholism	
1.3	Metabolism of Cholesterol: Catabolism, Anabolism & Transport	
Unit II Nucleic Acid Metabolism & Integration of Metabolism		
2.1	Metabolism of Purine and pyrimidine	15 Lectures
2.1.1	Biosynthesis and degradation	
2.1.2	Salvage pathway	
2.1.3	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 starvation - Liver, Adipose tissues, Skeletal muscle, Brain	
Unit III Centrifugation & Protein Purification techniques		
3.1	Centrifugation	15 Lectures
3.1.1	RCF, RPM and derivation of an equation relating the two; Nomogram; Sedimentation coefficient	
3.1.2	Types and applications of centrifuges – Clinical, High speed, Ultra centrifuge - preparative and analytical.	
3.1.3	Types of centrifugation and its applications– Differential, Rate zonal, Isopycnic (Centrifugation with and without density gradients)	
3.2	Protein purification techniques	
3.2.1	Methods of Cell rupture – solid shear, liquid shear, high pressure, ultrasound, osmotic shock, chemical treatment (enzyme, organic solvent), temperature, Cell bomb, homogenizer, Beads method	
3.2.2	Protein isolation (Selection of source, methods, stabilization, assay)	
3.2.3	Factors affecting protein solubility – Salt Concentration, organic solvents, pH, crystallization	
3.2.4	Molecular filtration of proteins	
Unit IV Electrophoresis		
4.1	Basic principle of electrophoresis, factors affecting rate of electrophoresis, concept of electro-osmotic flow	15 Lectures
4.2	Support Media used in electrophoresis- Agarose, polyacrylamide, Cellulose acetate	
4.3	Electrophoresis of proteins – Concept of discontinuous buffer system, SDS PAGE, Native PAGE, Gradient gel, Isoelectric focusing of gel, 2D gel	
4.4	Detection of protein in gel- CBB, Silver staining, Zinc staining Electrophoresis of Nucleic acid (DNA & RNA) -AGE, PFGE	
4.5	Detection of Nucleic acid in gel- Ethidium bromide, syber green	

	PRACTICALS	
RUSBCHP601	Practicals based on course in theory –RUSBCH601	**2**
	1) Separation of amino acids by circular paper chromatography 2) Determination of the optimum pH of Urease 3) Determination of Km of Urease 4) Determination of the optimum pH of pectinesterase 5) Determination of Km of pectinesterase 6) Estimation of lactose by Cole's ferricyanide method 7) Estimation of Glucose Iodometrically 8) Separation of plant pigments/Oils by Thin Layer Chromatography	

SEMESTER VI		
Course Code	**Title**	**Credits**
RUSBCH602	**Nutrition & Pharmacology**	**3**
Unit I Nutrition & Diet Management		
1.1	Principles of nutrition	15 Lectures
1.1.1	Nutrients [Proximate principles, vitamins and minerals (macro and micro- role of Ca, Mg, Na, K and Fe, Zn)], Dietary fibre.	
1.1.2	Nutritional status [malnutrition (protein energy and protein calorie) and over	
1.2	nutrition]	
1.3	Energy Assessment - RQ, BMR	
1.4.1	Anthropometry – BMI, Waist:hip ratio	
1.4.2	Diet Management	
	Dietary Management in :- Obesity, Starvation, Diabetes Mellitus, Hypertension, Peptic ulcer , Obstructive Jaundice	
Unit II Vitamins and Coenzymes & their deficiency disorders		
2.1	Water soluble vitamins (Chemistry of the vitamin & its coenzyme form, Biochemical role and disorders) –Thiamin, Riboflavin, Niacin, Pyridoxine, Biotin, Lipoic acid:- Chemistry of the Vitamin and its coenzyme form [structure not to be done, only group involved in its activity]	15 Lectures
2.2	Fat soluble vitamins A, D, E, K (Chemistry of the vitamin & its coenzyme form, Biochemical role and disorders) –	
2.2.1	Vitamin A – Chemistry, Wald's Visual cycle and role of Rhodopsin (with structure), Transducin, cGMP in vision; Deficiency disorders (Night Blindness, Xerosis Conjunctiva, Xerosis Cornea, Bitot's Spots, Keratomalacia, Follicullar Hyperkeratosis)	
2.2.2	Vitamin D – role in Ca absorption and mobilization, Deficiency disorders (Rickets, Osteomalacia);	
2.2.3	Vit E and Vit K– physiological role (Vitamins D, E, K no structures)	
Unit III Pharmacokinetics and Bioassay		
3.1.1	Pharmacodynamics, Physicochemical properties of drugs,	15 Lectures
3.1.2	Drug absorption: through-GIT, pulmonary, renal, placental and blood-brain barrier	
3.1.3	Bioavailability and Bioequivalence	
3.1.4	Drug Distribution, Metabolism and Excretion	
3.2	Bioassays : Preclinical and clinical evaluation, Therapeutic drug monitoring	
Unit IV Therapeutic drugs & Drugs acting on Haemopoietic System		
4.1	Therapeutic drugs: (Mechanism of action and adverse effects)	15 Lectures
4.1.1	Anti inflammatory – non steroid anti inflammatory NSAID [Ibuprofen], Salicylates – [Aspirins]	
4.1.2	Cardiovascular drugs- CVS [Ca channel blocker-Amlodipine, and Beta blocker – Proprenolol]	
4.1.3	Antibiotic – Penicillin and Sulphonamide	
4.1.4	Antacid- Proton pump blocker –Omeprazole	
4.2	Drugs acting on Haemopoietic System	
4.2.1	Metabolism of iron	
4.2.2	Iron therapy: Oral Iron preparations, Parental Iron preparations, Toxicity of Iron: DesferrioxamineMesylate	
4.2.3	Folic Acid (Pteroylglutamic acid) : Mode of Action, Therapeutic Uses	
4.2.4	Vitamin B12 (Cyanocobalamin): Mode of Action, Therapeutic Uses	
4.2.5	Hydroxycobalamin	
4.2.6	Erythropoietin	

4.2.7 4.2.8	Colony Stimulating Factors: Filigrastim, Lenograstim, Molgramostim Anti-coagulants – Mechanism of Haemostasis Intravenous anticoagulants – Heparin Oral anticoagulants – Coumarin derivatives & Indanedione derivatives	
	PRACTICALS	
RUSBCHP602	Practicals based on course in theory –RUSBCH602	**2**
	1) Estimation of Fluoride in water by the Alizarin Red method 2) Determination of the Dissolved Oxygen content of water/ Effluent by the Winkler's Iodometric method 3) Determination of the Biological Oxygen Demand of water/ Effluent 4) Determination of the Alkalinity of water/ Effluent 5) Determination of the Acidity of water/ Effluent 6) Estimation of $CaCO_3$ of soil by Bromothymol Blue Method 7) Demonstration of Sohxlet method	

SEMESTER VI		
Course Code	**Title**	**Credits**
RUSBCH603	**Biostatistics & Bioinformatics**	**3**
Unit I Biostatistics & Descriptive Statistics		
1.1 1.2 1.3 1.4	Introduction: scope and applications of biostatistics Common statistical terms: Sources, nature and presentation of data; Measurement and scales of measurement Descriptive statistics: Measures of central tendency- Mean, Median and mode Measures of dispersion- Range, percentiles, variance, SD, Mean deviation,	15 Lectures
Unit II Probability, Normal Distribution & Bioinformatics		
2.1 2.1.1 2.1.2 2.1.3 2.2 2.2.1 2.2.2 2.2.3 2.2.4 2.2.5 2.2.6	Probability Concept of probability: definition Normal distribution and normal curve, Asymmetric distribution Statistical problems based on the above concepts Bioinformatics: Introduction Applications of Bioinformatics in – Sequence analysis, Molecular modeling and drug designing, Phylogeny/evolution, Ecology & population studies, Medical informatics and agriculture. Introduction to Genomics and Proteomics Databases- Definition & types – Public domain database, Sequence database, Structural database, Motif database, Genome database, Proteome database, Annotated sequence database. Full form & function in brief of - GenBank, EMBL, PIR, SWISS PROT, PDB, GDB. Sequence analysis Tools - Explain the following terms in brief - BLAST, FASTA, L-ALIGN, CLUSTAL- X & W, RASMOL, Micro-array analysis-concept and applications	15 Lectures
Unit III Hypothesis Testing of Means & ANOVA		
3.1 3.2 3.3 3.4 3.5	Introduction – Hypothesis, Type I and Type II errors, One-tailed and two tailed tests, Hypothesis testing of mean - Z-test, t-test Standard error ANOVA Statistical problems based on the above concepts	15 Lectures
Unit IV Hypothesis Testing of Difference Between Means & Chi-Square Test		
4.1 4.2 4.3	Hypothesis testing of difference between population means - Z-test, t-test (Paired and unpaired) Chi-square (Test of population variance, Test of goodness of fit, Test of association), 2 x 2 Table, Yates' correction Statistical problems based on the above concepts	15 Lectures

	PRACTICALS	
RUSBCHP603	Practicals based on course in theory –RUSBCH603	**2**
	1) Estimation of proteins by the Folin-Lowry method 2) Estimation of Iron by Wong's method 3) Study of Monograph of Acetyl Salicylate 4) Study of Monograph of Sucrose 5) Biostatistics – Problems 6) Isolation of RNA from Yeast/ Liver 7) Estimation of RNA by the Orcinol method	

SEMESTER VI		
Course Code	**Title**	**Credits**
RUSBCH604	**Immunology & Pathophysiology - II**	**3**
Unit I Metabolic disorders		
1.1	Metabolic disorder	15 Lectures
1.1.1	Inborn error: With respect to Etiology and Clinical manifestations	
1.2	Carbohydrate Metabolism: Glycogen storage diseases, Wernicke-Korsakoff syndrome, Classical galactosemia, essential fructosuria, hereditary fructose intolerance, Lactose intolerance	
1.3	Protein Metabolism: Albinism, Metabolic disorders of urea cycle	
1.4	Lipid Metabolism: TaySach's disease, Niemann-Pick disease, Wolman disease	
1.5	Nucleic acid Metabolism: Purine metabolism disorders (Gout and its types, Lesch-Nyhan syndrome), Pyrimidine metabolism disorders (Orotic aciduria, Reye's syndrome)	
Unit II TCR, MHC &Transplant Immunology		
2.1	T-cell Receptor, Structure & function of αβ and γδ	15 Lectures
2.1.1	Organization & rearrangement of TCR genes	
2.1.2	TCR complex (TCR-CD_3)	
2.1.3	T-cell accessory membrane molecules	
2.2	Major histocompatibility complex	
2.2.1	MHC polymorphism & organization of MHC genes- class I & class II; Cellular distribution & structure of class I & II molecules; Self MHC restriction of T cells.	
2.3	Role of antigen presenting cells.	
2.4	Transplant immunology:	
2.4.1	Types of transplant; immunological basis of allograft rejection.	
2.4.2	Autoimmunity: Organ specific –Myasthenia gravis; Hashimotos thyroiditis; Graves'	
2.4.3	Disease; Systemic – Rheumatoid arthritis, Systemic lupus erythematosus (immunological basis of these autoimmune diseases)	
Unit III Virology & AIDS		
3.1	Introduction to virology & General Structure of Virus	15 Lectures
3.1.1	Immune responses against viral infections and immune evasion mechanisms by viruses	
3.2	Structure and mechanism of replication in: 1. Vaccinia 2. Polio 3. Influenza 4. Hepatitis	
3.3	AIDS:	
3.3.1	Structure and genetics basis of AIDS virus.	
3.3.2	Replication of AIDS Virus.	
3.3.3	Diagnosis, Symptoms and Causes of AIDS.	
3.3.4	AIDS Therapy.	
Unit IV Ageing, Alzheimer's & Vaccines		
4.1	Ageing: Definition of ageing. Molecular changes during ageing. Theories of Ageing.	15 Lectures
4.2	Alzheimer's disease – Disease mechanism, characteristics, cause, diagnosis and management	
4.3	Vaccines	
4.3.1	Active & Passive immunization,	

4.3.2	Types of vaccine – 1. Live, attenuated vaccine; 2. Subunit vaccine – Toxoids (Antivenins), Triple antigen (DTP), Bacterial polysaccharide capsules, outer membrane proteins, viral glycoproteins, pathogen proteins, synthetic peptides (multivalent subunit vaccines) as vaccines 3. Conjugate vaccine; Anti-idiotype vaccines; 4. DNA vaccines; Recombinant vector vaccines	
	PRACTICALS	
RUSBCHP604	Practicals based on course in theory –RUSBCH604	**2**
	1) Isolation of Casein from milk 2) Diagnostic test for Typhoid-Widal Qualitative 3) Diagnostic test for Typhoid-Widal Quantitative 4) Immunoprecipitation reaction of Antigen and antibody 5) Separation of serum proteins by PAGE 6) Detection of Proteins by Silver Staining Method 7) Agarose gel electrophoresis- Chromosomal DNA and Plasmid DNA	

References:

1) Lehninger's- Principles of Biochemistry by David L. Nelson
2) Harper's Illustrated Biochemistry by Robert K. Murray
3) Biochemistry by Donald Voet
4) Biochemistry by Jeremy M. Berg
5) Biochemistry (2 Volume Set): The Chemical Reactions of Living Cells by David E. Metzler
6) Modern Experimental Biochemistry by Rodney F. Boyer
7) Basic Concepts in Biochemistry: A Student's Survival Guide by Hiram F. Gilbert
8) Analytical Biochemistry by David Holme
9) International Biochem by StryerTymoczko Berg
10) Biophysical Chemistry Upadhyay
11) Biochemistry by Dr. A.C. Deb
12) Essentials of Pharmacotherapeutics by FSK Brara
13) Textbook of Medical Biochemistry by M.N. Chatterjea&Ranashinde
14) Immunology by Goldsby and Kuby
15) iGenetics by Russel
16) Gene Biotechnology by Jogdand
17) Biostatistics by Arora
18) Methods of biostatistics for medical students and research workers by Mahajan, B.K.; Jaypeebrothers publishers.
19) General Principles of Biochemical Investigation by William & Wilson
20) Environmental Chemistry by A.K.De
21) Biotechnology by U.Satyanarayana
22) Advance in Biotechnology by Jogdand
23) Biochemical Calculation by Segel
24) Biochemical Methods by Sadashivam
25) Introductory Practical Biochemistry by Sawhney
26) Practical Biochemistry by David Plummer
27) Bioinformatics- Concepts, Skill and applications by Rastogi, S.C.; Mendiratta, Namita and Rastogi, Parag; C.B.S. Publishers & Distributors
28) Genes VIII by Lewin, Benjamin; Pearson Prentice and Hall publishers
29) Human nutrition and dietetics by Davidson, S. etal.; Churchill Livingstone Publishers.
30) Nutrition and dietetics by Joshi, Shubhangini A.; Tata McGraw and Hill publishers
31) Nutrition Science by Srilakshmi, B.; New Age International publishers
32) Introductory practical biochemistry by Sawhney, S.K. and Singh, Randhir; Narosa Publishing House
33) Biochemical calculation by Segel, Irwin H.; John Wiley & Sons publishers
34) Text book of Medical physiology by Guyton, Arthur C. and Hall, John E.; Harcourt Brace & Company Asia 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 / subjective)	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 – V

Course	RUSBCH501			RUSBCH502			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	RUSBCH503			RUSBCH504			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 – VI

Course	RUSBCH601			RUSBCH602			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	RUSBCH603			RUSBCH604			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	**200**
Practicals	20	30	50	20	30	50	**100**