

**S.P.Mandali's  
Ramnarain Ruia Autonomous College**



**Syllabus for *F. Y. B.Sc***

**Program: *B.Sc.***

**Course: *Biochemistry (RUSBCH)***

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

## Semester I

Course Code	Unit	Topics	Credits	Lectures
<b>Paper I - Biomolecules and Nutrition</b>				
RUSBCH101	I	Water and Biochemistry of minerals	2	15
	II	Nucleic acids		15
	III	Carbohydrates		15
<b>Paper II - Cell biology, Physiology and Microbiology</b>				
RUSBCH102	I	The cell	2	15
	II	Nucleus and cell cycle		15
	III	Microscopy		15
RUSBCHP101	Practicals based on course in theory - RUSBCH101		2	
RUSBCHP102	Practicals based on course in theory - RUSBCH102			

## Semester II

Course Code	Unit	Topics	Credits	Lectures
<b>Paper I - Biomolecules and Nutrition</b>				
RUSBCH201	I	Lipids	2	15
	II	Amino acids and proteins		15
	III	Nutrition		15
<b>Paper II – Introduction to cell biology, Physiology and Microbiology</b>				
RUSBCH202	I	Physiology of digestion and absorption	2	15
	II	Physiology of respiration and excretion		15
	III	Microbiology		15
RUSBCHP201	Practicals based on course in theory – RUSBCH201		2	
RUSBCHP202	Practicals based on course in theory – RUSBCH202			

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

### Learning Objectives:

The overall goal of this FYBSc course is for the student to gain a basic working knowledge of biochemical concepts and techniques which will be necessary for future scientific endeavors.

### Learning Outcomes:

Upon completion of the FYBSc course, the students are able to understand the following:

- 1) The basic scientific terms in the field of Biochemistry.
- 2) Enumeration of the biochemical functions of water, acids, bases & buffers.
- 3) The chemistry & structures of biomolecules (Carbohydrates, Proteins and Lipids), their classification and functions in living organism, structure-function relationship of biomolecules with their importance at molecular level. As these basic concepts form the basis for understanding metabolic fate of different biomolecules at the TYBSc level.
- 4) The Concept of the origin of life, basic cell structure and functions of cell organelles which is important for cytogenetics study and techniques associated with it.
- 5) An introduction to Microscopy which is included in the first semester of FYBSc. They will gain expertise to handle the microscope, helping them with the various microbial staining techniques which are a part of their practicals as well. This will also help them to understand the basics of microbiology included in the second semester.
- 6) The nucleic acids topic will lay the foundation to introduce them to the field of genetics.
- 7) Knowledge of physiological processes (Digestion, Absorption, Excretion etc.) and nutrition will enable them to understand metabolic and nutritional needs of the body which forms the basis of clinical and nutritional biochemistry.
- 8) All the practicals have been rearranged in accordance with the theory papers at each semester.
- 9) Students will learn to examine, assess, interpret and communicate data acquired performing laboratory experiments related to biochemistry.

## Detailed Syllabus

SEMESTER I		
Course Code	Title	Credits
<b>RUSBCH101</b>	<b>Biomolecules and Nutrition</b>	<b>02</b>
<b>Unit I</b>	<b>Water and Biochemistry of minerals</b>	<b>15 lectures</b>
1.1	Water	
1.1.1	Water, its structure and biological significance,	
1.1.2	Hydrogen bonding and its importance, Water as a universal solvent.	
1.2	Effect of water on Biomolecules	
1.2.1	Entropy and dissolution of solute	
1.2.2	Polar and non-polar compounds	
1.3	Weak interactions of biomolecules in aqueous solutions	
1.4	Ionization of water, weak acids and weak bases	
1.5	Biochemistry of minerals	
1.5.1	General functions, classification	
1.5.2	Mechanism of absorption and functions of – Calcium, Phosphorus, Magnesium, Sodium, Potassium, Iron, Iodine, Selenium	
<b>Unit II</b>	<b>Nucleic Acids</b>	<b>15 lectures</b>
2.1	Structure - Purine & Pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides (ATP, CTP, GTP, TTP, UTP) Formation of polynucleotide strand with its shorthand Representation	
2.2	RNAs (various types in prokaryotes and eukaryotes) mRNA, hnRNA, rRNA, snRNA & snoRNA - general account, tRNA - clover leaf model, Ribozymes	
2.3	DNA	
2.3.1	Physical evidence of DNA helical structure. Chargaff's rules (chemical evidence), Watson-Crick model of DNA & its features	
2.3.2	Physical properties of DNA - Effect of heat on physical properties of DNA (Viscosity, buoyant density, UV absorption), Hypochromism, hyperchromism, denaturation of DNA.	
2.3.3	Reactions of nucleic acids (with DPA and Orcinol)	
2.4	Central Dogma of Life (Definitions: Replication, Transcription, Translation & Reverse Transcription )	
<b>Unit III</b>	<b>Carbohydrates</b>	<b>15 lectures</b>
3.1	Definition, Classification, and functions of carbohydrates (mono, oligo,	
3.2	polysaccharides)	
3.2.1	Monosaccharides	
3.2.2	Classification in terms of aldoses and ketoses	
3.2.3	Structures and significance of glucose, fructose, galactose, mannose, and ribose	
	Properties:	
	a) Physical- isomerism D & L, optical; optical ; epimers: anomers	
	b) Chemical reactions –	

3.3	i. oxidation to produce aldonic. Aldaric and uronic acids (with respect to glucose);	
3.3.1	ii. reducing action in boiling alkali, enediol formation (with respect to glucose and fructose)	
3.3.2	iii. osazone formation (with respect to glucose and fructose)	
3.4	iv. orcinol (with respect to ribose)	
3.4.1	Disaccharides	
	Occurrence and structure of maltose, lactose and sucrose	
	Formation of glycosidic bonds	
	Polysaccharides	
	Classification based on function, storage and structure	
	a) Composition: homo & hetero. with examples	
	b) Storage: starch and glycogen - action of amylase on starch	
	c) Structural: cellulose, Chitin	
<b>PRACTICALS</b>		
<b>RUSBCHP101</b>	<b>PRACTICAL I</b>	<b>Credits 01</b>
	<ol style="list-style-type: none"> <li>1) Preparation &amp; Standardization of laboratory reagents</li> <li>2) pH meter – working of a pH meter</li> <li>3) Qualitative tests for carbohydrates – <ol style="list-style-type: none"> <li>a) Monosaccharides - glucose &amp; fructose</li> <li>b) Disaccharides - lactose, maltose, sucrose</li> <li>c) Polysaccharides - starch, dextrin</li> </ol> </li> <li>4) Qualitative tests to detect the unknown carbohydrates from the given solution</li> <li>5) Qualitative test for nucleic acids</li> </ol>	

<b>SEMESTER I</b>		
<b>Course Code</b>	<b>Title</b>	<b>Credits</b>
<b>RUSBCH102</b>	<b>Cell biology, Physiology and Microbiology</b>	<b>02</b>
<b>Unit I</b>	<b>The Cell</b>	<b>15 lectures</b>
1.1	Structural organization of cell	
1.1.1	Prokaryotic, eukaryotic and yeast cells – A comparative overview Cell wall structure (plant), cell membrane (fluid mosaic model)	
1.2	Cytoskeleton : microtubules & microfilaments	
1.3	Cell organelles:	
1.3.1	Mitochondrion: Organization & function of the mitochondria, mitochondrial genome	
1.3.2	Chloroplast: Structure & function of the chloroplast, the chloroplast genome, other plastids	
1.3.3	Ribosome, ER, Golgi apparatus: Structure & Function of Ribosome, ER, Golgi apparatus,	
1.3.4	Peroxisome & Lysosome: Peroxisome function & assembly (in brief) and Lysosome structure & function	
<b>Unit II</b>	<b>Nucleus and cell cycle</b>	<b>15 lectures</b>
2.1	Nucleus: Structure & Function of the nucleus,	
2.1.1	Nuclear envelope – Nuclear membranes, perinuclear space, nuclear pores, annulus, central granule, fibrous laminae. Functions of nuclear envelop	
2.1.2	Nucleolus – Structure, types and its functions	
2.3	Mitosis - Phases of mitosis, Cytokinesis	
2.3.1	Significance of mitosis	
2.3.2	Breakdown of nuclear envelope	
2.3.3	The spindle, Kinetochore	
2.3.4	Anaphasic movements	
2.4	Meiosis ( Types – zygotic, gametic and sporic)	
2.4.1	Phases of meiosis	
2.5	Cell cycle and its regulation (cyclins & CDKs)	
<b>Unit III</b>	<b>Microscopy</b>	<b>15 lectures</b>
3.1	Introduction and basic concept of Magnification, Resolving power, Numerical aperture, Limit of resolution, refractive index and role and RI of oil	
3.2	Parts and functions of Compound microscope	
3.3	Light microscope- Bright Field, Dark field, Phase contrast, Fluorescence microscopy( Immunofluorescence and FISH), Confocal Microscopy	
3.4	Electron Microscopy- SEM,TEM	
3.5	Electron tomography	
3.6	Integrated Microscopy (only principle)	
	<b>PRACTICALS</b>	
<b>RUSBCHP102</b>	<b>PRACTICAL II</b>	<b>Credits 01</b>
	1) Parts and maintenance of a Microscope	

	<ol style="list-style-type: none"><li>2) Gram Staining</li><li>3) A study of electron micrographs of cell organelles</li><li>4) Permanent Slides of Bacilli, Spirilla, cocci, Rhizopus</li><li>5) Nucleic acid Staining</li><li>6) Effect of hypo, hyper, isotonic solutions on cells of onion peel</li><li>7) Permanent slides of Mitosis and Meiosis</li><li>8) Qualitative Analysis of Minerals -Sodium, Potassium, Phosphorus, Iron, Chloride, Nitrate</li></ol>	
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SEMESTER II		
Course Code	Title	Credits
RUSBCH201	Biomolecules and Nutrition	02
<b>Unit I</b>	<b>Lipids</b>	<b>15 lectures</b>
1.1	Definition, classification (Bloor's) and functions of Lipids	
1.2	Fatty acids and Triacylglycerol	
1.2.1	Classification & Chemistry, Saturated fatty acids - classification of C2 to C20: even carbon: Common and IUPAC names. Unsaturated fatty acids MUFA, PUFA (2,3,4 double bonds) Omega - 3,6,9 fatty acids. Triacyl glycerol - simple and mixed - names and structure	
1.2.2	Chemical Reactions of fats Saponification, Iodination, Ozonolysis, Auto-oxidation, Action of heat on glycerol and choline, Rancidity Definition & significance - Acid number, Saponification number, Iodine number, Reichert - Meissel number	
1.3	Compound Lipids Functions of glycerophospholipids (PE, PC, PL) Phosphosphingolipids (ceramide, sphingomyelin), Glycolipids /Cerebrosides (gluco&galactocerebrosides )	
1.4	Steroids Cholesterol structure and biochemical significance	
<b>Unit II</b>	<b>Amino acids and proteins</b>	<b>15 lectures</b>
2.1	Amino acids	
2.1.1	Amino acid structure- D & L forms of all 20 amino acids	
2.1.2	Detailed classification based on polarity: essential & non-essential amino acids, Zwitter ion, pI of amino acids, amino acids as ampholytes	
2.1.3	Physical and chemical properties- Chemical reactions of amino acids with Ninhydrin, Sanger's reagent, Edman's reagent and Dansyl chloride. Functions of amino acids (in brief).	
2.2	Peptides and Proteins	
2.2.1	ASBC- APS classification on the basis of shape, function and physical properties & solubilities (Simple, conjugated & derived proteins). Nutritional classification (Complete & incomplete proteins)	
2.2.2	Properties of proteins. Primary structure -Formation and characterization of the peptide bond	
2.2.3	Secondary structure -Alpha helix and beta sheet	
2.2.4	Tertiary and Quaternary structures- an introduction with one example of each	
2.2.5	Protein denaturation	
<b>Unit III</b>	<b>Nutrition</b>	<b>15 lectures</b>
3.1	Nutrition & Energy Supply - Calorie, Joule, Respiratory Quotient	
3.2	Food calorimetry - calorific value determination by Bomb calorimeter, calorific values of proximate principles,	
3.3	Utilization of energy in man - BMR (Definition, factors affecting BMR, Significance of BMR in clinical diagnosis), SDA/DIT -General concept and significance, Energy requirement of individuals for various activities-	



3.4	sedentary, moderate and heavy	
3.5	Nutritional importance of Carbohydrates, Proteins, Lipids and Fiber	
3.6	Assessment of nutritive value of proteins - Chemical score of amino acids, Protein Deficiency Corrected Amino Acid Score, BV, PER, NPU	
3.7	Concept of BMI, RDA	
3.8	Balanced diet	
3.9	Nutritional disorders	
	Numerical problems based on above concepts	
<b>PRACTICALS</b>		
<b>RUSBCHP201</b>	<b>PRACTICAL I</b>	<b>Credits 01</b>
	<ol style="list-style-type: none"> <li>1) Quantitative estimation of normality of FAS</li> <li>2) Qualitative tests for amino acids</li> <li>3) Qualitative tests for proteins</li> <li>4) Tests to detect unknown proteins</li> <li>5) Qualitative tests for lipids</li> <li>6) Estimation of Saponification value</li> <li>7) Estimation of Acid value</li> <li>8) Estimation of vitamin C by dye method</li> <li>9) Demonstration of Analytical balance</li> </ol>	

<b>SEMESTER II</b>		
<b>Course Code</b>	<b>Title</b>	<b>Credits</b>
<b>RUSBCH202</b>	<b>Introduction to Cell biology, Physiology and Microbiology</b>	<b>02</b>
<b>Unit I</b>	<b>Physiology of digestion and absorption</b>	<b>15 lectures</b>
1.1	Parts and Functions of gastro intestinal tract (GIT)	
1.2	Organs and Glands associated with GIT Secretions and Juices of GIT (Saliva, Gastric juice, Intestinal juice, pancreatic and Bile juice)	
1.3	Digestion and Mechanism of Absorption of carbohydrates	
1.4	Digestion and Mechanism of Absorption of Lipids	
1.5	Digestion and Mechanism Absorption of Proteins	
1.6	Disorders - Peptic ulcer, Lactose Intolerance, Celiac disease, Pancreatitis	
<b>Unit II</b>	<b>Physiology of respiration and excretion</b>	<b>15 lectures</b>
2.1	Respiratory system,	
2.2	Breathing - inspiration and expiration,	
2.3	Composition of air and partial pressure of gases	
2.4	Physical exchange of gases	
2.4.1	Transport of oxygen	
2.4.2	Transport of carbon dioxide	
2.5	Respiratory disorders – Asthma, pharyngitis, laryngitis, hay fever, pneumonia, occupational lung disease (silicosis & asbestosis), cyanosis, respiratory acidosis and alkalosis	
2.6	Excretion	
2.6.1	Structure of the nephron: Bowman’s capsule & glomerulus - Structure & function, (ultrafiltration, pressures involved, GFR, regulation of GFR); Renal tubule - structure & function (proximal and distal convoluted tubules and Henle's loop)	
2.6.2	Urine formation: Reabsorption / Secretion of glucose, Na <sup>+</sup> , K <sup>+</sup> . HCO <sub>3</sub> <sup>-</sup> Cl <sup>-</sup> and H <sup>+</sup> : renal threshold,	
2.6.3	Normal & Abnormal constituents of urine, Excretory disorder: Nephritis	
<b>Unit III</b>	<b>Microbiology</b>	<b>15 lectures</b>
3.1	Historical background (contributions or Leeuwenhoek. Pasteur ,etc ) and General characteristics (size .shape. and structure) of Bacteria	
3.2	Microbial Taxonomy: Microbial species and strains. Classification of bacteria based on morphology (shape and flagella). staining reaction, nutrition and extreme environment (extremophiles: Thermophiles, Psychrophiles, Halophiles, Magnetotactic, Radiation resistant organisms: examples with their application)	
3.3	Bacterial cell wall: Structure and function, components of peptidoglycan framework (structure of NAG & NAMA not necessary)	
3.4	Staining methods (principles of staining & types or stains)and microscopic identification of bacteria	
3.5	Microbial Growth - Growth Curve, Mathematical expression, Synchronous growth, Generation time	
3.6	Culture media (N, C, Special requirements), Natural and Synthetic media	

	<b>PRACTICALS</b>	
<b>RUSBCHP202</b>	<b>PRACTICAL II</b>	<b>Credits 01</b>
	<ol style="list-style-type: none"> <li>1) Study of Human Digestive, Respiratory &amp; Excretory System with the help of diagrams</li> <li>2) Estimation of total acidity of gastric juice</li> <li>3) Urine analysis: Normal Constituents: Urea, Uric acid, Chloride Abnormal Constituents: Glucose, Protein</li> <li>4) Titrable acidity using Neutral red or Phenol red</li> <li>5) Qualitative tests for the detection of functional groups</li> <li>6) Capsule Staining</li> <li>7) Endospore Staining</li> <li>8) Lipid Staining</li> </ol>	

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## MODALITY OF ASSESSMENT

### Theory Examination Pattern:

#### A) Internal Assessment - 40% :40 marks.

Sr No	Evaluation type	Marks
1	One Assignment/poster presentation/Quiz	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 **04** questions each of **15** marks. On each unit there will be one question & last question will be based on all 3 units.
  2. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1)A)	Any 2 out of 3	04	Unit I
Q.1)B)	Any 2 out of 3 OR Any 4 out of 6	06	
Q.1)C)	Any 1 out of 2	05	
Q.2)A)	Any 2 out of 3	04	Unit II
Q.2)B)	Any 2 out of 3 OR Any 4 out of 6	06	
Q.2)C)	Any 1 out of 2	05	
Q.3)A)	Any 2 out of 3	04	Unit III
Q.3)B)	Any 2 out of 3 OR Any 4 out of 6	06	
Q.3)C)	Any 1 out of 2	05	
Q.4)A)	Any 1 out of 2	04	Unit I, II, III
Q.4)B)	Any 1 out of 2	04	
Q.4)C)	Any 1 out of 2	04	

Q.4)D)	Any 3 out of 5	03	
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**Practical Examination Pattern:**

**(A) Internal Examination:**

Heading	Practical I & II
Journal	05
Test	15
<b>Total</b>	<b>20</b>

**(B) External (Semester end practical examination):**

Particulars	Practical I & II
Laboratory work	25
Viva	5
<b>Total</b>	<b>30</b>

**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 & II**

Course	RUSBCH101			RUSBCH102			Grand Total
	Internal	External	Total	Internal	External	Total	
<b>Theory</b>	40	60	100	40	60	100	<b>200</b>
<b>Practicals</b>	20	30	50	20	30	50	<b>100</b>

Course	RUSBCH201			RUSBCH202			Grand Total
	Internal	External	Total	Internal	External	Total	
<b>Theory</b>	40	60	100	40	60	100	<b>200</b>
<b>Practicals</b>	20	30	50	20	30	50	<b>100</b>



Resolution No. AC/II(18-19).2.RUS2

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**Ramnarain Ruia Autonomous College**



**RUIA COLLEGE**

**Explore • Experience • Excel**

**Syllabus for S.Y.B.Sc.**

**Program: B.Sc.**

**Course: Biochemistry (RUSBCH)**

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

**Semester III**

Course Code	Unit	Topics	Credits	Lectures
<b>Paper I – Enzymology, Physiology &amp; Tools of Biochemistry</b>				
RUSBCH301	I	Enzymes and coenzymes	2	15
	II	Plant Biochemistry		15
	III	Acids, Bases, Buffers and Ionic Equilibria & pH meter		15
<b>Paper II - Fundamentals of Genetics and Physiology</b>				
RUSBCH302	I	Genetics : I	2	15
	II	Genetics : II		15
	III	Transport mechanisms and haematopoesis		15
<b>Paper III -Industrial Biotechnology &amp; Pharmacology</b>				
RUSBCH303	I	Sterilization & Disinfection Techniques and Cell culture	2	15
	II	Fermentation and Downstream processing		15
	III	Industrial Biotechnology		15
RUSBCHP301	Practicals based on the course in theory – RUSBCH301		3	
RUSBCHP302	Practicals based on the course in theory – RUSBCH302			
RUSBCHP303	Practicals based on the course in theory – RUSBCH303			

### Semester IV

Course Code	Unit	Topics	Credits	Lectures
<b>Paper I - Enzymology, Physiology &amp; Tools of Biochemistry</b>				
RUSBCH401	I	Physicochemical Principles	2	15
	II	Hormones		15
	III	Tools of Biochemistry		15
<b>Paper II - Fundamentals of Genetics and Physiology</b>				
RUSBCH402	I	Locomotion & Movement	2	15
	II	Neurophysiology		15
	III	Body Fluids		15
<b>Paper III - Industrial Biotechnology &amp; Pharmacology</b>				
RUSBCH403	I	Trends in Biotechnology	2	15
	II	Introduction to Pharmacology		15
	III	Pharmacodynamics and Adverse Drug Reactions (ADR)		15
RUSBCHP401	Practicals based on the course in theory – RUSBCH401		3	
RUSBCHP402	Practicals based on the course in theory – RUSBCH402			
RUSBCHP403	Practicals based on the course in theory – RUSBCH403 and Project work			

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

### **Learning Objectives:**

The overall goal of this SYBSc course is to introduce the student to the fields of enzymology, plant biochemistry, genetics, endocrinology, clinical biochemistry, industrial biotechnology, and pharmacology.

### **Learning Outcomes:**

Upon completion of the SYBSc course, the students would understand the following:

- 1) Enzymology which forms the core of Biochemistry. Enzyme immobilization to study a different aspect of enzyme kinetics.
- 2) Plant Biochemistry which will introduce the students to metabolism and enable them to study metabolism in plants.
- 3) Acids, Bases, Buffers and Ionic Equilibria & pH meter; hormones; membrane biochemistry and physicochemical principles which will help them to further understand the biochemical processes of the body.
- 4) Mendelian Genetics, variations over Mendelian Genetics, Genes and Chromosomes topics which will introduce them to the field of genetics.
- 5) Haematopoiesis and Body fluids topics to help them understand the basics of clinical biochemistry.
- 6) Concept of sterilization and disinfection, ATC, PTC & fermentation to enable them to understand the various microbial processes & techniques.
- 7) Tools of Biochemistry which includes basic instrumentation like Colorimetry, Spectrophotometry, Flame photometry, Fluorimetry and Flow Cytometry.

- 8) The applied aspects of Biochemistry through Biotechnology, Industrial Biosynthesis, Bioresources and their management.
- 9) General pharmacology, Pharmacodynamics and Adverse Drug Reactions (ADRs) will introduce the students to pharmacology.
- 10) All the practicals have been rearranged in accordance with the theory papers at each semester.
- 11) New experiments are added to cover the practical aspects of the newly added theoretical topics. E.g. colorimetric experiments like Glucose by DNSA method, Proteins by Biuret method and Demonstration of spectrophotometer.
- 12) Research project has been introduced in Semester IV Practical III to inculcate research culture in the students. This will familiarize them with Research methodology i.e. reference work, experimental work, analysis of experimental data, interpretation of results obtained, writing of project or work and compilation of bibliography in proper order.

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## Detailed Syllabus

<b>SEMESTER III</b>		
<b>Course Code</b>	<b>Title</b>	<b>Credits</b>
<b>RUSBCH301</b>	<b>Enzymology, Physiology &amp; Tools of Biochemistry</b>	<b>02</b>
<b>Unit I Enzymes and Coenzymes</b>		
1.1 1.2 1.3 1.4 1.5 1.6 1.7	Definition – Enzyme, Apoenzyme, Holoenzyme, Prosthetic group, Active site, Enzyme specificity, Turnover number, Specific activity, Katal, IU, Coenzyme and Cofactor IUB / EC classification upto one digit. Enzyme specificity : Fischer's, lock & key and Koshland's, induced fit theories Activation energy, Mechanism of Enzyme action (concept of active site, single and bi-substrate reaction), Factors affecting enzyme activity – substrate concentration, pH, temperature Enzyme Kinetics – Derivation of Michaelis - Menten equation and Lineweaver Burke plot for monosubstrate reactions and numerical problems based on them Enzyme inhibition – Reversible and Irreversible; Competitive and Non competitive, one example of each Problems on entire Unit	15 Lectures
<b>Unit II Plant Biochemistry</b>		
2.1 2.2 2.3	Plant Growth Substances- Structure and Function of- Auxins, Gibberellins, Cytokinins, Ethylene and Abscissic Acid Photosynthesis Light and dark reactions, Z scheme and electron carriers, photophosphorylation [linear and cyclic]; Photorespiration, Photoperiodism Calvin cycle – schematic with enzymes, C <sub>4</sub> and CAM pathway Secondary metabolites of plants – Nitrogen containing compounds (Alkaloids), Terpenes & Phenolic compounds – An introduction to Shikimic acid pathway, Mevalonic acid pathway, MEP Pathway	15 Lectures
<b>Unit III Acids, Bases, Buffers and Ionic Equilibria &amp; pH meter</b>		
3.1 3.2 3.3 3.4 3.5 3.6	Definition – pH, pK, pK <sub>w</sub> , Isoelectric pH, Buffer, Buffering Capacity Derivations : Ionic product of water, Henderson-Hasselbalch equation, Relation between pI, pK <sub>a1</sub> and pK <sub>a2</sub> for a neutral, acidic and basic amino acid Titration and Ionization of Glycine, Lysine and Aspartic acid; pK <sub>a</sub> and pI values of these amino acids. pH meter and glass electrode Physiological Buffers : (Hb-HHb, Carbonate-Bicarbonate, Phosphate, and Protein) Numericals on above concepts	15 Lectures

<b>PRACTICALS</b>		
<b>RUSBCHP301</b>		<b>Credits 01</b>
	1) Extraction of $\beta$ -Amylase from sweet potato 2) Extraction of Urease from horse gram 3) Extraction of Invertase from baker's yeast 4) Preparation of Immobilised Yeast and its use in determination of Invertase activity 5) Determination of Achromic point of Amylase 6) Preparation of Buffers and measurement of pH using paper and pH meter 7) Acid –Base titration of a Polyprotic acid 8) Determination of refractive index using portable refractometer.	

<b>SEMESTER III</b>		
Course Code	Title	Credits
<b>RUSBCH302</b>	<b>Fundamentals of Genetics and Physiology</b>	02
<b>Unit I Genetics : I</b>		
1.1	Mendelian genetics: Mendels experiments, Laws of inheritance	15 Lectures
1.2	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	
1.3	Numericals on above concepts	
1.4	Chromosomal abnormalities (Down's Syndrome, Klinefelter's Syndrome, Turner's Syndrome, Cri-du-chat syndrome, Philadelphia Chromosome)	
<b>Unit II Genetics : II</b>		
2.1	Prokaryotic Genome: Circularity; Single origin	15 Lectures
2.2	Eukaryotic chromosomes: Organization of DNA into chromosomes (upto Solenoid structure)	
2.3	DNA supercoiling, Topoismerase, Chromatin structure, Euchromatin, Heterochromatin, structure of condensed chromatin, Nucleosomes, [Centromere, kinetochome, telomere], Acetylation & deacetylation of histones, Role of Telomerase	
2.4	Comparison of chromosomal structure in prokaryotes and eukaryotes	
2.5	Transformation : Definition and transformation in S.pneumoniae	
2.6	Transduction : Definition ; Explain general features with one example	
2.7	Conjugation : Mechanism , F+ , F- and Hfr strain	
<b>Unit III Transport mechanisms and Haematopoesis</b>		
3.1	Transport mechanism across Cell Membrane	15 Lectures
3.1.1	Channel proteins and Carrier proteins	
3.1.2	Active transport (primary – Na <sup>+</sup> & K <sup>+</sup> pump; secondary – Glucose) & Passive transport (simple and facilitated diffusion) with suitable examples; concept of symport and antiport. Endocytosis and Exocytosis – with one example each.	
3.1.3	Haematopoesis	
3.2	RBCs, WBCs, granulocytes & platelets – their development, morphology and maturation (in brief)	
3.2.2	Biosynthesis of haemoglobin, its regulation and metabolism	
<b>PRACTICALS</b>		

<b>RUSBCHP302</b>		<b>Credits 01</b>
	1) Laws of Mendel 2) A study of Human Karyotypes 3) Effect of organic solvents on cell rupture 4) Isoelectric precipitation of casein 5) Recrystallization of Benzoic acid 6) Estimation of Ascorbic acid Iodometrically 7) Detection of generation of carbon dioxide during fermentation by yeast 8) Sugar fermentation test 9) Assignment – G banding, C banding, Q banding, of chromosomes	

<b>SEMESTER III</b>		
<b>Course Code</b>	<b>Title</b>	<b>Credits</b>
<b>RUSBCH303</b>	<b>Industrial Biotechnology &amp; Pharmacology</b>	<b>02</b>
<b>Unit I Sterilization &amp; Disinfection techniques and Cell culture</b>		
1.1	Sterilization and Disinfection techniques Physical Agent of sterilization - Temperature- Pressure (Hot Air Oven, Autoclave), Radiations (UV, Gamma) (examples with mechanism) Chemical agents of sterilization - Alcohol, Halogens, Formaldehyde	15 Lectures
1.2	Animal Tissue Culture: Introduction, Requirements, Culture techniques (Contamination and Sterilization); Culture media: Stem cell culture; Advantages; Applications-Hybridomas, vaccines	
1.3	Plant Tissue-culture: Introduction; Plant breeding; Techniques for maintenance; Genetic culture techniques: Callus regeneration, mutant selection from culture; Protoplast fusion, Transformation: Applications	
<b>Unit II Fermentation and Downstream processing</b>		
2.1	Basics: Primary and secondary screening, preparation of inoculum, and fermentation media	15 Lectures
2.2	Fermentors: Types (Batch, Continuous and fluidized bed) and its construction and accessory equipment; Operation of a fermentor; sterilization, inoculation, aeration, agitation;	
2.3	Downstream processing: Introduction, Separation of particles (solidliquid), Cell disruption, extraction methods, concentration, Purification and resolution of mixtures, drying	
<b>Unit III Industrial Biotechnology</b>		
3.1	Industrial synthesis - Penicillin, Vit B12, Cheese, Amylase / Protease ; Ethanol ; Acetic Acid	15 Lectures
3.2	Immobilized enzymes: Introduction; Methods of immobilization (entrapment, adsorption, covalent binding, microencapsulation, cross-linking); Stabilization of soluble enzymes: Solvent and substrate stabilization, Enzyme stabilization by polymer, salts, and Chemical modification; Applications and Problems	
3.3	Biosensors: Features of biosensors; Types: Electrochemical, Thermometric, Optical, Piezoelectric, Whole cell, Immunobiosensor; Construction and development, Applications	
3.4	Single cell proteins: Introduction; Bacterial proteins; Yeast proteins; fungal proteins; algal proteins; Economic aspect; Applications	
<b>PRACTICALS</b>		
<b>RUSBCHP303</b>		<b>Credits 01</b>
	1) Demonstration of the Working of an Autoclave and a Hot Air Oven 2) Sterility Testing of Air by plate exposure technique	



	3) Study of microbial growth curve using optical density 4) Cell count in a culture medium using optical density 5) A study of culture inoculation methods – Pour plate, Spread plate & Streak Plate 6) Determination of minimum inhibitory concentration of any one disinfectant 7) Flow sheet diagrams of industrial synthesis of a Vitamin, an Antibiotic, a Food item, an enzyme, and alcohol 8) Demonstration of alcohol generated during fermentation by yeast	
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SEMESTER IV		
Course Code	Title	Credits
RUSBCH401	Enzymology, Physiology & Tools of Biochemistry	02
<b>Unit I Physicochemical Principles</b>		
1.1	Diffusion and Osmosis	15 Lectures
1.1.1	Explanation of : solute concentration (ways of expressing it- mole, molal , normal, percent), activity & ionic strength,	
1.1.2	Diffusion & definition of diffusion coefficient (factors affecting solute diffusion in solution)	
1.1.3	Osmosis- VantHoffs law of osmotic pressure (state law & write mathematical expression- no derivation), mechanism of osmosis, Role of osmosis in physiology. Eg. Renal dialysis. Distribution of solute between two immiscible solvents	
1.2	Colloids and Viscosity	
1.2.1	Colloidal state in relation to surface forces, surface area, electrical charge, precipitation and flocculation.	
1.2.2	Surface tension and its measurement, factors affecting surface tension. Eg. Role of bile in digestion	
1.2.3	Viscosity – definition , measurement; Donnan membrane equilibrium, relation between Donnan equilibrium and osmotic pressure	
1.2.4	Adsorption and its characteristics	
<b>Unit II Hormones</b>		
2.1	Definition of Hormones, hormone receptor, endocrine & exocrine glands	15 Lectures
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	Hierarchal 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, adenylatecyclase, kinases)	
<b>Unit III Tools of Biochemistry</b>		
3.1	Spectrophotometry and Colorimetry	15 Lectures
3.1.1	Beer-Lambert law, derivation, limitations, application – estimation of sugar(DNSA) and protein (Biuret); concepts of Lambda max; determination of molar extinction coefficient	

3.1.2	Construction and working of a simple colorimeter and spectrophotometer Applications of Beer-Lambert law in the estimation of sugar [DNSA] and protein[Biuret]	
3.1.3	Numericals based on the above concepts	
3.2	Principles and applications of –	
3.2.1	Flame photometry	
3.2.2	Fluorimetry	
3.2.3	Flow cytometry, FRAP, FRET, FLIM	
<b>PRACTICALS</b>		
<b>RUSBCHP401</b>		<b>Credits 01</b>
	<ol style="list-style-type: none"> <li>1) Adsorption of oxalic acid on activated charcoal</li> <li>2) Determination of viscosity by Ostwald's Viscometer</li> <li>3) Determination of density of sugar syrup</li> <li>4) Demonstration of spectrophotometer</li> <li>5) Estimation of glucose by DNSA method</li> <li>6) Estimation of proteins by the Biuret method</li> <li>7) Estimation of anthocyanin content in vegetable</li> <li>8) Determination of consistency of juices / sauces /squashes / syrup using portable consistometer.</li> </ol>	

<b>SEMESTER IV</b>			
<b>Course Code</b>	<b>Title</b>	<b>Credits</b>	
<b>RUSBCH402</b>	<b>Fundamentals of Genetics and Physiology</b>	<b>02</b>	
<b>Unit I Locomotion &amp; Movement</b>			
1.1	Muscle contraction	15 Lectures	
1.1.1	Types of muscles – Smooth, Skeletal, Cardiac		
1.1.2	Structural organization of a muscle fibre, myofibril. Muscle proteins – Actin, Myosin, Troponin, Tropomyosin		
1.2	Contraction and Relaxation of Muscles – mechanisms (Sliding filament theory)		
1.2.1	Other types of contractions – eg twitch, tetanus, wave summation, Isotonic, Isometric Regulation of Muscle contraction Physiology of plant movements		
1.2.2	Physical movements – Xerochasy, Hydrochasy Vital movements – Protoplasmic streaming, paratonic movements Tactic movements – Chemotaxis, Phototaxis, Thermotaxis Tropic movements – Chemo / geo / hydro / photo / thigmo tropism Nastic movements – Seismonasty, Nyctynasty, Photonasty, Chemonasty, Thermonasty Spontaneous movements – Ciliary, Amoeboid, Cyclosis		
<b>Unit II Neurophysiology</b>			
2.1	Nervous System – Classification: CNS, PNS; Components : Neurons (3 types) and Neuroglia (6 types) – structure and function, Axonal transport		15 Lectures
2.2	Resting Membrane Potential, ion channels [voltage and ligand gated], Action Potential (depolarization, polarization and refraction period), propagation of action potential (salutatory & continuous conduction)		
2.3	Physiological anatomy of a synapse ; Transmission at synapses – Electrical & Chemical synapses, Excitatory & Inhibitory post synaptic potentials, Agonists &		
2.4	Antagonists, Removal of Neurotransmitters Neurotransmitters- acetylcholine and Catecholamines, GABA, Glutamate & Aspartate – structure and function		
<b>Unit III Body Fluids</b>			
3.1	Fluid compartments of the body – ICF and ECF	15 Lectures	
3.2	Blood : Composition, characteristics and function ; role of plasma proteins, Starlings hypothesis; blood clotting and factors involved [ no pathway]		
3.3	Bile : Composition, characteristics and function ; storage		

3.4	Lymph : Composition, Formation and Circulation	
<b>PRACTICALS</b>		
<b>RUSBCHP402</b>		<b>Credits 01</b>
	1) Permanent slides of Muscle Tissue 2) Demonstration of Plant Movements 3) Determination of Total WBC count: Haemocytometry 4) Determination of Total RBC count: Haemocytometry 5) Bleeding time 6) Clotting time 7) Effect of Hypotonic, Isotonic and Hypertonic solutions on RBC's 8) Bile Analysis: Detection of Bilirubin & Bile salts 9) Determination of acidity of Vinegar	

<b>SEMESTER IV</b>		
<b>Course Code</b>	<b>Title</b>	<b>Credits</b>
<b>RUSBCH403</b>	<b>Industrial Biotechnology &amp; Pharmacology</b>	02
<b>Unit I Trends in Biotechnology</b>		
1.1	Bioaugmentation, Genetically Engineered Microbes	15 Lectures
1.2	Bioremediation: Introduction; Factors affecting bioremediation; Types; Types of reactions (Aerobic, anaerobic, sequential); Biodegradation of – hydrocarbons, xenobiotics, heavy metals (Uranium); Paper Pulp Industry.	
1.3	Biopesticides, Biofungicide	
1.4	Bioherbicides and agricultural antibiotics	
1.5	Biofertilizers	
1.6	Integrated Pest Management	
<b>Unit II Introduction to Pharmacology</b>		
2.1	Scope of pharmacology	15 Lectures
2.2	Sources, Classification and Nomenclature of drugs	
2.3	Dosage forms and routes of drug administration; Factors affecting dosage and drug delivery	
2.4	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	
<b>Unit III Pharmacodynamics and Adverse Drug Reactions (ADR)</b>		
3.1	Pharmacodynamics	15 Lectures
3.1.1	Basis of Drug Action	
3.1.2	Drug Receptor Interaction – Receptor Theory of Drug Action, Location of Drug Receptor-G-Coupled Protein receptors	
3.1.3	Drug Acting on enzymes	
3.1.4	Non receptor mechanism	
3.1.5	Placebo effect	
3.1.6	Affinity and Intrinsic Activity	
3.1.7	Intensity of Drug Response – Potency and Efficacy	
3.1.8	Combined Effects of Drug – Synergism, Antagonism	
3.2	Adverse Drug Reactions (ADR)	
3.2.1	Definition and Types of ADR	
3.2.2	Repeated Dosage, Drug dependence, Over dosage, Acute poisoning	
3.2.3	General Principles of Management of Poisoning	

<b>PRACTICALS</b>		
<b>RUSBCHP403</b>		<b>Credits 01</b>
	1) Determination of the amylase exoenzyme secreted by the micro-organisms 2) Determination of the zone of inhibition of microorganisms using the agar well method and disc diffusion method 3) Study of antimicrobial activity of different plant sources. 4) Qualitative determination of reducing sugars formed by starch hydrolyzing micro-organisms.	
	<b>PROJECT WORK</b>	
	<p><b>GUIDELINE TO CARRY OUT PROJECTWORK</b></p> <ol style="list-style-type: none"> <li>1. The main purpose of introduction of Project Work at SYBSc is to inculcate research culture at under-graduation level. It will also make the students familiar with Research Methodology i.e. reference work, experimental work, analysis of experimental data, interpretation of results obtained, writing of project work and compilation of bibliography in proper order.</li> <li>2. Each student individually or in a group shall complete a small research project during their academic year of SYBSc. However, the initial reference work for the project can be started after the conclusion of FYBSc Semester II examination and summer vacation to SYBSc.</li> <li>3. <b>Nature of Research Project:-</b>Experimental-based involving laboratory analytical work will be considered as the Research Project.</li> <li>4. <b>Duration of Project work:-</b>Using the infrastructure available in the Biochemistry Department, Ramnarain Ruia Autonomous College, the duration to complete the project work will be from the commencement of the project work till the end of January of SYBSc (Sem IV) academic year.</li> <li>5. <b>Schedule for Submission of project Work:-</b>Experimental work must be completed and the report on the same (2 Copies) will have to be submitted by the end of January of SYBSc (Sem IV) academic year.</li> <li>6. The project should be divided into the following parts:-               <ol style="list-style-type: none"> <li>a) Certification of completion of Project Work</li> <li>b) Acknowledgement</li> <li>c) Introduction</li> <li>d) Review of Related Literature</li> <li>e) Aims and Objectives</li> <li>f) Plan of work</li> <li>g) Material and Methods</li> <li>h) Results</li> <li>i) Discussion</li> <li>j) Bibliography</li> </ol> </li> <li>7. The project will be assessed.</li> </ol>	

### **GUIDELINE FOR THE ASSESMENT OF PROJECT WORK**

1. The practical 403 of Sem IV (Course Code No. RUSBCHP403) 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 SYBSc (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.
5. The following Marking Scheme shall be considered while assessing the project work

<b>Particular</b>		<b>Marks</b>
a)	Project Work (Contents Submitted in the bound form)	10
b)	Presentation of Project Work to examiner	10
c)	Viva- voce Exam based on Project Work	05
d)	Attendance	05
<b><u>TOTAL</u></b>		<b>30</b>

#### **References:**

#### **Semester III**

- 1) Textbook of Medical Physiology Gyton and Hall , Elsevier publishers
- 2) David L. Nelson, Michal M. Cox, Lehninger Principles of Biochemistry, W. H. Freeman & company, New york, 4th edition
- 3) Murry, R. K. & other, Harper's Biochemistry, Appleton & Lange ,california, 21st edition
- 4) J.. L. Jain, Fundamentals of Biochemistry, S. Chand & company, 2005 edition
- 5) Dr. A.C. Deb, Fundamentals of Biochemistry, New central book agency (P) Ltd., 8th edition
- 6) U. Satyanarayanan, Biochemistry, Books & allied (P) Ltd., Kolkata, 3rd edition
- 7) Murry, R. K. & other, Harper's Biochemistry, Appleton & Lange ,california, 21st edition.
- 8) J.B.Russel , Genetics
- 9) BenaminLewin, Gene VII , Oxford University Press
- 10) M.W. Strickberger, Genetics
- 11) William & Wilson

#### **Semester IV**

- 1) Microbiology by Stanier
- 2) Stanier, Microbiology Pelzer, Essentials of Microbiology
- 3) Friedfielder, Microbial genetics  
A. H. Patel, Industrial microbiology, Macmillan India Ltd.
- 4) L. E. Casida, Industrial microbiology, New age international publishers
- 5) F.S.K Brar, Essentials of Pharmacology, S . Chand Publisher
- 6) Upadhyay, Biophysical chemistry, Himalayan Publisher
- 7) Keith Wilson & John Walker, Practical Biochemistry, principle and technique, Cambridge University, 5th edition
- 8) Biotechnology, by Primrose , Dube
- 9) Biotechnology, Jodgan
- 10) U. Satyanarayanan, Biotechnology, Books & allied (P) Ltd., Kolkata

## MODALITY OF ASSESSMENT

### Theory Examination Pattern:

#### **B) Internal Assessment - 40% :40 marks.**

Sr No	Evaluation type	Marks
1	One Assignment/presentation/Quiz	20
2	One class Test (multiple choice questions / subjective)	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 **04** questions each of **15** marks. On each unit there will be one question & last question will be based on all 3 units.

4. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1)A)	Any 2 out of 3	04	Unit I
Q.1)B)	Any 2 out of 3 OR Any 4 out of 6	06	
Q.1)C)	Any 1 out of 2	05	

Q.2)A)	Any 2 out of 3	04	Unit II
Q.2)B)	Any 2 out of 3 OR Any 4 out of 6	06	
Q.2)C)	Any 1 out of 2	05	
Q.3)A)	Any 2 out of 3	04	Unit III
Q.3)B)	Any 2 out of 3 OR Any 4 out of 6	06	
Q.3)C)	Any 1 out of 2	05	
Q.4)A)	Any 1 out of 2	04	Unit I, II, III
Q.4)B)	Any 1 out of 2	04	
Q.4)C)	Any 1 out of 2	04	
Q.4)D)	Any 3 out of 5	03	

**Practical Examination Pattern:**

**(A) Internal Examination:**

Heading	Practical I, II & III
Journal	05
Test	15
<b>Total</b>	<b>20</b>

**(B) External (Semester end practical examination):**

Particulars	Practical I, II & III
Laboratory work	25
Viva	5
<b>Total</b>	<b>30</b>

**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 & IV**

Course	RUSBCH301			RUSBCH302			RUSBCH303			Grand Total
	Internal	External	Total	Internal	External	Total	Internal	External	Total	
<b>Theory</b>	40	60	100	40	60	100	40	60	100	<b>300</b>
<b>Practicals</b>	20	30	50	20	30	50	20	30	50	<b>150</b>

Course	RUSBCH401			RUSBCH402			RUSBCH403			Grand Total
	Internal	External	Total	Internal	External	Total	Internal	External	Total	
<b>Theory</b>	40	60	100	40	60	100	40	60	100	<b>300</b>
<b>Practicals</b>	20	30	50	20	30	50	20	30	50	<b>150</b>

Resolution No. AC/II(18-19).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
<b>Paper I - Metabolism &amp; Analytical Techniques - I</b>				
RUSBCH501	I	Carbohydrate Metabolism	3	15
	II	Amino acid and protein metabolism & Biochemistry of senses		15
	III	Bioenergetics & Oxidative Phosphorylation		15
	IV	Chromatography		15
<b>Paper II – Environmental Science &amp; Cell Biology</b>				
RUSBCH502	I	Air	3	15
	II	Water & Water Treatment		15
	III	Soil & Noise & Environmental Monitoring		15
	IV	Cell – Cell Communication		15
<b>Paper III –Advanced Genetics &amp; RDT</b>				
RUSBCH503	I	DNA Replication & Repair	3	15
	II	Transcription		15
	III	Translation		15
	IV	Recombinant DNA Technology (RDT)		15
<b>Paper IV – Immunology &amp; Pathophysiology - I</b>				
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	
RUSBCHP502	Practicals based on course in theory – RUSBCH502			
RUSBCHP503	Practicals based on course in theory – RUSBCH503		4	
RUSBCHP504	Practicals based on course in theory – RUSBCH504			

Semester VI

Course Code	Unit	Topics	Credits	Lectures
<b>Paper I - Metabolism &amp; Analytical Techniques - II</b>				
RUSBCH601	I	Lipid metabolism	3	15
	II	Nucleic Acid Metabolism & Integration of Metabolism		15
	III	Centrifugation & Protein Purification techniques		15
	IV	Electrophoresis		15
<b>Paper II – Nutrition &amp; Pharmacology</b>				
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
<b>Paper III – Biostatistics &amp; Bioinformatics</b>				
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		15

		& Chi-square test		
<b>Paper IV – Immunology &amp; Pathophysiology - II</b>				
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
<b>RUSBCH501</b>	<b>Metabolism &amp; Analytical Techniques - I</b>	<b>3</b>
<b>Unit I Carbohydrate metabolism</b>		
1.1 1.1.1 1.1.2 1.1.3 1.1.4 1.2	Catabolism – Cellular location, sequence of reactions, labelling of carbon atoms, and energetics of : 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 Oxidation of pyruvate, Krebs cycle; Glyoxylate pathway; Glycogenolysis – [schematic – no structures, but with enzymes and coenzymes] Anabolism – HMP shunt ( Cellular location, sequence of reactions, multifunctional nature); Gluconeogenesis, Glycogenesis – [schematic – no structures, but with enzymes and coenzymes]	15 Lectures
<b>Unit II Amino acid and protein metabolism &amp; Biochemistry of Senses</b>		
2.1 2.1.1 2.1.2	Amino acid and protein metabolism 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] Definition – ketogenic and glucogenic amino acids	15 Lectures

2.1.3	Urea cycle – Cellular location, sequence of reactions, Labeling of N atom, transport of NH <sub>3</sub>	
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	
<b>Unit III Bioenergetics &amp; Oxidative Phosphorylation</b>		
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]	
<b>Unit IV Chromatography</b>		
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	
<b>PRACTICALS</b>		
<b>RUSBCHP501</b>	Practicals based on course in theory –RUSBCH501	<b>2</b>
	<ol style="list-style-type: none"> <li>1) Identification of biomolecules</li> <li>2) Determination of the optimum pH of <math>\beta</math>-Amylase</li> <li>3) Determination of Km value of <math>\beta</math>-Amylase</li> <li>4) Study the effect of inhibitor on <math>\beta</math>-Amylase</li> <li>5) Determination of the activity and specific activity of <math>\beta</math>-Amylase from sweet potato</li> <li>6) Estimation of glucose by Benedict's method</li> <li>7) Separation of sugars by circular paper chromatography</li> <li>8) Separation of plant pigments by Adsorption Column Chromatography</li> </ol>	

<b>SEMESTER V</b>		
<b>Course Code</b>	<b>Title</b>	<b>Credits</b>
<b>RUSBCH502</b>	<b>Environmental Science &amp; Cell Biology</b>	<b>3</b>
<b>Unit I Air</b>		
1.1	Atmosphere	15 Lectures
1.1.1	Composition and structure of atmosphere	
1.1.2	Particles , ions and radicals in the atmosphere	
1.1.3	Chemical and photochemical reactions in the atmosphere [reactions of oxygen, ozone, sulphur dioxide , nitrogen oxide and organic compounds]	
1.2	Air Pollutants – CO, Oxides of Nitrogen, SO <sub>2</sub> , hydrocarbons and photochemical smog, Green house gases, suspended particulate matter[ sources and effect of] , depletion of ozone	
<b>Unit II Water &amp; Water Treatment</b>		
2.1	Water	15 Lectures
2.1.1	Hydrosphere- characteristics and the water cycle	
2.2	Water Pollution	
2.2.1	Organic pollutants[pesticides, insecticides, detergents, oil spills, toxic organic	
2.2.2	chemicals]	
2.3	Inorganic pollutants [heavy metals – Hg, Pb, As, Cd] Thermal pollution of water	
2.3.1	Water treatment	
	Criteria for water purity, Water purification [preliminary, primary, secondary, tertiary-chlorination, ion exchange]	
<b>Unit III Soil, Noise &amp; Environmental monitoring</b>		
3.1	Soil	15 Lectures
3.1.1	Composition of soil,	
3.1.2	Nitrogen cycle	
3.1.3	Types of soil pollution – acidification, agrochemical pollution, salinization, and contamination by metalliferous wastes	



3.2	Noise and its measurement	
3.2.1	Classification of Noise	
3.2.2	Causes and consequences of Noise pollution	
3.3	Environmental monitoring	
3.3.1	Approaches used to monitor the environment-air, water and soil. [Principles and Significance only. Protocols for each factor – not required ]	
3.3.2	Remote Sensing	
<b>Unit IV Cell – Cell Communication</b>		
4.1	Introduction, Significance of cell communication	15 Lectures
4.2	Cell Junctions & its classification –	
4.2.1	Occluding junction (tight junctions, septate junctions)	
4.2.2	Anchoring junction (Actin filament attachment sites & Intermediate filament attachment sites),	
4.2.3	Communicating junction (Gap junction, Chemical synapses, Plasmodesmata)	
4.3	Cell – Cell Adhesion	
4.3.1	Mechanism of Adhesion – Junctional & Non-junctional	
4.3.2	Cadherins mediated Ca <sup>2+</sup> -dependent Cell - Cell Adhesion	
<b>PRACTICALS</b>		
<b>RUSBCHP502</b>	Practicals based on course in theory –RUSBCH502	<b>2</b>
	<ol style="list-style-type: none"> <li>1) Determination of the pH of water/ Effluent/ soil using a pH meter</li> <li>2) Determination of the conductance of water/Effluent</li> <li>3) Estimation of Organic content of soil by Diphenylamine method</li> <li>4) Estimation of lead by the EDTA method</li> <li>5) Estimation of copper by the Isoamyl alcohol method</li> <li>6) Determination of salinity / chlorides in water by Silver nitrate method</li> <li>7) Determination of the Chemical Oxygen Demand of water/ Effluent by the Potassium Dichromate method</li> <li>8) Determination of potability of water by conducting a coliform count</li> </ol>	

SEMESTER V		
Course Code	Title	Credits
RUSBCH503	Advanced Genetics & RDT	3
<b>Unit I DNA Replication &amp; Repair</b>		
1.1.1	Replication of DNA (in prokaryotes)	15 Lectures
1.1.2	Models of DNA replication : Semi-conservative, Dispersive & Conservative	
1.1.3	Modes of DNA replication: Theta & rolling circle	
1.1.4	Enzymes (pol I, II and III) and accessory proteins	
1.1.5	Mechanism of semi-conservative replication (Initiation, elongation & termination)	
1.1.6	DNA Mutations, mutagens	
1.2	DNA repair: Direct, Photoreactivation, O6 methyl guanine DNA methyl transferase, Excision repair, Mismatch repair, Recombination repair, SOS-error prone repair	
<b>Unit II Transcription</b>		
2.1	Transcription in prokaryotes	15 Lectures
2.1.1	Prokaryotic RNA polymerase and promoter; Transcription unit, Upstream regulatory sequences,	
2.1.2	Mechanism of RNA transcription: Initiation, elongation and termination (Type I & II)	
2.2	Comparative overview of transcription in prokaryotes & eukaryotes	
2.3	Processing of tRNA , rRNA, mRNA (prokaryotes and eukaryotes)	
2.4	Concept of split genes, reverse transcription.	
2.5	Role of Inhibitor-Rifampicin, Actinomycin D	
<b>Unit III Translation</b>		
3.1	Translation (protein biosynthesis) in prokaryotes	15 Lectures
3.1.1	Genetic code, mechanism of translation: Activation of amino acids, chain initiation, elongation & termination	
3.2	Signal hypothesis	
3.3	Post translational modifications of proteins (proteolytic cleavage, acylation,	

3.4	phosphorylation, methylation, glycosylation), Protein targeting Inhibitors of translation	
<b>Unit IV Recombinant DNA Technology (RDT)</b>		
4.1	Introduction of RDT	15 Lectures
4.2	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	
4.3	Applications of RDT- Agriculture (Bt Cotton); Medicine (Insulin); GM food	
4.4	Isolation of gene: Gene library and c-DNA library; Southern blot; Northern blot;	
4.5	Gene Transfer: Transfection, Electroporation, Microinjection, Liposome, Microprojectile (in brief)	
4.6	Selection and screening- Antibiotic and colony hybridization	
4.7	DNA Amplification by PCR	
<b>PRACTICALS</b>		
<b>RUSBCHP503</b>	Practicals based on course in theory –RUSBCH503	<b>2</b>
	<ol style="list-style-type: none"> <li>1) Estimation of glucose by the Folin-Wu method</li> <li>2) Estimation of glucose by the GOD-POD method</li> <li>3) Estimation of Calcium by the Erichrome Black T- EDTA method</li> <li>4) Estimation of Magnesium by the Erichrome Black T- EDTA method</li> <li>5) Estimation of phosphorus by Fiske Subbarow method</li> <li>6) Estimation of DNA by the Diphenylamine method</li> <li>7) Isolation and spooling of DNA from onion/moong</li> <li>8) Estimation of UV absorption of nucleic acids&amp; proteins</li> </ol>	

SEMESTER V		
Course Code	Title	Credits
<b>RUSBCH504</b>	<b>Immunology &amp; Pathophysiology - I</b>	<b>3</b>
<b>Unit I Human immune system</b>		
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.	
<b>Unit II Antigen- Antibody</b>		
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	

<b>Unit III Antigen- Antibody interactions &amp; Complement system</b>		
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]	
<b>Unit IV Tumour immunology &amp; Apoptosis</b>		
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)	
<b>PRACTICALS</b>		
<b>RUSBCHP504</b>	Practicals based on course in theory –RUSBCH504	<b>2</b>
	<ol style="list-style-type: none"> <li>1) Isolation of starch from potato</li> <li>2) Estimation of percentage purity of starch hydrolysate by Willstatter's method</li> <li>3) Extraction of lipid from oil seeds by the Cold Percolation Method</li> <li>4) Determination of Blood groups</li> <li>5) Determination of the Haemoglobin content by the Sahli's haemoglobinometer</li> <li>6) Making of pH paper using anthocyanin extracted from vegetables</li> <li>7) Use of anthocyanin as pH indicator</li> </ol>	

<b>SEMESTER VI</b>		
<b>Course Code</b>	<b>Title</b>	<b>Credits</b>
<b>RUSBCH601</b>	<b>Metabolism &amp; Analytical Techniques - II</b>	<b>3</b>
<b>Unit I Lipid metabolism</b>		
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	
<b>Unit II Nucleic Acid Metabolism &amp; Integration of Metabolism</b>		
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	
<b>Unit III Centrifugation &amp; Protein Purification techniques</b>		
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 -	

3.1.3	preparative and analytical. 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	
<b>Unit IV Electrophoresis</b>		
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	
4.5	Electrophoresis of Nucleic acid (DNA & RNA) -AGE, PFGE Detection of Nucleic acid in gel- Ethidium bromide, syber green	

<b>PRACTICALS</b>		
<b>RUSBCHP601</b>	Practicals based on course in theory –RUSBCH601	<b>2</b>
	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	

<b>SEMESTER VI</b>		
<b>Course Code</b>	<b>Title</b>	<b>Credits</b>
<b>RUSBCH602</b>	<b>Nutrition &amp; Pharmacology</b>	<b>3</b>
<b>Unit I Nutrition &amp; Diet Management</b>		
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 nutrition]	
1.2	Energy Assessment - RQ, BMR	
1.3	Anthropometry – BML, Waist:hip ratio	
1.4.1	Diet Management	
1.4.2	Dietary Management in :- Obesity, Starvation, Diabetes Mellitus, Hypertension, Peptic ulcer , Obstructive Jaundice	
<b>Unit II Vitamins and Coenzymes &amp; their deficiency disorders</b>		
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, Follicular 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)	



<b>Unit III Pharmacokinetics and Bioassay</b>		
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	
<b>Unit IV Therapeutic drugs &amp; Drugs acting on Haemopoietic System</b>		
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 – Propranolol]	
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	Colony Stimulating Factors: Filigrastim, Lenograstim, Molgramostim	
4.2.8	Anti-coagulants – Mechanism of Haemostasis Intravenous anticoagulants – Heparin Oral anticoagulants – Coumarin derivatives & Indanedione derivatives	
<b>PRACTICALS</b>		
<b>RUSBCHP602</b>	Practicals based on course in theory –RUSBCH602	<b>2</b>
	<ol style="list-style-type: none"> <li>1) Estimation of Fluoride in water by the Alizarin Red method</li> <li>2) Determination of the Dissolved Oxygen content of water/ Effluent by the Winkler's Iodometric method</li> <li>3) Determination of the Biological Oxygen Demand of water/ Effluent</li> <li>4) Determination of the Alkalinity of water/ Effluent</li> <li>5) Determination of the Acidity of water/ Effluent</li> <li>6) Estimation of CaCO<sub>3</sub> of soil by Bromothymol Blue Method</li> <li>7) Demonstration of Soxhlet method</li> </ol>	

<b>SEMESTER VI</b>		
<b>Course Code</b>	<b>Title</b>	<b>Credits</b>
<b>RUSBCH603</b>	<b>Biostatistics &amp; Bioinformatics</b>	<b>3</b>
<b>Unit I Biostatistics &amp; Descriptive Statistics</b>		
1.1	Introduction: scope and applications of biostatistics	15 Lectures
1.2	Common statistical terms: Sources, nature and presentation of data; Measurement and scales of measurement	
1.3	Descriptive statistics: Measures of central tendency- Mean, Median and mode	
1.4	Measures of dispersion- Range, percentiles, variance, SD, Mean deviation,	
<b>Unit II Probability, Normal Distribution &amp; Bioinformatics</b>		
2.1	Probability	15 Lectures
2.1.1	Concept of probability: definition	
2.1.2	Normal distribution and normal curve, Asymmetric distribution	
2.1.3	Statistical problems based on the above concepts	
2.2	Bioinformatics:	
2.2.1	Introduction	
2.2.2	Applications of Bioinformatics in – Sequence analysis, Molecular modeling and drug designing, Phylogeny/evolution, Ecology & population studies, Medical informatics and agriculture.	
2.2.3	Introduction to Genomics and Proteomics Databases- Definition & types – Public domain database, Sequence database, Structural database, Motif database, Genome database, Proteome database, Annotated sequence database.	
2.2.4	Full form & function in brief of - GenBank, EMBL, PIR, SWISS PROT, PDB, GDB.	
2.2.5	Sequence analysis Tools - Explain the following terms in brief - BLAST, FASTA, L-ALIGN, CLUSTAL- X & W, RASMOL,	
2.2.6	Micro-array analysis-concept and applications	

<b>Unit III Hypothesis Testing of Means &amp; ANOVA</b>		
3.1	Introduction – Hypothesis, Type I and Type II errors, One-tailed and two tailed tests,	15 Lectures
3.2	Hypothesis testing of mean - Z-test, t-test	
3.3	Standard error	
3.4	ANOVA	
3.5	Statistical problems based on the above concepts	
<b>Unit IV Hypothesis Testing of Difference Between Means &amp; Chi-Square Test</b>		
4.1	Hypothesis testing of difference between population means - Z-test, t-test (Paired and unpaired)	15 Lectures
4.2	Chi-square (Test of population variance, Test of goodness of fit, Test of association), 2 x 2 Table, Yates' correction	
4.3	Statistical problems based on the above concepts	

<b>PRACTICALS</b>		
<b>RUSBCHP603</b>	Practicals based on course in theory –RUSBCH603	<b>2</b>
	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	

<b>SEMESTER VI</b>		
<b>Course Code</b>	<b>Title</b>	<b>Credits</b>
<b>RUSBCH604</b>	<b>Immunology &amp; Pathophysiology - II</b>	<b>3</b>
<b>Unit I Metabolic disorders</b>		
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)	
<b>Unit II TCR, MHC &amp; Transplant Immunology</b>		
2.1	T-cell Receptor, Structure & function of $\alpha\beta$ and $\gamma\delta$	15 Lectures
2.1.1	Organization & rearrangement of TCR genes	
2.1.2	TCR complex (TCR-CD <sub>3</sub> )	
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)		
<b>Unit III Virology &amp; AIDS</b>			
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.		
<b>Unit IV Ageing, Alzheimer’s &amp; Vaccines</b>			
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-idiotypic vaccines; 4. DNA vaccines; Recombinant vector vaccines		
<b>PRACTICALS</b>			
<b>RUSBCHP604</b>	Practicals based on course in theory –RUSBCH604	<b>2</b>	
	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 Stryer Tymoczko 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.; Jaypee brothers 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. et al.; 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:

#### C) 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**

- v. Duration - These examinations shall be of **2 hours** duration.
- vi. Paper Pattern:
  5. 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.
  6. 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
<b>Total</b>	<b>20</b>

**(B) External (Semester end practical examination):**

Particulars	Practical 1
Laboratory work	25
Viva	5
<b>Total</b>	<b>30</b>



## 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/ Coordinator / 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	
<b>Theory</b>	40	60	100	40	60	100	<b>200</b>
<b>Practicals</b>	20	30	50	20	30	50	<b>100</b>

Course	RUSBCH503			RUSBCH504			Grand Total
	Internal	External	Total	Internal	External	Total	
<b>Theory</b>	40	60	100	40	60	100	<b>200</b>
<b>Practicals</b>	20	30	50	20	30	50	<b>100</b>

**Semester – VI**

Course	RUSBCH601			RUSBCH602			Grand Total
	Internal	External	Total	Internal	External	Total	
<b>Theory</b>	40	60	100	40	60	100	200
<b>Practicals</b>	20	30	50	20	30	50	100

Course	RUSBCH603			RUSBCH604			Grand Total
	Internal	External	Total	Internal	External	Total	
<b>Theory</b>	40	60	100	40	60	100	200
<b>Practicals</b>	20	30	50	20	30	50	100

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