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

S.P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore • Experience • Excel

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
Paper I - Biomolecules and Nutrition				
RUSBCH101	I	Water and Biochemistry of minerals	2	15
	II	Nucleic acids		15
	III	Carbohydrates		15
Paper II - Cell biology, Physiology and Microbiology				
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
Paper I - Biomolecules and Nutrition				
RUSBCH201	I	Lipids	2	15
	II	Amino acids and proteins		15
	III	Nutrition		15
Paper II – Introduction to cell biology, Physiology and Microbiology				
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 FYBSc 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**
RUSBCH101	**Biomolecules and Nutrition**	**02**
Unit I	**Water and Biochemistry of minerals**	**15 lectures**
1.1 1.1.1 1.1.2 1.2 1.2.1 1.2.2 1.3 1.4 1.5 1.5.1 1.5.2	Water Water, its structure and biological significance, Hydrogen bonding and its importance, Water as a universal solvent. Effect of water on Biomolecules Entropy and dissolution of solute Polar and non-polar compounds Weak interactions of biomolecules in aqueous solutions Ionization of water, weak acids and weak bases Biochemistry of minerals General functions, classification Mechanism of absorption and functions of – Calcium, Phosphorus, Magnesium, Sodium, Potassium, Iron, Iodine, Selenium	
Unit II	**Nucleic Acids**	**15 lectures**
2.1 2.2 2.3 2.3.1 2.3.2 2.3.3 2.4	Structure - Purine & Pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides (ATP, CTP, GTP, TTP, UTP) Formation of polynucleotide strand with its shorthand Representation RNAs (various types in prokaryotes and eukaryotes) mRNA, hnRNA, rRNA, snRNA & snoRNA - general account, tRNA - clover leaf model, Ribozymes DNA Physical evidence of DNA helical structure. Chargaff's rules (chemical evidence), Watson-Crick model of DNA & its features Physical properties of DNA - Effect of heat on physical properties of DNA (Viscosity, buoyant density, UV absorption), Hypochromism, hyperchromism, denaturation of DNA. Reactions of nucleic acids (with DPA and Orcinol) Central Dogma of Life (Definitions: Replication, Transcription, Translation & Reverse Transcription)	
Unit III	**Carbohydrates**	**15 lectures**
3.1 3.2 3.2.1 3.2.2 3.2.3	Definition, Classification, and functions of carbohydrates (mono, oligo, polysaccharides) Monosaccharides Classification in terms of aldoses and ketoses Structures and significance of glucose, fructose, galactose, mannose, and ribose Properties: a) Physical- isomerism D & L, optical; optical; epimers: anomers	

	b) Chemical reactions – i. oxidation to produce aldonic. Aldaric and uronic acids (with respect to glucose); ii. reducing action in boiling alkali, enedi01 formation (with respect to glucose and fructose) iii. osazone formation (with respect to glucose and fructose) iv. orcinol (with respect to ribose)	
3.3 3.3.1 3.3.2 3.4 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	
	PRACTICALS	
RUSBCHP101	**PRACTICAL I**	**Credits 01**
	1) Preparation & Standardization of laboratory reagents 2) pH meter – working of a pH meter 3) Qualitative tests for carbohydrates – a) Monosaccharides - glucose & fructose b) Disaccharides - lactose, maltose, sucrose c) Polysaccharides - starch, dextrin 4) Qualitative tests to detect the unknown carbohydrates from the given solution 5) Qualitative test for nucleic acids	

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

	PRACTICALS	
RUSBCHP102	**PRACTICAL II**	**Credits 01**
	1) Parts and maintenance of a Microscope 2) Gram Staining 3) A study of electron micrographs of cell organelles 4) Permanent Slides of bacilli, spirilla, cocci, rhizopus 5) Nucleic acid Staining 6) Effect of hypo, hyper, isotonic solutions on cells of onion peel 7) Permanent slides of Mitosis and Meiosis 8) Qualitative Analysis of Minerals -Sodium, Potassium, Phosphorus, Iron, Chloride, Nitrate	

SEMESTER II		
Course Code	**Title**	**Credits**
RUSBCH201	**Biomolecules and Nutrition**	**02**
Unit I	**Lipids**	**15 lectures**
1.1 1.2 1.2.1 1.2.2 1.3 1.4	Definition, classification (Bloor's) and functions of Lipids Fatty acids and Triacylglvcerol 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 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 Compound Lipids Functions of glycerophospholipids (PE.PC.PL) Phosphosphingolipids (ceramide, sphingomyelin), Glycolipids /Cerebrosides (gluco & galactocerebrosides) Steroids Cholesterol structure and biochemical significance	
Unit II	**Amino acids and proteins**	**15 lectures**
2.1 2.1.1 2.1.2 2.1.3 2.2 2.2.1 2.2.2 2.2.3 2.2.4 2.2.5	Amino acids Amino acid structure- D & L forms of all 20 amino acids Detailed classification based on polarity: essential & non-essential amino acids, Zwitter ion, pI of amino acids, amino acids as ampholytes 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). Peptides and Proteins ASBC- APS classification on the basis of shape, function and physical properties & solubilities (Simple, conjugated & derived proteins). Nutritional classification (Complete & incomplete proteins) Properties of proteins. Primary structure -Formation and characterization of the peptide bond Secondary structure -Alpha helix and beta sheet Tertiary and Quaternary structures- an introduction with one example of each Protein denaturation	
Unit III	**Nutrition**	**15 lectures**
3.1 3.2	Nutrition & Energy Supply - Calorie, Joule, Respiratory Quotient Food calorimetry - calorific value determination by Bomb calorimeter, calorific values of proximate principles,	

3.3 3.4 3.5 3.6 3.7 3.8 3.9	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- sedentary, moderate and heavy Nutritional importance of Carbohydrates, Proteins, Lipids and Fiber Assessment of nutritive value of proteins - Chemical score of amino acids, Protein Deficiency Corrected Amino Acid Score, BV, PER, NPU Concept of BMI, RDA Balanced diet Nutritional disorders Numerical problems based on above concepts	
	PRACTICALS	
RUSBCHP201	**PRACTICAL I**	**Credits 01**
	1) Quantitative estimation of normality of FAS 2) Qualitative tests for amino acids 3) Qualitative tests for proteins 4) Tests to detect unknown proteins 5) Qualitative tests for lipids 6) Estimation of Saponification value 7) Estimation of Acid value 8) Estimation of vitamin C by dye method 9) Demonstration of Analytical balance	

SEMESTER II			
Course Code		**Title**	**Credits**
RUSBCH202		**Introduction to Cell biology, Physiology and Microbiology**	**02**
Unit I	**Physiology of digestion and absorption**		**15 lectures**
1.1 1.2 1.3 1.4 1.5 1.6	Parts and Functions of gastro intestinal tract (GIT) Organs and Glands associated with GIT Secretions and Juices of GIT (Saliva, Gastric juice, Intestinal juice, pancreatic and Bile juice) Digestion and Mechanism of Absorption of carbohydrates Digestion and Mechanism of Absorption of Lipids Digestion and Mechanism Absorption of Proteins Disorders - Peptic ulcer, Lactose Intolerance, Celiac disease, Pancreatitis		
Unit II	**Physiology of respiration and excretion**		**15 lectures**
2.1 2.2 2.3 2.4 2.4.1 2.4.2 2.5 2.6 2.6.1 2.6.2 2.6.3	Respiratory system, Breathing - inspiration and expiration, Composition of air and partial pressure of gases Physical exchange of gases Transport of oxygen Transport of carbon dioxide Respiratory disorders – Asthma, pharyngitis, laryngitis, hay fever, pneumonia, occupational lung disease (silicosis & asbestosis), cyanosis, respiratory acidosis and alkalosis Excretion 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) Urine formation: Reabsorption / Secretion of glucose, Na+, K+. HCO3 Cl- and H+: renal threshold, Normal & Abnormal constituents of urine, Excretory disorder: Nephritis		
Unit III	**Microbiology**		**15 lectures**
3.1 3.2 3.3 3.4 3.5	Historical background (contributions or Leeuwenhoek. Pasteur, etc) and General characteristics (size, shape and structure) of Bacteria 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) Bacterial cell wall: Structure and function, components of peptidoglycan framework (structure of NAG & NAMA not necessary) Staining methods (principles of staining & types or stains) and microscopic identification of bacteria Microbial Growth - Growth Curve, Mathematical expression, Synchronous growth, Generation time		

3.6	Culture media (N, C, Special requirements), Natural and Synthetic media	
	PRACTICALS	
RUSBCHP202	**PRACTICAL II**	**Credits 01**
	1) Study of Human Digestive, Respiratory & Excretory System with the help of diagrams 2) Estimation of total acidity of gastric juice 3) Urine analysis: Normal Constituents: Urea, Uric acid, Chloride Abnormal Constituents: Glucose, Protein 4) Titrable acidity using Neutral red or Phenol red 5) Qualitative tests for the detection of functional groups 6) Capsule Staining 7) Endospore Staining 8) Lipid Staining	

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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	

Practical Examination Pattern:

(A) Internal Examination:

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

(B) External (Semester end practical examination):

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

PRACTICAL BOOK/JOURNAL

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

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

Overall Examination and Marks Distribution Pattern

Semester – I & II

Course	RUSBCH101			RUSBCH102			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	RUSBCH201			RUSBCH202			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	**200**
Practicals	20	30	50	20	30	50	**100**