Resolution No. AC/II(22-23).3.RUS2

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore • Experience • Excel

Syllabus for

Program: F.Y.B.Sc.

Program Code: RUSBCH

(As per the guidelines of National Education Policy 2020-Academic year 2023-24)

(Choice Based Credit System)

GRADUATE ATTRIBUTES

S.P. Mandali's Ramnrain Ruia Autonomous College has adopted the Outcome Based Education model to make its science graduates globally competent and capable of advancing in their careers. The Bachelor's Program in Science also encourages students to reflect on the broader purpose of their education.

GA	GA Description **A student completing Bachelor's Degree in SCIENCE program will be able to:**
GA 1	Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science.
GA 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.
GA 3	Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools.
GA 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
GA 5	Take complex challenges, work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner.
GA 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
GA 7	Follow ethical practices at workplace and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it.

GA 8	Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner

PROGRAM OUTCOMES

PO	Description **A student completing Bachelor's Degree in SCIENCE program in the subject of BIOCHEMISTRY will be able to:**
PO 1	Achieve better understanding of the major thrust areas of the disciplines like Chemistry of Biomolecules & their metabolism, Cell biology (Basics, Membrane biochemistry, Cancer), Enzymology, Genetics, Plant Biochemistry, Pharmacology, Microbiology & Immunology.
PO 2	Gain acumen of the fundamental biochemical processes occurring at the molecular and gene level.
PO 3	Understand the role of Biochemistry in food and human nutrition
PO 4	Get insights into multiple important analytical tools for Biochemical testing and apply contextual knowledge and tools of biochemical research for problems solving.
PO 5	Acquire and empower technical knowledge by connecting disciplinary and interdisciplinary aspects of biochemistry.
PO 6	Compile and interpret Biological data using Biostatistics and Bioinformatics tools.
PO 7	Express ideas persuasively through scientific writing and oral presentation which will help in the development of the leadership qualities.
PO 8	Possess scientific temperament by research project-based learning.
PO 9	Procure hands-on real time experience in industries.
PO 10	Get exposure to the strong theoretical and practical understanding of various dimensions of Biochemistry and take up research-oriented courses in the fields of Biochemistry, Nutrition & Dietetics, Molecular Biology, etc.

CREDIT STRUCTURE BSc

Semester	Subject 1		Subject 2	GE/ OE course (Across disciplines)	Vocational and Skill Enhancement Course (VSC) & SEC	Ability Enhancement Course/ VEC/IKS	OJT/FP/CEPCC, RP	Total Credits
	DSC	DSE						
1	4		4	4 (2*2)	VSC-2 + SEC -2	AEC- 2 (CSK) + VEC- 2 (Env Sc.) + IKS-2		22
2	4		4	4 (2*2)	VSC-2 + SEC-2	AEC-2 (CSK)+ VEC-2 (Understanding India)	CC-2	22
Total	8		8	8	8	10	2	44
Exit option: award of UG certificate in Major with 44 credits and an additional 4 credit Core NSQF course/ Internship or Continue with Major and Minor								
3	Major 8		Minor 4	2	VSC-2	AEC-2 MIL	FP -2, CC-2	22
4	Major 8		Minor 4	2	SEC-2	AEC-2 MIL	CEP-2, CC-2	22
Total	16		8	4	4	4	8	44
Exit option: award of UG Diploma in Major with 88 credits and an additional 4 credit Core NSQF course/ Internship or Continue with Major and Minor								
5	DSC 12	DSE 4	Minor 2		VSC-2		CEP/FP-2	22
6	DSC 12	DSE 4	Minor 2				OJT-4	22
Total	24	8	4		2		6	44
	Exit option: award of UG Degree in Major with 132 credits or Continue with Major for Honours/ Research							

Course Code: RUSBCH.O101

Course Title: Biomolecules

Type of course: Discipline Specific Core Course

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO1	Categorize lipids, identify structure and functions of fats, phospholipids and cholesterol, and explain the structural differences between saturated, monounsaturated and polyunsaturated fatty acids with the functional implications.
CO2	Illustrate the structures of amino acid, peptide bond formation and classes of amino acids, identify the four levels of protein structure and summarize the function for a range of proteins
CO3	Outline the structure, biological significance of biomolecules - carbohydrates, proteins & lipids which forms the foundation of Biochemistry
CO 4	Explain the chemistry that governs physical, chemical properties and reactions of carbohydrates, proteins and amino acids & lipids.
CO 5	Summarize the important reactions taking place in the biotic world to study metabolic pathways which will be utilized in higher classes of this program.
CO 6	Categorize the structures of several monosaccharides, disaccharides and polysaccharides, and explain their functions.
CO 7	Compare & state differences in quantitative & qualitative estimation and understanding the role and functions of biomolecules.
CO 8	Make use of theoretical concepts of Biomolecules and develop experimental acumen

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Biomolecules RUSBCH.O101	Credits/ Hours 3 / 45 Hours
I	**1**	**Carbohydrates**	**15**
	1.1	Definition, Occurrence and functions of carbohydrates	
	1.2	Classification (Monosaccharides, Oligosaccharides, Polysaccharides)	
	1.3	Monosaccharides	
	1.3.1	Concept of aldoses and ketoses	
	1.3.2	Structures and significance of biologically important monosaccharides: glucose, fructose, galactose, mannose, and ribose.	
	1.4.1	Physical Properties: Chirality: Isomerism D & L, Stereoisomerism: Enantiomers and Diastereomers, Epimers and Anomers, Optical Isomers, Mutarotation	
	1.4.2	Chemical reactions: Oxidation to acidic sugars (Aldonic, Aldaric and Uronic acids) (with respect to glucose) Reduction to sugar alcohols (In boiling alkali, Enediol formation) (with respect to glucose and fructose) Osazone formation (with respect to glucose and fructose) Orcinol formation (with respect to ribose)	
	1.5	Disaccharides Occurrence and structure of Maltose, Lactose and Sucrose Chemical reaction: Formation of glycosidic bonds	
	1.6	Polysaccharides Classification based on structure, occurrence, properties and biological importance Composition: Homopolysaccharides and Heteropolysaccharides with examples	
II	**2**	**Amino acids & Proteins**	**15**
	2.1	Amino acid	
	2.1.1	Structure- D & L forms of all 20 amino acids	
	2.1.2	Detailed classification based on: Polarity, Nutritional classification (Essential & Non-essential)	

	2.2.1	Physical Properties: Zwitter ion, pI of amino acids and Amino acids as ampholytes	
	2.2.2	Chemical reactions of amino acids with Ninhydrin, Sanger's reagent, Edman's reagent and Dansyl chloride	
	2.3	Non-standard amino acids	
	2.4	Functions of amino acids (in brief)	
	2.5	Comparative overview of D- and L-amino acids	
	2.6	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 and colour reactions of proteins	
	2.7	Overview of Protein structure	
	2.8	A) Primary structure -Formation and characterization of the peptide bond B) Secondary structure -Alpha helix and beta sheet C)Tertiary and Quaternary structures- an introduction with one example of each	
	2.9	Protein denaturation	
III	**3**	**Lipids**	**15**
	3.1.1	Definition and function of lipids	
	3.1.2	Classification (Simple, Complex and Derived lipids)	
	3.2	Fatty Acids and Triacylglycerols	
	3.2.1	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 Triacylglycerol - simple and mixed (names and structure)	
	3.2.2	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	
	3.3	Compound Lipids	

		Functions of glycerophospholipids Phosphosphingolipids (ceramide, sphingomyelin) Glycolipids / Cerebrosides (gluco & galactocerebrosides)	
	3.4	Steroids and Lipoproteins Steroids - Cholesterol structure and biochemical significance Lipoproteins – Types (Chylomicrons, VLDL, LDL and HDL) and biochemical significance	

Practical

Sr. No	**Course code-** RUSBCHP.O101 **Practical Title-** Practicals based on RUSBCH.O101	1 Credit
1	Safety measures in laboratories.	
2	Qualitative tests for monosaccharides	
3	Qualitative tests for disaccharides	
4	Qualitative tests for polysaccharides	
5	Qualitative test for amino acids	
6	Qualitative test for proteins	
7	Qualitative test for lipids	
8	Determination of the acid value of a fat	

References:

1. Lehninger, Albert L, Biochemistry, Kalyani Publishers
2. Zubay, Geoffrey L., Biochemistry; Wm. C. Brown publishers
3. Stryer, Lubert; W.H.; Biochemistry; Freeman publishers
4. U. Satyanarayan, U. Chakrapani; Biochemistry. Elsevier
5. Plummer, David T.; Introduction to practical biochemistry; Tata Mc. Graw and Hill publishers.
6. Biochemical methods by S Sadashivam & A Minackam, New Age International publisher.
7. Sawhney, S.K. and Singh, Randhir; Introductory practical biochemistry; Narosa Publishing House
8. Textbook of Medical Biochemistry (8th Edition) – by MN Chatterjea & Rana Shinde, Jaypee publications

Modality of Assessment: Discipline Specific Core Course (3 Credit Theory Course for BSc)

A) Internal Assessment- 40%- 30 Marks

Sr No	Evaluation type	Marks
1	Class test	20
2	Class test/ Project/ Assignment/ Presentation	10
	TOTAL	**30**

B) External Examination- (Semester End) 60%- 45 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **One hour and 30 Minutes** duration.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	Any 3 out of 5	15	UNIT I
Q2.	Any 3 out of 5	15	UNIT II
Q3.	Any 3 out of 5	15	UNIT III
	TOTAL	**45**	

Practical Examination Pattern: Total Marks 25

Particulars	Marks
Laboratory Work	25
Viva & Journal	05
Total	**30**

Semester II

Course Code: RUSBCH.E111

Course Title: Cell Biology & Physiology

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Define the structure and function of nucleic acid strengthening the basic information of DNA and RNA, understanding nitrogenous bases, their bond formation & reactions of nucleic acids.
CO2	Illustrate the mechanism of cell to cell interaction and cell division, to explain structural and functional aspects of the cells.
CO3	Explain difference between weak and strong acids/bases, recognize different ways of expressing concentrations of a solution.
CO4	Interpret the biological significance and functions of water, acids, bases and buffers.
CO5	Summarize the role of cytoskeleton and understand its different components, function and distribution.
CO 6	Interpret the principles of pH measurement, acid-base, buffers and biological buffers its properties and determination of pH using electrodes.
CO7	Analyse the basic concepts of genetics and transmission of genetic information.
CO8	Make use of theoretical concepts of Cell Biology & Physiology in Biochemistry and develop experimental acumen

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Cell Biology & Physiology RUSBCH.E111	Credits/ Hours 3 / 45 Hours
I	**1**	**Nucleus & its components**	**15**
	1.1	Overview of Nucleus, Nuclear Envelop, Nucleolous	
	1.2	Introduction to nucleic acids	
	1.2.1	Structure - Purine & Pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides (ATP, CTP, GTP, TTP, UTP)	
	1.2.2	Formation of phosphodiester bond and shorthand representation of polynucleotide strand	
	1.3	RNAs (various types in prokaryotes and eukaryotes) mRNA, hnRNA, rRNA, snRNA & snoRNA - general account, tRNA - clover leaf model, Ribozymes	
	1.4	DNA	
	1.4.1	Physical evidence of DNA helical structure. Chargaff's rules (chemical evidence), Watson-Crick model of DNA & its features	
	1.4.2	Physical properties of DNA - Effect of heat on physical properties of DNA (Viscosity, buoyant density, UV absorption), Hypochromism, hyperchromism, denaturation of DNA.	
	1.5	Reactions of nucleic acids (with DPA and Orcinol)	
II	**2**	**Cytoskeleton, Cell-cell interaction & Cell cycle**	**15**
	2.1	Introduction and Importance of Cytoskeleton	
	2.2	Types (Microtubules, Microfilaments & Intermediate Filaments)	
	2.2.1	Structure, assembly and function of Microtubules: Axonemal and cytoplasmic microtubules (cilia, flagella, centrioles, basal bodies)	
	2.2.2	Microfilaments: Actin & Myosin, Cytoplasmic streaming	
	2.2.3	Intermediate Filaments: Anchoring cell junctions	
	2.3	Motor Proteins – Kinesins, Dyneins & Myosins	
	2.4	Cell - Cell Interaction	
	2.4.1	Cell-Cell Interactions and Cell-Matrix Interactions	
	2.2.4	Components of Extracellular Matrix: Collagen and Non-Collagen Components	
	2.4.3	Tight Junctions; Gap Junctions; Chemical synapses and Plasmodesmata	

	2.5	Role & Importance of Cell Interaction	
	2.6	Cell Cycle	
	2.6.1	Overview of Cell Cycle, Phases of Cell Cycle	
	2.6.2	Role of checkpoints, Regulation of cell cycle - Cyclins & CDKs	
III	**3**	**Water and Acids, bases & buffers**	**15**
	3.1	Water	
	3.1.1	Water and its biological significance, water as a universal solvent.	
	3.1.2	Hydrogen bonding and structure	
	3.1.3	Concepts of mole, molar, molar equivalent and normal, Dalton	
	3.1.4	Ionization of water, weak acids and weak bases	
	3.1.5	Numericals based on the above concept	
	3.2	Acid and Bases	
	3.2.1	Definitions and Introduction of pH Scale, Measurements, Indicators, Strong and Weak Electrolytes	
	3.2.2	Titration Curve of glycine	
	3.2.3	Working of pH meter and glass electrode	
	3.3	Buffers	
	3.3.1	Mechanism of Buffer Action, Buffering Capacity	
	3.3.2	Preparation of Buffer Solutions – Acidic and Basic Expression of Hendersen–Hasselbalch equation, Henderson equation of acidic and basic buffer solution	
		Numericals based on the above concept	

Practical

Sr. No	**Course code-** RUSBCHP.E111 **Practical Title-** RUSBCH. E111	1 Credit
1	Qualitative test for nucleic acids	
2	Smear technique to demonstrate sex chromatin in buccal epithelial cells	
3	Preparation & standardization of laboratory reagents	
4	Quantitative estimation of normality of FAS	
5	Preparation of buffers, phosphate and acetate buffers	
6	Determination of pKa of glycine	
7	Determination of the Alkalinity of water/ Effluent	
8	Determination of the Acidity of water/ Effluent	

References:

1. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma, V.K. Agarwal
2. Zubay, Geoffrey L., Biochemistry; Wm. C. Brown publishers
3. Stryer, Lubert; W.H.; Biochemistry; Freeman publishers
4. U. Satyanarayan, U. Chakrapani; Biochemistry. Elsevier
5. Stanier,Ingraham et al ,General Microbiology 4th & 5th Ed. 1987, Macmillan Education Ltd
6. Analytical Biochemistry by David Holme
7. Biophysical Chemistry, Avinash Upadhyay
8. Keith Wilson & John Walker, Practical Biochemistry, principle and technique, Cambridge University, 5th edition
9. Plummer, David T.; Introduction to practical biochemistry; Tata Mc. Graw and Hill publishers.
10. Boyer, Rodney F., Modern experimental biochemistry
11. Sawhney, S.K. and Singh, Randhir; Introductory practical biochemistry; Narosa Publishing House
12. Jane B Reece; Neil A Campbell, Campbell biology 9th edition, Boston: Benjamin Cummings / Pearson, ©2011.
13. Bruce albert, Molecular Biology of the cell 6th edition, Taylor & Francis (Garland Science)

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