Resolution No. AC/II(20-21).2.RUS2

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore • Experience • Excel

Syllabus for

TYBSc

Program: BSc

Program Code: RUSBCH

(Credit Based Semester and Grading System for academic year 2020–2021)

PROGRAM OUTCOMES

PO	PO Description **A student completing Bachelor's Degree in SCIENCE program will be able to:**
PO 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.
PO 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.
PO 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.
PO 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
PO 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.
PO 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
PO 7	Follow ethical practices at work place and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it.
PO 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 SPECIFIC OUTCOMES

PSO	Description **A student completing Bachelor's Degree in SCIENCE program in the subject of BIOCHEMISTRY will be able to:**
PSO 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.
PSO 2	Gain acumen of the fundamental biochemical processes occurring at the molecular and gene level.
PSO 3	Understand the role of Biochemistry in food, human nutrition and environmental science.
PSO 4	Get insights into multiple important analytical tools for Biochemical testing and apply contextual knowledge and tools of biochemical research for problems solving.
PSO 5	Acquire and empower technical knowledge by connecting disciplinary and interdisciplinary aspects of biochemistry.
PSO 6	Compile and interpret Biological data using Biostatistics and Bioinformatics tools.
PSO 7	Express ideas persuasively through scientific writing and oral presentation which will help in the development of the leadership qualities.
PSO 8	Possess scientific temperament by research project-based learning.
PSO 9	Procure hands-on real time experience in industries.
PSO 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.

PROGRAM OUTLINE

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
TYBSc	V	RUSBCH501	Membrane Biochemistry & Cancer Biology	2.5
		RUSBCH502	Analytical Techniques & Introduction to Immunology	2.5
		RUSBCH503	Molecular Biology	2.5
		RUSBCH504	Biostatistics & Bioinformatics	2.5
		RUSBCHP501	Practicals based on RUSBCH501	1.5
		RUSBCHP502	Practicals based on RUSBCH502	1.5
		RUSBCHP503	Practicals based on RUSBCH503	1.5
		RUSBCHP504	Practicals based on RUSBCH504	1.5
	VI	RUSBCH601	Human Physiology & Pharmacology	2.5
		RUSBCH602	Food Biochemistry & Environmental Science	2.5
		RUSBCH603	Biochemistry of Metabolism	2.5
		RUSBCH604	Nutritional Biochemistry	2.5
		RUSBCHP601	Project Work	1.5
		RUSBCHP602	Practicals based on RUSBCH602	1.5
		RUSBCHP603	Practicals based on RUSBCH603	1.5
		RUSBCHP604	Practicals based on RUSBCH604	1.5

Semester V

Course Code: RUSBCH501

Course Title: Membrane Biochemistry & Cancer Biology

Academic year 2020-21

COURSE OUTCOMES:

After successful completion of this course, the students would be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand the importance of carbohydrates, lipids and proteins as a structural component of biomembranes.
CO 2	Summarize the composition and structure of biomembranes, transport mechanisms across biological membranes.
CO 3	Illustrate the mechanism of oxidative phosphorylation, photophosphorylation and basic concept of Bioenergetics
CO 4	Learn the concept and mechanism of ATP synthesis
CO 5	Describe factors that contribute to cancer development, discuss cancer prevention and currently available therapeutic treatments.
CO 6	Develop an understanding on various genetic and molecular changes which takes place during transformation into malignant cells.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title Membrane Biochemistry & Cancer Biology RUSBCH501	Credits/ Lectures 2.5 Credits
I	**1**	**Biomembranes & Cell Surface**	**15L**
	1.1	Overview of membrane functions	2L
	1.2	Fluid mosaic model	
	1.3	Chemical Composition of Membranes	3L
	1.3.1	Membrane lipids (Phospholipids, Glycolipids, sterols (Cholesterol), Lipid rafts	
	1.3.2	Membrane proteins - Classification- Peripheral Proteins, Integral Membrane Proteins and Lipid-Anchored proteins Peripheral Proteins- Spectrin on RBC Integral Membrane Proteins- Glycophorin A on RBC Lipid-Anchored proteins- Role of GPI anchored protein in blood grouping	8L
	1.3.3	Membrane carbohydrate – Role of membrane glycoproteins	2L
II	**2**	**Membrane Transport, Vesicular Transport and Membrane Fusion**	**15L**
	2.1	Introduction to the transport mechanism across cell membrane	3L
	2.2	Passive transport – Passive diffusion (Polar & Non polar),diffusion and osmosis, facilitated diffusion of ions and molecules	
	2.3	Ion channels- Ligand gated, mechanical gated, Voltage gated	3L
	2.4.1	Primary Active transport ATPases pump- Na^+-K^+ Pump, ABC transporter	2L
	2.4.2	Secondary active transports Symport (Mechanism of Absorption of peptides by eneterocytes)	2L
	2.5	Specialized ion channels- Aquaporins	3L
	2.6	Antiport -Absorption of peptides by eneterocytes,	
	2.7	Artificial membrane vesicle-Liposomes, Micelles	2L
III	**3**	**Bioenergetics & Oxidative Phosphorylation**	**15L**
	3.1.1	Principle of Bioenergetics	2L
	3.1.2	Importance of thermodynamics, concept of Gibb's free energy, enthalpy, entropy, Standard free energy change and equilibrium constant	3L
	3.2	Oxidative phosphorylation Electron transfer reactions in mitochondrion (Complexes I to IV; Q cycle in Complex III)	4L

	3.3	Structure of ATP synthase and ATP synthesis Models for ATP synthesis - chemiosmotic model & Rotational Catalysis	4L
	3.4	Inhibitors & Uncouplers of ETC and ATP synthesis	2L
IV	**4**	**Cancer Biology & Apoptosis**	**15L**
	4.1.1	Introduction to the biology of cancer	2L
	4.1.2	Difference between tumor and Cancer	
	4.2.1	Classification of tumor	2L
	4.2.2	Properties of cancer cells	
	4.3	Cell cycle regulators and cancer	1L
	4.4.1	Oncogene- Ras protein	2L
	4.4.2	Tumor suppressor gene- Role of P53, Comparison between functional & Non Functional p53	
	4.5	Assays – Trypan blue exclusion method, MTT assay, Soft Agar Colony Formation Assay	2L
	4.6	Cancer therapy -	2L
	4.6.1	Chemotherapy (purine & pyrimidine analog)	
	4.6.2	Demethlyating agents	
	4.7	Apoptosis –	2L
	4.7.1	Properties of apoptotic cells	
	4.7.2	Difference between apoptosis and Necrosis	
	4.7.3	Role of caspases in apoptosis	
	4.7.4	Mechanism (Intrinsic & Extrinsic pathway)	2L
		Practicals – RUSBCHP501	**1.5 Credits**
	1	Osmosis across dialysing membrane	
	2	Diffusion rate of $KMnO_4$	
	3	Study the differential permeability of a semi-permeable membrane	
	4	Effect of temperature and molecular weight on diffusion	
	5	Visualization of cells by methylene blue	
	6	Study of viability of cells using Neutral red Assay	
	7	Mitochondrial respiration and effect of different Inhibitors for ETC (Dry lab)	

References:

1. Jain MK. Introduction to Biological membranes, John Wiley and sons New York, 1988
2. Vance DE & Vance JE, Biochemistry of lipids and Biomembranes, Benzamin Cummings 1985
3. Biomembranes by RB Gennis Springer Verlag 2012 2nd edition
4. Jones MN & Chapman D. Micelles monolayers and biomembranes Wiley-Lis New York, 1995
5. Molecular Biology of Cell: Bruce Alberts, 4th Edition, Garland Science
6. Weinberg RA. The Biology of Cancer, Second Edition, NewYork: GarlandScience,2013.
7. Ruddon RW. Cancer Biology, fourth edition, Oxford University Press, USA.
8. Biochemistry by Voet & Voet, International student version
9. Lehninger's - Principles of Biochemistry by David L. Nelson
10. Introductory Practical Biochemistry by Sawhney

11. Practical Biochemistry by David Plummer
12. Biochemical methods by S Sadashivam & A Minackam, New Age International publisher.

Course Code: RUSBCH502

Course Title: Analytical Techniques & Introduction to Immunology

Academic year 2020-21

COURSE OUTCOMES:

After successful completion of this course, the students would be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand isolation, culture and counting of cells and model organisms used in research.
CO 2	Describe the separation & purification techniques for proteins & techniques to quantify biomolecules.
CO 3	Develop an understanding of the characteristics and the nature of antigen – antibody reactions
CO 4	Justify the role of immune cells and their mechanism in body defence system
CO 5	Illustrate various mechanisms that regulate immunological response and how it's triggered and regulated
CO 6	Learn different tools & techniques used in diagnosis like Radioimmunoassay, ELISA, Immunofluorescence, Western Blotting, etc.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title Analytical Techniques & Introduction to Immunology RUSBCH502	Credits/ Lectures 2.5 Credits
I	**1**	**Biochemical Investigation**	**15L**
	1.1	Approaches to and levels of biochemical investigations	2L
	1.2	Whole animal and plant studies – the advantages and disadvantages of model systems for biochemical investigation (*E.coli*, Yeast, *Dictyostelium*, *C. elegans*, *Drosophila*, *Arabidopsis*)	4L
	1.3	Organ & Tissue studies	3L
	1.4	Isolated and cultured tissue and cell techniques: isolation, culture and counting of cells	
	1.5	Cell Fractionation:	3L
	1.5.1	Cell rupture – solid shear, liquid shear, high pressure, ultrasound, osmotic shock, chemical treatment (enzyme, organic solvent), temperature	
	1.5.2	Choice of suspension medium (isotonic & hypotonic solution, PBS) and separation methods	3L
	1.5.3	Problems of cell fractionation	
II	**2**	**Protein Purification Techniques**	**15L**
	2.1	Protein Isolation Selection of a Protein Source Methods of Solubilization Stabilization of Proteins Assay of Proteins	3L
	2.2	General Strategy of Protein Purification Solubilities of Proteins Effects of Salt Concentrations Effects of Organic Solvents Effects of pH Crystallization	3L
	2.3	Ultracentrifugation- Preparative Ultracentrifugation	1L
	2.4	Chromatographic Separations- Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography	4L
	2.5	Electrophoresis- Gel Electrophoresis, SDS PAGE, Isoelectric Focusing	4L
III	**3**	**Introduction to Immunology**	**15L**
	3.1.1	Innate immunity – Anatomical barriers, physiological barriers, phagocytic/endocytic barriers, Inflammatory barriers	4L
	3.1.2	Adaptive immunity – Active & Passive	

	3.2	Cells of the immune system: Lymphocytes – B cells and T cells, Natural killer cells – Mononuclear phagocytes, Granulocytes, Antigen presenting cells	4L
	3.3	Organs of the immune system	4L
	3.3.1	Primary lymphoid organs: Thymus, Bone marrow	
	3.3.2	Secondary lymphoid organs: Lymphatic system, Lymph nodes, Spleen, MALT	
	3.4	Immune responses - Humoral & Cell mediated response	3L
	3.5	Overview of B-cell & T-Cell activation, maturation & differentiation	
IV	**4**	**Antigens and antibodies**	**15L**
	4.1	Antigens: Antigenecity, immunogenecity, epitope, factors determining immunogenecity, Haptens, adjuvants	3L
	4.2	Antibodies	5L
	4.2.1	Tiselius & Kabat Experiment, Porter & Edelman Experiment	
	4.2.2	Fine structure of immunoglobulin	
	4.2.3	Antibody classes and biological activities	
	4.2.4	Antigenic determinants on immunoglobulins, B-cell receptor	
	4.3	Antigen- Antibody interactions: Forces involved, antibody affinity, antibody avidity, Cross reactivity	2L
	4.3.1	Precipitation reactions – Oudins, Ouchterlony	2L
	4.3.2	Agglutination reactions: Blood typing, bacterial agglutination, passive agglutination, agglutination inhibition, Coomb's test	3L
	4.3.3	Immunoelectrophoresis : Principles of Radioimmunoassay, ELISA, Immunofluorescence, Western Blotting	
		Practicals – RUSBCHP502	**1.5 Credits**
	1	Separation of proteins by gel filtration chromatography	
	2	Demonstration of separation of proteins using anion-exchange chromatography	
	3	Ammonium sulphate fractionation of proteins	
	4	Virtual lab – Study of model organisms in research	
	5	Isolation & Partial purification of an enzyme (Cell lysis, Centrifugation, salting out dialysis & size exclusion chromatography) (Note- Size exclusion chromatography- Separation based on molecular weight)	
	6	Preparation of blood smear and Differential leucocyte count	
	7	Immunoprecipitation of antigen and antibody	
	8	Ouchterlony double immunodiffusion (DID)	

	9	Assays based on agglutination reactions - Blood typing	
	10	Demonstration of Enzyme linked immunosorbent assay (ELISA)	
	11	WIDAL test – Qualitative & Quantitative	

References:

1. Cell Biology: Essential techniques – David Rickwood – Wiley
2. Cell Separation A practical Approach – D. Fisher, G E Francis and D Rickwood – Oxford University Press
3. A.L., Lehninger, Principles of Biochemistry (1982), Worth Publishers, Inc. New York.
4. Protein Purification: Principles, High Resolution Methods, and Applications (Methods of Biochemical Analysis), Jan-Christer Janson, 2011.
5. Immunology by Goldsby and Kuby, W.H. Freeman Co.
6. Weir D.M., Immunology: Student's Notes, ELBS- Oxford.
7. Bowry T.R., Immunology Simplified, 2nd Ed., ELBS and Oxford.
8. Ivan, Immunology Method Manual, Vol. 4 1997, Academic Press, Sani Diego.
9. Roitt Ivan and others, Immunology, 6th Ed., Mosby, Edinburg.
10. Hood Leroy E., Immunology, 2nd Ed., 1976, Benjamin Cummings Publication
11. Biochemical methods - S Sadashivam and A Manickam - New Age International publishers
12. Laboratory Manual in Biochemistry - J. Jayaraman - New Age International
13. An Introduction to Practical Biochemistry - Plummer David

Course Code: RUSBCH503

Course Title: Molecular Biology

Academic year 2020-21

COURSE OUTCOMES:

After successful completion of this course, the students would be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Learn the molecular events of DNA Replication, transcription and translation process
CO 2	Understand the principle of gene organization and the roles of promoters, coding and termination sequences
CO 3	Distinguish and compare the transcription process occurring in prokaryotes and eukaryotes
CO 4	Describe how gene expression is regulated at the post-transcriptional level
CO 5	Analyse the tools and techniques for construction of recombinant DNA, cloning vectors & genomic and cDNA library
CO 6	Gain knowledge on the applications of RDT in various field

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title Molecular Biology RUSBCH503	Credits/ Lectures 2.5 Credits
I	**1**	**DNA Replication & Repair**	**15L**
	1.1.1	Replication of DNA (in prokaryotes)	3L
	1.1.2	Modes of DNA replication: Theta & rolling circle	
	1.2	Enzymes (pol I, II and III) and accessory proteins	3L
	1.3	Mechanism of semi-conservative replication (Initiation, elongation & termination)	3L
	1.4	DNA repair Mechanisms	4L
	1.4.1	Direct repair (Photoreactivation, O^6 methyl guanine DNA methyl transferase)	
	1.4.2	Excision repairs - base & nucleotide excision, Mismatch repair (Hemimethylation of DNA)	
	1.4.3	SOS repair	2L
	1.4.4	Recombinational repair	
II	**2**	**Transcription & Post-transcriptional Modifications**	**15L**
	2.1	Introduction to Transcription	1L
	2.2	Types of RNA & its function	2L
	2.3	Assembly for transcription-Template strand, RNA polymerase Holoenzyme, Transcriptional unit, Promoter	
	2.4	Mechanism of RNA transcription in prokaryotes: Initiation, elongation and termination	3L
	2.5	Significance of Sigma factor, Concept of Abortive initiation	1L
	2.6	Comparative overview of transcription in prokaryotes & eukaryotes	2L
	2.7	Inhibitors of transcription -Rifampicin, Actinomycin D	
	2.8.1	mRNA (Mechanism of formation of 5'-cap and poly A tail),	1L
	2.8.2	Post-transcriptional modifications: Concept of introns, exons, split genes and mechanism of mRNA splicing	2L
	2.8.3	Processing of tRNA, rRNA (arrangement of prokaryotic rDNA)	1L
	2.9	Reverse transcription (Mechanism, significance & application)	2L
III	**3**	**Translation & Post-translational Modifications**	**15L**
	3.1	Introduction to Translation (protein biosynthesis) in prokaryotes	1L
	3.2	Characteristics of Genetic code, tRNA synthetase	2L
	3.3	Mechanism of translation: Activation of amino acids, chain initiation, elongation & termination	4L

	3.4	Inhibitors of prokaryotic translation (Puromycin, Streptomycin, Tetracycline, Chloramphenicol, Erythromycin)	2L
	3.5	Post translational modifications of proteins (proteolytic cleavage, acylation, phosphorylation, methylation, glycosylation)	2L
	3.6	Signal hypothesis	2L
	3.7	Concept of Protein sorting in cell organelles	2L
IV	**4**	**Introduction to RDT & techniques of RDT**	**15L**
	4.1	Introduction of RDT	3L
	4.2	Tools for RDT	
	4.2.1	Enzymes- Restriction endonucleases, ligases, terminal transferases, reverse transcriptase	
	4.2.2	Cloning and Expression Vectors- Plasmid, pBR 322, PUC-19 Bacteriophage – Lambda phage Cosmid; Artificial Chromosomes(BAC and YAC) Shuttle vectors	3L
	4.2.3	Probes- DNA probes	2L
	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	2L
	4.5	Gene Transfer: Transfection, Electroporation, Microinjection, Liposome, Microprojectile (in brief)	3L
	4.6	Selection and screening- Antibiotic and colony hybridization	2L
	4.7	DNA Amplification by PCR	
	1 2 3 4 5 6 7 8	**Practicals – RUSBCHP503** To hydrolyze DNA and separate nucleotide bases by paper chromatography Estimation of UV absorption of nucleic acids & proteins Study of viscosity of DNA solution Estimation of DNA by the Diphenylamine method Isolation of chromosomal DNA from *E coli* cells Isolation of RNA from Yeast/ Liver Estimation of RNA by Orcinol Method Extraction of total nucleic acids from plant tissue	**1.5 Credits**

References:

1. Molecular Biology of Cell: Bruce Alberts, 4th Edition, Garland Science
2. Tropp, B.E. Molecular Biology. Genes to Proteins.2011 (4th Ed.) Jones and Bartlett publications.
3. Freifelder, D. Essential of Molecular Biology, 1998 (3rd Ed.)
4. Lewin, B. Gene X, Jones & Bartlett, 2009

5. Molecular Cell Biology by James Dernell, Harvey Lodish and David Baltimore, W.H. Freeman & Co., 2007 (6th Ed.).
6. From Genes to Genomes by Bale J.W. & Schantz M. V. (2003).
7. Gene Biotechnology by Jogdand
8. Biochemical methods by S Sadashivam & A Minackam, New Age International publisher.

Course Code: RUSBCH504

Course Title: Biostatistics & Bioinformatics

Academic year 2020-21

COURSE OUTCOMES:

After successful completion of this course, the students would be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Organize the fundamental concepts in the design and analysis of medicinal studies, including difference between observational and experimental studies, the outcome measure of study, comparability of the control group or control population.
CO 2	Collect data relating to variables which can be examined and descriptive statistics can be calculated from the obtained data
CO 3	Translate the knowledge gained on types of data and tools of data collection in compiling and performing statistical analysis.
CO 4	Gain knowledge about various biological databases that provide information about nucleic acid and proteins.
CO 5	Locate and extract data from key bioinformatics databases and resources.
CO 6	Understand the use of computational skills in the field of Biology

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title Biostatistics & Bioinformatics RUSBCH504	Credits/ Lectures 2.5 Credits
I	**1**	**Biostatistics & descriptive statistics**	**15L**
	1.1	Introduction to Biostatistics	2L
	1.2	Scope and applications of biostatistics	
	1.3	Common statistical terms: Sources, nature and presentation of data; Measurement and scales of measurement	3L
	1.4	Descriptive statistics:	4L
	1.4.1	Measures of central tendency - Mean, Median and mode	
	1.4.2	Measures of dispersion- Range, percentiles, variance, SD, Mean deviation, Coefficient of variation	6L
II	**2**	**Test of Hypothesis I**	**15L**
	2.1.1	Normal distribution and normal curve	4L
	2.1.2	Asymmetric distribution	
	2.1.3	Normal variate & its significance	
	2.1.4	Statistical problems based on the above concepts	
	2.2	Introduction to Hypothesis	3L
	2.2.1	Concept of Level of Significance, Degrees of freedom, One-tailed and two tailed tests, Type I and Type II errors	
	2.2.2	Hypothesis testing of mean - Z-test, t-test (grouped and ungrouped data)	5L
	2.2.3	Statistical problems based on the above concepts	
	2.3.1	Introduction to ANOVA, Types of ANOVA	3L
	2.3.2	Statistical problems based on the above concepts	
III	**3**	**Test of Hypothesis II**	**15L**
	3.1.1	Introduction to Hypothesis testing of difference between population means	5L
	3.1.2	Z-test, t-test (Paired and unpaired)	
	3.1.3	Statistical problems based on the above concepts	
	3.2	Tests based on Chi-square distribution	4L
	3.2.1	Test of population variance	
	3.2.2	Test of goodness of fit	3L
	3.2.3	Test of association - 2 x 2 Table, Yates' correction	3L
	3.2.4	Statistical problems based on the above concepts	
IV	**4**	**Bioinformatics**	**15L**
	4.1	Introduction to Bioinformatics	1L
	4.2	Sequence & Nomenclature	2L
	4.2.1	IUPAC Symbol	
	4.2.2	Nomenclature of DNA Sequences	
	4.2.3	Nomenclature of Protein Sequences	
	4.2.4	Directionality of sequences	

	4.3	Types of sequences used in bioinformatics- Genomic DNA, cDNA, Organelle DNA, EST's, Gene sequencing tag, STS & Biomolecules	2L
	4.4	Information sources in Bioinformatics Genome database, Mouse genome database, Genebank	1L
	4.5	Information retrieval from biological databases- Entrez, Taxonomy browser, Locus link & Sequence Retrieval Systems (SRS)	3L
	4.6	Similarity based database searching tools- BLAST & FASTA	3L
	4.7	Resources for gene level sequence- Uni-gene database, Homo-gene database & Refseq database	2L
	4.8	Applications of informatics tools in Analysis- Genomics and Proteomics	1L
		Practicals – RUSBCHP504	**1.5 Credits**
	1	Descriptive statistics using Microsoft excel	
	2	Hypothesis testing of means & ANOVA using excel	
	3	Hypothesis testing of difference between means &	
	4	Chi-square test using excel	
	5	Sequence retrieval (protein and gene) from NCBI and Molecular file formats - FASTA, GenBank/Genpept.	
	6	BLAST suite of tools for pairwise alignment	
	7	Molecular Visualization Softwares: Pymol and Rasmol for protein structures from PDB	
		Multiple sequence alignment (CLUSTALW/TCoffee) and construction of phylogenetic trees	

References:

1. Biostatistics by P. K. Malhan and P. N. Arora, Himalaya Publishing house
2. Methods of biostatistics for medical students and research workers by Mahajan, B.K.; Jaypee brothers publishers.
3. Bioinformatics- Concepts, Skill and applications by Rastogi, S.C.; Mendiratta, Namita and Rastogi, Parag; C.B.S. Publishers & Distributors
4. Principles of biostatistics, M. Pagano and K. Gauvreau (2000); Duxbury Thomas learnings
5. Essential Bioinformatics (2006), JinXiong, Cambridge University Press
6. Bioinformatics: Sequence and Genome Analysis (2001), 1st ed., Mount, D.W. Cold Spring Harbor Laborator Press (New York)
7. Bioinformatics and Functional Genomics (2003), 1st ed., Pevsner, J., John Wiley & Sons,Inc. (New Jersey)
8. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (2005), 3rd ed.,Baxevanis, A.D. & Ouellette, B.F., John Wiley & Sons, Inc. (New Jersey)
9. Bioinformatics – Principles and Applications (2008), 1st ed. Ghosh, Z. and Mallick, B.,Oxford University Press (India)

Modality of Assessment (SEMESTER V)

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	One Assignment/poster presentation/Model making/Quiz	20
2	One class Test (multiple choice questions / subjective)	20
	TOTAL	40

B) External Examination- 60%- 60 Marks
Semester End Theory Examination:

1. Duration - These examinations shall be of **02 HOURS** duration.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1. A	Any 1 out of 2	03	UNIT I
Q1. B	Any 2 out of 3	06	
Q2. A	Any 1 out of 2	03	UNIT II
Q2. B	Any 2 out of 3	06	
Q3. A	Any 1 out of 2	03	UNIT III
Q3. B	Any 2 out of 3	06	
Q4. A	Any 1 out of 2	03	UNIT IV
Q4. B	Any 2 out of 3	06	
	TOTAL	60	

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

Particulars	Practical I, II, III & IV
Journal	05
Experimental tasks	15
Total	**20**

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:

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

Overall Examination & Marks Distribution Pattern

Semester V

Course	501			502			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	503			504			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

Semester VI

Course Code: RUSBCH601

Course Title: Human Physiology & Pharmacology

Academic year 2020-21

COURSE OUTCOMES:

After successful completion of this course, the students would be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand the functions of physiological systems such as cardiac and reproductive and its related disorders.
CO 2	Elucidate the structure, layer, chamber and valves of the human cardiac system
CO 3	Describe the structure of the organs of the reproductive system in males and females.
CO 4	Recognize the speed of onset of drug action, intensity of the drug's effect and duration of action controlled by fundamental pathways of drug movement and modification in the body - Absorption, Distribution, Metabolism and Elimination.
CO 5	Impart fundamental knowledge on the mode of action of different therapeutic drugs its mechanism and adverse effects.
CO 6	Apply knowledge of research culture at under graduate level, to know the concept of research its objectives, tools and importance and techniques of documentation.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title Human Physiology & Pharmacology RUSBCH601	Credits/ Lectures 2.5 Credits
I	**1**	**Cardiac Physiology and related disorders**	**15L**
	1.1.1	Structure of the heart	3L
	1.1.2	Layers of the heart wall	
	1.1.3	Chambers and valves of the heart	
	1.2	Physiology of the cardiac muscle	2L
	1.3	Conducting system of heart, comparative rates of conduction system of heart	3L
	1.4	Heart sound, heart rate and factors influencing heart rate	2L
	1.5	Cardiac cycle and effect of heart rate on cardiac cycle	2L
	1.6	Cardiac output	1L
	1.7	Hypertension, congestive heart disease, myocardial infarction, cardiac arrhythmias	2L
II	**2**	**Reproductive system**	**15L**
	2.1	Male reproductive system: scrotum, testes, reproductive system ducts of in males, accessory sex glands	3L
	2.2	Female reproductive system: Ovaries, uterine tubes, uterus, vagina, vulva, perineum, mammary glands	3L
	2.3	The female reproductive cycle: Hormonal regulation of the female reproductive cycle, phases of the female reproductive cycle	2L
	2.4	Birth control measures; abortion: Surgical sterilization, hormonal methods, abortion	2L
	2.5	Development of the reproductive systems Aging; reproductive systems	2L
	2.6	Clinical connection: Cryptorchidism, vasectomy, circumcision, premature ejaculation, ovarian cysts	3L
III	**3**	**Pharmacokinetics & Bioassay**	**15L**
	3.1	Physicochemical properties of drugs	2L
	3.2	Routes of drug administration	3L
	3.2.1	Drug absorption: through-GIT, pulmonary, renal, placental and blood-brain barrier	2L
	3.2.2	Bioavailability and Bioequivalence	1L
	3.3	Drug Distribution	1L
	3.4	Drug Metabolism and Excretion	2L
	3.5	Factors affecting drug dosage and drug delivery	2L
	3.6	Bioassays: Preclinical and clinical evaluation, Therapeutic drug monitoring	2L
IV	**4**	**Therapeutic drugs & Drugs acting on Haemopoietic System**	**15L**

	4.1	Therapeutic drugs: (Mechanism of action and adverse effects)	1L
	4.1.1	Anti-inflammatory – Non steroid anti-inflammatory NSAID [Ibuprofen], Salicylates – [Aspirins]	1L
	4.1.2	Cardiovascular drugs- CVS [Ca channel blocker- Amlodipine, and Beta blocker – Proprenolol]	1L
	4.1.3	Antibiotic – Penicillin and Sulphonamide	2L
	4.1.4	Antacid- Proton pump blocker –Omeprazole	
	4.2	Drugs acting on Haemopoietic System	
	4.2.1	Metabolism of iron	1L
	4.2.2	Iron therapy: Oral Iron preparations, Parental Iron preparations, Toxicity of Iron: Desferrioxamine Mesylate	2L
	4.2.3	Folic Acid (Pteroylglutamic acid) : Mode of Action, Therapeutic Uses	1L
	4.2.4	Vitamin B12 (Cyanocobalamin): Mode of Action, Therapeutic Uses	1L
	4.2.5	Hydroxycobalamin	1L
	4.2.6	Erythropoietin	
	4.2.7	Colony Stimulating Factors: Filigrastim, Lenograstim, Molgramostim	1L
	4.2.8	Anti-coagulants – Mechanism of Haemostasis Intravenous anticoagulants – Heparin Oral anticoagulants – Coumarin derivatives & Indanedione derivatives	3L
		Practicals – RUSBCHP601: PROJECT WORK Guideline to Carry Out Project work 1. The main purpose of introduction of Project Work at TYBSc 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. 2. Each student individually or in a group shall complete a small research project during their academic year of TYBSc. However, the initial reference work for the project can be started after the conclusion of SYBSc Semester IV examination and summer vacation to TYBSc. 3. Nature of Research Project:-Experimental-based involving laboratory analytical work will be considered as the Research Project. 4. Duration of Project work:-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 mid of January of TYBSc (Sem V) academic year.	**1.5 Credits**

5. Schedule for Submission of project Work:- Experimental work must be completed and the report on the same (2 Copies) will have to be submitted by the end of January of TYBSc (Sem V) academic year.
6. The project should be divided into the following parts:-
    a) Certification of completion of Project Work
    b) Acknowledgement
    c) Introduction
    d) Review of Related Literature
    e) Aims and Objectives
    f) Plan of work
    g) Material and Methods
    h) Results
    i) Discussion
    j) Bibliography
7. The project will be assessed

GUIDELINE FOR THE ASSESMENT OF PROJECT WORK

1. The practical 601 of Sem VI (Course Code No. RUSBCHP601) 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 TYBSc (Sem V) 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

Particular		**Marks**
a)	Project Work (Contents Submitted in the bound form)	30
b)	Presentation of Project Work to examiner	10
c)	Viva- voce Exam based on Project Work	10
	TOTAL	**50**

References:

1. Principles of Anatomy and Physiology: Gerard J, 12th edition, John Wiley & Sons.
2. Human Physiology –Chatterjee.C.C, Medical Allied Agency
3. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T., McGraw Hill International Publications (New York),
4. Textbook of Medical Physiology (2011) 10th ed., Guyton, A.C. and Hall, J.E., Reed Elseviers India Pvt. Ltd. (New Delhi).
5. Fundamental of Anatomy and Physiology (2009), 8th ed., Martini, F.H. and Nath, J.L., Pearson Publications (San Francisco),
6. Essentials of Pharmacotherapeutics by FSK Barar
7. Pharmacology and Pharmacotherapeutics by R.S. Satoskar, Nirmala N. Rege, S.D. Bhandarkar, Elsevier

Course Code: RUSBCH602

Course Title: Food Biochemistry & Environmental Science

Academic year 2020-21

COURSE OUTCOMES:

After successful completion of this course, the students would be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand physical & chemical reactions in food, the role of enzymes in food processing and how they aid in carrying out changes in food
CO 2	Identify the chemistry and applications of enzymes in food industries and flavour.
CO 3	Acquire thorough knowledge about the changes in reactions in food and how enzymes could be of great importance in food processing
CO 4	Know the properties of different food components and to understand the principle underlying the biochemical techniques used in food analysis.
CO 5	Describe the interdisciplinary nature of environmental studies and also create awareness for the same.
CO 6	Impart knowledge of various methodologies that are adapted for effective monitoring of environmental parameters.
CO 7	Introduce the concept of water and waste water treatment techniques and the aspects involved in solid waste minimization and complete environmentally safe method of their disposal.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title Food Biochemistry & Environmental Science RUSBCH602	Credits/ Lectures 2.5 Credits
I	**1**	**Physicochemical Principles of food**	**15L**
	1.1	Introduction & Importance	2L
	1.1.1	Physical & chemical characteristics of food	
	1.2	Factors affecting physicochemical properties	4L
	1.2.1	Enzymatic reactions- softening, Oxidation (Ascorbic acid & Phenolic oxidation) Glycolytic reaction, Hydrolytic reactions, pigmentation (Cholorophylase) browning, Maillard reaction & Caramelization reaction	
	1.2.2	Chemical reactions- 1. Lipid oxidation, non-enzymatic browning 2. Colour changes - Chlorophylls - Anthocyanins - Carotenoids (lipid soluble compounds) 3. Flavour changes 4. Phenophytinisation -photo- oxidation. – Oxidation – 5. Enzyme-induced oxidative breakdown of unsaturated fatty acids	4L
	1.3	Physicochemical changes in following food Changes in fruit ripening Comparison between Raw vs Ripe Fruit	1L
	1.3.1	Changes in meat- Post Mortem Changes in Meat (Pre-rigor stage, Rigor Mortis, Post Rigor Stage Lipid oxidation	3L
	1.3.2	Non enzymatic hydrolysis by Haeme protein Autolytic enzyme spoilage	1L
II	**2**	**Enzymes in Food Processing**	**15L**
	2.1	Enzymes in carbohydrates, proteins and lipid modifications	3L
	2.1.1	Enzymes for starch modification- maltodextrins and corn syrup solids: liquefaction, saccharification, dextrinization, isomerization for production of high-fructose-corn-syrup, fructose and fructo-oligosaccharides	
	2.1.2	Enzymes for protein modification - hydrolysates and bioactive peptides	3L
	2.1.3	Enzymes for Lipid modification- Lipase catalyzed synthesis of structured triglycerides, fats, and margarine	3L
	2.2 2.2.1 2.2.2	Enzymes as processing aids Role of enzymes in Dairy processing - cheese making and whey processing Role of enzymes in meat processing- tenderization	3L

		and flavour development	
	2.2.3	Role of enzymes in fish processing- De-skinning, collagen extraction	
	2.2.4	Role of enzymes in Egg processing- catalase, glucose oxidase, hydrolase	
	2.3	Role of enzymes in the production of flavours	3L
	2.3.1	Enzyme-aided extraction of plant materials for production of flavours	
	2.3.2	Production of flavour enhancers such as nucleotides, MSG; flavours from hydrolyzed vegetable/animal protein	
III	**3**	**Fundamentals of Environmental Chemistry**	**15L**
	3.1	Air and Atmosphere	3L
	3.1.1	Particles, ions and radicals in the atmosphere	
	3.1.2	Chemical processes for formation of inorganic and organic particulate matter	
	3.1.3	Thermochemical and photochemical reactions in the atmosphere	2L
	3.1.4	Oxygen and ozone chemistry – Formation of ozone layer, sources and effects of ozone depletion on environment	
	3.1.5	Chemistry of air pollutants	2L
	3.1.6	Photochemical smog, Carcinogens in the air	
	3.1.7	Effects of air pollution on health	
	3.2	Water and aquatic system	2L
	3.2.1	Organic pollutants [pesticides, insecticides, detergents, oil spills, toxic organic chemicals]	
	3.2.2	Inorganic pollutants [heavy metals – Hg, Pb, As, Cd]	
	3.2.3	Thermal pollution of water	3L
	3.2.4	Concept of DO, BOD, COD, Acidity, Alkalinity, Hardness	
	3.2.5	Effects of water pollution on health	
	3.3	Soil Soil properties, Types of soil pollution – acidification, agrochemical pollution, salinization, and contamination by metalliferous wastes	3L
IV	**4**	**Environmental pollution management and environmental monitoring**	**15L**
	4.1	Air Pollution Management	3L
	4.1.1	Control methods for particulates - Gravitational Settling Chambers, Centrifugal collectors, Wet collectors, Fabric Filters, Electro Static Precipitators	
	4.1.2	Control methods for gaseous pollutants - Adsorption, Absorption, Condensation, Combustion	
	4.2	Water analysis & Waste water management	5L
	4.2.1	Physico – chemical and Bacteriological sampling and analysis of water quality	
	4.2.2	Primary treatment methods – screening, grit removal, primary sedimentation	

	4.2.3	Secondary treatment methods - Activated sludge process, Trickling filters, Rotating biological contactors, Oxidation ponds and Lagoons	
	4.2.4	Tertiary treatment methods - Chlorination, Ion Exchange	
	4.3	Solid Waste Management Sanitary Landfill, Recycling, Composting, Incineration, Energy recovery options from organic wastes	2L
	4.4	Environmental monitoring and remote sensing	4L
	4.4.1	Introduction & Objective	
	4.4.2	Types of Monitoring- Source Monitoring & Ambient environment monitoring	
	4.4.3	Importance of remote sensing in environmental monitoring	
	4.4.4	Approaches used to monitor the environment-air, water and soil (Principles and Significance)	1L
		Practicals – RUSBCHP602	**1.5 Credits**
	1	Determination of salinity / chlorides in water by Silver nitrate method	
	2	Determination of the Chemical Oxygen Demand of water/ Effluent by the Potassium Dichromate method	
	3	Determination of potability of water by conducting a coliform count	
	4	Determination of the Dissolved Oxygen content of water/ Effluent by the Winkler's Iodometric method	
	5	Determination of the Biological Oxygen Demand of water/ Effluent	
	6	Determination of the Alkalinity of water/ Effluent	
	7	Determination of the Acidity of water/ Effluent	
	8	Estimation of lead by the EDTA method	
	9	Estimation of Organic content of soil by Diphenylamine method	
	10	Estimation of $CaCO_3$ of soil by Bromothymol Blue Method	
	11	Visit to a Food processing industry and report writing	

References:

1. Total Quality Assurance for the Food Industries – WA Gould & RW Gould. CTI Publications Inc., USA 1988
2. Current Good Manufacturing Practices for Food Plan Sanitation – WA Gould, CTI Publications Inc. USA 1980
3. Fundamental Concepts of Environmental Chemistry – Sodhi, Narosa Publishing House, 2002
4. Principles of Environmental Chemistry – Kothandaram & Swaminathan, B I Publishers, Chennai
5. Environmental Chemistry – AK De, New Age International Publishers
6. Biochemical methods by S Sadashivam & A Minackam, New Age International publisher.

Course Code: RUSBCH603

Course Title: Biochemistry of Metabolism

Academic year 2020-21

COURSE OUTCOMES:

After successful completion of this course, the students would be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Comprehend the reactions of catabolism and anabolism of biomolecules -carbohydrates, amino acids and lipids.
CO 2	Illustrate the pathways and cycles of nucleic acid metabolism
CO 3	Recognize the involvement of biomolecules in energy metabolism and storage of energy through anabolic pathways
CO 4	Recognize the involvement of biomolecules in energy metabolism and outflow of energy through catabolic pathways.
CO 5	Learn various experiments carried out by scientists to enable understanding of the pathways and cycles of metabolism.
CO 6	Understand simple concepts related to metabolism and to be familiar with the various metabolic pathways.
CO 7	Describe the interrelationship between metabolic pathways of different biomolecules and their interdependence.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title Biochemistry of Metabolism RUSBCH603	Credits/ Lectures 2.5 Credits
I	**1**	**Carbohydrate Metabolism**	**15L**
	1.1	Overview of glucose metabolism	4L
	1.1.1	Glycolysis- Salient features, reactions,	
	1.1.2	Conversion of pyruvate to lactate & its significance	
	1.1.3	Irreversible reactions of glycolysis	
	1.1.4	Regulation of glycolysis	
	1.2	Conversion of pyruvate to Acetyl CoA- Role of Pyruvate dehydrogenase complex & its regulation	1L
	1.3	Citric acid cycle- Pathway with reactions & its regulation	3L
	1.4	Glycogenolysis – [schematic – no structures, but with enzymes and coenzymes]	1L
	1.5	HMP shunt (Cellular location, sequence of reactions, multifunctional nature)	2L
	1.6	Gluconeogenesis, Glycogenesis – [schematic – no structures, but with enzymes and coenzymes]	3L
	1.7	Glyoxylate pathway	1L
II	**2**	**Amino acid metabolism**	**15L**
	2.1.1	Chemical nature, functional groups and reactivity of amino acids	4L
	2.1.2	Reactions of amino acids: Deamination, Transamination, Decarboxylation, Transmethylation, Transdeamination	
	2.2	Ammonia formation, transport and detoxification in brain and liver.	3L
	2.3	Urea cycle & its regulation	2L
	2.4	Metabolism of significant amino acids– Glycine, Phenylalanine, Tyrosine, Tryptophan	2L
	2.5	Formation of specialized products from amino acids and their functions-glutathione, creatine, creatinine, biogenic amines (dopamine, norepinephrine, GABA, Histamine)	4L
III	**3**	**Lipid metabolism**	**15L**
	3.1	Introduction to lipid metabolism	5L
	3.1.1	Lipid Digestion, Absorption, and Transport	
	3.1.2	Fatty Acid Oxidation-Fatty Acid Activation, Transport Across the Mitochondrial Membrane, Beta-Oxidation	
	3.1.3	Oxidation of Unsaturated Fatty Acids	
	3.1.4	Oxidation of Odd-Chain Fatty Acids	
	3.2	Ketone Bodies	2L
	3.3	Fatty Acid Biosynthesis- Pathway Overview, Acetyl CoA Carboxylase, Fatty Acid Synthase, Transport of	3L

		Mitochondrial Acetyl-CoA Into the Cytosol, Elongases and Desaturases	
	3.4	Synthesis of Triacylglycerols	1L
	3.5	Regulation of Fatty Acid Metabolism	1L
	3.6	Cholesterol Metabolism- Cholesterol Biosynthesis, Control of Cholesterol Biosynthesis and Transport, Cholesterol Utilization	3L
IV	4	Nucleic Acid Metabolism & Integration of Metabolism	15L
	4.1	Metabolism of Purine and pyrimidine	6L
	4.1.1	Biosynthesis and degradation	
	4.1.2	Salvage pathway	
	4.1.3	Inhibitors	
	4.2	Integration of metabolism	1L
	4.2.1	Integration of major metabolic pathways of energy metabolism	1L
	4.2.2	Organ specialization and metabolic integration – Liver, Adipose tissues, Skeletal muscle, Brain, Kidney	4L
	4.2.3	Metabolism of starvation - Liver, Adipose tissues, Skeletal muscle, Brain	3L
		Practicals – RUSBCHP603	**1.5 Credits**
	1	Estimation of glucose by the Folin-Wu method	
	2	Estimation of glucose by the GOD-POD method	
	3	Demonstration of glucose metabolism using handheld glucometer	
	4	Assay of serum transaminases – SGOT and SGPT	
	5	Estimation of serum urea.	
	6	Estimation of serum creatinine.	
	7	Estimation of serum uric acid by phosphotungstic acid method (Caraways method)	
	8	Assay of glutamate dehydrogenase	
	9	Lipid Profile –	
	a	Estimation of total cholesterol and HDL	
	b	Estimation of Triglycerides	
	c	Estimation of LDL by calculation	
	10	Use of softwares to understand metabolism – KEGG, Ecocyc, Metacyc, Biocyc	

References:

1. Biochemistry - U. Sathyanarayana - Books and Allied (P) Ltd. Kolkata.
2. Biochemistry - Voet, D. and Voet, J.G. - John Wiley & Sons, Inc. USA.
3. Biochemistry by L. Stryer W.H. Freeman Press, San Francisco, USA.
4. Outlines of Biochemistry - E.E. Conn and P.K. Stumpf – Wiley Eastern, New Delhi.
5. Text book of Biochemistry - J.L Jain
6. Text Book of Biochemistry - D.M. Vasudevan
7. Text Book of Biochemistry - A.C. Deb, 9th revised edition (2017)
8. Biochemistry - Garret, R.H. and Grisham, C.M. (2005) Thomson Learning INC.

9. Biochemical methods - S Sadashivam and A Manickam - New Age International publishers
10. Laboratory Manual in Biochemistry - J. Jayaraman - New Age International
11. An Introduction to Practical Biochemistry - Plummer David

Course Code: RUSBCH604

Course Title: Nutritional Biochemistry

Academic year 2020-21

COURSE OUTCOMES:

After successful completion of this course, the students would be able to:

COURSE OUTCOME	DESCRIPTION
CO 1	Realize the importance of balanced diet and other parameters in maintaining it.
CO 2	Explore the functions of macronutrients & micronutrients and to examine the clinical and biochemical effects of its depletion.
CO 3	Examine the biochemical, physiological and clinical impact of inadequate intakes of specific nutrients.
CO 4	Develop a keen insight into interrelationship between genes and nutrients.
CO 5	Acquaint the importance of nutrition in health and study the main features of carbohydrates, proteins, lipids and minerals.
CO 6	Familiarize newer concepts of dietary management of various disorders and disease.
CO 7	Select biochemical techniques relevant in nutritional biochemical research
CO 8	Provide an understanding of biochemistry and explore the biochemical activity in the human body of nutrients and food constituents.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title Nutritional Biochemistry RUSBCH604	Credits/ Lectures 2.5 Credits
I	**1**	**Introduction to Nutrition**	**15L**
	1.1.1	Introduction to Human nutrition & energy supply	2L
	1.1.2	Measurement of energy content of food- Calorific value of different biomolecules & mixed diet, Determination of calorific value using bomb Calorimeter (Principle & Working)	
	1.2	Respiratory quotient of food	2L
	1.3	Measurement of energy expenditure Basal metabolic rate- Definition, Measurement, factors affecting BMR & its significance	
	1.4	Specific dynamic action of food- Definition, Mechanism & its significance	1L
	1.5	Sources, Daily requirement & Nutritional importance of biomolecules	4L
	1.5.1	Carbohydrates- Concept of Glycemic Index of food (Graph), Importance of fiber (Complex carbohydrate) in nutrition	
	1.5.2	Lipids-Role of essential fatty acids	
	1.5.3	Proteins- Essential amino acids, Nitrogen Balance (Positive, Negative Nitrogen balance & factors affecting)	
	1.6	Assessment of nutritive value of protein	3L
	1.6.1	Protein efficiency ratio	
	1.6.2	Biological value of protein	
	1.6.3	Net protein utilization	
	1.6.4	Chemical score	
	1.6.5	Mutual supplementation of protein	
	1.7	Recommended Dietary allowances (RDA)-Definition, Factors affecting RDA, RDA for adult	1L
	1.8	Balance diet – Concept & significance, Designing diet for different subjects (infants, toddlers, adolescents, adults, geriatric, diseased state)	2L
	1.9	Numericals based on above concepts	
II	**2**	**Macroelements**	**15L**
	2.1	Biochemistry of macroelements	3L
	2.2	Sources, Recommended daily allowances, Absorption, transport, excretion, Biochemical significance & Disorders related to:	3L
	2.2.1	Calcium	3L
	2.2.2	Phosphorous	
	2.2.3	Magnesium	3L
	2.2.4	Sodium	

	2.2.5	Potassium	3L
	2.2.6	Chlorine	
	2.2.7	Sulphur	
III	**3**	**Microelements**	**15L**
	3.1	Biochemistry of microelements	2L
	3.2	Sources, Recommended daily allowances, Biochemical significance & Disorders related to:	3L
	3.2.1	Copper	3L
	3.2.2	Iodine	
	3.2.3	Manganese	3L
	3.2.4	Zinc	
	3.2.5	Molybdenum	3L
	3.2.6	Cobalt	
	3.2.7	Fluorine	
	3.2.8	Selenium	1L
IV	**4**	**Nutrigenomics, Nutritional disorders and Antinutritional Factors**	**15L**
	4.1	Nutrient-Gene Interaction	2L
	4.2	Drug-Nutrient Interaction	
	4.3	Obesity, Brown and White Adipose Tissue, Specific dynamic action factors affecting thermic effect of food.	2L
	4.4	Role of Leptin, Ghrenin, Adiponectin in food intake.	2L
	4.5	Pathophysiology of Nutritional disorders	2L
	4.5.1	Nutritional disorders of carbohydrate- Obesity, Non-Insulin dependent diabetes mellitus, Lactose intolerance, Celiac disease, Dental carries	
	4.5.2	Nutritional disorders of proteins- Protein energy Malnutrition (Kwashiorker, Marasmus & Marasmic kwashiorkor)	2L
	4.5.3	Nutritional disorders related to lipids – Essential fatty acid deficiency, cholesterol (Good vs Bad), Atherosclerosis & Arteriosclerosis	2L
	4.5.4	Eating disorders – Bulimia nervosa, Anorexia nervosa	2L
	4.6	Antinutritional factors – Phytin, oxalates, tannins, trypsin inhibitors, soluble and non-soluble NSPs	1L
		Practicals – RUSBCHP604	**1.5 Credits**
		Anthropometric measurements	
	1	Isolation of casein from milk	
	2	Extraction of albumins and globulins from egg white	
	3	Isolation of lipids from egg yolk and separation by	
	4	TLC.	
	5	Estimation of Cholesterol	
	6	Estimation of Calcium by EDTA method	
	7	Estimation of phosphorus by Fiske Subarrow method	
	8	Estimation of copper by the Isoamyl alcohol method	
	9	Survey on nutritional disorders and its statistical analysis	

References:

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York)
2. Human nutrition and dietetics by Davidson, S. etal.; Churchill Livingstone Publishers.
3. Nutrition and dietetics by Joshi, Shubhangini A.; Tata McGraw and Hill publishers
4. Nutrition Science by Srilakshmi, B.; New Age International publishers
5. Krause's Food and Nutrition Care process.(2012); Mahan, L.K Strings, S.E, Raymond, J. Elsevier's Publications.
6. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications..
7. Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford University Press.
8. Nutritional Biochemistry: Tom Brody.
9. Textbook of medical laboratory technology: Dr. Praful Godkar, Bhalani Publishing House
10. Biochemical methods by S Sadashivam & A Minackam, New Age International publisher.

Modality of Assessment (SEMESTER VI)

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	One Assignment/poster presentation/Model making/Quiz	20
2	One class Test (multiple choice questions / subjective)	20
	TOTAL	40

B) External Examination- 60%- 60 Marks
Semester End Theory Examination:

1. Duration - These examinations shall be of **02 HOURS** duration.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1. A	Any 1 out of 2	03	UNIT I
Q1. B	Any 2 out of 3	06	
Q2. A	Any 1 out of 2	03	UNIT II
Q2. B	Any 2 out of 3	06	
Q3. A	Any 1 out of 2	03	UNIT III
Q3. B	Any 2 out of 3	06	
Q4. A	Any 1 out of 2	03	UNIT IV
Q4. B	Any 2 out of 3	06	
	TOTAL	60	

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

Particulars	Practical I, II, III & IV
Journal	05
Experimental tasks	15
Total	20

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:

Particulars	Practical I, II, III & IV
Laboratory work	25
Viva	5
Total	30

Overall Examination & Marks Distribution Pattern

Semester VI

Course	601			602			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	603			604			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100
