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: BSc

Program Code: RUSBCH

Credit Based Semester and Grading System for the academic year 2023-24

GRADUATE ATTRIBUTES

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, human nutrition and environmental science.
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.

PROGRAM OUTLINE

YEAR	SEM	CORE COURSE	COURSE TITLE	CREDITS
TYBSc	V	RUSBCH501	Membrane Biochemistry & Cancer Biology	2.5
		RUSBCH502	Introduction to Pharmacology & Basics of 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	2.5
		RUSBCH602	Food Biochemistry & Environmental Science	2.5
		RUSBCH603	Clinical Biochemistry	2.5
		RUSBCH604	Nutritional Biochemistry	2.5
		RUSBCHP601	Project Work / Certificate Courses	1.5
		RUSBCHP602	Practicals based on RUSBCH602	1.5
		RUSBCHP603	Practicals based on RUSBCH603	1.5
		RUSBCHP604	Practicals based on RUSBCH604	1.5

Course Code: RUSBCH501

Course Title: Membrane Biochemistry & Cancer Biology

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Outline 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	Recall the concept and mechanism of ATP synthesis.
CO 5	Classify different types of transporters.
CO 6	Explain the factors that contribute to cancer development, discuss cancer prevention and currently available therapeutic treatments.
CO 7	Develop an understanding on various genetic and molecular changes which takes place during transformation into malignant cells.
CO 8	Make use of theoretical concepts of Membrane Biochemistry & Cancer Biology and develop experimental acumen.

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 and Vesicular Transport**	**15L**
	2.1	Introduction to the transport mechanism across cell membrane	4L
	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	4L
	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,	
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 semi-permeable membrane	
	2	Effect of temperature and molecular weight on diffusion	
	3	Visualization of cells by Trypan blue	
	4	Study of viability of cells using Neutral Red Assay	
	5	Mitochondrial respiration and effect of different Inhibitors for ETC (Dry lab)	
	6	In-vitro study of RBC membrane stabilization	
	7	Sums based on Bioenergetics	
	8	Internship / Workshop / Hands-on training (1 – 4 weeks)	

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.
13. Principles of Genetics by D. Peter Snustad, Michael J. Simmons
14. Concepts of Genetics by William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino, Darrell Killian
15. Molecular Biology of Cancer Mechanisms, Targets, and Therapeutics by Lauren Pecorino

Course Code: RUSBCH502

Course Title: Introduction to Pharmacology & Basics of Immunology

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Outline the basics of pharmacology like scope & general principles
CO 2	Summarize the process of Drug Receptor Interaction
CO 3	Explain the basic concepts of Pharmacokinetics with Drug absorption, Distribution, Metabolism and Excretion
CO 4	Design bioassays to meet regulatory requirements
CO 5	Develop an understanding of the characteristics and the nature of antigen – antibody reactions
CO 6	Justify the role of immune cells and their mechanism in body defence system
CO 7	Illustrate various mechanisms that regulate immunological response and how it's triggered and regulated
CO 8	Recall different tools & techniques used in diagnosis like Radioimmunoassay, ELISA, Immunofluorescence, Western Blotting, etc.
CO 9	Make use of theoretical concepts of immunology and pharmacology and develop experimental acumen.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title Introduction to Pharmacology & Basics of Immunology RUSBCH502	Credits/ Lectures 2.5 Credits
I	**1**	**Introduction to Pharmacology & Pharmacodynamics**	**15L**
	1.1	Introduction to pharmacology	1L
	1.2	Drugs - Sources, Classification and Nomenclature	3L
	1.3	Pharmacodynamics and Basis of Drug Action	
	1.4.1	Drug Receptor Interaction – Receptor Theory of Drug Action, Location of Drug Receptor-G-Coupled Protein receptors	4L
	1.4.2	Drug Acting on enzymes	2L
	1.4.3	Non receptor mechanism of drug action	
	1.4.4	Placebo effect	
	1.5.1	Affinity and Intrinsic Activity	3L
	1.5.2	Intensity of Drug Response – Potency and Efficacy	
	1.6	Combined Effects of Drug – Synergism, Antagonism	2L
II	**2**	**Pharmacokinetics & Bioassay**	**15L**
	2.1	Physicochemical properties of drugs	1L
	2.2	Routes of drug administration	3L
	2.3.1	Drug absorption: through-GIT, pulmonary, renal, placental and blood-brain barrier	3L
	2.3.2	Bioavailability and Bioequivalence	1L
	2.4	Drug Distribution	
	2.5	Drug Metabolism and Excretion	2L
	2.6	Factors affecting drug dosage and drug delivery	2L
	2.7	Bioassay – Preclinical & clinical studies	3L
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

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	Monograph of a pharmaceutical drug	
	2	Problems based on drug dosage	
	3	Preparation of blood smear and Differential leucocyte count	
	4	Immunoprecipitation of antigen and antibody	
	5	Ouchterlony double immunodiffusion (DID)	
	6	Assays based on agglutination reactions – Blood typing	
	7	Demonstration of Enzyme linked immunosorbent assay (ELISA)	
	8	WIDAL test – Qualitative & Quantitative	

References:

1. Essentials of Pharmacotherapeutics by FSK Barar
2. Pharmacology and Pharmacotherapeutics by R.S. Satoskar, Nirmala N. Rege, S.D. Bhandarkar, Elsevier
3. Immunology by Goldsby and Kuby, W.H. Freeman Co.
4. Weir D.M., Immunology: Student's Notes, ELBS- Oxford.
5. Bowry T.R., Immunology Simplified, 2nd Ed., ELBS and Oxford.
6. Ivan, Immunology Method Manual, Vol. 4 1997, Academic Press, Sani Diego.
7. Roitt Ivan and others, Immunology, 6th Ed., Mosby, Edinburg.
8. Hood Leroy E., Immunology, 2nd Ed., 1976, Benjamin Cummings Publication
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: RUSBCH503

Course Title: Molecular Biology

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Define the molecular events of DNA Replication, transcription, and translation process
CO 2	Enlist different types of repair mechanisms and explain their mechanisms
CO 3	Outline the principle of gene organization and the roles of promoters, coding, and termination sequences
CO 4	Compare and state differences in the transcription process occurring in prokaryotes and eukaryotes
CO 5	Discuss how gene expression is regulated at the post-transcriptional level
CO 6	Analyse the tools and techniques for construction of recombinant DNA, cloning vectors & genomic and cDNA library
CO 7	Recall the applications of RDT in various field
CO 8	Make use of theoretical concepts of molecular biology and develop experimental acumen.

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)	4L
	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	5L
	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)	
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	
		Practicals – RUSBCHP503	1.5 Credits
	1	Extraction of total nucleic acids from plant tissue	
	2	Estimation of UV absorption of nucleic acids & proteins	
	3	Study of viscosity of DNA solution	
	4	Estimation of DNA by the Diphenylamine method	
	5	Isolation of chromosomal DNA from *E coli* cells	
	6	Isolation of RNA from Yeast/ Liver	
	7	Estimation of RNA by Orcinol Method	

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 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Define 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	Summarize the 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	Recall various biological databases that provide information about nucleic acid and proteins.
CO 5	Outline the data from key bioinformatics databases and resources.
CO 6	Explain the use of computational skills in the field of Biology
CO 7	Classify databases and explain the same.
CO 8	Make use of theoretical concepts of Biostatistics & Bioinformatics and develop experimental acumen.

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	3L
	1.2	Descriptive statistics:	6L
	1.2.1	Measures of central tendency - Mean, Median and mode	
	1.2.2	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	5L
	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	5L
	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	
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	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 (one sample) – z-test, t-test	
	3	Hypothesis testing – Two sample z-test, unpaired t-test	
	4	Sequence retrieval (protein and gene) from NCBI and Uniprot	
	5	BLAST suite of tools for pairwise alignment	
	6	Molecular Visualization Softwares: Rasmol for protein structures from PDB	
	7	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)
10. A Textbook of Biotechnology – R.C. Dubey by S Chand Publication

Modality of Assessment (SEMESTER V)

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	Class test	20
2	Class test/ Project/ Assignment/ Presentation	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.	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
Q4.	Any 3 out of 5	15	UNIT IV
	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
Report (Internal)	10
Presentation & Viva (External)	10
Laboratory work	10
Total	30

Particulars	Practical II, III & IV
Laboratory work	25
Viva	05
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

Course Code: RUSBCH601

Course Title: Human Physiology

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Explain the organization and processes of the muscular system and describe its location, function & physiology of muscle contraction
CO 2	Identify the major functions, composition, and physiology of bone
CO 3	Outline the functions of physiological systems such as cardiac and reproductive and its related disorders.
CO 4	Recall the structure of the organs of the reproductive system in males and females.
CO 5	Name the cellular and molecular mechanisms in neurons. To comprehend established information about neurophysiology
CO 6	Summarize the organs of male and female reproductive system including structure its function & development and maturation in emergence of secondary characteristics
CO 7	Apply knowledge of research culture at under-graduate level, to know the concept of research its objectives, tools and importance and techniques of documentation.
CO 8	Make use of theoretical concepts of human physiology and develop experimental acumen.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title Human Physiology RUSBCH601	Credits/ Lectures 2.5 Credits
I	**1**	**Musculoskeletal system**	**15L**
	1.1	Bone physiology	2L
	1.1.1	Function and Composition of bone	
	1.1.2	Structural considerations-structure of bone; cells of bone	1L
	1.1.3	Physiological considerations- Bone growth, Bone formation, bone resorption; Bone remodelling	3L
	1.1.4	Metabolic Bone diseases- Rickets, Osteomalacia; Osteoporosis	2L
	1.2	Muscle Physiology	2L
	1.2.1	Types of muscle cells- Skeletal, Cardiac; Smooth muscle (Structure; Comparison)	
	1.2.2	Structure of skeletal muscle, Muscle proteins- Structural proteins (Actin; Myosin) & Cross-linking proteins (Tropomyosin; Troponin)	3L
	1.2.3	Molecular theory of muscle contraction	2L
II	**2**	**Cardiac Physiology and related disorders**	**15L**
	2.1.1	Structure of the heart	3L
	2.1.2	Layers of the heart wall	
	2.1.3	Chambers and valves of the heart	
	2.2	Physiology of the cardiac muscle	2L
	2.3	Conducting system of heart, comparative rates of conduction system of heart	3L
	2.4	Heart sound, heart rate and factors influencing heart rate	2L
	2.5	Cardiac cycle and effect of heart rate on cardiac cycle	2L
	2.6	Cardiac output	1L
	2.7	Hypertension, congestive heart disease, myocardial infarction, cardiac arrhythmias	2L
III	**3**	**Neurophysiology**	**15L**
	3.1.1	Nervous system - Overview, Classification	3L
	3.1.2	Neuron – Structure, classification based on structure and function	
	3.1.3	Glial cells, formation of myelin sheath	2L
	3.1.4	Concept of myelinated and unmyelinated neuron	
	3.2.1	Resting membrane potential of a neuron	2L
	3.2.2	Processes – Depolarization, repolarization, hyperpolarization	
	3.3	Generation of nerve impulse	2L
	3.4	Saltatory conduction of impulse, All-or-none principle	1L
	3.5.1	Neuromuscular junction	2L
	3.5.2	Action of Acetylcholine at chemical synapse	

	3.5.3	Removal of acetylcholine after its action and regeneration	
	3.6	Excitatory and inhibitory neurotransmitter pair in brain and spinal cord	2L
	3.7	Catecholamines as neurotransmitter	1L
IV	**4**	**Reproductive system**	**15L**
	4.1	Male reproductive system: scrotum, testes, reproductive system ducts of in males, accessory sex glands	3L
	4.2	Female reproductive system: Ovaries, uterine tubes, uterus, vagina, vulva, perineum, mammary glands	3L
	4.3	The female reproductive cycle: Hormonal regulation of the female reproductive cycle, phases of the female reproductive cycle	3L
	4.4	Birth control measures; abortion: Surgical sterilization, hormonal methods, abortion	3L
	4.5	Development of the reproductive systems Aging; reproductive systems	3L
		Practicals – RUSBCHP601: **PROJECT WORK / Certificate Courses** 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. 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.	1.5 Credits

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

OR

Certificate Courses –
Students shall complete certificate courses available on MOOC / SWAYAM / NPTEL platforms / short-term certificate courses.

Contact hours – 30 to 45 hours

Student shall produce successful completion certificates made available at the end of the above mentioned courses.

A powerpoint presentation on the summary of the courses studied should be made and presented which will be assessed as follows –

Particular		Marks
a)	Successful completion of courses (30 to 45 contact hours)	30
b)	Presentation to external examiner	10
c)	Viva- voce	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),

Course Code: RUSBCH602

Course Title: Food Biochemistry & Environmental Science

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Summarize physical & chemical reactions in food, the role of enzymes in food processing and how they aid in carrying out changes in food
CO 2	Outline the chemistry and applications of enzymes in food industries and flavour.
CO 3	Enlist the changes in reactions in food and how enzymes could be of great importance in food processing
CO 4	Recall the properties of different food components and to understand the principle underlying the biochemical techniques used in food analysis.
CO 5	Explain the interdisciplinary nature of environmental studies and create awareness for the same.
CO 6	Demonstrate various methodologies that are adapted for effective monitoring of environmental parameters.
CO 7	Elaborate on 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.
CO 8	Make use of theoretical concepts of Food Biochemistry & Environmental Science and develop experimental acumen.

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	5L
	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	5L
		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 Alkalinity of water/ Effluent Determination of the Acidity of water/ Effluent	
	5	Estimation of lead by the EDTA method	
	6	Estimation of Organic content of soil by	
	7	Diphenylamine method	
	8	Estimation of $CaCO_3$ of soil by Bromothymol Blue Method	

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. Enzymes in food and beverage processing by Muthusamy Chandrasekaran, CRC Press
4. Enzymes in Food Processing by Tilak Nagodawithana, Gerald Reed and Steve Taylor, Academic Press
5. Fundamental Concepts of Environmental Chemistry – Sodhi, Narosa Publishing House, 2002
6. Principles of Environmental Chemistry – Kothandaram & Swaminathan, B I Publishers, Chennai
7. Environmental Chemistry – AK De, New Age International Publishers
8. Biochemical methods by S Sadashivam & A Minackam, New Age International publisher.

Course Code: RUSBCH603

Course Title: Clinical Biochemistry

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Outline the basics of circulatory system including Iron Metabolism, haematopoiesis, and Erythropoiesis
CO 2	Compare and state differences in hemochromatosis and anaemia from the perspective of iron homeostasis
CO 3	Define the composition of normal hemoglobin at various stages of development
CO 4	Explain the structural difference between different types of haemoglobin, compare O2 binding properties of haemoglobin, including haeme- haeme interactions
CO 5	Summarize Fundamentals, composition, and significance of Body fluids
CO 6	Elaborate on the chemical nature of hormones, the relationship between structure and function of hormones, quantitative aspects of hormonal action in relation to endocrine disorder, the role of hormones as a regulatory factor of a living system, relation with some diseases
CO 7	Discuss the clinical significance of the organ function tests
CO 8	Make use of theoretical concepts of Clinical Biochemistry and develop experimental acumen.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title Clinical Biochemistry RUSBCH603	Credits/ Lectures 2.5 Credits
I	**1**	**Biochemistry of Haeme**	**15L**
	1.1.1	Iron metabolism- Absorption, Transport, distribution, Storage & excretion	2L
	1.1.2	Role of apoferritin & Transferin	2L
	1.1.3	Haemochromatosis	
	1.2	Haematopoiesis	3L
	1.2.1	Erythropoiesis - Stages of development of erythrocytes, Precursors of RBCs	
	1.2.2	Factors influencing erythropoiesis	
	1.3	Anemias: Definition and types (Hemolytic, hemorrhagic, megaloblast, pernicious, iron deficiency and aplastic anemia), polycythemia	3L
	1.4.1	Chemistry of Haemoglobin (Hb)- Haeme & globin, Varieties of haemoglobin, Hemoglobin derivatives with gases, Haeme-haeme interactions	3L
	1.4.2	Overview of Biosynthesis of Haemoglobin	2L
II	**2**	**Body Fluids**	**15L**
	2.1	Intracellular, extracellular and interstitial fluid. Homeostasis, control system and their components	3L
	2.2	Bile - Formation, composition, function and disorder (jaundice, bile duct stones)	3L
	2.3	Plasma – Composition, plasma proteins, function , plasma cell disorder	3L
	2.4	CSF – Composition, function, CSF analysis, CSF leak	3L
	2.5	Composition and function of –Synovial fluid, Pericardial fluid, Tears, Sweat	3L
III	**3**	**Endocrinology**	**15L**
	3.1	Definition of Hormones, hormone receptor, endocrine & exocrine glands	2L
	3.2	Classification of hormones on the basis of: i)Distance of target tissue- autocrine, paracrine, endocrine ii) Chemistry - One example for each sub class.	2L
	3.3	Hierarchal organization of the mammalian endocrine system	1L
	3.4.1	Chemistry, synthesis, secretion & physiological role of thyroxine and insulin (Synthesis from preproinsulin)	2L
	3.4.2	Hypothyroidism (cretinism and myxedema), Hyperthyroidism (goiter – simple & toxic), Diabetes mellitus	2L
	3.5	Physiological role of glucocorticoids, oxytocin & vasopressin, FSH, LH, Estrogen, Progesterone (Reproductive cycle)	3L

	3.6	Mode of action of steroid hormones and epinephrine (amplification cascade with G proteins, cAMP, adenylate cyclase, kinases)	3L
IV	**4**	**Organ Function Tests, Biochemical Assessments and Changes in Endocrine Disorders**	**15L**
	4.1	Organ Function Tests	4L
	4.1.1	Liver Function test – Bilirubin (direct and indirect), SGPT, SGOT, ALP, Prothrombin time	
	4.1.2	Renal Function test - Urea clearance test, Creatinine clearance test, Test of renal ability to excrete acid, Intravenous pyelography, Radioactive renogram	4L
	4.1.3	Gastric Function test – Examination of resting contents	4L
	4.1.4	Pancreatic function test – Serum amylase activity, GTT	
	4.1.5	Cardiac Profile – Cardiac biomarkers to diagnose heart attack, Serum cholesterol and triglycerides test	3L
	1 2 3 4 5 6 7	Practicals – RUSBCHP603 Estimation of RBC count by Haemocytometer Estimation of iron by Wong's method Bile Analysis: Detection of Bilirubin & Bile salts Clinical analysis of CSF – glucose, proteins, chlorides Liver Function Tests – a) Estimation of serum ALT and AST b) Estimation of total and direct bilirubin Renal Function tests – a) Creatinine clearance test b) Urea clearance test Estimation of serum amylase activity	1.5 Credits

References:

1. Harpers Illustrated Biochemistry 30th Edition
2. Burtis, C.A., Awood, E.R. and Bruns, D.E. TIETZ Text book of Clinical Chemistry and Molecular Diagnosis, 4th Ed. Elsevier.
3. Bishop, M.L., Fody, E.P and Schoeff, L. Clinical Chemistry- Principles, Procedures, Correlations. 5th Ed. Lippincort Willimy & Wilkins.
4. Textbook of medical laboratory technology: Dr. Praful Godkar, Bhalani Publishing House
5. Henry Richard et al – Clinical Chemistry, Principles and Techniques, 2nd edition, Harper and Row, New York
6. Kamal SH – Clinical Biochemistry for Medical Technologies, Churchill Livingston, London
7. Todd et al – Clinical Diagnosis and Management, 17th edition, WB Saunders, Philadelphia
8. Gill CV – Short cases in clinical biochemistry, Churchill Livingston, Edinburgh,
9. Bayens Dominiezak – Medical biochemistry, Mosby Publishers, Harcourt
10. Textbook of medical laboratory technology: Dr. Praful Godkar, Bhalani Publishing House
11. Biochemical methods by S Sadashivam & A ManIckam, New Age International publisher.

Course Code: RUSBCH604

Course Title: Nutritional Biochemistry

Academic year 2023-24

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Outline the importance of balanced diet and other parameters in maintaining it.
CO 2	Explain the functions of macronutrients & micronutrients
CO 3	Enlist the biochemical, physiological, and clinical impacts of inadequate intake of specific nutrients.
CO 4	Develop a keen insight into interrelationship between genes and nutrients.
CO 5	Justify the importance of nutrition in health and study the main features of carbohydrates, proteins, lipids, and minerals.
CO 6	Summarize the newer concepts of dietary management of various disorders and disease.
CO 7	Select biochemical techniques relevant in nutritional biochemical research
CO 8	Make use of theoretical concepts of Nutritional Biochemistry and develop experimental acumen.

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- Non-Insulin dependent diabetes mellitus, Lactose intolerance, Celiac disease	
	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)	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
	1 2 3 4 5 6 7 8	**Practicals – RUSBCHP604** Anthropometric measurements Isolation of casein from milk Extraction of albumins and globulins from egg white Isolation of lipids from egg yolk and separation by TLC. Estimation of Calcium by EDTA method Estimation of phosphorus by Fiske Subarrow method Estimation of copper by the Isoamyl alcohol method Survey on nutritional disorders and its statistical analysis	1.5 Credits

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.
11. Introduction to Human nutrition, second edition, Edited on behalf of The Nutrition Society by Michael J Gibney, Susan A Lanham-New, Aedin Cassidy, Hester H Vorster Wiley Blackwell Publications

Modality of Assessment (SEMESTER VI)

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	Class test	20
2	Class test/ Project/ Assignment/ Presentation	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.	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
Q4.	Any 3 out of 5	15	UNIT IV
	TOTAL	60	

Practical Examination Pattern:

Practical I

	Particular	Marks			Particular	Marks
a)	Project Work (Contents Submitted in the bound form)	30	OR	a)	Successful completion of courses (30 to 45 contact hours)	30
b)	Presentation to external examiner	10		b)	Presentation to external examiner	10
c)	Viva- voce	10		c)	Viva- voce	10
	TOTAL	**50**			**TOTAL**	50

A) Internal Examination: 40%- 40 Marks

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

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:

Particulars	Practical 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
