Resolution No. AC/II(23-24).2.RPS2

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for

Program: MSc Part I

Program Code: RPSBCH

(As per the guidelines of National Education Policy 2020-Academic year 2024-25)

GRADUATE ATTRIBUTES

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

GA	GA Description **A student completing Master's Degree in Science program will be able to:**
GA 1	Demonstrate in depth understanding in the relevant science discipline. Recall, explain, extrapolate, and organize conceptual scientific knowledge for execution and application and also to evaluate its relevance.
GA 2	Critically evaluate, analyse, and comprehend a scientific problem. Think creatively, experiment and generate a solution independently, check and validate it and modify if necessary.
GA 3	Access, evaluate, understand, and compare digital information from various sources and apply it for scientific knowledge acquisition as well as scientific data analysis and presentation.
GA 4	Articulate scientific ideas, put forth a hypothesis, design and execute testing tools and draw relevant inferences. Communicate the research work in appropriate scientific language.
GA 5	Demonstrate initiative, competence, and tenacity at the workplace. Successfully plan and execute tasks independently as well as with team members. Effectively communicate and present complex information accurately and appropriately to different groups.
GA 6	Use an objective, unbiased and non-manipulative approach in collection and interpretation of scientific data and avoid plagiarism and violation of Intellectual Property Rights. Appreciate and be sensitive to environmental and sustainability issues and understand its scientific significance and global relevance.
GA 7	Translate academic research into innovation and creatively design scientific solutions to problems. Exemplify project plans, use management skills, and lead a team for planning and execution of a task.
GA 8	Understand cross disciplinary relevance of scientific developments and relearn and reskill so as to adapt to technological advancements.

PROGRAM OUTCOMES

PO	Description **A student completing Master's Degree in Science program in the subject of Biochemistry will be able to:**
PO 1	Acquire necessary knowledge and skills to undertake a career in research, either in industry or in an academic set up.
PO 2	Compare and contrast the breadth and depth of scientific knowledge in the broad range of fields including Protein biochemistry, Bioenergetics, Diagnostic Biochemistry, Hormonal Biochemistry, Molecular Biology, Nutritional Biochemistry, and Nanotechnology.
PO 3	Extrapolate and comprehend the regulatory role of metabolic processes and understand the underlying cause of metabolic disorders
PO 4	Acquire thorough knowledge of Biochemical Techniques, Advanced Immunology, Physiology, Genetic Engineering, and Biotechnology
PO 5	Describe and express the biochemical basis of human diseases, protein structure and conformation, non-invasive diagnostics, clinical research, and its importance in drug development. Usage of this knowledge further for multitude of laboratory applications.
PO 6	Integrate and apply the techniques in Biophysics, Analytical Biochemistry, Clinical biochemistry, Microbiology, Molecular Biology and Basics in Bioinformatics
PO 7	Gain proficiency in laboratory techniques in both Biochemistry and Molecular Biology, and be able to apply the scientific method to the processes of experimentation and Hypothesis testing
PO 8	Develop and enhance skills & improve employability through academic, research and internship opportunities
PO 9	Gain exposure to basic research through the provision of PG research based project.
PO 10	Learn to work as a team as well as independently to compile and interpret Biological data, carry out Research investigations and draw conclusions

CREDIT STRUCTURE MSc I

Semester	Mandatory	Elective	RM	OJT/FP	RP/ Internship	Cum.Credits
1	14 (3+1)*3+2	4(3+1)	4	0	0	22
2	14 (3+1)*3+2	4(3+1)	0	4 FP	0	22

Semester I

Course Code : RPSBCH.O501

Course Title: Haematology

Type of course: Discipline Specific Core Course I

Academic year 2024-25

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	Examine the composition of normal hemoglobin at various stages of development
CO 4	Evaluate the structural difference between different types of hemoglobin, compare O2 binding properties of hemoglobin, including haeme- haeme interactions
CO 5	Elaborate on the mechanism of blood coagulation and anticoagulants
CO 6	Conclude pathophysiology of certain disorders related to blood and haemoglobin
CO 7	Discuss the importance of blood gas analysis in haematology and related disorders
CO 8	Make use of theoretical concepts of Haematology and develop experimental acumen.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Haematology RPSBCH.O501	Credits/ Hours 3 / 45 Hours
I	**1**	**Haematopoiesis & Ferrokinetics**	**15**
	1.1	Introduction to Haematopoiesis	
	1.2	Erythropoiesis - Stages of development of erythrocytes, Precursors of RBCs, Factors influencing erythropoiesis, Role of erythropoietin	
	1.3	Leucopoiesis, Leucocytosis and factors responsible, Leukopenia	
	1.4	Thrombopoiesis, Thrombocytopenia	

	1.5.1	Iron metabolism- Absorption, Transport, distribution, Storage & excretion	
	1.5.2	Role of apoferritin & Transferin	
II	**2**	**Haeme Catabolism & Blood Coagulation**	**15**
	2.1	Haemoglobin (Hb)-Features, varieties, combination of Hb with gases, Haeme-haeme interactions	
	2.2	Biosynthesis of Haemoglobin (with structures)	
	2.2.1	Biochemical pathway for Porphyrin synthesis, formation of Haeme	
	2.3	Haeme catabolism	
	2.4	Haemostasis, Molecular mechanism of blood coagulation, role of vitamin K in coagulation, fibrinolysis and anticoagulant	
III	**3**	**Blood disorders**	**15**
	3.1	Haemophilia and its types, Thrombosis	
	3.2	Haemochromatosis, Siderosis	
	3.3	Haemoglobinopathies	
	3.3.1	Genetics basis of haemoglobinopathies - Sickle cell anemia, Thalassemia – alpha (Subtypes of alpha thalassemia) & beta	
	3.3.2	Anemias: Definition and types (Hemolytic, hemorrhagic, megaloblast, pernicious, iron deficiency and aplastic anemia), polycythemia	
	3.4	Cyanosis & its types	
	3.5	Respiratory Acidosis & Alkalosis	
	3.6	Blood gas analysis	

PRACTICAL

	Course code- RPSBCHP.O501 **Practical Title-** Practicals based on RPSBCH.O501	1 Credit
1) 2) 3) 4) 5) 6) 7) 8)	Estimation of RBC count by Haemocytometer Examination of Blood Film Estimation of iron by dipyridyl method Bleeding time Clotting time Erythrocyte Sedimentation Rate Packed Cell Volume Estimation of Haemoglobin	

References:

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

2. Introduction to Human Physiology (2013) 8th edition; Lauralee Sherwood. Brooks/Cole, Cengage Learning.
3. The World of the cell, 7th edition (2009)
4. Genetics (2012) Snustad and Simmons
5. Urinalysis and Body Fluids by Susan King Strasinger & Marjorie Schaub Di Lorenzo, 6th Edition
6. Graff's Textbook of Urinalysis and Body Fluids – Lillian A. Mundt & Kristy Shanahan, 2nd Edition
7. Fundamentals of the study of urine and body fluids – Nancy A. Brunzel, 3rd Edition, Elsevier
8. A Textbook of Medical Biochemistry – MN Chatterjea & Rana Shinde, 8th Edition, Jaypee Publication
9. Clinical Biochemistry Metabolic and Clinical Aspects by William J. Marshall, Márta Lapsley, Andrew Day, Ruth Ayling
10. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA Principles of Biochemistry by G. Zubay, W. Parson, D.

Course Code : RPSBCH.O502

Course Title: Vitamins & Minerals

Type of course: Discipline Specific Core Course II

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Outline the concepts of vitamins, their classification and biochemical role
CO 2	Select biochemical techniques relevant in nutritional biochemical research
CO 3	Conclude the biochemical activity in the human body of vitamins and minerals
CO 4	Discuss the nutritional requirements and significance of dietary minerals like macroelements and microelements
CO 5	Elaborate on the simple concepts related to metabolism, metabolic roles played by vitamins and minerals, appreciate the correlation between energy molecules, reducing equivalents and their role in metabolic pathways.
CO 6	Justify the importance of enzymes and coenzymes in pathophysiology of diseases.
CO 7	Explain the functions of macronutrients & micronutrients
CO 8	Make use of theoretical concepts of vitamins and minerals and develop experimental acumen.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Vitamins & Minerals RPSBCH.O502	Credits/ Hours 3 / 45 Hours
I	**1**	**Vitamins**	**15**
	1.1	Introduction and classification	
	1.2	Fat soluble vitamins- A,D,E,K (Chemistry of the vitamin & Biochemical role	
	1.2.1	Vitamin A – Chemistry, Wald's Visual cycle and role of Rhodopsin (with structure), Transducin, cGMP in vision; Deficiency disorders (Night Blindness, Xerosis Conjunctiva, Xerosis Cornea, Bitot's Spots, Keratomalacia, Follicullar Hyperkeratosis)	

	1.2.2	Vitamin D – role in Ca absorption and mobilization, Deficiency disorders (Rickets, Osteomalacia);	
		Vit E and Vit K– physiological role (Vitamins D, E, K no structures)	
	1.3	Water soluble vitamins	
	1.3.1	Vitamin B complex (Chemistry of the vitamin & its coenzyme form, Biochemical role–Thiamin, Riboflavin, Niacin, Pyridoxine, Biotin, Lipoic acid:- Chemistry of the Vitamin and its coenzyme form [structure not to be done, only group involved in its activity]	
	1.3.2	Vitamin C	
II	**2**	**Macroelements**	**15**
	2.1	Biochemistry of macroelements	
	2.2	Sources, Recommended daily allowances, Absorption, transport, excretion, Biochemical significance & Disorders related to:	
	2.2.1	Calcium	
	2.2.2	Phosphorous	
	2.2.3	Magnesium	
	2.2.4	Sodium	
	2.2.5	Potassium	
	2.2.6	Chlorine	
	2.2.7	Sulphur	
III	**3**	**Microelements**	**15**
	3.1	Biochemistry of microelements	
	3.2	Sources, Recommended daily allowances, Biochemical significance & Disorders related to:	
	3.2.1	Copper	
	3.2.2	Iodine	
	3.2.3	Manganese	
	3.2.4	Zinc	
	3.2.5	Molybdenum	
	3.2.6	Cobalt	
	3.2.7	Fluorine	
	3.2.8	Selenium	

PRACTICAL

	Course code- RPSBCHP.O502 **Practical Title-** Practicals based on RPSBCH.O502	1 Credit
1)	Estimation of vitamin C by dichlorophenol dye method	
2)	Estimation of vitamin C iodometrically	
3)	Estimation of Magnesium by EDTA method	
4)	Determination of chlorides in water by Silver nitrate method	
5)	Estimation of Fluoride in water by the Alizarin Red method	
6)	Estimation of Iron by Wong's method	
7)	Estimation of Copper by the Isoamyl alcohol method	

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

Course Code : RPSBCH.O503

Course Title: Ecology & Molecular Evolution

Type of course: Discipline Specific Core Course III

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Recall different concepts in population studies and ecology
CO 2	Determine variety of ways that organisms interact with both the physical and biological activity
CO 3	Justify the role of organisms that shape the distribution and abundance of organism from the micro-habitat to the globe
CO 4	Predict distribution of organisms is a product of positive and negative interactions within and across trophic level, including competition, mutualism, predation and parasitism
CO 5	Discuss the impact of ecological processes across all scales are affected by human activities, and apply basic ecological principles to meet societal resource management and conservation goals
CO 6	Conclude different evolutionary processes that shape biodiversity.
CO 7	Assess evolutionary principles to a variety of practical questions ranging from conservation genetics to genome evolution
CO 8	Make use of theoretical concepts of Ecology & Molecular Evolution and develop experimental acumen.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Ecology & Molecular Evolution RPSBCH.O503	Credits/ Hours 3 / 45 Hours
I	**1**	**Ecological Principles**	**15**
	1.1	The Environment	
	1.1.1	Physical environment; biotic environment; biotic and abiotic interactions	
	1.2	Habitat and Niche	
		Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement	

	1.3	Ecological Succession	
	1.3.1	Types; mechanisms; changes involved in succession; concept of climax.	
	1.4	Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.	
	1.5	Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine)	
II	**2**	**Population Ecology & Species Interaction**	**15**
	2.1	Population Ecology	
	2.1.1	Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations	
	2.2	Species Interactions	
	2.2.1	Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis	
	2.3	Community Ecology	
	2.3.1	Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones	
III	**3**	**Molecular Evolution and mechanism**	**15**
	3.1	Concepts of neutral evolution	
	3.2	Molecular divergence and molecular clocks	
	3.3	Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence	
	3.4	The mechanisms	
	3.4.1	Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law	
	3.4.2	Concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, Adaptive radiation	
	3.4.3	Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution	

PRACTICAL

	Course code- RPSBCHP.O503 **Practical Title-** Practicals based on RPSBCH.O503	1 Credit
1)	Study of Gause principle using *Paramecium* species (K-strategies) as study model	
2)	Study of logistic vs exponential growth curve	
3)	Problems on population ecology	
4)	Graphical study of Lotka Voltera competition equation	
5)	Problems on Hardy-Weinberg Law	
6)	Case studies on Ecology	

References:

1) Fundamentals of Ecology, Eugene Odum, Saunders Publication, 3rd Edition
2) Ecology: Principles & Applications, J. L. Chapman, M. J. Reiss, Cambridge University Press
3) Ecology and Environment, P. D. Sharma, Rastogi Publications, 2011
4) Elements of Ecology, Thomas Smith, Robert Smith, Pearson Education
5) Concept of Ecology, N. Arumugam, Saras Publications
6) Verma, P.S. and Agarwal, V.K. Concept of ecology (Environmental Biology), S.Chand & Co. Ltd., New Delhi 2004.

Course Code : RPSBCH.O504

Course Title: Instrumentation I

Type of course: Discipline Specific Core Course IV

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Discuss major spectrophotometric and chromatographic instruments commonly used in biochemical analysis.
CO 2	Summarize different methods of performing biochemical analysis of various organic and inorganic compounds.
CO 3	Analyse principle, instrumentation and working of spectrophotometric and chromatographic analytical instruments
CO 4	Evaluate the quality and quantity of different samples using different analytical techniques mentioned in the content of this course
CO 5	Develop critical thinking for interpreting analytical data.
CO 6	Identify appropriate instruments as per the measurement need.
CO 7	Justify the importance of spectrophotometric and chromatographic techniques in biochemical analysis
CO 8	Make use of theoretical concepts of spectrophotometric and chromatographic techniques and develop experimental acumen.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Instrumentation I RPSBCH.O504	Credits/ Hours 2 / 30 Hours
I	**1**	**Spectrophotometric techniques based on molecular structure and interactions**	**15**
	1.1	Introduction to spectroscopic techniques for Structural analysis	

	1.2	Principle, Instrumentation, Working & Biochemical applications of	
	1.2.1	Infrared and Raman spectroscopy	
	1.2.2	Surface plasmon resonance	
	1.2.3	Electron paramagnetic resonance	
	1.2.4	Nuclear magnetic resonance	
	1.2.5	X-ray diffraction	
	1.2.6	Small-angle scattering	
II	**2**	**Chromatography**	**15**
	2.1	Introduction, Types of Chromatography	
	2.2	Gas chromatography, Principle, Working, Detectors (ECD, TCD, FID, NP)	
	2.3	High performance liquid Chromatography- Principle, Working Detectors (UV, PDA, RI, conductivity, fluorescence)	
	2.4	Introduction to Hyphenation GC-MS and LC-MS	
	2.5	MALDI & MALDI-TOF	
	2.6	Sample Preparation and Biochemical Applications of above mentioned Techniques	

References:

1. Principles and Techniques of Biochemistry and Molecular Biology (2010) 7th ed., Wilson, K., and Walker, J. (eds), Cambridge University Press (New Delhi)
2. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D.,Wiley Blackwell (West Sussex)
3. Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch
4. Introduction to Instrumentation in Life Sciences (2012) Bisen, P.S. and Sharma, A., CRC Press/Taylor and Francis Group (California), ISBN:978-1-4665-1240-
5. Biophysical Chemistry (2013), Schimmel, C.R.C., Macmillan Higher Education
6. Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay and Nath – Himalaya Publ. House.
7. Medical Biochemistry by Ramakrishnan (2012)
8. TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore

Modality of Assessment: Semester I

DSC I, II and III

A) Internal Assessment- 40%- 30 Marks

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

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

Semester End Theory Examination:

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

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	Any 3 out of 4	15	UNIT I
Q2.	Any 3 out of 4	15	UNIT II
Q3.	Any 3 out of 4	15	UNIT III
	TOTAL	**45**	

DSC IV

Semester End Theory Examination:

1. Duration - These examinations shall be of **Two hours & 30 Minutes** duration.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	Any 3 out of 4	18	UNIT I
Q2.	Any 3 out of 4	18	UNIT II
Q3.	Any 2 out of 4	14	UNIT I & II
	TOTAL	**50**	

DSC I, II and III

Semester End Practical Examination:

Practical Examination Pattern:

	Particulars	Marks
1	Laboratory work	20
2	Viva & Journal	05
	TOTAL	**25**

Semester II

Course Code : RPSBCH.E511

Course Title: Human Physiology

Type of course: Discipline Specific Core Course I

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Analyse the organization and processes of the muscular system and describe its location, function & physiology of muscle contraction
CO 2	Summarize the distinguishing features and types of muscle & identify the role of the muscular system in homeostasis of the human body
CO 3	Explain the major functions, composition and physiology of bone
CO 4	Conclude the importance of physiological systems such as cardiac and reproductive and its related disorders.
CO 5	Illustrate structure, layer, chamber and valves of the human cardiac system
CO 6	Justify cellular and molecular mechanisms in neurons to comprehend established information about neurophysiology
CO 7	Interpret the effects of neurotransmitters
CO 8	Make use of theoretical concepts of Human physiology and develop experimental acumen.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Human Physiology RPSBCH.E511	Credits/ Hours 3 / 45 Hours
I	**1**	**Musculoskeletal System**	**15**
	1.1	Bone physiology	
	1.1.1	Function and Composition of bone	
	1.1.2	Structural considerations-structure of bone; cells of bone	
	1.1.3	Physiological considerations- Bone growth, Bone formation, bone resorption; Bone remodelling	
	1.1.4	Metabolic Bone diseases- Rickets, Osteomalacia; Osteoporosis	

	1.2	Muscle Physiology	
	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)	
	1.2.3	Molecular theory of muscle contraction	
II	**2**	**Cardiac Physiology and related disorders**	**15**
	2.1.1	Structure of the heart	
	2.1.2	Layers of the heart wall	
	2.1.3	Chambers and valves of the heart	
	2.2	Physiology of the cardiac muscle	
	2.3	Conducting system of heart, comparative rates of conduction system of heart	
	2.4	Heart sound, heart rate and factors influencing heart rate	
	2.5	Cardiac cycle and effect of heart rate on cardiac cycle	
	2.6	Cardiac output	
	2.7	Hypertension, congestive heart disease, myocardial infarction, cardiac arrhythmias	
III	**3**	**Neurophysiology**	**15**
	3.1.1	Nervous system - Overview, Classification	
	3.1.2	Neuron – Structure, classification based on structure and function	
	3.1.3	Glial cells, formation of myelin sheath	
	3.1.4	Concept of myelinated and unmyelinated neuron	
	3.2.1	Resting membrane potential of a neuron	
	3.2.2	Processes – Depolarization, repolarization, hyperpolarization	
	3.3	Generation of nerve impulse	
	3.4	Saltatory conduction of impulse, All-or-none principle	
	3.5.1	Neuromuscular junction	
	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	
	3.7	Catecholamines as neurotransmitter	

	Course code- RPSBCHP.E511 **Practical Title-** Practicals based on RPSBCH. E511	1 Credit
1)	Estimation of Calcium by EDTA method	
2)	Estimation of phosphorus by Fiske Subarrow method	
3)	Estimation of Glycine by Sorensen's method	
4)	Study of Electrocardiograms in healthy & diseased states	
5)	Virtual Labs – Patch Clamp Techniques	
6)	Field visit & report writing	

References:

1. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T., McGraw Hill International Publications (New York), ISBN: 978-0-07-128366-3.
2. Harper's Biochemistry (2012) 29th ed., Murray, R.K., Granner, D.K., Mayes and P.A., Rodwell, V.W., Lange Medical Books/McGraw Hill. ISBN:978-0-07-176-576-3.
3. Textbook of Medical Physiology (2011) 10th ed., Guyton, A.C. and Hall, J.E., Reed Elseviers India Pvt. Ltd. (New Delhi). ISBN: 978-1-4160-4574-8.
4. Fundamental of Anatomy and Physiology (2009), 8th ed., Martini, F.H. and Nath, J.L., Pearson Publications (San Francisco), ISBN: 10:0-321-53910-9 / ISBN: 13: 978-0321-53910-6.

Course Code : RPSBCH.E512

Course Title: Genetic Engineering & RDT

Type of course: Discipline Specific Core Course II

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION **A student completing this course will be able to:**
CO 1	Illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
CO 2	Explain application of recombinant DNA technology in biotechnological research.
CO 3	Elaborate the fundamental steps of genetic engineering and describe thee versatile tools and techniques employed in genetic engineering.
CO 4	Discuss the techniques used to probe DNA for specific gene of interest.
CO 5	Explain the methodology of PCR and its applications.
CO 6	Analyse the tools and techniques for construction of recombinant DNA, cloning vectors & genomic and cDNA library
CO 7	Justify the use of rDNA technology from academic and industrial perspective.
CO 8	Make use of theoretical concepts of genetic engineering and RDT and develop experimental acumen.

DETAILED SYLLABUS

Course Code	**Unit**	**Course/ Unit Title** Genetic Engineering & RDT RPSBCH.E512	**Credits/ Hours** 3 / 45 Hours
I	**1**	**Introduction to RDT & cloning vectors**	**15**
	1.1	Overview of RDT, Extraction and purification of plasmid and bacteriophage DNA	
		Restriction and modification systems, restriction endonucleases, Concept of sticky ends, blunt ends	
	1.2	Other enzymes used in manipulating DNA molecules:	
		Terminal transferases, linkers and adapters, homopolymer tailing	
	1.3	Reverse transcriptase	
	1.3.1	DNA ligase, Ligation of DNA molecules	

	1.3.2	Synthetic oligonucleotides - synthesis and use	
	1.3.3	Plasmids and bacteriophages as vectors for gene cloning	
	1.4	Cloning vectors based on E. coli plasmids, pBR322, pUC8, pGEM3Z	
	1.5	Cloning vectors based on M13 and λ bacteriophage, and in vitro packaging Vectors for yeast, Ti-plasmid, and retroviral vectors, high capacity vectors	
	1.5.1	BAC and YAC	
	1.6	cDNA and Genomic libraries, identification of a clone from gene library, colony and plaque hybridization probing, Southern and Northern hybridization	
	1.7	Methods based on detection of the translation product of the cloned gene	
II	**2**	**Expression of cloned genes, PCR & DNA sequencing**	**15**
	2.1.1	Vectors for expression of foreign genes in E. coli, cassettes and gene fusions	
	2.1.2	Challenges in producing recombinant protein in E. coli	
	2.2	Production of recombinant protein by eukaryotic cells	
	2.2.1	Fusion tags such as, poly-histidine, glutathione, maltose binding protein and their role in purification of recombinant proteins	
	2.2.1	Fundamentals of polymerase chain reaction	
	2.2.2	Types of PCR – hot start, multiplex, reverse transcriptase PCR and Nested PCR, quantitative PCR, Primer, designing for PCR, Cloning PCR products	
	2.3	DNA sequencing by Sanger's method, Automated Sanger's DNA sequencing, Pyrosequencing	
III	**3**	**Application of genetic engineering in Biotechnology**	**15**
	3.1	Site–directed mutagenesis (original method, Kunkel's method, cassette mutagenesis, PCR oligonucleotide mutagenesis), Protein engineering (T4-lysozyme), yeast two hybrid systems	
	3.2	Production of recombinant pharmaceuticals such as insulin, human growth hormone (original, receptor fragment-hormone coupled, albutropin), factor VIII.	

	3.3	Recombinant vaccines	
	3.4	Gene therapy & its application; CRISPR-Cas 9 system	
	3.5	Applications in agriculture – Bt cotton, problems with genetically modified plants, glyphosate herbicide resistant crops, ethical & safety concerns	
	3.6	RDT in diagnosis and treatment of diseases	
	3.7	Model organisms: *Escherichia coli, Saccharomyces cerevisiae, Drosophila melanogaster, Caenorhabditis elegans, Danio rerio* and *Arabidopsis thaliana*	

	Course code- RPSBCHP.E512 **Practical Title-** Practicals based on RPSBCH. E512	1 Credit
1	Isolation of chromosomal DNA from E coli cells	
2	Isolation of plasmid DNA from E. coli cells	
3	Separation of chromosomal & plasmid DNA using agarose gel electrophoresis	
4	Designing of primers	
5	Digestion of plasmid DNA with restriction enzymes	
6	Preparation of competent cells (CaCl2 treatment)	
7	Transformation of E. coli cells with plasmid DNA	
8	Demonstration of complementation of β−galactosidase for Blue and White selection	

References:

1. Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell publishing (Oxford, UK), ISBN: 978-1-4051-8173-0.
2. Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S.B., and Twyman, R. M., Blackwell publishing (Oxford, UK) ISBN:13: 978-1-4051-3544-3.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC), ISBN: 978-1-55581-498-4 (HC).
4. Genetic engineering and its applications, P. Joshi, Botania Publishers and Distributors
5. Recombinant DNA: A short course, Watson etal, Scientific Americal Books
6. Biotechnology Fundamentals and Applications, S.S.Purohitt, Agrobios Publishers, 2001.
7. Molecular Biology of the Gene: Watson, Baker, Bell, Gann, Levine, Losick; Pearson Benjamin Cummings & CSHL Press
8. Gene cloning & DNA analysis: an introduction; seventh edition; T A Brown; Wiley Blackwell publications

Course Code : RPSBCH.E513

Course Title: Applied Biochemistry

Type of course: Discipline Specific Core Course III

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Summarize about large scale production and purification of various industrially important products
CO 2	Illustrate the manufacturing processes for Industrial Importance of Carbohydrates, Proteins & Lipids
CO 3	Conclude different types and applications of biosensors in the field of biology.
CO 4	Discuss production of different types of vaccines
CO 5	Adapt fermentation process, inoculum development and fermentation media
CO 6	Develop designing and working of various fermenters and bioprocess parameters from market point of view
CO 7	Formulate recovery operations together with the fundamental principles for basic methods in production technique for bio-based products.
CO 8	Make use of theoretical concepts of applied biochemistry to develop experimental acumen.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Applied Biochemistry RPSBCH.E513	Credits/ Hours 3 / 45 Hours
I	**1**	**Industrial Importance of Carbohydrates, Proteins & Lipids**	**15**
	1.1	Carbohydrates of industrial importance	
	1.1.1	Manufacturing and refining of cane sugar, pectin & cellulose	

	1.1.2	Manufacturing of polysaccharides-Plant polysaccharide (Gum Arabic), microbial polysaccharides– modified starches & celluloses	
	1.2	Lipids of industrial importance	
	1.2.1	Extraction and refining of vegetable oils and animal fats & essential oils	
	1.2.2	Extraction and applications of chlorophyll, carotene, lycopene Turmeric	
	1.3	Proteins of industrial importance	
	1.3.1	Hormones – conventional & engineered-Insulin, Erythropoietin, Growth hormones	
	1.3.2	Non – catalytic industrial proteins – casein, whey proteins, Egg proteins, wheat germ proteins.	
II	**2**	**Biosensors & Vaccine Technology**	**15**
	2.1	Biosensors	
	2.1.1	Beneficial features of biosensors	
	2.1.2	Basic components of biosensor	
	2.2	Types: Electrochemical, Thermometric, Optical, Piezoelectric, Whole cell, Immunobiosensor (Construction and development) Types of biosensors, their construction, working and application in various industries and medicine	
	2.2.1	Calorimetric biosensor – Enzyme based sensors (Importance in clinical diagnosis)	
	2.2.2	Potentiometric biosensor- Ion selective electrode (Importance in environmental monitoring)	
	2.2.3	Amperometric biosensor- (Glucose monitoring) Optical biosensor- Chromogenic reaction	
	2.2.4	Piezo-electric biosensor –Crystal study	
	2.2.5	Immunosensor - ELISA	
	2.3	Production of vaccine	
	2.3.1	Vaccine derived from whole organism Attenuated & Inactivated vaccine	
	2.3.2	Vaccine derived from macromolecules purified from pathogenic organism – Use of Bacterial polysaccharide, Toxoid, Proteins, Synthetic peptide for vaccine development	
	2.3.3	Recombinant vector vaccine	
	2.3.4	Multivalent subunit vaccine- (SMAA complex & ISCOM)	
	2.3.5	DNA vaccine (Production & applications)	
	2.3.6	Anti-Idiotype vaccine (Use of hybridoma technology)	

III	**3**	**Bioprocess technology**	**15**
	3.1	Upstream processing:	
	3.1.1	Strains and Strain Improvement of industrial microorganisms	
	3.1.2	Isolation of industrially important microorganisms	
	3.1.3	Improvement of industrial microorganisms a) Selection of induced mutants for primary metabolite b) Isolation of induced mutants for secondary metabolites	
	3.1.4	Sterilization i) Introduction ii) Media sterilization	
	3.1.5	Design and methods of batch sterilization	
	3.1.6	Design and methods of continuous sterilization	
	3.2	Downstream processing	
	3.2.1	Recovery & Purification of fermentation products: i. Introduction, Precipitation, Filtration - theory, filter-aids, batch filters (Plate and frame filters), continuous filters (Rotary vacuum), Centrifugation: flocculating agent, range of centrifuges - Basket, tubular bowl. ii. Cell disruption: Physico-chemical. iii. Liquid – Liquid extraction, Solvent recovery, iv. Chromatography, Ultrafiltration, reverse osmosis, liquid membranes, drying, crystallization, Whole broth processing.	
	3.3	Environmental aspects	
	3.3.1	Effluent treatment and regulations for fermentation industry	
	3.3.2	Modern methods of effluent treatment	

	Course code- RPSBCHP.E513 **Practical Title-** Practicals based on RPSBCH. E513	1 Credit
1	Estimation of Total Carbohydrates by anthrone method	
2	Colorimetric estimation of fructose	
3	Isolation of pectin form apples	
4	Estimation of cellulose	
5	Isolation of Lecithin & Cholesterol from egg yolk	
6	Extraction & estimation of carotene	
7	Extraction of oils using Soxhlet apparatus and it's analysis	

References:

1) L.E.Casida, Industrial Microbiology, New Age International publishers
2) Biosensors: Fundamentals and Applications, Bansi Dhar Malhotra and Chandra Mouli Pandey (Smithers Rapra)
3) Handbook of Good Laboratory Practices (GLP), Second Edition – World Health Organization
4) Quality Assurance - A Practical Guide to the Design and Implementation of Assessments and Monitoring Programmes, Jamie Bartram and Gareth Rees, World Health Organization
5) M. Pelczar, E.C.S. Chan and M.R. Krieg, MICROBIOLOGY, McGraw Hill Inc., Singapore (1997).
6) Industrial Fermentation by Paul Allen
7) Biochemical methods, S Sadashivam and A Manickam, new age international publishers
8) J. Jayaraman, Laboratory Manual in Biochemistry, 2003, New Age International

Course Code : RPSBCH.E514

Course Title: Instrumentation II

Type of course: Discipline Specific Core Course IV

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Choose appropriate advanced instrument as per the measurement need in biochemical analysis.
CO 2	Illustrate basic principle and working of advanced instruments as mentioned in the course
CO 3	Estimate different disease conditions using advanced medical Instruments
CO 4	Explain the basic features of advanced instruments used in medicine
CO 5	Analyze the performance characteristics of each advanced instruments as mentioned in the course
CO 6	Interpret the data obtained after the analysis of different samples
CO 7	Develop interest in analysis of biomolecules and this will help them in undertaking further research in the area of biochemistry in any research/industrial institution.
CO 8	Apply the complete knowledge of various electronics instruments/transducers to measure the physical quantities in the field of science, engineering and technology

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Instrumentation II RPSBCH.E514	Credits/ Hours 2 / 30 Hours
I	**1**	**Special Instrumental Methods of Analysis**	**15**
	1.1	Basic Principles, Instrumentation, working and applications of -	
	1.1.1	FRAP, FRET, FLIM	
	1.1.2	Conductometry	

	1.1.3	Potentiometry	
	1.1.4	Selective Ion Meters	
	1.1.5	High Frequency Titrations	
	1.1.6	Polarography	
	1.1.7	Anode Stripping Voltammetry	
	1.1.8	Neutron Activation Analysis	
II	**2**	**Instruments used in medicine**	**15**
	2.1	Principle and working of Dialyser, Nebulizer, Otoscope, Bone Densitometry Single neuron recording, patch-clamp recording	
	2.2	ECG, Defibrillator	
	2.3	Brain activity recording, lesion & stimulation of brain - PET, MRI, fMRI, CAT	
	2.4	Medical imaging –	
	2.4.1	Ultrasound (medical ultrasonography), Elastography, Tactile imaging	
	2.4.2	Echocardiography (Heart Ultrasound)	

References:

1. Principles and Techniques of Biochemistry and Molecular Biology (2010) 7th ed., Wilson, K., and Walker, J. (eds), Cambridge University Press (New Delhi)
2. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D.,Wiley Blackwell (West Sussex)
3. Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch
4. Introduction to Instrumentation in Life Sciences (2012) Bisen, P.S. and Sharma, A., CRC Press/Taylor and Francis Group (California), ISBN:978-1-4665-1240-
5. Biophysical Chemistry (2013), Schimmel, C.R.C., Macmillan Higher Education
6. Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay and Nath – Himalaya Publ. House.
7. Medical Biochemistry by Ramakrishnan (2012)
8. TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore

Modality of Assessment: Semester II

DSC I, II and III

A) Internal Assessment- 40%- 30 Marks

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

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

Semester End Theory Examination:

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

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	Any 3 out of 4	15	UNIT I
Q2.	Any 3 out of 4	15	UNIT II
Q3.	Any 3 out of 4	15	UNIT III
	TOTAL	**45**	

DSC IV

Semester End Theory Examination:

1. Duration - These examinations shall be of **Two hours & 30 Minutes** duration.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	Any 3 out of 4	18	UNIT I
Q2.	Any 3 out of 4	18	UNIT II
Q3.	Any 2 out of 3	14	UNIT I & II
	TOTAL	**50**	

DSC I, II and III

Semester End Practical Examination:

Practical Examination Pattern:

	Particulars	Marks
1	Laboratory work	20
2	Viva & Journal	05
	TOTAL	**25**