

S. P. Mandali's
Ramnarain Ruia Autonomous College
(Affiliated to University of Mumbai)



Syllabus for

Program: MSc

Program Code: RPSBCH

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

GRADUATE ATTRIBUTE

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 FOR MSc

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
3	12 (3+1)*3	4(3+1)	0	0	6 RP	22
4	8 (3+1)*2	4(3+1)	0		10 OJT	22
Total CREDITS	48	16	4	4	16	88

PROGRAM OUTLINE

YEAR	SEM	CORE COURSE	Type of Course	COURSE TITLE	CREDITS	
MSc II	III	RPSBCHO601	DSC I	Advanced Metabolism	3	
		RPSBCHPO601	Practical DSC I	Practicals based on Major Theory	1	
		RPSBCHO602	DSC II	Eukaryotic Molecular Biology	3	
		RPSBCHPO602	Practical DSC II	Practicals based on Major Theory	1	
		RPSBCHO603	DSC III	Advanced Endocrinology	3	
		RPSBCHPO603	Practical DSC III	Practicals based on Major Theory	1	
		RPSBCHO604	DSE	Plant Biochemistry	3	
		RPSBCHPO604	Practical DSE	Practicals based on Theory	1	
				Dissertation		
	IV	RPSBCHE611	DSC I	Developmental Biology, Cancer & Immuno-deficiencies	3	
		RPSBCHPE611	Practical DSC I	Practicals based on Major Theory	1	
		RPSBCHE612	DSC II	Advanced Immunology	3	
		RPSBCHPE612	Practical DSC II	Practicals based on Major Theory	1	
		RPSBCHE613	DSE	Pathophysiology of Diseases & Clinical Research	3	
		RPSBCHPE613	Practical DSE	Practicals based on Major Theory	1	
				Internship		

Discipline Specific Elective- RPSBCHO604**Course Title: Plant Biochemistry****Academic year 2024-25****COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION Plant Biochemistry A student completing this course will be able to:
CO 1	Explain the structural details of the plant cell
CO 2	Illustrate the chemistry of different plant pigments in order to explore their isolation, characterization and applications in various fields
CO 3	Correlate photosynthetic process with humans and environment.
CO 4	Justify the importance of nitrogen fixation in agricultural production and environment
CO 5	Discuss the importance of secondary metabolites and its industrial applications.
CO 6	Identify the class and functions of secondary metabolites and appreciate their role in physiology of plants
CO 7	Choose appropriate plant growth regulators for development of plants
CO8	Make use of theoretical concepts of plant biochemistry and develop experimental acumen.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours
		Plant Biochemistry RPSBCHO604	3 / 45 Hours
I	1	Overview of Plant cell structure, plant pigments & plant metabolism	15
	1.1	Plant cell wall (structure), Overview of Leaf structure – Upper epidermis, palisade mesophyll, spongy mesophyll, lower epidermis, Guard cells and stomata	
	1.2.1	Specialized plant cells (in brief) – Parenchyma, Sclerenchyma, Collenchyma, Xylem and phloem, Bulliform cells	
	1.2.2	Concept of apoplast, apoplastic and symplastic pathways	
	1.2	Plant pigments –	
	1.2.1	Primary pigment - Chlorophyll (Types and function)	
	1.2.2	Role of accessory pigments and their biological significance Carotenoids, Xanthophylls, Betalains, Anthocyanins and other flavonoids	
	1.3	Plant Micronutrients	
	1.4	Nitrogen metabolism	
	1.4.1	Sources of Nitrogen, different forms of nitrogen in plants	
	1.4.2	Conversion of nitrate to nitrite & finally to ammonia, biological nitrogen fixation in plants	
	1.4.3	Sulphur metabolism, Phosphorous metabolism	
II	2	Photosynthesis, Photorespiration and plant movements	15
	2.1	Photosynthesis	
	2.2.1	Light reactions: Light harvesting complexes, Absorption of light, Photophosphorylation: Cyclic and Non-cyclic (Z scheme)	
	2.2.2	Dark reactions: Calvin cycle, regulation of Calvin cycle	
	2.3	C ₄ cycle and CAM pathway	
	2.4	Synthesis of glucose, starch, sucrose	
	2.5	Photorespiration, Photoperiodism and photoinhibition	
	2.6	Physiology of plant movements	

	Physical movements – Xerochasy, Hydrochasy Vital movements – Protoplasmic streaming, paratonic movements Tactic movements – Chemotaxis, Phototaxis, Thermotaxis Tropic movements – Chemo / geo / hydro / photo / thigmo tropism Nastic movements – Seismonasty, Nyctynasty, Photonasty, Chemonasty, Thermonasty	
3	Regulation of plant growth, secondary metabolites and Sexual reproduction in plants	
3.1	Plant Growth Substances Structure and Function of - Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic Acid	
3.2	Secondary metabolites of plants Nitrogen containing compounds (Alkaloids), Terpenes & Phenolic compounds – Shikimic acid pathway, Mevalonic acid pathway, MEP Pathway	
3.3	Reproduction in plants and PTC	
3.3.1	Asexual reproduction in gymnosperms. Life Cycle of Gymnosperms.	
3.3.2	Sexual Reproduction in angiosperms: Structure of plant gametes. Life cycle of angiosperm	
3.3.3	Double fertilization in plants	
3.4	Post fertilization events in plants	

	Course code- RPSBCHPO604 Practical Title- Practicals based on RPSBCHO604	1 Credit
1	Phytochemical analysis – Qualitative test	1 Credit
2	Quantitative estimation of Total Phenolic content	
3	Quantitative estimation of Alkaloids content	
4	Quantitative estimation of Flavonoids content	
5	Quantitative estimation of Saponins content	
6	Estimation of antioxidant capacity of plant extract	
7	Separation of plant pigments by Adsorption Column Chromatography & TLC	

References:

1. Biochemistry & Molecular Biology of Plants - Bob B. Buchanan - Wilhelm Gruissem and Russel L. Jones
2. Plant Biochemistry - Heldt H.-W., Piechulla B.
3. Methods in plant biochemistry and molecular biology - Dashek, William V

4. Plant Secondary Metabolites: Occurrence, Structure and Role in the Human Diet - Alan Crozier
5. Plant Physiology - Taiz and Zeiger - Sinauer Associates Inc.
6. Plant Biochemistry - Caroline Bowsher, Martin Steer, Alyson Tobin - Garland Science
7. Plant Biochemistry - P.M Dey and J.B. Harborne - Academic Press
8. Biochemical methods - S Sadashivam and A Manickam - New Age International publishers.

RAMNARAIN RUIA AUTONOMOUS COLLEGE

Modality of Assessment: Semester III

Discipline Specific Elective

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	

Semester End Practical Examination:

Practical Examination Pattern:

	Particulars	Marks
1	Laboratory work	40
2	Viva	05
3	Journal	05
	TOTAL	50

Semester IV**Discipline Specific Elective- RPSBCHE613****Course Title: Pathophysiology of Diseases & Clinical Research****Academic year 2024-25****COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	The student will be able to understand the cooperative relationship between Biochemistry and Medicine
CO 2	Learn the factors in the spread of infectious diseases & Explain biology and pathogenesis of infectious agents
CO 3	Describe the Immune responses of body against various pathogenic organisms
CO 4	Recognize the Biochemical aspect of cancer, Assays for diagnosis & treatment
CO 5	Understand the Physiology of cardiovascular diseases
CO 6	Realize the importance of drug development through clinical research

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Pathophysiology of Diseases & Clinical Research RPSBCHE613	Credits/ Hours 3 / 45 Hours
I	1	Infectious Diseases	15
	1.1	Bacterial infections: Tetanus, Diphtheria, Tuberculosis, Typhoid, Cholera	
	1.2	Viral infection: Measles, Mumps, influenza, HIV	
	1.3	Protozoan: Malaria and Trypanosomiasis	
	1.4	Parasitic infection: Leishmaniasis	
	1.5	Treatment of infectious agents	
	1.5.1	Characteristics of an ideal chemotherapeutic agent	
	1.6	Mode of action of antibiotics on	
	1.6.1	Cell wall (Penicillin and Cephalosporins)	
	1.6.2	Cell Membrane (Polymyxin and Imidazole)	
	1.6.3	Protein Synthesis (Streptomycin, Tetracycline and Chloramphenicol)	
	1.6.4	Nucleic acid (Quinolones, Nalidixic acid, Rifamycin)	
	1.6.5	Enzyme inhibitors (Trimethoprim)	
	1.7	Mechanisms of drug resistance- evolution, pathways and origin	
II	2	Cardiovascular Diseases	15
	2.1	Definition; The origin of cardiovascular diseases (electrical, structural and circulatory) and types of CVDs	
	2.2	Defining the broad spectrum of Ailments	
	2.3	Stages of CVDs	
	2.4	Molecular basis of CVDs - hypertension, coronary heart (artery) disease, cerebrovascular disease, cardiomyopathy, cardiac hypertrophy, atherosclerosis, myocardial infarction.	
	2.5	Diagnosis and Treatment strategies: screening methods; Current treatment modalities and their advantages and disadvantages, major side effects; Challenges of treatment. biomarkers for CVDs	
III	3	Clinical research	15
	3.1	Introduction of Clinical Research	
	3.1.1	Clinical Trial Phases & Evaluation	

	Role of Placebo Interpretation of clinical data, Meta-analysis	
3.1.2	Pharmacological Principal of Clinical Research Drug Development And Launch	
3.1.3	Clinical Trial Design and Project Managements	
3.2	Drug Invention; New Drug Development and Drug Assay	
3.2.1	Animal Toxicity studies: Systemic toxicity studies, Local toxicity studies & Specialised toxicity studies Interpretation of animal data, Subjective responses	
3.2.2	Drug Assay: 1. Chemical 2. Biological – Indication, Principle, Types & Biostandardisation Immunological	
3.3	Radio-receptor assays & ELISA	
3.4	Essential documents in Clinical Research and Regulatory Requirements	
3.4.1	IND Application	
3.4.2	NDA Application	
3.4.3	Informed Consent process and Documentation	
3.4.4	Clinical Study Report	

PRACTICAL

	Course code- RPSBCHPE613 Practical Title- Practicals based on RPSBCHE613	1 Credit
1)	Study of lifecycle of plasmodium	
2)	WIDAL test – Qualitative & Quantitative	
3)	Rapid antigen test	
4)	Bioassay of penicillin/ampicillin	
5)	Determination of MIC of antibiotic	
6)	Detection and measuring of heart beats (Manually) in Daphnia	
7)	Case studies on clinical research	

References:

- 1) Kuby Immunology (2007) 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN:13: 978-0-7167-8590-3 / ISBN: 10:0-7617-8590-0.
- 2) Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.
- 3) Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

- 4) Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7
- 5) Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer, L., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.
- 6) Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.
- 7) Textbook of Designing Clinical Research by Stephen B. Hulley

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