

Resolution Number: AC/II(23-24).2.RUS1

S. P. Mandali's
Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)



Syllabus for:

Program: Integrated M.Sc. in Bioanalytical Sciences
(S.Y. B.Sc. Syllabus)

Program Code: RUSBAS

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

(Choice based Credit System)

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 work place 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)

PO	Description
	A student completing Bachelor's Degree in Science program in the subject of Bioanalytical Sciences will be able to:
PO 1	Gain high quality science education in a vibrant academic ambience with the faculty of distinguished teachers and scientists.
PO 2	Take up the challenge of doing quality research and teaching and also contribute to industrial production and R & D in the fields of Bioanalysis, Bioinformatics and Nutraceutical Sciences.
PO 3	Amalgamate classical analytical chemical techniques with modern genomic and proteomic technologies of manufacturing and analysis to better characterize the products useful as medicines as well as nutraceuticals.

CREDIT STRUCTURE S. Y. B.Sc. Semester III

Year/ Level	Semester	Subject 1	Subject 2	Subject 3	Subject 4 (Minor)	Vocational & Skills(VSC) Life Skills(LS) Ethics & Value		AEC/GE	Internship/ Research project/ Case study	Total Credits
						VSC	LS			
II/5.0	3	Bioanalytical Sciences	Chemical Sciences	Pharmaceutical Sciences	Computational Sciences	VSC	LS			
		Physiology and Biochemistry	Analytical Chemistry I	Pharmacology I	Statistics II	Tools and Techniques in Biology I	Communication Skills	Entrepreneurship Skills I	-	
	Credits	4	4	4	4	(2)	(2)	(2)	(0)	22
	4	Microbiology and Immunology	Analytical Chemistry II	Pharmacology II	Bioinformatics	Tools and Techniques in Biology II	-	Entrepreneurship Skills II	Field Project/Regional Case Study	
Credits	4	4	4	4	(2)	(0)	(2)	(2)	22	

Semester III

Course Code: RUSMJBAS0201

Subject I: Bioanalytical Sciences

Course Title: Physiology and Biochemistry

Type of Course: Discipline Specific Core Course (Major)

Academic Year 2024-25

S. Y. B.Sc.

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Explain the concepts of Developmental biology
CO 2	Describe the system of muscle and nerve conduction.
CO 3	Comprehend central dogma of molecular biology as a prerequisite to study techniques like cloning, PCR, RFLP, etc.

DETAILED SYLLABUS

Paper Code	Semester III	Credits / Hours
RUSMJBAS0201	Physiology and Biochemistry	3/45
201.1	Developmental Biology	15
	Development of organ system, Developmental signals – polarity, differentiation, apoptosis, Ageing, regeneration (Example of Limb Bud Development), Process of Fertilization in humans, <i>in vitro</i> Fertilization- Gamete Collection and Storage techniques, Introduction to Stem Cell therapy and its applications	
201.2	Biology of Muscles and Nerve Conduction	15
	Muscle structure, Physiological and biochemical basis of muscle contraction Gibbs-Donnan Membrane Equilibrium and Physiology of nerve conduction Synapse & Synaptic conduction, Neurotransmitters, Drug addiction, Neuropathies	
201.3	Central Dogma of Molecular Biology	15

<p>Concept of Central dogma of molecular biology, Genetic code Replication in prokaryotes, Transcription & Translation in prokaryotes, Post translational modification, Regulation of gene expression in prokaryotes, (lac operon and trp operon)</p>	
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RUSMJBASPO201	PRACTICALS	Credits/Hours 1/30
<ol style="list-style-type: none"> 1. Handling of Micropipettes 2. Extraction of DNA from suitable biological source. 3. Agarose gel electrophoresis. 4. Study of bacterial Growth curve 5. Protein extraction from a suitable biological sample and its estimation by Biuret method 6. Carbohydrates extraction from a suitable biological sample and its estimation by TLC 7. Study of embryonic development from a suitable animal model (Demo). 		

Reference Books:

<p>Physiology and Biochemistry</p>	<ul style="list-style-type: none"> • Buns, G. W.: Science of Genetics - An introduction to heredity, Macmillan, New York. • Fairbanks, Daniel J. and Anderson, W. R.: Genetics, Wadsworth Publication. • William S. Kluge and Cummings, M.R.: Concepts of Genetics, Pearson Edu. • Kalthoff, Klaus: Analysis of Biological Development, The University of Texas at Austin. Mc GRAW-HILL, INC. • Peter Russell - Genetics • Buns, G. W.: Science of Genetics - An introduction to heredity, Macmillan, New York • Berril, N. J., Mc. Graw Hill: Developmental Biology, New York. • Brookbank, J.W. and Harpar: Developmental Biology, Raw Publishers, New York. • Subramoniam: Molecular Developmental Biology, Narosa Publishing House, New Delhi, 2008
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Semester III

Course Code: RUSMJBAS0202

Subject II: Chemical Sciences

Course Title: Analytical Chemistry I

Type of Course: Discipline Specific Core Course (Major)

Academic Year 2024-25

S. Y. B.Sc.

Course Outcomes:

COURSE OUTCOME	DESCRIPTION
CO 1	Describe the basic concepts of analytical chemistry
CO 2	Apply the concepts of pH in buffer preparations.
CO 3	Apply the principles of electrochemistry in conductometric analysis.

DETAILED SYLLABUS

Paper Code	Semester III	Credits/ Hours
RUSBAS.0202	Analytical Chemistry I	3/45
202.1 Basic Analytical Chemistry		15
1. Classification of analytical methods: Classical and Instrumental Methods 2. Chemical and physical methods in quantitative analysis 3. Steps and methods involved in quantitative analysis 4. Sample population and Sampling: Importance of sampling, sampling techniques 5. Types of errors and measures of dispersion & Central Tendency		
202.2 pH and Buffers		15
1. Acid- Base concept, Hard and soft acid and base (HSAB) 2. Concept of pH, pKa, pKw, Henderson–Hasselbalch equation, Isoelectric pH, Buffer, Buffering Capacity, 3. Relation between pI, pKa1 and pKa2 for a neutral, acidic and basic amino acid. 4. Ionic product of water, Activity coefficient, Solubility, Complex 5. formation and organic complexes, Oxidation and reduction equilibria, 6. Hydrolysis of salts and Solubility product 7. Concept of physiological buffer 8. Preparation and Numericals based on pH and Buffer		
202.3 Electrochemistry		15
1. Nature of electrolytes in solution: Variation of molar conductance with concentration for weak and strong electrolytes (derivation of equation is not expected). 2. Kohlrausch's law and its application to determine Molar conductance at infinite dilution of a weak electrolyte, Dissociation constant of a weak electrolyte, Solubility of sparingly soluble salts, Migration of ions, ionic mobilities. Nernst theory, EMF, cells, activity, ionic strength, Membrane potential applications Conversion of chemical energy to electrical energy. Galvanic cells, reversible and irreversible cells. 3. Types of electrodes: Metal – metal ion electrode, Redox electrodes, Gas electrode, Glass electrode 4. Classification of cells – Chemical and concentration cells, concentration cells with transference, concentration cells without transference, liquid junction potential, use of salt bridge. 5. Applications, strengths and limitations of electrochemical analysis		

RUSMJBASPO202	PRACTICALS	Credits/Hours 1/30
<p>Conductometry:</p> <ul style="list-style-type: none"> a) Determination of Cell constant of conductivity cell b) Verification of Ostwald's dilution law c) Determination of relative strength of acetic acid and chloroacetic acid by conductivity measurement. <p>pH-Metry:</p> <ul style="list-style-type: none"> d) Make the buffer for the desired pH and evaluate it using a pH meter e) Identification of an acid by acid-base titration pH-metrically f) pH titration of sodium carbonate against HCl to demonstrate the selection of indicators for two inflections. 		

Reference Books:

Analytical Chemistry I	<ul style="list-style-type: none"> ● Douglas. A. Skoog, F. James Holler, Stanley R Crouch: Principles of analytical Chemistry: 6th edition: Thomson/Brooks/Cole ● David Harvey: Modern Analytical Chemistry: Mc Grow Hill Publishers ● Somenath Mitra: Sample preparation Technique in Analytical Chemistry: Wiley interscience ● Allen J. bard: Electrochemical Methods
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Semester III

Course Code: RUSMJBAS0203

Subject III: Pharmaceutical Sciences

Course Title: Pharmacology I

Type Course: Discipline Specific Core Course (Major)

Academic Year 2024-25

S. Y. B.Sc.

COURSE OUTCOME	DESCRIPTION
CO 1	Evaluate the significance of pharmacokinetics and pharmacodynamics in Bioanalysis.
CO 2	Explain the mechanism of drugs acting on nervous system.
CO 3	Explain the mechanism of drugs acting on nervous system.

DETAILED SYLLABUS

Paper Code	Semester III	Credits / Hours
RUSMJBAS0203	Pharmacology I	3/45
203.1	Pharmacokinetics and Pharmacodynamics	15
1. Scope of Pharmacology 3. Dose- Response Relationship 4. Factors influencing drug dosage and drug action. 5. Drug disposition & Pharmacokinetics 6. Drug Metabolism: Introduction, Absorption, Distribution, Bio-transformation, Excretion 7. Mechanisms of Drug Action- Pharmacodynamics 8. Different Pharmacokinetic & Pharmacodynamics parameters and their meanings and basic techniques to evaluate the parameters		

203.2	Drugs acting on Nervous System	15
1.	Drugs acting on Peripheral Nervous System: Local anesthetics	
2.	Drugs acting on Central Nervous System: General Anesthetics, Ethyl and Methyl Alcohol, Sedative-hypnotics, Opioid Analgesics and Antagonists, Drugs used in mental illness, CNS stimulants and Cognition enhancers	
3.	Drugs acting on Autonomic Nervous System: Cholinergic agonists and antagonists, Adrenergic agonist and antagonists	
203.3	Drugs acting on Digestive, Excretory, and Reproductive System	15
1.	Drugs acting on Digestive System: Drugs for Pectic ulcer, emesis, reflux, digestive disorders, constipation and diarrhea.	
2.	Drugs acting on Excretory system: Uretics and Antidiuretics	
3.	Drugs Acting on Reproductive system: Androgens and Drugs for Erectile Dysfunction, Estrogens, Progestins and Contraceptives, Oxytocin and Other Drugs Acting on Uterus	

RUSMJBASPO203	PRACTICALS	Credits/Hours
		1/30
<ol style="list-style-type: none"> 1. Titrimetric estimation of neutralizing capacity an antacid tablet. 2. Complexometric estimation of MgCO₃ in an antacid tablet. 3. Detection of Luteinizing hormone using ovulation kit 4. Estimation of caffeine by qualitative/quantitative method 5. Detection of ethanol from given biological sample (blood/urine). 6. Assay of a given diuretic (Mannitol) as per pharmacopoeia (Melting point/solubility/specific rotation/total and reducing sugar estimation) 		

Reference Books:

Pharmacology I	Essentials of Medical Pharmacology, K.D. Tripathi
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Semester III**Modality of Assessment for: S. Y. B.Sc. Semester III/IV**

Sr. No.	Number of Credits	Total Marks	Internal Assessment (Marks)	Internal Assessment (Pattern)	Semester End Examination (Marks)	Semester End Examination (Pattern)	Duration of Semester End Exam
1.	3	75	30	a)1 Class Test of 20 Marks b)1 Assignment of 10 Marks	45	Three Questions of 15 Marks each	1 Hr 30 Mins
2.	2	50	20	Class Test/Assignment/Open Book Test	30	Two Questions of 15 marks each/Three Questions of 10 Marks each	1 Hr
3.	1 (Practical)	25	NA	NA	25	Required Experiments Performed with appropriate principle, approach, Observations, Result, Demonstration of skills, Conclusion and Viva.	45 Minutes

Semester IV

Course Code: RUSMJBASE211

Subject I: Bioanalytical Sciences

Course Title: Microbiology and Immunology

Type of Course: Discipline Specific Core Course (Major)

Academic Year 2024-25

S. Y. B.Sc.

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Describe the types of viruses and their life cycles
CO 2	Differentiate between adaptive and innate immunity.
CO2	Apply principles of industrial microbiology in bioprospecting

DETAILED SYLLABUS

Paper Code	Semester IV	Credits /Hours
RUSMJBASE211	Microbiology and Immunology	3/45
211.1	Virology and interaction of microbes with humans	15
Virology: Introduction, Scope and Current trends in virology Structures and life cycles of bacteriophages, plant and animal viruses Interactions of microbes with Humans – Influenza, Staphylococcus, Plasmodium, Candida, SARS-CoV-2 Control of Viruses and Eukaryotic Pathogens.		
211.2	Introduction to Immunology	15
Concept of antigen, antibody, Types of immunity, Antigen-Antibody Reactions (MHC, APC introduction), Hypersensitivity and its types, Mechanism of wound healing, Autoimmune disorders (minimum two) and their management		
211.3	Industrial Microbiology	15
Sources of antimicrobial agents: plants and microorganisms, Antimicrobial Agents Used In vivo and their commercial production. Antimicrobial Drug Resistance and Drug Discovery Important microbes in Food & Drug industry, Pathogenic Organisms in Food & Pharma Industry Commercial significance of Microbes: Biopolymers, Biosurfactants.		

RUSMJBASPE211 PRACTICALS

1. Working in Laminar air flow
2. Total viable count of the provided sample.
3. Direct microscopic counts of provided sample using Breeds count method
4. Physical and chemical methods of disinfection
5. Study of Normal flora of human body, common microbial contaminants in foods: *S. aureus*, *S. typhi*, *B. subtilis*
6. Analysis of Crude drugs by Microscopy with an emphasis on identification of adulteration

Reference Books:

Microbiology and Immunology	<ul style="list-style-type: none">● Flint - Virology● Kindt, Goldsby, Osborne - Kuby Immunology● S. Pathak and U. Palan – Immunology and Fundamental● Michael J. Pelczar, Jr. E.C.S. Chan, Noel R. Krieg – Microbiology● Lasing. M. Prescott, Harley, Klein, Microbiology
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Semester IV**Course Code: RUSMJBASE212****Subject II: Chemical Sciences**
Course Title: Analytical Chemistry II**Type of Course: Discipline Specific Core Course****Academic Year 2024-25****S. Y. B.Sc.****COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
CO 1	Evaluate the importance of various extraction and purification methods in bioanalysis
CO 2	Explain the concepts of spectroscopy
CO 3	Apply the principles of chromatography in separation of molecules.

DETAILED SYLLABUS

Paper Code	Semester IV	CREDITS /HOURS
RUSMJBASE212	Analytical Chemistry II	3/45
212.1	Methods of Extraction and Purification in Analysis	15
	<ol style="list-style-type: none"> 1. Partition coefficient and distribution ratio, extraction efficiency, separation factor, role of complexing agents in solvent extraction, chelation, ion pair formation, solvation, types of solvent extraction: batch, continuous. 2. Purification of solid organic compounds, recrystallisation, use of miscible solvents, use of drying agents and their properties, sublimation. 3. Purification of liquids. Experimental techniques of distillation, fractional distillation, distillation under reduced pressure. 4. Solvent extraction, use of immiscible solvents 5. Difference between extraction, separation and their applications. 	
212.2	Basic Spectroscopy	15
	<ol style="list-style-type: none"> 1. Electromagnetic spectrum (EMR), Units of wavelength and frequency and their inter conversions. 2. Interaction of EMR with matter: Nature of radiation, energy of molecules electronic, vibrational and rotational 3. Beer-Lambert's law, Concept of absorbance, transmittance and molar absorptivity, deviation of Beer-Lambert's equation and its limitations, 4. Quantization of energy, Bohr frequency condition 5. Single beam colorimeter – Principle, components and working. 6. Regions of electromagnetic spectrum and process associated with each region. 7. UV-Visible spectroscopy: Basic theory, Solvents, Nature of UV-Visible spectrum, Concept of Chromophore, Auxochrome, Bathochromic Shift, Hyper chromic and Hypochromic effect, Chromophore-Chromophore interactions and Chromophore-Auxochrome interactions. Sample Preparation, Evaluation of errors and applications of Colorimetry and UV Visible spectroscopy 	

212.3	Introduction to Planar Chromatography	15
	<ol style="list-style-type: none"> Principles of Planar Chromatography Basics of Chromatography: Stationary Phase, Mobile Phase, Rf Value, Chromatogram, Chromatograph, Solvent front, etc. Sample preparation for paper chromatography and thin layer chromatography (TLC) Paper chromatography and its applications TLC and its applications Introduction to High Performance Thin Layer Chromatography (HPTLC) Advances of HPTLC over TLC 	
RUSMJBASPE212	PRACTICALS	
	<p>Separation of Organic mixtures:</p> <ol style="list-style-type: none"> Water soluble + Water insoluble (Solid + Solid) Water insoluble + Water insoluble (Solid + Solid) <p>Paper Chromatography: To separate the components of the given sample using paper chromatography</p> <p>Solvent Extraction: Determination of Fe and Cu from their mixture</p> <p>Colorimetry To determine indicator constant of a given indicator by Colorimetric measurements</p> <p>Turbidimetry Turbidimetric analysis of cough syrup</p>	

Reference Books:

Analytical Chemistry II	<ul style="list-style-type: none"> Dand Harvey: Modern Analytical Chemistry: Mc Grow Hill Publishers Hobart. H. Williard, Lyne L. Merrit, John A. Dean, Frank. A. Settle. Jr. : Instrumental Methods of Analysis: CBS Publisher. David Harvey: Modern Analytical Chemistry: Mc Grow Hill Publishers Douglas. A. Skoog, F. James Holler, Stanley R Crouch: Principles of analytical: 6th edition: Thomson/Brooks/Cole Donald Pavia, Gary Lampman, George Kriz, James Vyvyan: Introduction to Spectroscopy: 4th Edition: Brooks/Cole
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Semester IV

Course Code: RUSMJBASE213

Subject III: Pharmaceutical Sciences

Course Title: Pharmacology II

Type of Course: Discipline Specific Core Course

Academic Year 2024-25

S. Y. B.Sc.

COURSE OUTCOMES: s

COURSE OUTCOME	DESCRIPTION
CO 1	Students should study pharmaceutical chemistry and bio-organic chemistry with the perspective of their applications in Bioanalytical sciences.
CO 2	Students should be aware of the advances in biopolymers biomaterials and their applications.

DETAILED SYLLABUS

Paper Code	Semester III Pharmacology II	CREDITS/ HOURS 3/45
RUSMJBASE213		
213.1 Systemic Anti-infective agents		15
1. Antimicrobial drugs 2. Antiviral drugs 3. Antifungal, Anti-tubercular, Anti-malarial drugs		
213.2 Drugs acting on Hemopoietic system		15
1. Haematinics and Erythropoietin 2. Drugs Affecting Coagulation, Bleeding and Thrombosis 3. Hypolipidemic agents and plasma expanders		
213.3 Drugs acting on Cardiovascular System		15
1. Drugs Affecting Renin-Angiotensin System and Plasma Kinins		
2. Cardiac Glycosides and Drugs for Heart Failure		
3. Antiarrhythmic Drugs		
4. Antianginal and Other Anti-ischaemic Drugs		
5. Antihypertensive Drugs		

RUSMJBASPE213	PRACTICALS
<ol style="list-style-type: none">1. Study of antimicrobial agents by: i) Disk diffusion ii) Agar Well-diffusion2. Study of Pharmacopeial monograph for different types of drugs3. Estimation of MIC of the given antimicrobial/antifungal agent.4. Demonstration of the activity of the given antimicrobial/antifungal agent by time-kill assay.5. Estimation of iron from the given formulation using colorimetry6. Effect of an anticoagulant on Activated clotting time (ACT).	

Reference Books:

Pharmacology II	Essentials of Medical Pharmacology, K.D. Tripathi
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Ramnarain Ruia Autonomous College

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