AC/II(23-24).2.RUS3

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for UG Biotechnology

Program: S.Y.BSc.

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

(Choice based Credit System)

GA	GRADUATE ATTRIBUTES **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	Description **A student completing Bachelor's Degree in Science program in the subject of Biotechnology will be able to:**
PO 1	Adept in basic sciences along with a thorough understanding of biotechnology principles and chemical sciences to create a foundation for higher education with the insights into interdisciplinary approach.
PO 2	Demonstrate the applications of fundamental biological processes from the molecular, cellular, industrial and environmental perspective.
PO 3	Develop effective communication skills with improved individual and team work abilities in the domain of scientific research writing. Showcase their innovative ideas and research work efficiently.
PO 4	Reflect, analyse and interpret information or data for investigating the problem in fields of biotechnology. Acquire scientific and entrepreneur skills to furnish sustainable solutions to coeval problems
PO 5	Illustrate the relevance of ethical implications and standard laboratory practices in tissue culture techniques, forensic biology, developmental biology and other fields of biotechnology.
PO 6	Apply the conceptual knowledge to develop coherent, efficacious and proficient practical, technical and analytical skills.

Credit Structure for SYBSc. Biotechnology 24-25

Semester	Subject 1 (Major)		Subject 2 (Minor)	GE/ OE course	Vocational and Skill Enhancement Course (VSC) & SEC	Ability Enhancement Course/ VEC/IKS	OJT/FP/CEP CC, RP	Total Credits
	DSC	DSE						
3	Major 8 4*2/ (3T+1P) *2		Minor 4 (3T+1P)	2	VSC-2-Major	AEC-2 MIL (Marathi/Hindi)	FP -2, CC-2	22
4	Major 8 4*2/ (3T+1P) *2		Minor 4 (3T+1P)	2	SEC-2	AEC-2 MIL (Marathi/ Hindi)	CEP-2, CC-2	22
Total	16		8	4	4	4	8	44
Exit option: award of UG Diploma in Major with 88 credits and an additional 4 credit Core NSQF course/ Internship or Continue with Major and Minor								

PROGRAMME OUTLINE

YEAR	SEMESTER	PAPER	COURSE CODE	COURSE TITLE	CREDITS
SYBSc	III	DSC-I	RUSBTKMJO201	IMMUNOLOGY	3
		DSC-I	RUSBTKMJPO201	PRACTICAL BASED ON IMMUNOLOGY	1
		DSC-II	RUSMJBTKO202	PLANT AND ANIMAL PHYSIOLOGY	3
		DSC-II	RUSMJBTKPO202	PRACTICAL OF PLANT AND ANIMAL PHYSIOLOGY	1
		MINOR	RUSMIBTKO203	BIOCHEMISTRY	3
		MINOR	RUSMIBTKPO202	PRACTICAL BASED ON BIOCHEMISTRY	1
		VSC	RUSVSCBTKPO201	ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY	2
SYBSc	IV	DSC-I	RUSMJBTKE211	AIR WATER AND SOIL MICROBIOLOGY	3
		DSC-I	RUSMJBTKPE211	PRACTICAL BASED ON AIR WATER AND SOIL MICROBIOLOGY	1
		DSC-II	RUSMJBTKE212	MOLECULAR BIOLOGY	3
		DSC-II	RUSMJBTKPE212	PRACTICAL BASED ON MOLECULAR BIOLOGY	1
		MINOR	RUSMIBTKE213	BIOPHYSICAL CHEMISTRY	3
		MINOR	RUSMIBTKPE213	PRACTICAL BASED ON BIOPHYSICAL CHEMISTRY	1
		SEC	RUSSECBTKE211	BIOINFORMATICS AND BIOSTATISTICS	2

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

SEMESTER III

Course Code: RUSBTKMJO201

Course Title: IMMUNOLOGY

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	Describe the different complement pathways and give their functions
CO2	Compare and distinguish between molecules and pathways involved in complement system
CO 3	Elucidate the steps involved in production and maturation of different blood cells
CO4	Explain the principle and differentiate between the precipitation, agglutination reactions using suitable examples
CO 5	Comment on the application of multiple agglutination and precipitation technique/s in detection of different antigens
CO 6	State the principle, significance and applications of advanced immune techniques .
CO 7	Develop suitable immuno-technique for detection of pathogenic and/or non pathogenic antigens .

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours 3/45
	Unit I	**Hematopoiesis and Complement system:** Haematopoiesis - process, regulation and uses; Complement System- Classical, Alternate and Lectin; Regulation and Biological Effects of Complement System; Deficiencies of Complement System	
	Unit II	**Antigen antibody interaction techniques- Precipitation Reactions:** Immunoprecipitation, Immunoelectrophoresis, CIEP, Rocket Electrophoresis and 2-D Immunoelectrophoresis **Agglutination Reactions** Passive, Reverse Passive, Agglutination Inhibition Coomb's Test; Complement Fixation Tests. Synthesis of Monoclonal antibodies & Applications	
	Unit III	**Immunotechniques** RIA, ELISA, ELISPOT, Chemiluminescence, Western Blot, Immunofluorescence, Flow Cytometry. Alternatives to Antigen- Antibody Reactions	

References:

1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY

2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and ShubhangiSontakke, University Press, India

3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.

4. Introduction to Immunology- C V Rao- Narosa Publishing House

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

SEMESTER III

Course Code: RUSBTKMJPO201

Course Title: PRACTICALS BASED ON IMMUNOLOGY

Sr. No.	Practical Title
1.	WIDAL test – Qualitative and Quantitative
2.	ELISA (Antibody Capture)
3.	Dot ELISA
4	Single radial immunodiffusion
5	Ouchterlony's double immunodiffusion
6	Rapid Antigen Test (Salmonella) Rapid antigen test (Malaria)
7	Isohemagglutinin titre detection
8	Demonstration of Flow cytometry - A lab visit/ Video Demonstration
9	Detection of antigen/antibody using western blot

References:

1. **Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY**
2. **Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and ShubhangiSontakke, University Press, India**

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

SEMESTER III

Course Code: RUSMJBTKO202

Course Title: PLANT AND ANIMAL PHYSIOLOGY

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	Define the basic life processes of plants and animals
CO 2	Illustrate important chemical reactions, pathways involved in Major systemic processes of plants and animals
CO 3	Determine role and uses of Hormones affecting plant and animal growth characteristics
CO 4	Elucidate effect chemical and non chemical factors regulating plant and animal growth characteristics
CO 5	Describe the interdependence of different biological systems on the basis of their respective functions and anatomies of their organs.
CO6	Estimate elevation or deprivation of different biocompounds during one or more systemic malfunctions and suggest the corrective measures for the same
CO7	Analyse and interpret different tests to estimate biochemical and anatomical problems in a biological system

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours 3/45
	Unit I	Plant Physiology Photosynthesis, Intracellular Organization of Photosynthetic System. Fundamental Reactions of Photosynthesis, Photosynthetic Pigments, Role of Light. Hill Reaction and its Significance, Light Reactions, Cyclic and Non-Cyclic Photo induced Electron Flow, Energetics of Photosynthesis Photorespiration, Dark Phase of Photosynthesis, Calvin Cycle, C-3, C-4 pathways	
	Unit II	Animal Physiology-I Physiology of Digestion, Movement of Food and Absorption, Secretary functions of Alimentary Canal, Digestion and Absorption, assimilation in Gut of Mammals Anatomy of Mammalian Kidney, Structure of Nephron, Physiology of Urine Formation and Role of Kidney in Excretion and Osmoregulation Physiology of Respiration, Mechanism of Respiration, Principles of Gaseous Exchange in the Blood and Body Fluids,	
	Unit III	Animal physiology –II Blood and Circulation: Blood Composition, Structure and Function of its Constituents Blood Coagulation and Anticoagulants Hemoglobin and its Polymorphism Regulation of the Circulation Mechanism and working of Heart in Human. Structure and functions of neurons, types and physiologic anatomy of the synapse, transmission of nerve impulse, ion channels, neurotransmitters	

		and neuropeptides, electrical events during neuronal excitation and inhibition, neurotoxins	

References:

1. **Plant physiology,3rd ed, Lincoln Taiz and Eduardo Zeiger**
2. **Plant Biochemistry, Hans Walter Heldt, Birgit Peichulla.**
3. **Ganong's Review of Medical Physiology -23rd edition**
4. **Inderbir singh's Textbook of Human Neuroanatomy -10th edition**

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

SEMESTER III

Course Code: RUSMJBTKPO202

Course Title:PRACTICALS BASED ON PLANT AND ANIMAL PHYSIOLOGY

Sr. No.	Practical Title
1.	Spectroscopic studies of plant pigments
2.	Determination of chlorophyll content
3.	To study seed germination under red and far red radiation.
4	To study effect of growth factors on plant growth
5	To analyse the chemical nature of soil by rapid spot tests
6	To compare the loss of water from mesophyte and xerophyte a) $CoCl_2$ method b) Four leaf method
7	To study the activity of catalase in different food sources like potato and wheat sprouts.
8	Determination of serum total cholesterol.
9	Detection of uric acid, creatinine, ketone bodies and bile salts in urine sample

10	Interpretation of ECG and 2D echo results
11	study of platelet and estimation of platelet count using haemocytometer
12	Staining of reticulocytes
13	Estimation of blood lactic acid levels pre and post physical workout
14	Estimation of blood pressure before and after physical exercise
15	Estimation of haemoglobin count pre and post physical activity

References:

1. **Plant physiology,3rd ed, Lincoln Taiz and Eduardo Zeiger**
2. **Plant Biochemistry, Hans Walter Heldt, Birgit Peichulla.**
3. **Ganong's Review of Medical Physiology -23rd edition**
4. **Inderbir singh's Textbook of Human Neuroanatomy -10th edition**
5. **Centre for disease control and prevention- ECG manual.**

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

SEMESTER III

Course Code: RUSMIBTKO203

Course Title: BIOCHEMISTRY

Type of Course: MINOR

Academic year 2024-25

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Illustrate the mechanism and steps involved in the carbohydrate metabolism
CO2	Elaborate on different chemical and non chemical factors involved in carbohydrate metabolism and regulation
CO3	Demonstrate appropriate biochemical tests for carbohydrate detection.
CO 4	Describe the regulation and ATP formation in the breakdown and synthesis pathways.
CO 5	Analyse the energy formation via Oxidative phosphorylation.
CO 6	Explain the role of amino acid metabolism in providing energy and excretion.
CO 7	Differentiate between Glucogenic and Ketogenic amino acids.
CO 8	Analyse the lipid metabolism pathway & correlate between the steps and the reaction energetics.
CO9	Diagnose the metabolic errors using quantitative estimation of biomolecules and metabolic enzymes also suggest corrective measures for the same

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours 3/45
	Unit I	**Carbohydrate Metabolism, ETS** **Carbohydrate Metabolism:** Glycolytic Pathway and its Regulation, Homolactic Fermentation; Alcoholic Fermentation; Energetics of Fermentation; Citric Acid Cycle and its Regulation **Electron Transport System:** Electron Transport and Oxidative Phosphorylation. Inhibitors of ETS	
	Unit II	Amino Acid Metabolism Amino Acid Breakdown: Deamination, Transamination, Urea Cycle, Breakdown of Glucogenic and Ketogenic Amino Acids. Amino Acids as Biosynthetic Precursors	
	Unit III	**Lipid Metabolism** Mobilization, Transport of Fatty Acids. Beta, Alpha and Omega Oxidation of Saturated Fatty Acids; Oxidation of Unsaturated Fatty Acids, Oxidation of Odd Chain Fatty Acids. Energy Yield, Ketone Body Breakdown to Yield Energy. (Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above Pathways)	

References:

- Outlines of Biochemistry: 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA
- Principles of Biochemistry, 4th edition (1997), JefforyZubey, McGraw-Hill College, USA
- Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.
- Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet& Judith Voet, John Wiley and Sons, Inc. USA
- Biochemistry: 7th Edition, (2012), Jeremy Berg, LubertStryer, W.H.Freeman and company, NY

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

SEMESTER III

Course Code: RUSMIBTKPO203

Course Title: PRACTICALS BASED ON BIOCHEMISTRY

Sr. No.	Practical Title
1.	Determination of blood glucose levels for detection of Diabetes mellitus.
2.	Study of transamination activity (SGPT, SGOT)
3	Demonstration of Glutamate dehydrogenase assay
4	Determination of crude fat by soxhlet method
5	Isolation of Mitochondria and Demonstration of ETC using a Marker Enzyme.
6	Determination of iodine number of oil/ fats.
7	Determination of acid number of oil/fats
8	Detection of amino acid by TLC
9	Detection of sugars by TLC
10	Detection of Aromatic amino acid by xanthoproteic test

11	Detection of Sulphur containing aminoacid by nitroprusside test
12	Quantification of Aromatic amino acids using UV spectrophotometry

References:

- Outlines of Biochemistry: 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA
- Principles of Biochemistry, 4th edition (1997), JefforyZubey, McGraw-Hill College, USA
- Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.
- Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet& Judith Voet, John Wiley and Sons, Inc. USA
- Biochemistry: 7th Edition, (2012), Jeremy Berg, LubertStryer, W.H.Freeman and company, NY

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

Semester IV

Course Code: RUSMJBTKE211

Course Title: AIR WATER SOIL MICROBIOLOGY

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	Explain the concept of strata and spheres.
CO 2	Demonstrate the concept of sampling,enrichment, enumeration and isolation of microbes in air, water and soil from different sources.
CO 3	Design the process to analyse water, soil and air quality and characterization of microbes present in respective ecosystems.
CO 4	Elaborate the microbiology of air, water and soil ecosystem
CO 5	Illustrate the relevance of soil, water and air profile, structure and types to various nutrient cycles.
CO 6	Design various Physiological and biochemical methods for studying soil, air and water biota and their functions

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours
	Unit I	**Microbiology of air** The components and layers of atmosphere, Aero-microbiological pathway,	

		Number and kind of microorganisms in air, Airborne diseases, Dust, Droplet & Droplet nuclei, Sampling, Quantitative & Qualitative methods for enumeration of bacteria in air, Air sanitation (Chemical & Physical methods) intramural aero-microbiology and intermural aero-microbiology	
	Unit II	**Microbiology of water** The components and layers of hydrosphere, Introduction to aquatic microbiology, Distribution of aquatic environment, Types of microorganisms. Microbiology of potable water Introduction – Definition & characteristics, standards, demand & use, various sources, water borne diseases. Analysis of potable water – Physical, Chemical & Biological parameters Microbiology of fresh marine water system and estuaries Biofilms in water distribution system Microbiology of wastewater	
	Unit III	**. Microbiology of Soil** Soil profile, soil texture, soil structure, soil habitat scale, microorganism present in soil, C cycle and microbes, N cycle and microbes, P cycle and microbes. Physiological and biochemical methods for studying soil biota and their functions	

Reference:

1. **Microbiology-6th edition (2006), Pelczar M.J, Chan E.C.S, Krieg N.R., The Mc Graw Hill Companies Inc. NY**
2. **Prescott's Microbiology, 8th Ed (2010), Joanne M Wille, Joanne Wiley, Linda Sherwood, Mc Graw Hill Science Engineering, USA.**

RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025

Semester IV

Course Code: RUSMJBTKPE211

Course Title: PRACTICAL BASED ON AIR WATER SOIL MICROBIOLOGY

Sr. No.	Practical Title
1.	Enrichment and isolation of psychrophilic microorganisms from water
2.	Enrichment and isolation of halophilic micro-organisms from water
3.	Enrichment and isolation of thermophilic microorganisms from water
4	Study and preparation of Winogradsky's column
5	Contact slide method of different water samples A. Marine water sample B. Fresh water sample C. Estuarine water sample
6	Enrichment and isolation of nitrifying microorganisms from soil
7	Enrichment and isolation of phosphate solubilizing microorganisms from soil
8	Enrichment and isolation of Sulphur utilising bacteria from soil
9	Techniques for microbial air impaction

10	To check the quality of potable water by a. Standard plate count b. Most Probable Number for coliform detection c. Estimation of Clostridium spp
11	Enrichment and isolation of microorganisms from wastewater sample a. dairy effluent sample b. textile industry effluent c. automobile industry effluent d. laundry waste effluent

Reference:

3. **Microbiology-6th edition (2006), Pelczar M.J, Chan E.C.S, Krieg N.R., The Mc Graw Hill Companies Inc. NY**
4. **Prescott's Microbiology, 8th Ed (2010), Joanne M Wille, Joanne Wiley, Linda Sherwood, Mc Graw Hill Science Engineering, USA.**
5. **Environmental biotechnology- Basic concepts and applications 2nd edition**

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

SEMESTER IV

Course Code: RUSMJBTKE212

Course Title: MOLECULAR BIOLOGY

Type of Course: Discipline Specific Core Course

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Explain the steps involved in the transcription of prokaryotes and eukaryotes.
CO 2	Elaborate the role of RNA polymerase in the process of transcription.
CO 3	Describe the phenomenon of the Wobble hypothesis.
CO 4	Express the in-depth mechanism of protein synthesis.
CO5	Elucidate the process of protein sorting in prokaryotes and eukaryotes
CO 6	Explain the principle, working, regulation and significance of different operon systems
CO 7	Illustrate the process and significance of jumping genes in maize
CO8	Demonstrate separation, characterization and quantification of nucleic acids from prokaryotes and eukaryotes.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours 3/45
	Unit I	**Gene Expression – Transcription** Gene Expression- an Overview. Transcription Process in Prokaryotes: RNA Synthesis; Promoters and Enhancers; Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain. Transcription in eukaryotes and transcription of protein coding genes by RNA polymerase	
	Unit II	**Gene Expression- Translation** Introduction to the translation process, Nature of Genetic Code, Deciphering the genetic code, Wobble Hypothesis Process of protein synthesis (initiation, elongation , translocation and termination) in prokaryotes and eukaryotes, protein sorting in the cell	
	Unit III	**Regulation of Gene Expression** In prokaryotes: *Lac* operon of *E.coli, trp*Operon of *E.coli* In Eukaryotes: operons in eukaryotes, control of Transcriptional Initiation, jumping genes in maize	

References:

1. Cell and Molecular Biology – De Robertis- Lippincott Williams& Wilkins
2. Cell and Molecular Biology- Concepts and Experiments—Karp – Wiley International
3. Essential iGenetics- Peter Russell -Pearson Education
4. Microbial Genetics- Freifelder –Narosa Publishing House
5. Genetics, (2006) Strickberger MW - (Prentice Hall, India

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

SEMESTER IV

Course Code: RUSMJBTKPE212

Course Title: PRACTICALS BASED ON MOLECULAR BIOLOGY

Sr. No.	Practical Title
1.	Expression of β- galactosidase and Measurement of Activity.
2.	Isolation of Genomic DNA from Bacteria
3.	Isolation of Genomic DNA from yeast
4.	Isolation of total RNA from Bacteria
5.	Isolation, of total RNA from yeast
6.	Qualitative analysis of DNA using Agarose Gel Electrophoresis
7.	Qualitative analysis of RNA using Agarose Gel electrophoresis
8.	Quantitative analysis of DNA using UV spectrophotometer
9.	Quantitative analysis of RNA using UV spectrophotometer
10.	Quantitative analysis of plasmid DNA using UV spectrophotometer

References:

1. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA

2. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA

3. Molecular Biology, 5th Edition (2011), Weaver R., McGraw Hill Science. USA

4. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press.

5. Molecular Biology: genes to proteins, 4th edition (2011), Burton E Tropp Jones& Bartlett Learning, US

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

SEMESTER IV

Course Code: RUSMIBTKE213

Course Title: Biophysical chemistry

Type of Course: Discipline Specific Core Course

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Illustrate the concepts of Gibbs' and Helmholtz Free Energy to EMF measurements.
CO 2	Describe the types of Electrodes and Electrochemical Cells.
CO 3	Derive Nernst Equation and can give its applications.
CO 4	Calculate the pH for strong and weak electrolytes and Buffer Action.
CO 5	Explain the factors affecting the solubility of a precipitate.
CO 6	Describe different types of precipitation gravimetry.
CO7	Demonstrate the effect of various experimental factors on the particle size of the precipitate.
C08	Define the various terms involved in titrimetric analysis.
C09	Explain the theory of acid-base indicators and choose a suitable indicator for a particular acid-base titration.

C10	Elucidate factors affecting thermal transfer in the chemical reactions
C11	Calculate the enthalpy, entropy of a system under different environments.
C12	Demonstrate the effect of various experimental factors on the particle size of the precipitate.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours 3/45
	Unit I	**Physical Chemistry** Electrochemistry: Electromotive Force of Galvanic Cells Electrochemical cells, galvanic cells, reversible cells and reversible electrodes, conventions to represent Galvanic cells. Types of electrodes, standard electrode potential, electrochemical series. Cell potential and standard cell potential. Nernst equation and its importance. Calculation of thermodynamic parameters: ΔG, ΔH,ΔS and equilibrium constant from EMF data. Classification of galvanic cells: chemical cells and concentration cells Determination of pH using glass electrode and quinhydrone electrode. Buffers Buffer, Henderson's equation for acidic and basic buffer Buffer Capacity. Numerical Problems based on Buffers.	
	Unit II	**Classical methods of analysis**	

		Gravimetric analysis: Introduction to gravimetric analysis, types of gravimetric analysis, conditions for a reaction to be used in gravimetric analysis, solubility and solubility product, factors affecting solubility: temperature, common and diverse ion effect, pH, nature of the solvent, complexation. Unit operations in gravimetric analysis, precipitation, homogeneous and heterogeneous precipitation, relative supersaturation, nucleation and crystal growth, their effect on particle size, Ostwald's ripening, impurities associated with precipitate formation, filtration, washing of the precipitate, drying and incineration, use of thermal methods. **Titrimetric analysis** Introduction to titrimetric analysis, conditions for a reaction to be used in titrimetric analysis, terms involved: titrant, titrand, indicator, equivalence point, endpoint, titration error, types of titrations. **Acid –base titrations** Acid base indicators, theory of acid base indicators, conditions for choosing an indicator. Types of acid base titrations, titration curves. Construction of the titration curves and the choosing of the indicator for A) strong acid –strong base	
	Unit III	**Chemical Thermodynamics** Chemical Thermodynamics: Recapitulation: Introduction, terms involved: System, surrounding, open closed and isolated systems, intensive and extensive properties of system, state of a system, state function and path function. Different processes in thermodynamics. Heat (q), work (w) and internal energy (U) and their sign conventions Statement of first law,	

		work done in Irreversible process, internal energy change for isothermal and adiabatic processes. Numerical problems Enthalpy and enthalpy change in a constant volume and constant pressure process, enthalpy change in a reversible process. Numerical problems limitations of first law, need for the direction ofthe energy change, conversion of heat into other energy forms, heat engines, mechanical efficiency of a heat engine, Carnot's cycle, Carnot's theorem, Introduction to entropy, second law of thermodynamics, different statements of second law, entropy changes in a reversible and an irreversible process, combined statement of first and second law, entropy changes for different physical processes. Numerical problems Spontaneous processes need for prediction of a spontaneous process, Free energy, Gibbs free energy and Helmholtz free energy, changes in Gibbs and Helmholtz's free energy and inter relation between them, criteria for spontaneity of a process	

References:

1. University General Chemistry, 1st edition (2000), C.N. R. Rao, Macmillan Publishers, India

2. Physical Chemistry University for biological sciences, 1st edition, (2005), Chang R., Science Books, USA

3. Essentials of Physical Chemistry, 24th edition, (2000), B S Bahl, G D Tuli, Arun Bahl, S. Chand Limited, India.

4. Concise Inorganic Chemistry .5th edition (2008), Author: J. D. Lee, John Wiley & Sons, USA.

*RAMNARAIN RUIA AUTONOMOUS COLLEGE, SYLLABUS FOR **B. Sc. Biotechnology** 2024-2025*

SEMESTER IV

Course Code: RUSMIBTKPE213

Course Title: Practicals Based on Biophysical chemistry

Sr. No.	Practical Title
1.	1. To determine the amount of strong acid in the given solution by conductometric titration. 2. To determine the amount of strong acid in the given solution by pH-metric titration. 3. To determine the valence factor of $KMnO_4$ by titrating with oxalic acid. 4. To determine the acid-neutralizing power of commercially available antacid formulation 5. Quantitative determination of salts such as copper sulphate-pentahydrate, nickel chloride hexahydrate, anhydrous cupric chloride using standard volumetric methods(any 1) 6. Gravimetric estimation of Nickel (II) as Ni-DMG 7. To determine the amount of weak acid in the given solution by conductometric titration. 8. To determine the amount of weak acid in the given solution by pH-metric titration. 9. Preparation of buffers

1. University General Chemistry, 1st edition (2000), C.N. R. Rao, Macmillan Publishers, India

2. Physical Chemistry University for biological sciences, 1st edition, (2005), Chang R., Science Books, USA

3. Essentials of Physical Chemistry, 24th edition, (2000), B S Bahl, G D Tuli, Arun Bahl, S. Chand Limited, India.

4. Concise Inorganic Chemistry .5th edition (2008), Author: J. D. Lee, John Wiley & Sons, USA.

MODALITY OF ASSESMENT

DSC MAJOR AND MINOR

Theory Examination Pattern

Internal assessment -40%- 30 Marks

Sr.No	Evaluation Type	Marks
1	One Assignment (Animations/Presentations/Posters/ Video Making/ Skits/ Written assignments)	10
2	One class Test (multiple choice questions or objective & one sentence)	20
	Total Marks	30

B) External examination - 60 %: 45 marks

Semester End Theory Assessment - 45 marks

I. Duration - These examinations shall be of 1 hour and 30 mins duration.

II. Paper Pattern:
1. There shall be 03 questions each of 15 marks. On each unit there will be one question.
All questions shall be compulsory with internal choice within the questions.
2. 60% options will be provided.

Questions	Options	Marks	Questions from
Q1	a. Objectives (1M each) any 3 out of 4 b. Brief Answer(4M each) any 3 out of 4	3 12	Unit 1
Q2	c. Objectives (1M each) any 3 out of 4 d. Brief Answer(4M each) any 3 out of 4	3 12	Unit 2
Q3	e. Objectives (1M each) any 3 out of 4 f. Brief Answer(4M each) any 3 out of 4	3 12	Unit 3

Practical Examination Pattern:

(Semester end practical examination):

PARTICULARS	PRACTICAL COMPONENTS
Experimental Tasks **Major** **Minor 1** **Minor 2**	 **10** **06** **06**
Journal	**3**
TOTAL	**25**