

NATIONAL EDUCATION POLICY 2020

NEP 2020

**PROPOSED MODEL PROGRAMME STRUCTURE FOR 4 YEARS
UNDERGRADUATE PROGRAMME IN UNIVERSITIES AND
COLLEGES**

IN

BIOCHEMISTRY

SUBMITTED TO

KARNATAKA STATE HIGHER EDUCATION COUNCIL

BANGALORE

B.Sc. BIOCHEMISTRY (Honors)

1. Preamble

The learning outcomes are designed to help learners understand the objectives of studying B.Sc (Honors) Biochemistry that is, to analyze, appreciate , understand the basic concepts of biomolecular processes and chemical reactions occurring in the living system. This course is fundamental to tackle many of the health – related challenges facing society. Considering the rapid and far-reaching advances in biological sciences in 21st century, it is imperative to have curriculum incorporating these updated emerging concepts of biochemistry. The current pattern is designed to impart concept based learning with emphasis on hands-on training, skill development and research. Aimed at multi-faceted development of a student, the curriculum includes courses encompassing core courses, intra and inter discipline specific courses, skill and ability enhancement courses to impart in-depth knowledge in biochemistry complemented with varied subjects and skills. The course seeks to discover and nurture typical attributes of a competent science graduate such as; spirit of inquiry, critical thinking, problem solving, analytical reasoning, aptitude to research/industry and entrepreneurial instincts.

2. Programme Learning Outcome

The learning outcome-based curriculum is specific in terms of changes in cognitive and psychomotor behavior of students. Biochemistry Honors course is intended to provide a broad framework enabling students to acquire a skill set that helps them understand and appreciate the field of biochemistry. The structure or design of this framework shall ensure a high standard of the Honors degree in Biochemistry at national level. The programme specification are intended as a reference point for prospective students, current students, academic in delivering the programme and realizing its objectives.

Keeping in pace with the developmental trends in Biochemistry and allied areas, it is expected that the students undertaking Biochemistry (Honours) course become conversant with the essence of Biochemistry and exhibit certain levels of learning outcomes as proposed below;

PROGRAMME OUTCOME (PO)

- PO1-** To create interest in Biochemistry and appreciation for chemical basis of biological processes.
- PO2-** To inculcate the spirit of inquiry and value of systematic study of a discipline. Provide a general understanding of the related disciplines with a holistic knowledge generation in biological sciences.

- PO3-** To provide an in-depth understanding of chemical reaction mechanisms in biological processes.
- PO4-** To provide a flavor of historical developments of enzymes and their applications in research, diagnostics and various industries.
- PO5-** Gain proficiency in basic laboratory techniques and be able to apply the scientific method to the processes of experimentation, hypothesis testing, data interpretation and logical conclusions.
- PO6-** Develop problem solving and analytical skills through case studies, research papers and hands-on-experience
- PO7-** To appreciate biochemical mechanistic basis of physiological processes, metabolism under normal and pathological conditions importance and levels of metabolic regulations.
- PO8-** to apply and effectively communicate scientific reasoning and data analysis in both written and oral forms. They will be able to communicate effectively with well-designed posters and slides in talks aimed at scientific audiences as well as the general public.
- PO9-** To bridge the knowledge and skill gap between academic out and industry requirements.
- PO10-** To give students experience in conducting independent, hypothesis-driven, biological research, project planning and management
- PO11-** To provide skills to publish research findings, and awareness of IP rights, and scientific publication ethics and problems of plagiarism.
- PO12-** To prepare competent human resource with better knowledge, hands-on-experience and scientific attitude, at national and global levels for careers in research and development, academia and Pharma-, biotech- and agro-, and food processing industries.

1. Graduate Attributes **B.Sc. BIOCHEMISTRY (Honours):**

Graduates with strong academic knowledge, discipline-specific and generic skills complemented with social responsibility are greatest asset of the country. The curriculum frame work under NEP for Biochemistry graduates aims to build the following attributes;

Disciplinary Knowledge:

- a) Ability to comprehend fundamental concepts of biology, chemistry and apply basic principles of chemistry to biological systems.
- b) Ability to relate various interrelated physiological and metabolic events.
- c) Ability to critically evaluate a problem and resolve to challenge blindly accepted concepts
- d) Ability to think laterally and in an integrating manner and develop interdisciplinary
- e) Good experimental and quantitative skills and awareness of laboratory safety

f) A general awareness of current developments at the forefront in biochemistry and allied subjects.

g) Awareness of resources, and their conservation.

Communication Skills:

a) Ability to speak and write clearly in English and local language

b) Ability to listen to and follow scientific viewpoints and engage with them.

c) ability to understand and articulate with clarity and critical thinking one's position.

Critical Thinking:

a) Ability to conceptualize critical readings of scientific texts in order to comprehend.

b) Ability to place scientific statements and themes in contexts and also evaluate them in terms of generic conventions.

Problem Solving:

a) Ability make careful observation of the situation, and apply lateral thinking and analytical skills.

Analytical Reasoning:

a) Ability to evaluate the strengths and weaknesses in scholarly texts spotting flaws in their arguments.

b) Ability to use scientific evidences and experimental approach to substantiate one's argument in one's reading of scientific texts.

Research Skills:

a) Ability to formulate hypothesis and research questions, and to identify and consult relevant sources to find answers.

b) Ability to plan and write a research paper.

Teamwork and Time Management:

a) Willingness to participate constructively in class room discussions and contribute to group work.

b) Ability to meet a deadline.

Scientific Reasoning:

a) Ability to analyze theories and beliefs, evaluate ideas and scientific strategies.

b) Ability to formulate logical and convincing arguments.

Reflective Thinking:

Ability to locate oneself and see the influence of location—regional, national, global— on critical thinking.

Self-Directing Learning:

a) Ability to work independently in terms of organizing laboratory, and critically analyzing scientific literature.

b) Ability to postulate hypothesis, questions and search for answers.

Digital Literacy:

a) Ability to use digital resources, and apply various platforms to convey and explain concepts of biochemistry.

Multicultural Competence:

a) Ability to engage with and understand cultures of various nations and respect and transcend differences.

Moral and Ethical Values:

a) Ability to interrogate one's own ethical values, and to be aware of ethical and environmental issues.

b) Ability to read values inherited in society and criticism vis-a-vis, the environment, religion, spirituality, and structures of power.

Leadership qualities:

Ability to lead group discussions, to formulate questions related to scientific and social issues.

Life-long Learning:

a) Ability to retain and build on critical thinking skills, and use them to update scientific knowledge and apply them in day to day business.

Job opportunities in Biochemistry Core Course

Exit After **ONE** Year: **CERTIFICATE COURSE**

Knowledge	Skill Acquired	Employability
<p>Fundamental properties of elements, atoms, acids and bases, metals, non-metals, alloys and composites. Biological significance of elements. Understanding of chemical bonding, Physical properties of molecules, chemistry of toxic chemicals. Colligative properties, Properties of matter and electro chemistry, fundamentals and applications of nuclear and radio chemistry.</p> <p>Classification, structure, reactivity and biological significance of major organic compounds.</p> <p>A general scientific spirit of inquiry</p>	<p>Numerical calculations, data generation and analysis, including the application of data transformations. laboratory, safety and precautions, proficiency in preparation of laboratory reagents, use of glassware, Demonstration of basic oxidation and reduction reactions, primary and secondary standards. Handling basic instruments.</p> <p>Communication interpersonal and leadership skills, and ability enhancements complementing the core biochemistry, Entrepreneurship</p>	<p><i>Small and medium size chemistry/pharma based laboratories; as Jr. laboratory assistant assisting chemists/scientists.</i></p> <p><i>QC assistants in Laboratories dealing with QC service.</i></p> <p><i>Toiletries, chemicals, perfumery, oil industries, distilleries/textiles/pollution control units</i></p> <p><i>Entrepreneurship</i></p>

Exit After **two** Year: **Diploma COURSE**

Knowledge	Skill Acquired	Employability
<p>Basic chemistry of natural compounds, alkaloids, terpenes, heterocyclic compounds, drugs, stereochemistry, biological relevance of these compounds, outlines of Photochemistry and environmental chemistry. History of Biochemistry,</p> <p>Comprehensive knowledge and hand-on training in laboratory techniques of biochemistry. Analytical instrumentation and methodology</p>	<p>Acquaintance with analytical techniques that will permit them to study the biological system. Demonstrating skills of fractionating organic compounds.</p> <p>Hands on experience of handling instruments and analysis of data.</p> <p>Improving personality traits, team work, organizing abilities. Communication skills</p>	<p><i>Assistants in Health care/paramedical laboratories.</i></p> <p><i>Supervision and maintenance of laboratories. QC assistants in analytical laboratories dealing with biochemical/clinical/Food processing/pharma industrial settings.</i></p> <p><i>Marketing</i></p> <p><i>Entrepreneurial opportunities, Material safety data sheet maintenance, curation of chemical/drug stores, chemical store keeping</i></p>

Exit After three Years: B.Sc. degree

Knowledge	Skill Acquired	Employability
<p>Comprehensive knowledge of biomolecules: higher order structures of proteins, nucleic acids and their functions. Bioenergetics, metabolism, enzyme kinetics, basic molecular biology, industrial microbiology, Immunology recombinant DNA technology. Understanding interrelated physiological and metabolic events.</p> <p>Overall knowledge of the avenues for research and higher academic achievements in the field of biochemistry and allied subjects.</p>	<p>Basic skills in clinical laboratory techniques, Immunology and molecular biological experimental skills. Demonstrate the overall ability to independently design experiment and analyse data. Basic statistical handling of data.</p> <p>Oral and written skills to convey scientific experimental results. Ability to understand research findings and disseminate to common public. Teaching skills</p>	<p><i>Scientific assistants in biotech based industries. Chemical/pharma/animal feeds/scientific data mining, / Forensic science labs. Blood Banks, Public health support staff, Clinical research, Drug discovery R&D, Medical coding, medical transcription, Medical content writing Teaching at secondary school level</i></p>
<i>B.Sc. (Hons.)</i>		
Knowledge	Skill Acquired	Employability
<p>Introduction to advanced concepts in Biochemistry; Molecular Biology, Recombinant DNA technology, Clinical Biochemistry/ Plant Biochemistry, Immunology, Nutrition and Dietetics, Biochemical Pharmacology, Research methodology, Intellectual property rights, Bioinformatics skills, data analysis, Pharmacogenomics, Introduction to Intellectual property rights.</p> <p>A strong theoretical and practical knowledge of clinical and molecular setting, core research exposure.</p>	<p>Skills to isolate, identify and assay the biomolecules. Conducting independent research as part of project work. Hand on training in modern techniques in molecular biology. R-DNA techniques Computation skills, Prism, graph pad, Excel, Scientific writing skills: general articles, research reviews, Debating on scientific inventions and social implications.</p>	<p><i>Research staff, Clinical Biochemist, Forensic science technician, Biomedical scientist, Nutrition Dept. Pharma industry, Clinical research industries, R&D divisions of Pharma industries, Vaccine industry. Medical coding, Bioinformatics, Medical content writing, Patent examiner, Toxicological asst. Medical Science Liaison officer, Environmental science</i></p>

II A MODEL PROGRAMME STRUCTURE FOR THE UNDERGRADUATE PROGRAMS IN UNIVERSITIES AND COLLEGES [SUBJECTS WITH PRACTICES] WITH **ONE MAJOR AND ONE MINOR**

Sem.	Discipline Core (DSC) (L+T+P)	Discipline Elective(DSE) / Open Elective (OE)	Ability Enhancement Compulsory Courses (AECC), Languages (L+T+P)		Skill Enhancement Courses (SEC)		Total Credits
					Skill based (L+T+P)	Value based (L+T+P)	
I	DISCIPLINE A1 (4 + 2) CHEMICAL FOUNDATION OF BIOCHEMISTRY -1 DISCIPLINE B1 CHEMICAL FOUNDATION OF BIOCHEMISTRY -1	OE – 1 (3 CREDITS) BIOCHEMISTRY IN HEALTH AND DISEASES	L1-1 (3), L2- 1(3)		SEC-1: Digital Fluency (2)		23
	PRACTICALS – 1						
II	DISCIPLINE A2(4 + 2) CHEMICAL FOUNDATION OF BIOCHEMISTRY -2 DISCIPLINE B2 CHEMICAL FOUNDATION OF BIOCHEMISTRY -2	OE – 2 (3 CREDITS) NUTRITION AND DIETETICS	L1-2(3), L2-2 (3) (3+1+0 each)	Environmental Studies (2)		Health and Wellness/ Social & Emotional Learning (2)	25
	PRACTICALS – 2						
Exit option with Certificate (48 credits)							
III	DISCIPLINE A3(4 + 2) BIOORGANIC CHEMISTRY DISCIPLINE B3 BIOORGANIC CHEMISTRY	OE – 3 (3 CREDITS) BIOCHEMICAL TECHNIQUES	L1-3 (3), L2- 3(3) (3+1+0 each)		SEC-2: Artificial Intelligence (2)(1+0+2)		23
	PRACTICALS – 3						

IV	DISCIPLINE A4 (4 + 2) ANALYTICAL BIOCHEMISTRY DISCIPLINE B4 ANALYTICAL BIOCHEMISTRY	OE – 4 (3 CREDITS) BIOCHEMICAL TOXICOLOGY	L1-4 (3), L2- 4(3) (3+1+0 each)	Constitution of India (2)		Spots/NCC/ NSS	25
	PRACTICALS – 4						
Exit option with Diploma (96 credits)							
Choose any one Discipline as Major, the other as the Minor							
V	DISCIPLINE A5 (3 + 2) BIOCHEMISTRY OF MACROMOLECULES	DSE A1 (3 CREDITS) BASIC MOLECULAR BIOLOGY			SEC-3: Cyber Security (2) (1+0+2)	Ethics & Self Awareness (2) (1+0+2)	20
	DISCIPLINE A6 (3 + 2) HUMAN PHYSIOLOGY AND CELL BIOLOGY						
	DISCIPLINE B5 (3 + 2) BIOCHEMISTRY OF MACROMOLECULES						
	PRACTICALS – 5 & 6						
VI	DISCIPLINE A7 (3 + 2) ENZYMOLGY	DSE A2 (3 CREDITS) CLINICAL BIOCHEMISTRY			SEC-4: Professional/ Societal Communication (2)		20
	DISCIPLINE A8 (3 + 2) INTERMEDIARY METABOLISM						
	DISCIPLINE B6 (3 + 2) BIOENERGETICS AND METABOLISM						
	PRACTICALS – 7 & 8						

Exit option with Bachelor of Arts, B.A. / Bachelor of Science, B. Sc. Basic Degree (136 credits)							
VII	DISCIPLINE A9 (3 + 2) MOLECULAR BIOLOGY DISCIPLINE A10 (3 + 2) BIOCHEMISTRY OF HARMONES	DSE A3 (3 CREDITS) BASIC IMMUNOLOGY RESEARCH METHODOLOGY (3 CREDITS)					20
	PRACTICALS – 9 & 10						
	DISCIPLINE A11 (4) MEMBRANE BIOCHEMISTRY						
VIII	DISCIPLINE A12 (4) MOLECULAR IMMUNOLOGY DISCIPLINE A13 (4) GENETIC ENGINEERING DISCIPLINE A14 (3) PLANT BIOCHEMISTRY	DSE A4 (3 CREDITS) BIostatISTICS AND BIOINFORMATICS RESEARCH PROJECT (6 CREDITS)					20
Award of Bachelor of Science/ B.Sc. BIOCHEMISTRY (Hons) degree in a discipline (176 credits)							

*In lieu of the research Project, two additional elective papers/ Internship may be offered.

IIIA MODEL PROGRAMME STRUCTURE FOR THE UNDERGRADUATE PROGRAMS IN UNIVERSITIES AND COLLEGES [SUBJECTS WITH PRACTICLES] WITH BOTH THE SUBJECTS AS MAJOR IN 3rd YEAR

Sem.	Discipline Core (DSC) (L+T+P)	Discipline Elective(DSE) / Open Elective (OE)	Ability Enhancement Compulsory Courses (AECC), Languages (L+T+P)		Skill Enhancement Courses (SEC)		Total Credits
					Skill based (L+T+P)	Value based (L+T+P)	
I	DISCIPLINE A1 (4 + 2) CHEMICAL FOUNDATION OF BIOCHEMISTRY -1 DISCIPLINE B1 CHEMICAL FOUNDATION OF BIOCHEMISTRY -1	OE – 1 (3 CREDITS) BIOCHEMISTRY IN HEALTH AND DISEASES	L1-1 (3), L2-1(3)		SEC-1: Digital Fluency (2)		23
	PRACTICALS – 1						
II	DISCIPLINE A2(4 + 2) CHEMICAL FOUNDATION OF BIOCHEMISTRY -2 DISCIPLINE B2 CHEMICAL FOUNDATION OF BIOCHEMISTRY -2	OE – 2 (3 CREDITS) NUTRITION AND DIETETICS	L1-2(3), L2-2 (3) (3+1+0 each)	Environmental Studies (2)		Health and Wellness/ Social & Emotional Learning (2)	25
	PRACTICALS – 2						
Exit option with Certificate (48 credits)							
III	DISCIPLINE A3(4 + 2) BIOORGANIC CHEMISTRY DISCIPLINE B3 BIOORGANIC CHEMISTRY	OE – 3 (3 CREDITS) BIOCHEMICAL TECHNIQUES	L1-3 (3), L2-3(3) (3+1+0 each)		SEC-2: Artificial Intelligence (2)(1+0+2)		23
	PRACTICALS – 3						

IV	DISCIPLINE A4(4 + 2) ANALYTICAL BIOCHEMISTRY DISCIPLINE B4 ANALYTICAL BIOCHEMISTRY	OE – 4 (3 CREDITS) BIOCHEMICAL TOXICOLOGY	L1-4 (3), L2- 4(3) (3+1+0 each)	Constitution of India (2)		Spots/NCC/ NSS	25
	PRACTICALS – 4						
Exit option with Diploma (96 credits)							
Choose any one Discipline as Major, the other as the Minor							
V	DISCIPLINE A5 (3 + 2) BIOCHEMISTRY OF MACROMOLECULES DISCIPLINE A6 (3 + 2) HUMAN PHYSIOLOGY AND CELL BIOLOGY DISCIPLINE B5 (3 + 2) BIOCHEMISTRY OF MACROMOLECULES	DS- B ELECTIVE 1 (3 CREDITS) HUMAN PHYSIOLOGY AND CELL BIOLOGY			SEC-3: Cyber Security (2) (1+0+2)	Ethics & Self Awareness (2) (1+0+2)	20
	PRACTICALS – 5 & 6						
VI	DISCIPLINE A7 (3 + 2) ENZYMOLGY DISCIPLINE B6 (3 + 2) BIOENERGETICS AND METABOLISM DISCIPLINE B7 (3 + 2) BASIC IMMUNOLOGY	DS – A ELECTIVE -1 (3 CREDITS) CLINICAL BIOCHEMISTRY			SEC-4: Professional/ Societal Communication (2)		20
	PRACTICALS – 7						
Exit option with Bachelor of Arts, B.A. / Bachelor of Science, B. Sc. Basic Degree (136 credits)							

VII	DISCIPLINE A8 (3 + 2) INTERMEDIARY METABOLISM DISCIPLINE A9 (3 + 2) MOLECULAR BIOLOGY DISCIPLINE A10(4) BIOCHEMISTRY OF HARMONES	DS – A/B (3 CREDITS) CLINICAL BIOCHEMISTRY RESEARCH METHODOLOGY (3 CREDITS)					20
	PRACTICALS – 8 & 9						
VIII	DISCIPLINE A11 (4) GENETIC ENGINEERING DISCIPLINE A12 (4) MOLECULAR IMMUNOLOGY	DS – A/B ELECTIVE -3 PLANT BIOCHEMISTRY DS-A/B ELECTIVE - 4 (3 CREDITS) BIostatISTICS AND BIOINFORMATICS RESEARCH PROJECT (6 CREDITS)					20
Award of Bachelor of Science/ B.Sc. BIOCHEMISTRY (Hons) degree in a discipline (176 credits)							

*In lieu of the research Project, two additional elective papers/ Internship may be offered.

CURRICULUM STRUCTURE FOR UNDERGRADUATE DEGREE PROGRAM

(Inputs to this document: Program Outcomes of a program, List of core courses of the same program)

A) Name of the Degree: B.Sc.

B) Specialization: Biochemistry

C) Program Articulation Matrix:

This matrix lists only the core courses. Core courses list the courses that are essential for every student to earn his degree. It includes all types of courses (theory, lab, tutorial, Project, Internships ... that every student of the course). Electives are not part of this list.

Semester	Name of the Core course	What all program outcomes the course addresses (not exceeding three per course)	Pre-requisite course(s)	Concurrent course#	Pedagogy##	Assessment\$
1	BIO A1	PO1 AND PO2	CHEMISTRY/BIOLOGY	CORE COURSE PRACTICALS	MOOC,	Class work Seminar Assignment Class Tests Open discussion
	BIO B1					
2	BIO A2	PO2 AND PO3				
	BIO B2					
3	BIO A3	PO3 AND PO4				
	BIO B3					
4	BIO A4	PO5 AND PO6	BIOA1 , BIOA2			
	BIO B4					
5	BIO A5	PO6 AND PO7				
	BIO A6	PO4 AND PO5				
	BIO B5					
6	BIO A7	PO8 AND PO9			Problem solving, Book Chapter	Seminar, Project based
	BIO A8	PO4 AND PO8,PO9				
	BIO B6					

7	BIO A9	PO7 AND PO8			learning, Term paper	Articles writing, Interpretation of results
	BIO A10	PO10 AND PO9		CORE COURSE PRACTICALS	Assignment,	
	BIO A11	PO9 AND PO10			Group Discussion	
8	BIO A12	PO9 AND PO10				Articles writing,
	BIO A13	PO10,PO11 AND PO12			Research Project Instrumentation	Project proposal writing
	BIO A14	PO11 AND PO12				

#Concurrent course is a core (lab / tutorial / project/ ...) course that a student has to take along with this course in the same semester for effective learning. Course design of concurrent courses is preferred to be done by the same team.

##Pedagogy for student engagement is predominantly lectures. However, other pedagogies enhancing better student engagement to be recommended for each course. This list includes active learning / course projects / Problem Based or Project Based Learning / Case studies / Self-study like seminar, term paper or MOOC)

\$Every course needs to include assessment for higher order thinking skills (Applying / Analysing / Evaluating / Creating). However, this column may contain alternate assessment methods that help formative assessment (i.e. assessment for learning)

SEMESTER -1

COURSE TITLE : CHEMICAL FOUNDATION OF BIOCHEMISTRY -1	COURSE CREDITS: 4
TOTAL CONTACT HOURS: 56	DURATION OF ESA : 03
FORMATIVE ASSESSMENT MARKS : 30	SUMMATIVE ASSESSMENT MARKS : 70

Course Out come :

This will inculcate confidence and clarity of mind in students to understand the chemistry of Biomolecules, and Biological reactions.

UNIT -1 : Scope of Biochemistry and units of measurement

Origin of life, types of organisms, prokaryotes, eukaryotes, unicellular, multicellular, compartmentation of functions in lower and higher organisms, and common physiological events of organisms, chemical composition of living organisms, subcellular organelles, SI units, mass, volume, temperature, amount, length and time. An overview on the metric system, atomic weight, molecular weight, equivalent weight, basicity of acids, acidity of bases, Avogadro's number, molarity, normality, molality, Dalton concept, mole concept, concentration, mole to molar conversion, oxidation number and its significance, density and specific gravity, their significances.

14hrs

UNIT - 2 : Atomic structure and chemical bonds

Structure of an atom, , electrons and Quantum numbers, orbitals, shapes of orbitals, s, p, d, and f subshells, K, L, M, N, O, P, and Q shells. Illustration of Pauli's exclusion principle, Aufbau principle, and Hund's rule, electron configuration, octet rule. Formation and properties of non-covalent and covalent bonds, hydrogen bonds, ionic bonds, van der Waals interactions, London forces, dipole-dipole interactions, electrostatic interactions, and hydrophobic interactions. Sigma, pi and co-ordinate bonds, back bonding. Corresponding energy associated, outline of theories of bonding.

14 hrs

UNIT -3 : Buffers and colligative properties

Acids, bases, Arrhenius concept, proton transfer theory, Lewis concept, Lowry and Bronsted concepts. Buffers, composition, pH, pH scale, Henderson-Hasselbalch equation, titration curve of H_3PO_4 , pK value, isoelectric pH, ionization of HCl , HNO_3 , H_2SO_4 . Colligative properties and anomalous colligative properties of solutions, structure of water, phase diagram of pure water, ionic product of water, special properties of water, buffers in animal system. Solutions and types, ionizable solutes, non-ionizable solutes, vapor pressure and its application in distillation,

Vant Hoff law, Roul't's law, boiling point, freezing point, de-icing, osmosis and osmotic pressure determination, reverse osmosis, surface tension.

14 hrs

UNIT – 4 : Electrochemistry and redox reactions

Scope of electrochemistry, electrochemical cells, Daniel cell, galvanic cell, electrode potential and its measurement, electrolysis, types of electrolytes, primary and secondary batteries, electrodes, half cell reaction, standard electrodes. Laws of thermodynamics, entropy and enthalpy, their relation, Gibb's energy, free energy change, Lewis concept, ions, redox reactions, redox potential, application of redox potential, energy linked to redox reactions, reduction of oxygen, oxidation and reduction of iron in hemoglobin, biological active forms of zinc, calcium, nickel, molybdenum, selenium, and cobalt, NAD^+/NADH , $\text{NADP}^+/\text{NADPH}$, FAD/FADH_2 , FMN/FMNH_2 . Molecularity and order of a reaction.

14 hrs

REFERENCES :

1. Advanced Inorganic Chemistry: A comprehensive Text,1999, Cotton A and Geoffrey Wilkinson, 6th edition , Wiley publication
2. Inorganic Chemistry, 2014, Miessler GL , Paul Fischer PJ, and Tarr DA, 5th edition, Pearson Publication
3. Inorganic Chemistry, 2004, Catherine E and Sharpe AG, ACS publication
4. Inorganic Chemistry , 2015, Overton, Rourke , Weller , Armstrong and Hagerman, Oxford Press
5. Physical Chemistry: A molecular approach ,2019, Donald A, McQuarrie and Simon JD, Viva Books Publication
6. Physical chemistry 2019, Atkins P, Paula JD, Keeler J , 11th edition , Oxford press

PADAGOGY : MOOK/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TESTS)	20
SEMINARS / CLASS WORK	05
ASSIGNMENT/ OPEN DISCUSSION	05
TOTAL	30

SEMESTER -1

PRACTICALS - 1

COURSE TITLE : VOLUMETRIC ANALYSIS – PRACTICALS-1	COURSE CREDITS: 2
TOTAL CONTACT HOURS: 4 Hours/ Week	DURATION OF ESA : 03
FORMATIVE ASSESSMENT MARKS : 15	SUMMATIVE ASSESSMENT MARKS : 50

Course Outcome:

This course aims to familiarize students with the principles of analytical chemistry and basic analytical techniques such as volumetric analysis. Course Objective is to provide experimental practice of quantitative volumetric analysis. Upon successful completion students should be able to make solutions of various molar, normal concentrations and determine the amount of a substance in a given sample.

Experiments:

1. Concept of molarity, molality and normality. Calculation and preparation of molar solutions. (Problems to be given in exams). Calculation and preparation of normal solutions and percent solutions and dilute solutions.
2. Calibration of volumetric glassware's (Burette, pipette).
3. Preparation of standard Sodium carbonate solution, standardization of HCl (Methyl orange) and estimation of NaOH in the given solution. (methyl orange or phenolphthalein).
4. Preparation of standard Oxalic acid. Standardization of NaOH and estimation of H₂SO₄ in the given solution (phenolphthalein).

5. Preparation of standard Oxalic acid. Standardization of KMnO_4 and estimation of H_2O_2 in the given solution.
6. Preparation of standard $\text{K}_2\text{Cr}_2\text{O}_7$. Standardization of $\text{Na}_2\text{S}_2\text{O}_3$ and estimation of CuSO_4 in the given solution.
7. Preparation of ZnSO_4 . Standardization of EDTA and estimation of total hardness of water using Eriochrome black-T indicator.
8. Preparation of standard potassium biphthalate. Standardization of NaOH and estimation of HCl in the given solution. (Phenolphthalein).
9. Estimation of sulphuric acid and oxalic acid in a mixture using standard sodium hydroxide solution and standard potassium permanganate solution.
10. Preparation of standard Potassium dichromate and estimation of ferrous/ferric mixture using diphenylamine indicator (Demonstration).
11. Preparation of standard oxalic acid solution. Standardization of NaOH solution and estimation of acidity in vinegar.
12. Preparation of standard potassium biphthalate solution, standardization of sodium hydroxide solution and estimation of alkalinity of antacids.
13. Preparation of standard Oxalic acid solution. Standardization of KMnO_4 solution and estimation of calcium in milk.

REFERENCES:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Dr. O. P. Pandey, D. N. Bajpai, dr. S. Giri, Practical Chemistry S. Chand and Co. Ltd.,
4. Principles of Practical Chemistry- M. Viswanathan
5. Instrumental Methods of chemical Analysis B.K Sharma.
6. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
7. Advanced Practical Physical Chemistry J.B. Yadav, Goel Publishing House
8. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
9. Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
10. General Chemistry experiment – Anil J Elias (University press).
11. Vogel textbook of quantitative chemical analysis G.H. Jeffery, J. Basset.
12. Quantitative chemical analysis S. Sahay (S. Chand & Co.).
13. Practical Chemistry Dr O P Pandey, D N Bajpai, Dr S Giri. S. Chand Publication
14. College Practical Chemistry. V K Ahluwalia, Sunitha Dingra, Adarsh Gulati
15. Practical Physical Chemistry- B. Viswanathan, P S Raghavan. MV Learning Publication

PADAGOGY : PADAGOGY : MOOK/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CONTINUOUS EVALUATION AND CLASS TEST	10
RECORD / VIVA VOCE	05
TOTAL	50

SEMESTER - II

COURSE TITLE : CHEMICAL FOUNDATION OF BIOCHEMISTRY -2	COURSE CREDITS: 4
TOTAL CONTACT HOURS: 56	DURATION OF ESA : 03
FORMATIVE ASSESSMENT MARKS : 30	SUMMATIVE ASSESSMENT MARKS : 70

Course Outcome: These topics will enable students to understand the fundamentals of chemical processes in biological systems

UNIT 1. Chemical Catalysis: Definition, characteristics, types, intermolecular, multifunctional, theories of catalysis, properties, characteristics of enzyme catalysis, autocatalysis, industrial catalysis and their role in biological systems (brief). Colloids: true solutions, classification, peptisation, purification, ultrafiltration, Brownian movements, electric properties, coagulation, mutual, lyophilic sols, boiling, dialysis, electro and parient dialysis, addition of electrolytes, colloids in daily life and applications. Emulsion, types, micelles with biomolecules and its Biological applications.

14 Hours

UNIT 2. Nomenclature of Organic Compounds: Classification, naming, IUPAC nomenclature, compounds containing one, two functional groups with chains, homologous series. Stereochemistry, geometrical and structural Isomerism, conformation and free rotation. Optical isomerism, symmetry of elements, plane polarized light and optical purity. Nomenclature of enantiomers, epimers, racemic mixture, resolution. Fischer and Newmann projection formulae, molecule with one and two chiral and achiral centers. Priority rules; E and Z (CIP rules), R and S, D and L notations, absolute (r and s) and relative (d and l) configuration. Role of stereochemistry in biological systems.

14 Hours

UNIT 3. Organometallic Compounds: Metal atom linked organic compounds. Preparation of Grignard reagents and structure, limitations, protonolysis and reactions. Organolithium compounds, preparation and reactions. Organozinc compounds. Organoboranes its mechanisms. Ferrocenes. Introduction to mineral and ores, classification, concentration, extraction, refining, uses of minerals and metals and its importance.

Porphyrins and Metalions: Role of metal ions in biological systems, Fe, Cu, Zn, structure and functions of porphyrins, metalloporphyrins and iron-sulphur clusters with suitable examples and their role in biological systems.

14 Hours

UNIT 4. Inorganic Chemistry: Nomenclature of inorganic molecules and coordination compounds, formula. IUPAC nomenclature. Central metal ion, ligand, coordination number, sphere, complex ion, oxidation number of central atom, homoleptic and heteroleptic complexes. Isomerism in complexes, structural, ionisation, solvate, linkage and coordination Stereoisomerism, geometrical, optical isomerism with simple inorganic complexes. Applications of qualitative, quantitative analysis, photographic, metallurgy, medicine, catalysis and biosystems.

Heavy Metal Poisons: Introduction, poisons, lead, mercury, aluminium, arsenic, corrosives, cyanide, irritants, phosphorus, CO₂, SO₂, SO₃, NO₂, halides and acid fumes, poisoning, sources, signs and symptoms. Free radicals: introduction, definition, generation and scavenger systems. Redox reactions, types, stock notations, change in oxidation number and combination. Endergonic and exergonic reactions with examples. The Importance in biological systems.

14 Hours

REFERENCES

1. Physical Chemistry 2006, Peter Atkins. 8th edition, W.H. Freeman and Company
2. Inorganic Chemistry: Principles of structure and Reactivity, 2006, Huheey JE, Keiter EA, Keiter RL, Pearson Education India
3. Stereochemistry: Conformation and Mechanism, 2009, Kalsi PS, New Age International Publications
4. Introduction to Stereochemistry 2012, Kurt Mislow, Dover Publications
5. A text book of Organic Chemistry 2016, Raj K Bansal, 6th edition, New Age International Publications
6. Advanced Inorganic Chemistry 1999, Cotton et al, 6th edition, A Wiley - International

TEXT BOOKS

7. Principles of physical Chemistry by Puri, Sharma and Pathania.
 8. Physical Chemistry by R. L. Madan, G. D. Tuli. S. Chand and Co.
 9. A Text Book of Physical Chemistry by K. L. Kapoor. Vol. 2. Mc. Millan Publisher, India Ltd.
 10. Advanced Organic Chemistry by Bahl and Bahl.
-
-

PADAGOGY : PADAGOGY : MOOK/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING/
ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TESTS)	20
SEMINARS / CLASS WORK	05
ASSIGNMENT/ OPEN DISCUSSION	05
TOTAL	30

SEMESTER - II

PRACTICALS - 2

COURSE TITLE: QUALITATIVE AND QUANTITATIVE ANALYSIS – PRACTICALS – 2	COURSE CREDITS: 2
TOTAL CONTACT HOURS: 4 Hours/ Week	DURATION OF ESA : 03
FORMATIVE ASSESSMENT MARKS : 15	SUMMATIVE ASSESSMENT MARKS : 50

Course Outcome: The Course Objective is to provide experimental practice of quantitative and qualitative analysis. Also it provides training in physical chemistry laboratory techniques. Upon successful completion, students should develop skills in handling instruments and understand its application in research work.

Experiments:

1. Systematic Semi micro Qualitative Analysis of Inorganic salt Mixtures

Systematic semi micro qualitative analysis of two acid and two basic radicals in the given inorganic salt mixture. The constituent ions in the mixture to be restricted to the following. (Any four binary mixtures shall be given)

Anions: HCO_3^- , CO_3^{2-} , Cl^- , Br^- , NO_3^- , BO_3^{3-} , SO_4^{2-} and PO_4^{3-} .

Cations: Pb^{2+} , Al^{3+} , Fe^{2+} , Fe^{3+} , Mn^{2+} , Zn^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , K^+ , Na^+ and NH_4^+ .

2. Determination of density and viscosity of the given liquid using specific gravity bottle and Ostwald's viscometer.
3. Determination of density and surface tension of the given liquid using specific gravity bottle and stalagmometer.
4. Determination of molecular weight of non-volatile solute by Walker-Lumsden method.
5. Determination of rate constant of decomposition of H_2O_2 using KMnO_4 by volumetric analysis method using ferric chloride as catalyst.
6. Determination of distribution coefficient of benzoic acid between water and benzene or iodine between water and carbon tetrachloride.
7. Separation of Two Components from given Binary Mixture of Organic Compounds Qualitatively. (Types of binary mixtures- Solid – Solid, Solid – Liquid, Liquid – Liquid)
8. Verification of Beer's Law. Estimation of unknown concentration of a biomolecule by using colorimeter
9. Calibration of pH meter and determination of pH of aerated soft drinks.

REFERENCES:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Dr. O. P. Pandey, D. N. Bajpai, dr. S. Giri, Practical Chemistry S. Chand and Co. Ltd.,
4. Principles of Practical Chemistry- M. Viswanathan
5. Instrumental Methods of chemical Analysis B.K Sharma.
6. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
7. Advanced Practical Physical Chemistry J.B. Yadav, Goel Publishing House
8. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
9. Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
10. General Chemistry experiment – Anil J Elias (University press).

11. Vogel textbook of quantitative chemical analysis G.H. Jeffery, J. Basset.
12. Quantitative chemical analysis S. Sahay (S. Chand & Co.).
13. Practical Chemistry Dr O P Pandey, D N Bajpai, Dr S Giri. S. Chand Publication
14. College Practical Chemistry. V K Ahluwalia, Sunitha Dingra, Adarsh Gulati
15. Practical Physical Chemistry- B. Viswanathan, P S Raghavan. MV Learning Publication

PADAGOGY : MOOK/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CONTINUOUS EVALUATION AND CLASS TEST	10
RECORD / VIVA VOCE	05
TOTAL	50

**SEMESTER - I
OPEN ELECTIVE - 1**

COURSE TITLE : BIOCHEMISTRY IN HEALTH AND DISEASE	COURSE CREDITS: 3
TOTAL CONTACT HOURS: 42	DURATION OF ESA : 03
FORMATIVE ASSESSMENT MARKS : 30	SUMMATIVE ASSESSMENT MARKS : 70

Course Outcome: This open elective course offering to students of various streams gives knowledge about health and various terminologies used in health and disease conditions; Difference between communicable & non-communicable diseases; Health promotion & treatments for various diseases & disorders.

UNIT - 1

Introduction: WHO definition of health, Health and hygiene, General health care, Factors affecting health, Indices and evaluation of health, Disease patterns in developed and developing world; Classification of diseases - Endemic, Epidemic, Pandemic; Professional health hazards.

Disease conditions: Acute disease, Chronic disease, Incurable disease, Terminal disease, Illness, disorders, Syndrome, Pre-disease.

Treatment: Psychotherapy, Medications, Surgery, Medical devices, and Self-care.

Dimensions of Health: Physical, Mental, Spiritual, Emotional, Environmental, Philosophical.

14 hours

UNIT – 2

Communicable diseases: Tuberculosis, Cholera, Typhoid, Conjunctivitis.

Sexually transmitted diseases (*STD*): Information, statistics, and treatment guidelines for *STD*, Prevention: Syphilis, Gonorrhoea, AIDS, etc.,

Non-communicable diseases: Malnutrition- Under nutrition, Over nutrition, Nutritional deficiencies; Anemia, Stroke, Rheumatic heart disease, Coronary heart disease, Cancer, blindness, accidents, mental illness, Iodine deficiency, Fluorosis, Epilepsy, Asthma.

Genetic disorders: Down's syndrome, Klinefelter's syndrome, Turner's syndrome, Thalassemia, Sickle cell anemia.

Lifestyle disorders: Obesity, Liver cirrhosis, Diabetes mellitus, Hypertension (Causative agents, symptoms, diagnosis, treatment, prognosis, prevention)

14 hours

UNIT - 3

Health promotion: Preventing drug abuse, Oral health promotion by tobacco control.

Mental hygiene and mental health: Concepts of mental hygiene and mental health, Characteristics of mentally healthy person, Warning signs of poor mental health, Promotive mental health, strategies and services, Ego defense mechanisms and implications, Personal and social adjustments, Guidance and Counseling.

Infection control: Nature of infection, Chain of infection transmission, Defenses against infection transmission

14 hours

REFERENCES

1. Modern Nutrition in Health and Disease 2006 10th Edition by Maurice E. Shils, Moshe Shike, A Catharine Ross.
2. Clinical Biochemistry and Metabolic Medicine , 2012 Eighth Edition by Martin Andrew Crook, CRC Press,
3. Nutrition & Health in Developing Countries, 2000, Editors: R. Semba and M.W. Bloem, Humana Press

PADAGOGY : PADAGOGY : MOOK/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TESTS)	20
SEMINARS / CLASS WORK	05
ASSIGNMENT/ OPEN DISCUSSION	05
TOTAL	30

SEMESTER - II

OPEN ELECTIVE- 2

COURSE TITLE : NUTRITION AND DIETETICS	COURSE CREDITS: 3
TOTAL CONTACT HOURS: 42	DURATION OF ESA : 03
FORMATIVE ASSESSMENT MARKS : 30	SUMMATIVE ASSESSMENT MARKS : 70

Course outcomes:

- 1.The student will gain knowledge about energy requirements and the Recommended Dietary Allowances.
2. The student will understand the functions and role of macronutrients, their requirements and the effect of deficiency and excess
3. The student learns the impact of various functional foods on our health
4. The student will be able to apply basic nutrition knowledge in making foods choices and obtaining an adequate diet.
5. The student gains competence in connecting the role of various nutrients in maintaining health and learn to enhance traditional recipes.

UNIT - 1

Basic concepts of Nutrition: Introduction, Basic principles of a balanced diet to provide energy and nutrients. Composition of foods and proximate analysis of foods. Calorific value of foods, and Basal metabolism. Basal Metabolic Rate (BMR), Factors affecting BMR, Energy requirements for different physical activities, Specific dynamic action of food, Nutritive value of proteins. Energy requirements and recommended dietary allowance (RDA) for infants, children and pregnant women. Protein calorie malnutrition.

14 Hrs

UNIT – 2

Macronutrients and Micronutrients: Carbohydrates- Digestible and non-digestible, Dietary fibres, Essential fatty acids, lipoproteins and Cholesterol. Essential amino acids, Fortification of foods, Protein requirement for different categories. **Vitamins**-Sources, requirements, functions and deficiency symptoms of Vitamin-C, Thiamine, Riboflavin, Pyridoxine, Folic acid, Vitamin B12. Absorption of fat soluble vitamins- A, D, E and K. **Micronutrients:** Source, Daily requirement, functions and deficiency disease symptoms of Macro minerals (Ca, P, and Cl) and micro minerals/trace elements (I, Fe, Zn and Se).

14 Hrs

UNIT - 3

Dietetics and Diet Therapy: Introduction to nutrition. Food pyramid. Diet planning and introduction to diet therapy. Nutritional requirements for different age groups, anemic child, expectant women, and lactating women. Diet planning for prevention and cure of nutritional deficiency disorders. **Diet therapy:** Functional foods, Anthropometric measurements, dietary considerations during fever, malaria, and tuberculosis. Prevention and correction of obesity, underweight, and metabolic diseases by diet therapy. Dietary interventions to correct and or manage the gastrointestinal diseases (indigestion, peptic ulcer, constipation, diarrhoea, steatorrhoea, irritable bowel syndrome. Functional foods based diet therapy for diabetes, cardiovascular disease and cancer.

14 Hrs

REFERENCES:

Clinical Dietetics and Nutrition, 2002, Antia FP and Abraham P. Oxford University Press; 4th Edition. ISBN-10: 9780195664157.

Oxford Handbook of Nutrition and Dietetics, 2011, Webster-Gandy J, Madden A and Holds worth M. Oxford University Press, Print ISBN-13: 9780199585823.

Krause's Food, Nutrition and Diet therapy, 2003, Mahan KL and Escott-Stump S. Elsevier, ISBN: 9780721697840.

Human Nutrition and Dietetics. 1986, Passmore R. and Davidson S. Churchill Livingstone Publications, ISBN-10: 0443024863.

Rosemary Stanton's Complete Book of Food & Nutrition, 2007, Simon & Schuster Publishers, Australia, ISBN 10: 0731812999

Food Science and Nutrition, 2018, Roday S. Oxford University Press Publishers, ISBN: 9780199489084/0199489084.

Food Science, 2007, Srilakshmi S. New Age International (P) Limited Publishers, ISBN: 9788122420227/ 8122420222.

PADAGOGY : PADAGOGY : MOOK/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TESTS)	20
SEMINARS / CLASS WORK	05
ASSIGNMENT/ OPEN DISCUSSION	05
TOTAL	30

UNDER GRADUATE B.Sc SEMESTER I & II
MODEL QUESTION PAPER
BIOCHEMISTRY

TIME : 3 h

MAX. MARKS : 70

NOTE : ALL SECTIONS ARE COMPULSORY

SECTION – A

1. Answer any FIVE of the following $5 \times 2 = 10$
- a.
 - b.
 - c.
 - d.
 - e.
 - f.
 - g.

SECTION – B

Answer any FOUR of the following

$4 \times 5 = 20$

- 2.
- 3.
- 4.
- 5.
- 6.

SECTION – C

Answer all Questions

$4 \times 10 = 40$

7. UNIT – 1

OR

8. UNIT – 2

OR

9. UNIT – 3

OR

10. UNIT – 4

OR

UNDER GRADUATE B.Sc SEMESTER I & II
MODEL QUESTION PAPER
BIOCHEMISTRY

TIME : 3 h

OPEN ELECTIVE

MAX. MARKS : 70

NOTE : ALL SECTIONS ARE COMPULSORY

SECTION – A

1. Answer any FIVE of the following 5 x 2 = 10
- a.
 - b.
 - c.
 - d.
 - e.
 - f.
 - g.

SECTION – B

Answer any FIVE of the following 5 x 6 = 30

- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

SECTION – C

Answer all Questions 3 x 10 = 30

8. UNIT – 1

OR

9. UNIT – 2

OR

10. UNIT – 3

OR
