ETHIRAJ COLLEGE FOR WOMEN (AUTONOMOUS)

CHENNAI – 600 008

DEPARTMENT OF BIOCHEMISTRY

B.Sc BIOCHEMISTRY SYLLABUS

CHOICE BASED CREDIT SYSTEM

OUTCOME BASED EDUCATION

(OFFERED FROM THE ACADEMIC YEAR 2021-22)

ETHIRAJ COLLEGE FOR WOMEN (AUTONOMOUS) CHENNAI-08

DEPARTMENT OF BIOCHEMISTRY

MINUTES OF THE BOARD OF STUDIES MEETING

The Board of Studies of the Department of Biochemistry met on 22/7/2021 at 3.30 pm online with Dr. M.Sujatha in the Chair.

The Board approved the changes made in the examination pattern/papers during the pandemic for the syllabus adopted in 2018-21/2018-20.

The Board scrutinized the revision of the syllabus of B.Sc Biochemistry. The Board examined the credit structure and the curriculum template and approved the same.

The Board also Scrutinized the following aspects of the Syllabus:

Outcome Based Education pattern (including Bloom's Taxonomy to be used for Question Paper setting, the correlation of Programme Educational Objectives, Programme Outcomes, Programme Specific Objectives, Course Objectives, Course Outcomes, Mapping of Course Outcomes with PSO's); End Semester Question Paper pattern; Continuous Assessment pattern; Teaching Methodology; Recommended Text books and Recommended Reading; Journals; Online resources, and Panel of Question Paper Setters for each paper.

The Board made the following specific recommendations on the draft syllabi:

- Approved Introduction of Internship for extra credits
- Project for extra credits may be a review project

Changes recommended in Courses

- Cell biology- Rearrangement of topics and units
- Biomolecules - Inclusion of Non Protein amino acids, elaboration of chemical properties of amino acids and lipids
- Enzymology - Inclusion of Applications of immobilised enzymes (Overview)
- Intermediary Metabolism II - Inclusion of action of phospholipases and redox potential.

- Physiology - Inclusion of reflex action and Pituitary hormones
- Clinical Biochemistry - Inclusion of Lesch Nyhan Syndrome,serum enzymes
- Hospital Management (Elective) - Inclusion of NABH,Accreditation and case studies
- Clinical endocrinology (Self learning papers) - Inclusion of pituitary hormones and placental hormones
- Genetics and Nutritional Biochemistry - Inclusion of Dietary management in conditions of Kidney and Gallstones and Dietary requirements of Sodium,Potassium and Phosphorus.
- Immunology (Elective) - Inclusion of Rheumatoid Arthritis
- Allied Biochemistry I - Inclusion of Forces involved in tertiary structure
- Allied Chemistry II - Inclusion of preparation of Nanoparticles
- Expansion of Abbreviation in all courses

ETHIRAJ COLLEGE FOR WOMEN (AUTONOMOUS)

CHENNAI- 6000 08

PG DEPARTMENT OF BIOCHEMISTRY

BOARD OF STUDIES MEETING – B.Sc BIOCHEMISTRY

The Board of Studies meeting was held in the Department of Biochemistry on 22.7.2021.

The Board consisted of the following members:

S.NO	MEMBER'S NAME & DESIGNATION	SIGNATURE
1.	**Dr.M. SUJATHA (CHAIRMAN BOARD OF STUDIES)** ASSOCIATE PROFESSOR & HEAD DEPARTMENT OF BIOCHEMISTRY ETHIRAJ COLLEGE FOR WOMEN CHENNAI -600008.	
2.	**Dr. V. BHUVARAHAMURTHY (UNIVERSITY NOMINEE)** PROFESSOR AND HEAD DR. ALM POST GRADUATE INSTITUTE OF BASIC MEDICAL SCIENCES, TARAMANI CAMPUS, CHENNAI-600113	
3.	**Dr. N.MEENAKSHI** ASSOCIATE PROFESSOR, DEPT OF BIOCHEMISTRY, BHARATHI WOMENS COLLEGE, BROADWAY, GEORGE TOWN CHENNAI-600108.	
4.	**Dr.A. GNANAMANI** SR. PRINCIPAL SCIENTIST BIOLOGICAL MATERIAL LABORATORY CSIR-CENTRAL LEATHER RESEARCH INSTITUTE ADYAR, CHENNAI – 600020	
5.	**Dr.S.SUBRAMANIAM (INDUSTRIAL REPRESENTATIVE)** DIRECTOR REGENIX SUPER SPECIALITY LABORATORIES PVT LTD CHOOLAIMEDU CHENNAI -600034	

6. Dr. C.N.DEEPA
ASSOCIATE PROFESSOR
DEPARTMENT OF BIOCHEMISTRY
ETHIRAJ COLLEGE FOR WOMEN
CHENNAI – 6000 08.

7. Dr. V.MALATHI
ASSOCIATE PROFESSOR
DEPARTMENT OF BIOCHEMISTRY
ETHIRAJ COLLEGE FOR WOMEN
CHENNAI – 6000 08.

8. Dr. S.VIJAYALATHA
ASSISTANT PROFESSOR
DEPARTMENT OF BIOCHEMISTRY
ETHIRAJ COLLEGE FOR WOMEN
CHENNAI – 6000 08.

9. **Dr. SAFIYA**
ASSOCIATE PROFESSOR
DEPARTMENT OF BIOCHEMISTRY
ETHIRAJ COLLEGE FOR WOMEN
CHENNAI – 6000 08.

10. **Dr. J. PRIYA**
ASSISTANT PROFESSOR
DEPARTMENT OF BIOCHEMISTRY
ETHIRAJ COLLEGE FOR WOMEN
CHENNAI – 6000 08.

11. Ms. A.LAKSHMI DEVI
ASSISTANT PROFESSOR
DEPARTMENT OF BIOCHEMISTRY
ETHIRAJ COLLEGE FOR WOMEN
CHENNAI – 6000 08.

12. **Dr. B.THENDRAL HEPSIBHA**

ASSISTANT PROFESSOR
DEPARTMENT OF BIOCHEMISTRY
ETHIRAJ COLLEGE FOR WOMEN
CHENNAI – 6000 08.

13. **Dr. FATIMA CYNTHIA ANTONY**

ASSISTANT PROFESSOR
DEPARTMENT OF BIOCHEMISTRY
ETHIRAJ COLLEGE FOR WOMEN
CHENNAI – 6000 08.

14. **Ms.N.SUDHA**

ASSISTANT PROFESSOR
DEPARTMENT OF BIOCHEMISTRY
ETHIRAJ COLLEGE FOR WOMEN
CHENNAI – 6000 08.

15. **ALUMNA**

Ms. NANDHINIE.K
B.Sc Batch (2015-2018)

16. **STUDENT REPRESENTATIVE**

G.NANDITA – UG Final year

CONTENTS

ETHIRAJ COLLEGE FOR WOMEN (AUTONOMOUS)

CHENNAI- 600008

PG DEPARTMENT OF BIOCHEMISTRY

B.Sc BIOCHEMISTRY - REVISED SYLLABUS EFFECTIVE FROM 2021-22

PREAMBLE

The PG Department of Biochemistry is revising syllabi with effect from the academic year 2021-22 with existing CBCS and part IV and Part V components as specified by the Government of Tamil Nadu.

Part IV and Part V components will seek to build the capacity of the students and provide inputs for his or her social service and analytical capabilities.

Every academic year is divided into 2 semester sessions. Each semester will have a minimum of 90 working days and each day will have 5 working hours. Teaching is organized into a modular pattern of credit courses. Credit is normally related to the number of hours a teacher teaches a particular subject. It is also related to the number of hours a student spends learning a subject or carrying out an activity.

As the Revised Bloom's Taxonomy is being used for teaching learning and evaluation under the Outcome Based Education to improve the skills of students, all syllabi have to be framed keeping this objective in mind.

Course objectives have to be framed keeping the teaching in mind

Course outcomes have to be framed keeping the student in mind

All outcome should be observable and measurable

REGULATIONS

1. Eligibility for admission:

Candidates for admission to the first year of the U.G Biochemistry degree course shall be required to have passed the Higher secondary examinations conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereto by the syndicate of the University of Madras with Chemistry and biology/botany,zoology/biochemistry as one of the science subjects .

2. Eligibility for the award of degree:

The candidate shall be eligible for the award of the degree only if he /she has undergone the prescribed course of the study for the period of not less than 3 academic years, passed the examinations of all the 6 semesters prescribed.

3. Course of the study :

Part I :	Tamil / other languages
Part II :	English
Part III :	Core subjects, Allied subjects
Part IV:	Non Major Elective (1a, 1b, 1c)
	Soft Skill
	Environmental studies
	Value Education
Part V :	Extension Activity.

4. Passing minimum :

A candidate shall be declared to have passed in each paper /practical of the main subject of study wherever prescribed, if she secured NOT LESS THAN 40 % of the marks prescribed for the examination.

5. Classification of successful candidates :

Part I, II, III, IV

Successful candidates passing the examination and securing the marks

- 60 % and above , 50% and above but below 60 % in the aggregate shall be declared to have passed the examination in the FIRST and SECOND Class respectively
- All other successful candidates shall be declared to have passed the examination in the THIRD CLASS.

- Candidates who pass all the examinations (Part I, II, III, IV) prescribed for the course in the FIRST APPEARANCE ITSELF ALONE are eligible for ranking.

6. Question paper pattern :

COMPONENT	NATURE OF THE QUESTION	MAXIMUM MARKS
SECTION A	Remembering / Recalling concepts	20
SECTION B	Recalling / Understanding concepts	40
SECTION C	Understanding / Applying concepts	40

SECTION A: 10 questions, compulsory 2 questions from each unit (10X2=20)

SECTION B: 5 out of 8 questions, compulsory 1 question from each unit (5X8=40)

SECTION C: 2 out of 4 questions, each from different units (2X20=40)

CREDITS

Minimum Credits - 140

Optional Extra credits

- **Part V Extra Extension activity**
- **Self study papers-2 (Students who have no arrears and who have obtained distinction in all the previous semesters alone are eligible for these papers.)**
- **Internship -1 (Minimum 15 days)**
- **Project (Review)-2**

UNDERGRADUATE PROGRAMME

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

On obtaining an undergraduate degree the students will be able to:

PEO1: Apply and advance the knowledge and skills acquired, to become a creative professional in their chosen field.

PEO2: Engage in self-directed continuous learning, aimed at global competency, which will promote professional and personal growth

PEO3: Develop management skills and entrepreneurial skills, by harnessing core competencies tempered by values and ethics

PEO4: Work towards achieving economic and social equity for women through application of relevant knowledge

PEO5: Contribute to promoting environmental sustainability and social inclusivity

PROGRAMME OUTCOMES (POs)

On completion of the Programme, the learner will be able to

1. Understand the central features of the extraordinary diverse fields of life sciences
2. Gain critical thinking and problem solving ability
3. Apply knowledge for development of diagnostic methods
4. Develop aptitude towards research
5. Work towards gender specific health and environmental related issues

PROGRAMME SPECIFIC OUTCOME (PSOs)

On completion of B.Sc Biochemistry, the student will be able to:

PSO 1.Communicate the fundamental concepts of specific molecules, enzymes, cells, organ systems and metabolism of compounds

PSO 2.Apply the knowledge and expertise in industries, diagnostic laboratories and various research fields

PSO 3. Use practical skills and scientific knowledge in domains of molecular biology, enzymology, genetics, clinical biology and immunology

PSO 4. Develop problem solving ability by utilizing the fundamental and conceptual knowledge acquired .

PSO 5. Pursue post graduation in related fields in life sciences and contribute their knowledge to the betterment of the society in various research and health care sectors.

ETHIRAJ COLLEGE FOR WOMEN (AUTONOMOUS) CHENNAI -08

CURRICULUM (2021-22 ONWARDS)

UNDERGRADUATE PROGRAMME PROFILE

DEPARTMENT OF BIOCHEMISTRY

COURSE CODES AND CREDITS

TOTAL MINIMUM CREDITS: 140 **TOTAL TEACHING HOURS: 180**

I SEMESTER											
PART	**CORE/ALLIED/ ELECTIVE**	**TITLE OF THE PAPER**	**CODE**	**L**	**T**	**P**	**H**	**C**	**CA**	**SE**	**MM**
I	**Language**	**Tamil/Hindi/French/ Sanskrit**					**5**	**3**	**40**	**60**	**100**
II	**English**	**English**					**5**	**3**	**40**	**60**	**100**
III	**Core 1**	**Core-Cell Biology**	**BC21/1C/CBO**	**5**	**2**	**0**	**7**	**5**	**40**	**60**	**100**
III	**Allied**	**Allied Chemistry I**	**BC21/1A/CE1**	**3**	**1**	**0**	**4**	**4**	**40**	**60**	**100**
III	**Core Practical**	**Core Practical I**	**BC21/2C/PR1**	**0**	**0**	**3**	**3**	**-**	**-**	**-**	**-**
III	**Allied Practical**	**Allied Chemistry Practical**	**BC21/2A/CEP**	**0**	**0**	**2**	**2**	**-**	**-**	**-**	**-**
IV	**EVS**	**Environmental studies**		2	**0**	**0**	**2**	**2**	**-**	**50**	**50**
IV	**Soft Skill**	**Soft Skill**					**2**	**3**		**50**	**50**

II SEMESTER											
PART	**CORE/ALLIED /ELECTIVE**	**TITLE OF THE PAPER**	**CODE**	**L**	**T**	**P**	**H**	**C**	**CA**	**SE**	**MM**
I	**Language**	**Tamil/Hindi/French/ Sanskrit**					**5**	**3**	**40**	**60**	**100**
II	**English**	**English**					**5**	**3**	**40**	**60**	**100**
III	**Core 2**	**Core-Biomolecules**	**BC21/2C/BOM**	**5**	**2**	**0**	**7**	**5**	**40**	**60**	**100**
III	**Allied**	**Allied Chemistry II**	**BC21/2A/CE2**	**3**	**1**	**0**	**4**	**4**	**40**	**60**	**100**
III	**Core Practical**	**Core Practical I**	**BC21/2C/PR1**	**0**	**0**	**3**	**3**	**3**	**-**	**-**	**-**
III	**Allied Practical**	**Allied Chemistry Practical**	**BC21/2A/CEP**	**0**	**0**	**2**	**2**	**2**	**40**	**60**	**100**
IV	**Val.Edu**	**Value Education**		**2**	**0**	**0**	**2**	**2**	**2**	**50**	**50**
IV	**Soft Skill**	**Soft Skill**					**2**	**3**		**50**	**50**

III SEMESTER											
PART	**CORE/ALLIED/ ELECTIVE**	**TITLE OF THE PAPER**	**CODE**	**L**	**T**	**P**	**H**	**C**	**CA**	**SE**	**MM**
I	**Language**	**Tamil/Hindi/French/ Sanskrit**					**5**	**3**	**40**	**60**	**100**
II	**English**	**English**					**5**	**3**	**40**	**60**	**100**
III	**Core 3**	**Core- Biophysical & Biochemical techniques**	**BC21/3C/BIT**	**5**	**2**	**0**	**7**	**5**	**40**	**60**	**100**
III	**Allied**	**Allied Microbiology I**					**4**	**4**	**40**	**60**	**100**
III	**Core Practical**	**Core Practical II**	**BC21/4C/PR2**	**0**	**0**	**3**	**3**	**-**	**-**	**-**	**-**
III	**Allied Practical**	**Allied Microbiology Practical**		**0**	**0**	**2**	**2**	**-**	**-**	**-**	**-**
IV	**NME (1C)**	**Non Major Elective (1a/1b/1c)**		**2**	**0**	**0**	**2**	**2**	**-**	**50**	**50**
IV	**Soft Skill**	**Soft Skill**					**2**	**3**		**50**	**50**

IV SEMESTER											
PART	**CORE/ALLIED /ELECTIVE**	**TITLE OF THE PAPER**	**CODE**	**L**	**T**	**P**	**H**	**C**	**CA**	**SE**	**MM**
I	**Language**	**Tamil/Hindi/French/ Sanskrit**					**5**	**3**	**40**	**60**	**100**
II	**English**	**English**					**5**	**3**	**40**	**60**	**100**
III	**Core 4**	**Core-Enzymology**	**BC21/4C/ENM**	**5**	**2**	**0**	**7**	**5**	**40**	**60**	**100**
III	**Allied**	**Allied Microbiology II**					**4**	**4**	**40**	**60**	**100**
III	**Core Practical II**	**Core Practical II**	**BC21/4C/PR2**	**0**	**0**	**3**	**3**	**3**	**40**	**60**	**100**
III	**Allied Practical**	**Allied Microbiology Practical**		**0**	**0**	**2**	**2**	**2**	**40**	**60**	**100**
IV	**NME**	**Non Major Elective(1a/1b/1c)**		**2**	**0**	**0**	**2**	**2**	**-**	**50**	**50**
IV	**Soft Skill**	**Soft Skill**					**2**	**3**		**50**	**50**

V SEMESTER											
PART	**CORE/ALLIED /ELECTIVE**	**TITLE OF THE PAPER**	**CODE**	**L**	**T**	**P**	**H**	**C**	**CA**	**SE**	**MM**
I	**Core 5**	**Core -Intermediary Metabolism – I**	**BC21/5C/IN1**	**4**	**0**	**0**	**4**	**4**	**40**	**60**	**100**
II	**Core 6**	**Core-Intermediary Metabolism II**	**BC21/5C/IN2**	**4**	**0**	**0**	**4**	**4**	**40**	**60**	**100**
III	**Core 7**	**Core-Clinical Biochemistry**	**BC21/5C/CBI**	**4**	**0**	**0**	**4**	**4**	**40**	**60**	**100**
III	**Core 8**	**Core –Human Physiology**	**BC21/5C/HPH**	**4**	**0**	**0**	**4**	**4**	**40**	**60**	**100**
III	**Elective**	**Bioinstrumentation and Biostatistics** **Hospital Management**	**BC21/5E1/BIB** **BC21/5E2/HOM**	**5**	**0**	**0**	**5**	**5**	**40**	**60**	**100**
III	**Core Practical**	**Core Practical III**	**BC21/6C/PR3**	**0**	**0**	**4**	**4**	**-**	**-**	**-**	**-**
III	**Core Practical**	**Core Practical IV**	**BC21/6C/PR4**	**0**	**0**	**4**	**5**	**-**	**-**	**-**	**-**

VI SEMESTER											
PART	**CORE/ALLIED/ ELECTIVE**	**TITLE OF THE PAPER**	**CODE**	**L**	**T**	**P**	**H**	**C**	**CA**	**SE**	**MM**
I	**Core 9**	**Molecular biology**	**BC21/6C/MOB**	**4**	**0**	**0**	**4**	**4**	**40**	**60**	**100**
II	**Core 10**	**Genetics and Nutritional Biochemistry**	**BC21/6C/GEB**	**4**	**0**	**0**	**4**	**4**	**40**	**60**	**100**
III	**Core 11**	**Core-Plant and Animal Biotechnology**	**BC21/6C/PAB**	**4**	**0**	**0**	**4**	**4**	**40**	**60**	**100**
III	**Elective**	**Elective-Basic Immunology**	**BC21/6E/BIM**	**5**	**0**	**0**	**5**	**5**	**40**	**60**	**100**
III	**Optional Elective**	**Elective- Basics of Bioinformatics** **Plant Biochemistry**	**BC21/6E1/BOB** **BC21/6E2/PBI**	**5**	**0**	**0**	**5**	**5**	**40**	**60**	**100**
III	**Core Practical**	**Core Practical III**	**BC21/6C/PR3**	**0**	**0**	**4**	**4**	**3**	**40**	**60**	**100**
III	**Core Practical**	**Core Practical IV**	**BC21/6C/PR4**	**0**	**0**	**4**	**4**	**3**	**40**	**60**	**100**

VI SEMESTER - continued											
PART	**CORE/ALLIED/ELECTIVE**	**TITLE OF THE PAPER**	**CODE**	**L**	**T**	**P**	**H**	**C**	**CA**	**SE**	**MM**
V		**Extension Activity (Sports/NCC/NSS/CSS/ YRC/RRC/Rotaract/Yoga)**					**Min 60 Hours**	**1**	**-**	**-**	**-**
V		**Optional Extra Credits**									
IV	**Extra Credits**	**Self Study (Semester V)**		**-**	**-**	**-**	**-**	**2**	**-**	**100**	**100**
		Internship (Summer Vacation after IV Semester)					**Min 14 days**	**1**			
		Project- Review (Semester VI)		**-**	**-**	**-**	**-**	**2**	**-**	**100**	**100**

SELF STUDY PAPER (SEMESTER V)

PART	CORE/ ALLIED/ ELECTIVE	TITLE OF THE PAPER	CODE	L	T	P	H	C	CA	SE	MM
IV	Self Study	Clinical Endocrinology	BC21/5SS/CEN					2	-	100	100
IV	Self Study	Health for Women	BC21/5SS/HFW					2		100	100

Allied Papers for I B.Sc Microbiology											
PART	**CORE/ALLIED/ ELECTIVE**	**TITLE OF THE PAPER**	**CODE**	**L**	**T**	**P**	**H**	**C**	**CA**	**SE**	**MM**
III	**Allied**	**Allied Biochemistry I**	**BC21/1A/BI1**	**4**	**0**	**0**	**4**	**4**	**40**	**60**	**100**
III	**Allied**	**Allied Biochemistry II**	**BC21/2A/BI2**	**4**	**0**	**0**	**4**	**4**	**40**	**60**	**100**
III	**Allied Practicals**	**Allied Biochemistry Practical**	**BC21/2A/ABP**	**0**	**0**	**2**	**2**	**2**	**40**	**60**	**100**

Allied Papers for I B.Sc Clinical Nutrition and Dietetics											
PART	**CORE/ALLIED/ ELECTIVE**	**TITLE OF THE PAPER**	**CODE**	**L**	**T**	**P**	**H**	**C**	**CA**	**SE**	**MM**
III	**Allied**	**Allied Basic Chemistry I**	**BC21/1A/AC1**	**3**	**1**	**0**	**4**	**4**	**40**	**60**	**100**
III	**Allied**	**Allied Basic Chemistry II**	**BC21/2A/AC2**	**3**	**1**	**0**	**4**	**4**	**40**	**60**	**100**
III	**Allied Practicals**	**Allied Chemistry Practical**	**BC21/2A/AEP**	**0**	**0**	**2**	**2**	**2**	**40**	**60**	**100**

Non Major Elective subjects –offered to other Departments											
PART	**CORE /ALLIED/ ELECTIVE**	**TITLE OF THE PAPER**	**CODE**	**L**	**T**	**P**	**H**	**C**	**CA**	**SE**	**MM**
IV	**NME**	**Yoga and Diet**	**BC21/3N/YOG**	**2**	**0**	**0**	**2**	**3**	**-**	**-**	**50**
IV	**NME**	**Life Style Diseases In Women**	**BC21/4N/LSD**	**2**	**0**	**0**	**2**	**3**	**-**	**-**	**50**

L = Lecture Hours

T = Tutorial Hours

P=Practical Hours

H = Hours per week

C= Credits

CA=Continuous Assessment

SE= Semester Examinations

MM=Maximum Marks

EVALUATION PATTERN FOR CONTINUOUS ASSESSMENT-UG

INTERNAL VALUATION BY COURSE TEACHERS

PART I, II AND III-THEORY PAPERS - CA marks

COMPONENT	TIME	MAX.MARKS	CAMARK
1. TEST I	**2 HRS**	**50 MARKS (TO BE CONVERTED)**	**10**
2.TEST II	**2 HRS**	**50 MARKS (TO BE CONVERTED)**	**10**
3.ASSIGNMENT/SEMINAR/ FIELD VISIT			**10**
4.PARTICIPATORY LEARNING			**10**
		Total	**40**

PART III- PRACTICAL PAPERS

COMPONENT	MAX.MARKS	CAMARK
1. MODEL PRACTICAL EXAM	**50 MARKS (TO BE CONVERTED)**	**20**
2. PARTICIPATORY LEARNING		**20**
	Total	**40**

CA TEST

QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K 1	A-7X2 marks	50	14	50
K1. K 2	B-2/3 x 8 marks	500	16	
K2, K 3	C-1/2x20 marks	1200	20	

RUBRICS FOR CONTINUOUS ASSESSMENT

Assignment	**Content/originality/Presentation/Schematic Representation and Diagram/Bibliography**
Seminar	**Organisation/Subject Knowledge/Visual Aids/Confidence level/presentation-Communication and Language**
Field Visit	**Participation/Preparation/Attitude/Leadership**
Participation	**Answering Questions/Clearing Doubts/Participating in Group Discussions/Regular Attendance**
Case Study	**Finding the Problem/Analysis/Solution/Justification**
Problem Solving	**Understanding Concepts/Formula and Variable Identification/Logical Sequence/Answer**
Group Discussion	**Preparation/Situation Analysis/Relationship Management/Information Exchange/Delivery Skills**
Flipped/Blended Learning	**Preparation/Information Exchange/ Group interaction/Clearing doubts**

- FIRST FOUR RUBRICS SHOULD BE INCLUDED.
- OTHERS ARE OPTIONAL BASED ON TEACHING-LEARNING METHODOLOGY ADOPTED FOR THE PROGRAMME OF STUDY

EVALUATION PATTERN FOR END SEMESTER - UG

THEORY PAPERS

PART I/II/III

SEMESTER II/IV/VI

DOUBLE VALUATION BY COURSE TEACHER AND EXTERNAL EXAMINER

MAXIMUM MARKS: 100 TO BE CONVERTED TO 60

PASSING MARK: 40

PRACTICAL PAPERS

PART III

SEMESTER I/II/III/IV/V/VI

DOUBLE VALUATION BY COURSE TEACHER AND EXTERNAL EXAMINER

MAXIMUM MARKS: 60

PASSING MARKS:24

PART IV

SINGLE VALUATION

ORAL TEST/WRITTEN TEST

MAXIMUM MARKS: 50

PASSING MARK:20

QUESTION PAPER PATTERN FOR PART IV

Knowledge Level	Section	Word Limit	Marks	Total
K 1, K2	**A-5X10**	**350**	**50**	**50**

SELF STUDY PAPER

SINGLE VALUATION

MAXIMUM MARKS:100

PASSING MARK:40

QUESTION PAPER PATTERN FOR SELF STUDY PAPER

QUESTION PAPER PATTERN

nowledge vel	Section	Word Limit	Marks	Total	Special Instruction if any
1	A-10X2 marks	50	20	100	Question number compulsory for all questions Section A - Two questions from each unit Section B - Minimum of 1 question from each unit Section C - 4 Questions from 4 different units.
1, K 2	B-5/8x8 marks	500	40		
2, K 3	C-2/4x20 marks	1200	40		

SEMESTER I

CELL BIOLOGY

TOTAL HOURS: 105 **COURSE CODE: BC21/1C/CBO**

CREDITS: 5 **L-T-P: 5-2-0**

COURSE OBJECTIVES:

1. To gain an understanding on the basic components of prokaryotic and eukaryotic cells.
2. To know about the membrane components and their structure.
3. To understand various modes of transport of substances across the membrane.
4. To know about different cell types, surfaces and junctions.
5. To provide knowledge on cell division, developmental stages and stem cells

COURSE OUTLINE

UNIT I (21 hours)

The cell and cell organelles: Prokaryotic cell –Structure of bacteria - E.Coli, Eukaryotic cell- Plant cell, Animal cell. Cytoskeleton, microtubules and microtubular organization. Endomembrane system - Structure and functions of Endoplasmic reticulum, Golgi complex, Intracellular organelles – Mitochondria, Chloroplast, Lysosome, Peroxisomes and Glyoxisomes and Nucleus.

UNIT II (21 hours)

Cell boundries: Cell coat, Plant cell wall–Structure, Composition and Function. Cell membrane – Functions of plasma membrane, Models of cell membrane – Lipid bilayer, Sandwich model and Fluid mosaic model. Composition of membrane – Membrane lipids, Carbohydrates, Proteins and their functions, Membrane asymmetry and fluidity.

UNIT III (21 hours)

Cell types and function: Epithelial cell – Simple and Compound, Muscle cell Skeletal, Cardiac, Smooth muscle cells. Nerve cell, Cancer cell. Differentiation of cell surface- Invagination, Microvilli, Basement membrane, Tight junction, Desmosome, Gap junction, Overview of Extracellular matrix and functions - Collagen, Hyaluronicacid, Heparin, Dermatan sulphate and Keratan sulphate

UNIT IV (21 hours)

Membrane transport: Passive transport – Osmosis, Simple and Facilitated diffusion (Ligand and Voltage Gated Channels), Active transport (Na-K ATPase, Calcium ATPase and proton pump) – Uniport, Symport, Antiport, Bulk transport – Exocytosis, Phagocytosis and Endocytosis (Pinocytosis and Receptor mediated endocytosis).

UNIT V (21 hours)

Cell division: Mitosis, significance of mitosis, Meiosis – Kinds of meiosis and Significance of meiosis. Developmental Biology - an overview of Gametogenesis, fertilization,cleavage, blastulation, gastrulation, Organogenesis, Differentiation and Morphogenesis. Cell renewal, Properties of Stem cells- Embryonic and adult stem cell- their applications

RECOMMENDED TEXTBOOKS:

1. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology - Dr P S Verma and Dr V K Agarwal, Chand (S.) & Co Ltd, India, 2004
2. Cell Biology- Channarayappa, Orient Black Swan / Universities Press,2010

REFERENCE BOOKS:

1. The World of the Cell - Wayne M. Becker, Lewis J. Kleinsmith, Jeff Hardin, Gregory Paul Bertoni, Pearson Publisher, 7th Edition, 2009.
2. The Cell: A Molecular Approach- Geoffrey M. Cooper , Robert E. Hausman, ASM Press, 4th Edition, 2007.
3. Cell and Molecular Biology - PragyaKhanna**,** IK International Publishing House Pvt. Ltd.2008.
4. Lehninger Principles of Biochemistry-`David L. Nelson & Michael M.Cox, W. H. Publication, 4th Edition, 2004.
5. Biochemistry-Donald Voet& Judith G. Voet , John Wiley and Sons Publication, 3rd Edition, 2004.

JOURNALS:

1. Indian Journal of Experimental Biology
2. European journal of Cell biology – Elsevier
3. The International journal of Biochemistry & cell biology-Elsevier
4. International journal of Cell Biology
5. Trends in Cell Biology - Cell Press

e- LEARNING RESOURCES:

1. https://www.microscopemaster.com/organelles.html
2. https://nptel.ac.in/content/storage2/courses/102103012/pdf/mod1.pdf
3. https://www.kenhub.com/en/library/anatomy/cellular-organelles
4. https://nptel.ac.in/content/storage2/courses/102103012/pdf/mod3.pdf
5. https://nptel.ac.in/courses/102/103/102103012/
6. https://www.brainkart.com/article/Developmental-Biology---Gametogenesis,-Spermatogenesis,-Oogenesis,-Fertilization_668/

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Distinguish between prokaryotes and eukaryotes and understand the biological actions carried out by organelles	K1, K2, K3
CO 2	Apply the knowledge to link the structure and functions of different components in the envelope system	K2, K3
CO3	Relate and apply the concept of solute transport across biological membranes	K1, K2, K3
CO4	Predict the nature and mechanism of cell differentiation to various activities.	K1, K2,K3
CO5	Reason and think about how cells divide and develop into an adult organism	K2, K3

MAPPING COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2
CO2	2	3	3	2	3
CO3	3	3	3	3	3
CO4	3	3	2	2	2
CO5	3	2	3	3	3
AVERAGE	**2.8**	**2.6**	**2.6**	**2.4**	**2.6**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)
2. Videos
3. Quiz, Seminar

QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total	Special Instruction if any
K 1	A-10X2	50	20	100	Question number compulsory for all questions Section A - Two questions from each unit Section B - Minimum of 1 question from each unit Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8	500	40		
K2, K 3	C-2/4x20	1200	40		

SEMESTER I

ALLIED CHEMISTRY - I

(For I B.Sc. Biochemistry)

TOTAL HOURS: 60 **COURSE CODE: BC21/1A/CE1**

CREDITS: 4 **L-T-P: 3-1-0**

COURSE OBJECTIVES:

1. The classification of organic reactions is introduced. To interpret and use the terminology associated with organic reactions.
2. To know the configuration and conformation of organic molecules
3. To learn different electrodes and their functions.
4. To learn the various concepts of Acids and bases. Introducing pH, and buffers.
5. To understand various types of volumetric titrations and the chemical reaction associated with each type of volumetric titration.

COURSE OUTLINE:

UNIT I (12 hours)

Mechanistic basis of organic reactions – Electronic displacement effects- Inductive, Resonance and Steric effects. Definition of substrates – Electrophiles , Nucleophiles – Elementary treatments of Substitution reactions SN1 , SN2 Walden inversion - Aromatic Electrophilic substitution (Nitration, Sulphonation) - Elimination Reaction- E1 , E2 Hoffmann and saytzeff rule- Addition Reaction – Markonikoff's rule and Kharash effect.

UNIT II (12 hours)

Isomerism - elements of symmetry, Definition of chirality, racemisation, resolution, R & D configuration. Structural Isomerism - Chain, positional, functional group. Stereoisomerism- Geometrical & Optical Isomerism. Naturally occurring enantiomers. Maleic & fumaric acid, Keto-enol tautomerism.

UNIT III (12 hours)

Electrochemistry – Thermodynamic concept of electrode potential (Nernst equation). Electro motive force, Measurement of emf using Oxygen, Calomel, Quinhydrone electrodes. Single electrode potential – Standard Hydrogen electrode, Electrochemical series and its uses

UNIT IV (12 hours)

Acids and Bases – Arrhenius concept- Bronsted-Lowry concept- Conjugate Acids and Bases – Lewis concept Concept of pH and pOH – Determination of pH using Potentiometric method (pH meter) –Buffer examples for Acidic and Basic buffer – Buffer action – Biological applications of buffers.

UNIT V (12 hours)

Volumetric analysis – Advantages of Volumetric analysis over other quantitative analysis – Preparation of solutions – Primary and Secondary Standards – (examples) – Definition of Mole, Molarity, Molality, Normality, Formality, Dilution, Difference between End point, Equivalence point - Types of volumetric analysis – Acidimetry and Alkalimetry – Examples & Indicators used Strong acid Vs. Strong base , Strong acid Vs. Weak base, Weak acid Vs. Strong acid, Weak acid Vs. Weak base – Redox Titrations – Permanganometry, Dichrometry,Iodometry,Iodimetry – Complexometry – EDTA Titrations.

RECOMMENDED TEXTBOOKS:

1. Allied Chemistry-Gopalan and Sundaram, Sultan Chand & Sons (P) Ltd., 3rd edition 2006.
2. Text Book of Allied Chemistry-Dr.V.Veeraiyan, Highmount Publishing House, 2008.

REFERENCE BOOKS:

1. Modern Inorganic Chemistry-R.D.Madan, Satya Prakash ,Published by S Chand & Co Ltd,2008.
2. Textbook Organic Chemistry-P.L.Soni,H.M.Chawla,29th edition ,2007.
3. Principles of Physical Chemistry-P.L.Soni,U.N.Dash,23rd revised edition,2007.
4. Chemistry for degree students – RL Madan, S.Chand Publishers, 2010.
5. Textbook Physical Chemistry-Puri & Sharma, Vishal Publishing Co., 38th edition , 2007.

JOURNALS

1. Indian Journal of Chemistry
2. Journal of Saudi Chemical Society
3. New Journal of Chemistry
4. Chemical reviews
5. Nature chemistry

e- LEARNING RESOURCES:

1. http://www.chemistry.org
2. http://www.chemhelper.com
3. https://www.chemeddl.org
4. https://www.chemistryguide.org
5. https://www.acs.org/content/acs/en/education.html

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO1	Gain knowledge on the types of bonds, understand VB and MO theories. Learn the concept of intermolecular forces. Deduce the shape of different polyatomic molecules.	K1, K2
CO2	Able to describe the mechanism of electrophilic and nucleophilic substitution reactions. Learn how to apply rules in addition and elimination reactions.	K1, K2, K3
CO 3	Able to classify the electrolytes To differentiate conductors and insulators, Familiarize with the laws of electricity.	K1, K2
CO4	Able to explain qualitatively the difference in behaviour between strong and weak acids and bases and the pH values of their aqueous solution e to apply the uses of buffer.	K2, K3
CO5	To familiarize with term molarity, molality normality and formality and indicators. Based on law of mass action to arrive at the amount of substance in a unknown solution.	K2,K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	3	3
CO2	2	2	2	1	2
CO3	2	2	2	1	2
CO4	2	2	2	3	2
CO5	2	2	2	3	3
AVERAGE	**2**	**2**	**2**	**2.2**	**2.4**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)
2. Videos
3. Quiz, Seminar

QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total	Special Instruction if any
K 1	A-10X2	50	20	100	Question number compulsory for all questions Section A - Two questions from each unit Section B - Minimum of 1 question from each unit Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8	500	40		
K2, K 3	C-2/4x20	1200	40		

SEMESTER II

BIOMOLECULES

TOTAL HOURS: 105 **COURSE CODE:BC21/2C/BOM**

CREDITS: 5 **L-T-P: 5-2-0**

COURSE OBJECTIVE

1. To inculcate the knowledge on different types of carbohydrates and their structure.
2. To instil the knowledge on the structure and types of amino acids, proteins and their organization.
3. To impart the fundamental knowledge about lipids and their types. .
4. To understand the structural and functional aspects of compound and derived lipids.
5. To provide knowledge on the types, structure and function of DNA and RNA.

COURSE OUTLINE

UNIT I (21 hours)

Carbohydrates – Classification, Biological functions, Optical isomerism of Sugars, Van'thoff rule, Kiliani's cyanohydrin synthesis, Epimers, Enantiomers, Mutarotation, Racemic mixture, Anomeric Forms. Introduction to Haworth structures. Monosaccharides (Glucose, Fructose), Properties of Monosaccharides. Disaccharides (Lactose, Sucrose), Polysaccharides - Homopolysaccharides (Starch, Glycogen), Hetero polysaccharides.-Muco polysaccharides (Heparin, Chondroitin sulphate).

UNIT II (21 hours)

Amino acids – Amphoteric nature, Isoelectric pH, Zwitter ion, Peptide bond, Classification and Structure based on composition of side chain. Essential and Non-essential amino acids, Non-protein aminoacids. Proteins – Classification based on solubility, shape, composition and functions. Protein Structure – Primary, Secondary (collagen triple helix),Tertiary structure (myoglobin) and Quaternary Structure . Forces stabilizing protein structure. Physical and Chemical properties of proteins (Reactions involving acidic, amino and side chain groups).

UNIT III (21 hours)

Lipids- Bloors classification, Biomedical importance of lipids,Types of Fatty acids-saturated, unsaturated, cyclic, hydroxy fatty acids, Essential Fatty Acids-its functions, Triglycerides. Chemical characterization of fats. Physical and chemical properties, (Reactions involving carboxyl, hydroxyl groups and double bonds).

UNIT IV (21 hours)

Phospholipids-Structure and Biological functions of Lecithin, Cephalins, Plasmalogens, Phosphosphingosides, Phosphoinositol. Glycolipids (Cerebrosides, Gangliosides & sulfolipids, Derived lipids (Cholesterol, Bile acids and Bile salts). Lipoproteins - classification and their functions.

UNIT V (21 hours)

Structure of Purine and Pyrimidine bases, Nucleosides, Nucleotides. Cyclic nucleotides-cAMP, cGMP. Watson and crick model of DNA Structure of different types of DNA -A, B and Z. Denaturation, Melting temperature, Hyperchromicity and Annealing of DNA. Structure and role of different types of RNA- mRNA, rRNA, tRNA (Clover leaf), Unusual bases, Heterogenous nuclear RNA.

RECOMMENDED TEXTBOOKS:

1. Fundamentals of Biochemistry- J L Jain, Sunjay Jain and Nithin Jain, S.Chand Publishers, 2004.
2. Biochemistry - U Satyanarayana, , Elsevier India, 4th Edition ,2013.

REFERENCE BOOKS:

1. Lehninger Principles of Biochemistry- `David L. Nelson & Michael M.Cox, W. H. Freeman Publication, 4th Edition, 2004.
2. Biochemistry-Donald Voet& Judith G. Voet , John Wiley and Sons Publication, 3rd Edition,2004.
3. Biochemistry- Jeremy M Berg, John L Tymoczko, and LubertStryer, Freeman Publications, 6th Edition, 2006.
4. Textbook of Medical Biochemistry – MN Chatterjee & Rana Shindee, Jaypee Publishers, 7th Edition, 2007.
5. Introduction to Biochemistry – Mary K. Campbell & Shawn O. Farrell, Cengage Learning, 1st Edition, 2009.

JOURNALS:

1. Indian Journal of Biochemistry & Biophysics
2. Indian Journal of Experimental Biology
3. International Journal of Biological Macromolecules
4. Journal of Biomolecules and Biochemistry
5. Biomolecules-MDPI Multidisciplinary Digital Publishing Institute

e- LEARNING RESOURCES:

1. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-02.pdf
2. https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod12.pdf
3. https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod10.pdf

4. https://nptel.ac.in/content/storage2/courses/104102016/downloads/faq%20of%20mo d ule5.pdf
5. https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/Week-2_04-%20Fat.pdf
6. https://nptel.ac.in/content/storage2/courses/104103018/pdf/mod4.pdf
7. https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod14.pdf
8. https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200327145748085 5monisha_Basics_of_DNA.pdf

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Relate the role of sugars in energy production and living systems	K1, K2, K3
CO 2	Apply the link between the structure and functions of proteins in biological context	K1, K2, K3
CO3	Demonstrate the role of lipids and apply the techniques to identify their purity	K1, K2, K3
CO4	Relate the structure of lipids with their reactivity in biological membrane systems and life processes.	K2, K3
CO5	Apply the structural studies to metabolic processes like replication, transcription and translation	K2, K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	2	3	3	2	2
CO3	3	3	2	3	3
CO4	3	3	3	3	3
CO5	3	2	3	3	3
AVERAGE	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)

2. Videos
3. Quiz, Seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instruction if any
K 1	A- 10X2	50	20	100	Question number compulsory for all questions
K1, K 2	B- 5/8x8	500	40		Section A - Two questions from each unit
K2, K 3	C- 2/4x20	1200	40		Section B - Minimum of 1 question from each unit Section C - 4 Questions from 4 different units.

SEMESTER – II

ALLIED CHEMISTRY – II

(For I B.Sc. Biochemistry)

TOTAL HOURS: 60 **COURSE CODE:BC21/2A/CE2**

CREDITS: 4 **L-T-P: 3-1-0**

COURSE OBJECTIVES

1. To know the condition for co-ordinate bond and chelate formation.
2. To learn the definition and classification of fuel gases, synthetic inorganic polymers and dyes.
3. To understand the definition and classification of drugs.
4. To learn about nano materials and their applications.
5. To discuss more common methods of securing pure organic compounds from natural sources or from reaction product mixture.

COURSE OUTLINE:

UNIT I (12 hours)

Co–ordination Chemistry – Difference between Double salt and Co-ordination Compounds. Nomenclature, Werner's theory, Definition and Biological importance of Chelates – Haemoglobin, Application of chelates – Medicinal and Analytical –Determination of hardness of water and softening of water.TDS

UNIT II (12 hours)

Industrial Chemistry – Fuels, Classification, Fuel Gas – Natural gas, Water gas, Semi water gas, Carbureted Water gas, Producer gas, Oil gas, Gobar gas and LPG- Composition and uses. Silicones – Preparation, Properties and Uses. Synthetic Dyes – Classification of Dyes, Azo, Triphenylmethane, Vat and Mordant Dyes and their Preparation.

UNIT III (12 hours)

Drug Chemistry – Classification of Drugs, Preparation and Properties of Sulpha drugs - Sulpha pyridine, Prontosil, Sulphadiazine and Sulphafurazole. Mode of action of Sulpha drugs.

Antibiotics – Penicillin, Chloramphenicol. Definition and example for Analgesics, Antipyretics, Tranquillizers, Sedatives, Hypnotics, Local and General Anaesthetics.Steroidal drugs, Non- Steroidal inflammatory drugs.

UNIT IV (12 hours)

Nanochemistry - Nanoscience - Definition, Nanomaterials - terminology, Classification, Preparation methods and Characterisation, Distinction between molecules, Nanomaterials & Bulk materials, Properties. Nanoparticles and their applications in Biomedicine and Food.

UNIT V (12 hours)

Isolation and Purification of Organic Compounds – Extraction , Differential extraction,Distillation, Fractional distillation , Steam distillation,Crystallization, Sublimation, Food chemistry – Quality of lipids- rancidity, acid number, iodine number, saponification number. Food adulteration – Definition – Intentional addition and incidental addition – Common adulteration/contaminants in food – Food simple screening test for the detection of adulterants – Diseases or health effects caused by the adulterants – Prevention of Food Adulteration Act -1954.

RECOMMENDED TEXTBOOKS:

1. Allied Chemistry-Gopalan and Sundaram, Published by Sultan Chand & Sons (P) Ltd., 3rd edition, 2006.
2. Text Book of Allied Chemistry-Dr.V.Veeraiyan ,Highmount Publishing House,2008.

REFERENCE BOOKS:

1. Modern Inorganic Chemistry-R.D.Madan,Satya Prakash ,Published by S Chand & Co Ltd,2008.
2. Textbook Organic Chemistry-P.L.Soni, H.M.Chawla,29th edition ,2007.
3. Nanostructures & Nanomaterials, Synthesis, Properties & Applications - G.Cao Imperial College Press, 2004.
4. Food Chemistry – Alex V.Ramani, MJP Publishers, 2009.
5. Chemistry for degree students – RL Madan, S.Chand Publishers, 2010

JOURNALS

1. Indian Journal of Chemistry
2. Journal of Saudi Chemical Society
3. New Journal of Chemistry
4. Chemical reviews
5. Nature chemistry

e- LEARNING RESOURCES:

1. http://www.chemistry.org
2. http://www.chemhelper.com
3. https://www.chemeddl.org
4. https://www.chemistryguide.org

5. https://www.acs.org/content/acs/en/education.html

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO1	Able to name different co-ordinate compounds. Familiarize with the application of chelates in biological system and thereby their application in the field of medicine.	K1, K2
CO2	Apply the usage of fuel gas and dyes in daily life.	K1, K2, K3
CO3	Able to describe the mode of action of different drugs.	K1, K2
CO4	Causes and effects of Food adulteration and awareness to select Wholesome and non- adulterated food.	K2, K3
CO5	Develop knowledge on the nano materials and their uses. Various methods used to separate mixture of compounds and identify their compounds.	K2,K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3
CO2	2	2	2	2	2
CO3	2	2	2	2	2
CO4	2	2	2	2	2
CO5	2	2	2	2	2
AVERAGE	**2**	**2**	**2**	**2**	**2.2**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)
2. Videos
3. Quiz, Seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instruction if any
K 1	A-10X2	50	20	100	Question number compulsory for all questions Section A - Two questions from each Unit Section B - Minimum of 1 question from each unit Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8	500	40		
K2, K 3	C-2/4x20	1200	40		

SEMESTER I & II

CORE PRACTICAL I

TEACHING HOURS: 90 **COURSE CODE:BC21/2C/PR1**
CREDITS: 3 **L-T-P: 0- 0- 3**

COURSE OBJECTIVES:

1. To understand the structure of various cell types in the body
2. To identify the major types of sugar and the various aminoacids from unknown samples.
3. To know the principle, theory, protocol and calculations for various volumetric analysis and to train the students for preparations of starch and casein.

COURSE OUTLINE:

1. Identification of Slides

Epithelial cell-Squamous,Cuboidal,Columnar,Ciliated
Cardiac muscle cell, Skeletal muscle cell, Smooth muscle cell
Stages of mitosis
Stages of meiosis

2. Qualitative Analysis of Carbohydrates:

Monosaccharides : Glucose, Fructose
Disaccharides : Sucrose, Maltose
Polysaccharides : Starch, Dextrin

3. Qualitative Analysis of Amino acids:

Tyrosine, Tryptophan, Cysteine and Arginine.

4. Titration:

1. Estimation of Glycine.
2. Estimation of Glucose by Benedict's method.
3. Determination of Acid Number.
4. Determination of Iodine Number.

5. Group experiments

1. Preparation of Starch from Potato
2. Preparation of Casein from Milk

COURSE OUTCOMES:

1. Developing skills of microscopic examination of various types of cells.
2. Apply the analytical skills to identify the major sugars and amino acids.
3. Developing practical skills on titration and acquire the knowledge for preparation of compounds from samples.

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	1	1	1
CO2	3	3	3	3	3
CO3	3	3	3	3	3
AVERAGE	**2.3**	**2.3**	**2.3**	**2.3**	**2.3**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Hands on Training
2. Demonstration of experiments

SEMESTER I & II
ALLIED CHEMISTRY PRACTICAL
(For I B.Sc. Biochemistry & I B.Sc. CND)

TOTAL HOURS: 60 **COURSE CODE:BC21/2A/CEP**

CREDITS: 2 **L-T-P: 0-0-2**

COURSE OBJECTIVES:

1. To write and construct balanced equation.
2. To deduce stoichiometric relationship from calculation.
3. To learn conductometric titrations & gravimetric principles

COURSE OUTLINE:

1. VOLUMETRIC ANALYSIS

1. Estimation of HCl using Standard Oxalic Acid.
2. Estimation of Borax – Standard Sodium Carbonate.
3. Estimation of Ferrous Sulphate – Standard Mohr Salt Solution.
4. Estimation of Oxalic Acid – Standard Ferrous Sulphate.
5. Estimation of Ferrous Ion – Diphenylamine Indicator.
6. Estimation of Zinc Using EDTA – Standard Magnesium Sulphate.

2. ORGANIC SUBSTANCE ANALYSIS:

Systematic analysis of Organic compounds containing one functional group and characterization by confirmatory tests.

1. Reaction of Aldehyde (Aromatic).
2. Reaction of Carbohydrates.
3. Reaction of Carboxylic Acid (Mono & Di).
4. Reaction of Phenol.
5. Reaction of Amine (Aromatic, primary).
6. Reaction of Amide (Mono & Di).
7. Reaction of Ketone (Not for exam)

3. DEMONSTRATION EXPERIMENTS:

1. Conductometric Titrations - Weak acid Vs Weak base
2. Gravimetric - Estimation of calcium as Calcium Oxalate Monohydrate.

COURSE OUTCOMES:

1. Able to arrive at an overall identification of the substance under investigation.
2. Prepare a systematic report on the analysis and submit
3. Gain hands on knowledge on the analysis of organic substances

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	1	1	1
CO2	3	3	3	3	3
CO3	3	3	3	3	3
AVERAGE	**2.3**	**2.3**	**2.3**	**2.3**	**2.3**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Hands on Training

2. Demonstration of experiments

SEMESTER III

BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES

TOTAL HOURS: 105 **COURSE CODE: BC21/3C/BIT**

CREDITS: 5 **L-T -P: 5-2-0**

COURSE OBJECTIVES:

1. To Impart Knowledge about safety aspects of handling laboratory instruments.
2. To expose the students to various chromatographic techniques and fundamentals of radioactivity.
3. To appreciate electrophoretic and electrochemical principles in separation of compounds.
4. To understand the fundamentals of centrifugation techniques.
5. To study the principles and applications of spectroscopic methods.

COURSE OUTLINE:

UNIT I (21 hours)

Safety aspects and care of laboratory instruments, Balances, types of balances. Colloids - Introduction, Classification, Properties of colloids – Tyndall effect, Brownian movement and Electrical double layer. Ultrafiltration- Biological significance. Donnan Membrane Equilibrium. Definition, Determination and Biological Significance of Viscosity, Surface tension and Osmotic pressure, Concept of Osmolarity and its significance.

UNIT II (21 hours)

Chromatographic techniques – General Principles of Chromatography, Principles, Operational procedures and Applications of Paper, Thin layer, Gel permeation, Ion exchange , Affinity and Gas liquid chromatography.

Radioisotopes, Nature of radioactive decay, Half life, Units of Radioactivity. Detection and Measurement of Radioactivity- Methods based on Ionization (GM counter), Excitation (Scintillation counter). Applications of radioisotopes in biology.

UNIT III (21 hours)

Electrophoretic techniques - General principles, Factors affecting Migration rate- Voltage, Electric field, Buffer, Supporting medium. Electrophoretic mobility of samples. Principle, technique, detection and applications of Paper, Cellulose acetate, Agarose gel electrophoresis, PAGE and SDS-PAGE.

Introduction to Henderson Hasselbalch equation ,Determination of pH using glass electrode, Buffers- Physiological importance of buffers in body fluids and tissues.

UNIT IV (21 hours)

Centrifugation techniques: Basic principles of centrifugation, Rotors, Types of centrifugation- Preparative and Analytical. Differential & Density gradient - Isopycnic, Rate zonal centrifugation technique. Analytical Ultra centrifugation, Application with special reference to determination of molecular weight of Macromolecules (with derivation).

UNIT V (21 hours)

Basic principles of Electromagnetic radiation – Energy, Wavelength, Wave number and Frequency. Absorption and Emission Spectra. Beer Lambert's law, Absorbance and Transmittance. Colorimetry – Principle, Instrumentation and Applications, Spectrophotometry - Principle, Instrumentation and applications. Spectrofluorimetry- Principle, Instrumentation and Application (Estimation of Thiamine).

RECOMMENDED TEXT BOOKS:

1. Practical Biochemistry- Keith Wilson & John Walker, Cambridge University press, V Edition, 2000.
2. Biophysical chemistry – Debajyothi Das,Academic publishers,10th edition,2000.

REFERENCE BOOKS:

1. Introductory Practical Biochemistry – Randhir Singh and S.K.Sawhney ,New Delhi Narosa publishing House, 2nd edition, 2014.
2. Instrumental methods of Chemical analysis- Chatwal Anand , Himalaya Publishing House ,2005.
3. Instrumental methods of Chemical analysis- BK Sharma, Goel Publishing House, 24th Edition, 2005.
4. An Introduction to Practical Biochemistry, David T. Plummer, McGraw – Hill Company, 3rd Edition, 1987.
5. Physical Biochemistry:Applications to Biochemistry & Molecular Biology(Life Science/Biochemistry) -David M.Freifelder, W.H.Freeman Publishers , 2nd edition,1982.

JOURNALS:

1. Biophysical journal-cell
2. Biophysical journal-Elsevier
3. Advanced Techniques in Biology & Medicine- Longdom
4. Analytical Biochemistry-Elsevier
5. Journal of Biochemical and Biophysical Methods-Elsevier

e- LEARNING RESOURSES:

1. NOC | Biophysical chemistry (nptel.ac.in)
2. https://www.ncbi.nlm.nih.gov › books ›

3. http://www cancer.umn.edu/for-researchers/shared resources/Analytical biochemistry
4. www.merlot.org
5. https://chem.libretexts.org

COURSE OUTCOMES:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Acquire and follow the safe lab practices and handling various balances, knowledge of colloids from physical and chemical perspectives, interfacial phenomenon in which central themes are surface tension, viscosity and osmotic pressure.	K1,K2,K3
CO 2	Able to apply various chromatographic techniques and radioisotopes and gain knowledge of electromagnetic radiation and apply them practically	K1,K2, K3
CO3	Use appropriate electrophoretic methods in separation of biomolecules and the physiological significance of buffers in body fluids and tissues.	K1,K2,K3
CO4	Acquire knowledge about centrifugations, types and its applications.	K1,K2, K3
CO5	Appreciate the principle, instrumentation and the difference between various spectroscopic methods to choose analysing biological samples.	K1,K2, K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2.0	3.0	2.0	2.0	2.0
CO2	3.0	3.0	3.0	3.0	3.0
CO3	3.0	3.0	3.0	3.0	3.0
CO4	3.0	3.0	3.0	3.0	3.0
CO5	3.0	3.0	3.0	3.0	3.0
AVERAGE	**2.8**	**3.0**	**2.8**	**2.8**	**2.8**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY

CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

Lecture (Chalk and Talk-OHP-LCD)
E content,
Videos
Quiz, Seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instruction if any
K 1	A-10X2	50	20	100	Question number compulsory for all questions Section A - Two questions from each Unit Section B - Minimum of 1 question from each unit Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8	500	40		
K2, K 3	C-2/4x20	1200	40		

SEMESTER IV

ENZYMOLOGY

TOTAL HOURS: 105 **COURSE CODE:BC21/4C/ENM**

CREDITS: 5 **L-T- P: 5-2-0**

COURSE OBJECTIVES:

1. To Impart Knowledge about properties of enzymes and the principles underlying their catalytic power.
2. To expose the students to various models of enzyme substrate complex, factors affecting their catalytic activity and kinetics.
3. To introduce enzyme inhibition, allosteric regulation and multienzyme system concepts.
4. To appreciate the various methods involved in enzyme extraction, isolation and purification.
5. To understand about cofactors and their role, application of enzymes in diagnosis and technique of immobilisation.

COURSE OUTLINE:

UNIT I (21 Hours)

Enzymes - definition and nature of enzymes (Protein and non-protein). Nomenclature and Classification of enzymes according to International Union of Biochemistry Convention.

Enzymes as catalysts – standard free energy, activation energy, transition state. Progress curve of uncatalysed and enzyme catalysed reaction. Active site and its characteristic features; Enzyme specificity – linkage, group, absolute, and stereo specificities. Isoenzymes – properties and significance (Lactate dehydrogenase). Definition – zymogens, abzymes.

UNIT II (21 Hours)

Enzyme- substrate (ES) complex formation, Lock and key hypothesis and induced fit model. Enzyme Kinetics – Michaelis Menten equation and its derivation, significance of Km and Vmax, Line weaver Burk plot. Factors influencing enzyme activity – pH, temperature, enzyme, substrate, modulators (Activators, inhibitors). Enzyme Units - IU, specific activity and Katal.

UNIT III (21 Hours)

Enzyme inhibition – reversible and irreversible. Types of reversible inhibition- competitive (with applications), Non- competitive, Uncompetitive – Derivations not included. Allosteric inhibition, simple sequential model, conserted model, feedback inhibition with ATCase as an example.

UNIT IV (21 Hours)

Extraction of enzymes – Nature of the extraction medium, extraction of soluble enzymes, technique for enzyme isolation, separation of cellular organelles by differential centrifugation, intracellular localization of enzymes and marker enzymes. Purification of enzymes - dialysis, ultrafiltration, chromatography, electrophoresis. Criteria of purity of enzymes.

UNIT V (21 Hours)

Cofactors and prosthetic group, apoenzymes, holoenzymes. Coenzymes - Structure and functional role of NAD, PLP. Role of metal ions in enzyme catalysis. Role of enzymes in diagnosis (SGPT, SGOT, CK, acid and alkaline phosphatase).
Immobilisation of enzymes by adsorption, covalent bonding, cross linking, entrapment and encapsulation. Applications of immbolised enzymes (Overview).

RECOMMENDED TEXTBOOKS:

1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry - Trevor Palmer, Horwood Publishing Limited , East- West Press Edition, 2004.

2. Enzyme Technology- Anusha Baskar and V.GVidhya, MJP Publishers,2014.

REFERENCE BOOKS:

1. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic proteins - Nicholas C.Price and Lewis Stevens, Oxford University Press, 3rd Edition, 2000.
2. Principles of Biochemistry - Lehninger, Nelson and Cox, WH Freeman and Company, New York, USA, 4th Edition, 2005.
3. Biochemistry- Donald Voet & Judith G. Voet, John Wiley and Sons Publication, 3rd Edition , 2004.
4. Biochemistry- Jeremy M Berg, John L Tymoczko, and Lubert Stryer, FreemanPublications, 6th Edition, 2006.
5. Introduction to Biochemistry – Mary K. Campbell & Shawn O. Farrell, Cengage Learning, 1st Edition, 2009.

JOURNALS:

1. Enzyme Research
2. Journal of Enzyme and Microbial Technology
3. Journal of Enzyme Inhibition and Medicinal Chemistry
4. ACS Catalysis
5. Bio catalysis and Biotransformation

e- LEARNING RESOURCES:

1. https://nptel.ac.in › /courses/102/102/102102033/
2. https://www.khanacademy.org/science/ap-biology/cellular-energetics/environmental-impacts-on-enzyme-function/a/basics-of-enzyme-kinetics-graphs
3. https://www.wolfram.com/system-modeler/examples/more/computational-biology/allosteric-regulation-explained-with-atcase
4. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/16.bio-organic_and_bio physical chemistry/09.extraction and purification of enzymes/et/5563 et
5. http://dedicaciontotal.udelar.edu.uy/adjuntos/produccion/465_academicas academi caarchivo.pdf

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Understand the concepts of activation energy and cellular reactions to occur by a biocatalyst, a system for naming and classifying enzymes and gain knowledge on isoenzymes.	K1,K2,K3
CO 2	Comprehend the role of enzyme substrate complex formation and types of models and enzyme specificity and apply the kinetics in various field of enzyme technology.	K1, K2, K3
CO3	Apply the concepts of inhibition in application of enzymes. Knowledge on allosteric mode on regulation and multienzyme complex.	K1, K2,K3
CO4	Discuss techniques of enzyme extraction from various tissues, isolation and their purification.	K1, K2, K3
CO5	Understand the role of cofactors in enzyme catalysed reactions. Knowledge on enzymes role in diagnosis and technique on immobilisation of enzyme.	K1, K2, K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	3	3
CO2	3	3	2	3	2
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
AVERAGE	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)
2. Videos
3. Quiz, Seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instruction if any
K 1	**A-10X2**	**50**	**20**	**100**	**Question number compulsory for all questions** **Section A - Two questions from each unit** **Section B - Minimum of 1 question from each unit** **Section C - 4 Questions from 4 different units.**
K1, K 2	**B-5/8x8**	**500**	**40**		
K2, K 3	**C-2/4x20**	**1200**	**40**		

SEMESTER – III & IV
CORE PRACTICAL- II

TOTAL HOURS: 90 **COURSE CODE:BC21/2C/PR2**

CREDITS: 3 **L-T-P: 0-0-3**

COURSE OBJECTIVES:

1. To impart hands-on training in redox reactions, colorimetric estimations and buffer preparation.
2. To train them in separation of biomolecules and biological samples by analytical techniques and to immobilise enzyme.
3. To understand and observe how biomolecules are separated by dialysis, chromatographic and electrophoretic techniques.

COURSE OUTLINE:

I. TITRATION

1. Estimation of Iron
2. Estimation of Copper
3. Estimation of Ascorbic acid

II. COLORIMETRY (IN UNKNOWN SOLUTION)

1. Estimation of protein by biuret method
2. Estimation of glucose by anthrone method
3. Estimation of iron by bipyridyl method
4. Estimation of amino acids by ninhydrin method
5. Estimation of chlorophyll a / b (in leaves)

III. PREPARATION OF BUFFERS - Phosphate buffer, Tris buffer

IV. GROUP EXPERIMENTS

1. Immobilisation of salivary amylase by entrapment method
2. Preparation of plasma and serum by centrifugation

V. DEMONSTRATION EXPERIMENTS

1. Separation of Amino acids by paper chromatography
2. Separation of Plant pigments by column chromatography
3. Separation of DNA by agarose electrophoresis
4. Ammonium sulphate precipitation of protein and its concentration using dialysis membrane

COURSE OUTCOMES:

1. Development of practical skill on redox reaction experiments

2. Acquire the knowledge on colorimetric estimations

3. Prepare various buffer solutions and to apply the chromatographic, electrophoretic and centrifugation skills to separate amino acids & plant pigments, DNA and biological sample respectively and to immobilise enzyme.

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	2
CO2	3	3	3	3	3
CO3	3	3	3	3	3
AVERAGE	**2.6**	**2.6**	**2.6**	**2.6**	**2.6**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Hands on Training
2. Demonstration of Experiments

SEMESTER V

INTERMEDIARY METABOLISM I

TOTAL HOURS: 60 **COURSE CODE:BC21/5C/IN1**

CREDITS: 4 **L-T -P: 4-0-0**

COURSE OBJECTIVES:

1. To introduce basic metabolic pathways and understand simple concepts related to metabolism.
2. To appreciate the correlation between energy molecules, reducing equivalents and pathways of carbohydrate metabolism.
3. To expose the students to degradation of amino acid and comprehend how any defect in a pathway could lead to diseases.
4. To Appreciate experiments carried out by scientists to enable understand the pathways and cycles of metabolism
5. To explain the pathways of nucleotide metabolism and importance of nucleotide coenzymes.

COURSE OUTLINE:

UNIT I (12 hours)

Introduction to Intermediary metabolism. Basic metabolic pathways – anabolic, catabolic and amphibolic pathways.

Integration of metabolic pathways (carbohydrate, lipids and amino acids), Role of hormones (Glucagon, Epinephrine and Insulin) in fuel metabolism, tissue specific metabolism (brain, muscle,liver).

Pathways and energetics - Glycolysis, oxidation of pyruvate, fate of pyruvate in alcoholic and lactic acid fermentation, Entry of fructose,Galactose and Mannose.

UNIT II (12 hours)

Pathways and energetics - TCA Cycle- anapleurotic and amphibolic reactions.Glyoxylate cycle.Pathway of Gluconeogenesis, Cori cycle, Pasteur effect. Glucuronic acid cycle. HMP shunt and its significance.

Glycogen metabolism - Glycogenesis and Glycogenolysis and its regulation.

UNIT III (12 hours)

Amino acid metabolism- Nitrogen cycle,incorporation of ammonia into biomolecules,Overview of the fate of carbon skeleton of aminoacids, Metabolic nitrogen Pool,Transamination reactions - AminoTransferases, Role of pyridoxal phosphate. Catabolism of amino acids - Oxidative and Non - oxidative deamination, Decarboxylation. Transport of Ammonia, Glucose -alanine cycle, Urea cycle and its regulation.

UNIT IV (12 hours)

Degradation of glucogenic and ketogenic amino acids - Phenyl alanine, Threonine, Arginine, Tryptophan, Methionine. Precursor functions of amino acids - Biosynthesis of creatine and creatinine, Polyamines (putresine, spermidine) Catecholamines (dopamine, epinephrine, nor epinephrine) Neurotransmitters (serotonin, GABA).

Biosynthesis of non- essential amino acids - Asparagine, Glutamine, Serine.

UNIT V (12 hours)

Nucleotide metabolism – Biosynthesis of Purine and pyrimidine bases, salvage pathway. Degradation of purine and pyrimidine bases in the Uricotelic and Ureotelic systems (Regulation not required).

RECOMMENDED TEXT BOOKS:

1. Principles of Biochemistry- Lehninger, Nelson and Cox, W.H.FreeMan&company, 7th edition, 2004.
2. Biochemistry -Donald Voet, Judith G. Voet,Wiley(publisher),IV edition ,2013.

REFERENCE BOOKS:

1. Biochemistry- Jeremy M Berg, John L Tymoczko, and Lubert Stryer,Freeman Publications,6th Edition, 2006.
2. Biochemistry- Geoffrey Zubay, Wm.C. Brown Publishers, 4th Edition,1998.
3. Harper's Illustrated Biochemistry- Robert K. Murray, Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell,Mcgraw-hill publishers, 26th Edition, 2003.
4. Text book of Biochemistry with Clinical Correlation- Thomas M. Devlin, John Wiley & Sons, 5th Edition, 2001.
5. Introduction to Biochemistry – Mary K. Campbell & Shawn O. Farrell, 1st Edition, Cengage Learning,1st Edition, 2009

JOURNAL:

1. Journal of Nutrition & Intermediary metabolism - Elsevier
2. International journal of Biochemistry Research & Review
3. International journal of Biochemistry- Elsevier
4. Human Nutrition & Metabolism- Elsevier
5. Metabolism - Elsevier

e- LEARNING RESOURCES

1. https://www.khanacademy.org/science/biology/cellular-respiration-and-fermentation/variations- on-cellular-respiration/a/connections-between-cellular-respiration-and-other-pathways

3. https://slidetodoc.com/carbohydrate-metabolismi-glycolysis-tca-cycle.
4. Alternative Metabolic Pathways | SchoolWorkHelper
5. https://www.lecturio.com/concepts/catabolism-of-amino-acids
6. https://slidetodoc.com/carbohydrate-metabolismi-glycolysis-tca-cycle...
7. https://www.lecturio.com/medical-courses/purine-and-pyrimidine-metabolism.course#

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Gain knowledge about various types of metabolism and pathways of carbohydrates by which nutrient molecules are degraded and hence energy production.	K1,K2,K3
CO 2	Explain how cells survive and proliferate by synthesis and degradation of glycogen and serve as a buffer for glucose ,HMP shunt for replenishing NADPH and ribose	K1, K2,K3
CO3	Outline the various types of aminoacid degradation and its excretory product.	K1,K2,K3
CO4	Gain insights in to the importance of aminoacid biosynthesis and degradation of specific glucogenic and ketogenic aminoacids and synthesis of specialised products.	K1 , K2,K3
CO5	Apply the knowledge of nucleic acid metabolic pathway for Cancer research and Carry out basic research in understanding aspects of metabolism that are still not clear	K2, K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO3	PSO 4	PSO 5
CO1	3	3	3	2	2
CO2	2	3	3	2	2
CO3	3	3	2	2	2
CO4	3	2	3	2	2
CO5	2	3	3	2	2
AVERAGE	2.6	2.8	2.8	2	2

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Flipped Learning/Blended Classroom-E content, Videos
3. Problem solving-Group Discussion-Role Modelling
4. Quiz ,Seminar

QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total	Special Instruction if any
K 1	A-10X2	50	20	100	Question number compulsory for all questions Section A - Two questions from each unit Section B - Minimum of 1 question from each unit Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8	500	40		
K2, K 3	C-2/4x20	1200	40		

SEMESTER V
INTERMEDIARY METABOLISM II

TOTAL HOURS: 60 **COURSE CODE:BC21/5C/IN2**

CREDITS: 4 **L-T-P: 4-0-0**

COURSE OBJECTIVES:

1. To understand the chemical principles of lipid metabolism and its regulation.
2. To instil the knowledge on the metabolic reactions and regulatory pathways of derived lipids.
3. To explain the synthetic pathway of coenzymes from vitamins, synthesis and breakdown of porphyrins and detoxification process.
4. To discuss about the components and the mechanism of ATP production.
5. To detail the mechanism of light harnessing and food production in plants

COURSE OUTLINE:

UNIT I (12 Hours)

Fatty acid synthase complex, Biosynthesis of saturated fatty acids (Palmitic acid) and unsaturated fatty acid (Oleic acid). Lipid metabolism- oxidation of fatty acids (saturated, odd and even numbered) - β oxidation. Ketogenesis. Biosynthesis and Degradation of triglyceride

UNIT II (12 Hours)

Synthesis of phospholipids in *Escherichia coli* (*E.coli*) (Phosphatidyl glycerol, Phosphatidyl serine, phosphatidyl ethanolmine and cardiolipin). Synthesis of Sphingolipid in *Escherichia coli* (*E.coli*).

Biosynthesis of Cholesterol – Regulation. Degradation of Cholesterol. Overview of lipoprotein metabolism. Action of Phospholipases.

UNIT III (12 hours)

Synthesis of Coenzymes from vitamins – Nicotinamide adenine dinucleotide (NAD), Flavin adenine dinucleotide (FAD), Pyridoxal Phosphate (PLP), Thiamine pyrophosphate (TPP), Coenzyme – A. Porphyrin biosynthesis (Stage I, II and III), Synthesis of heme and catabolism of heme.

Detoxification mechanism – Oxidation, reduction, hydrolysis and conjugation (types – methylation, acetylation, conjugation with sulphuric acid, conjugation with glucuronic acid, conjugation with amino acids) (Phase I and Phase II reactions).

UNIT IV (12 hours)

Biological oxidation – Redox potential; Electron transport chain- components and reactions of ETC. Mitchel's chemiosmotic coupling hypothesis, Structure of F_0F_1 ATPase, Mechanism of ATP synthesis. Inhibitors of ETC and oxidative phosphorylation, Uncouplers.

Chemical basis of high standard energy of hydrolysis of ATP, High energy compounds and linkages – anhydrides (1,3 bisphospho glycerate), enol phosphate (Phosphoenol pyruvate), phosphoguanidines (Creatine phosphate).

UNIT V (12 hours)

Photosynthesis – Chloroplast, Thylakoid membrane. Light reactions - Photosystem I & II, Z- Scheme of electron flow, oxygen evolving complex, cyclic and no-cyclic electron flow, CF_0-F_1 ATPase role in photophosphorylation, Dark reactions – calvin cycle – C3 & C4 pathway, Photorespiration.

RECOMMENDED TEXT BOOKS:

1. Principles of Biochemistry - Lehninger, Nelson and Cox, WH Freeman and Company, New York, USA, 4th Edition, 2005.
2. Biochemistry- Donald Voet & Judith G. Voet, John Wiley and Sons Publication, 3rd Edition, 2004.

REFERENCE BOOKS:

1. Biochemistry- Jeremy M Berg, John L Tymoczko, and Lubert Stryer, Freeman Publications, 6th Edition, 2006.
2. Biochemistry- Geoffrey L Zubay, Dubuque, IA : Wm. C. Brown Publishers, 4th Edition, 1998.
3. Harper's Illustrated Biochemistry - Robert K. Murray, Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Mcgraw-Hill, 26th Edition, 2003
4. Biochemistry – The Chemical reactions of living cells – David E. Metzler, Academic Press, 2nd Edition, 2003.
5. Introduction to Biochemistry – Mary K. Campbell & Shawn O. Farrell, Cengage Learning, 1st Edition, 2009.

JOURNALS:

1. Indian Journal of Endocrinology and Metabolism,
2. Journal of Nutrition & Intermediary metabolism
3. International journal of Biochemistry Research & Review
4. Metabolism: Clinical and Experimental
5. Metabolic Engineering

e- LEARNING RESOURCES:

1. https://ocw.mit.edu/courses/chemistry/5-07sc-biological-chemistry-i-fall- 2013/module-iii/session-17

2. https://www.lipidmaps.org/resources/lipidweb/lipidweb_html/lipids/simple/lipoprot/index.htm
3. https://pubs.acs.org/doi/10.1021/ja01100a526
4. https://ocw.mit.edu/courses/chemistry/5-07sc-biological-chemistry-i-fall- 2013/module-ii/session-12/
5. https://www.life.illinois.edu/govindjee/photoweb/subjects.html#bioenergy

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Appreciate the metabolic basics of diseases when lipid pathway is disturbed	K1, K2, K3
CO 2	Gain new insights in to the important lipids and their metabolism, clinical and therapeutic aspects	K1, K2, K3
CO3	Apply the knowledge of the detoxification process in drug development. Understand the synthesis of coenzymes and porphyrins in human system	K1, K2, K3
CO4	Compute the pathways and mechanism of energy generation	K1, K2, K3
CO5	Able to link the concept of photosynthesis with agricultural production	K1, K2, K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2
CO2	2	3	3	3	3
CO3	2	3	3	3	2
CO4	3	2	2	2	3
CO5	3	3	3	3	3
AVERAGE	**2.6**	**2.8**	**2.8**	**2.8**	**2.6**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)

2. Blended Classroom- Videos

3. Quiz, Seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instruction if any
K 1	A-10X2	50	20	100	Question number compulsory for all questions Section A - Two questions from each unit Section B - Minimum of 1 question from each unit Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8	500	40		
K2, K 3	C-2/4x20	1200	40		

SEMESTER-V

CLINICAL BIOCHEMISTRY

TOTAL HOURS: 60 **COURSE CODE:BC21/5C/CBI**

CREDITS: 4 **L-T-P: 4-0- 0**

COURSE OBJECTIVES:

1. To enable students understand the basics of biological specimen and hematological parameters in diagnosis
2. To impart knowledge on concepts of disorders of carbohydrate metabolism and educate students about the etiology,types,complications of diabetes mellitus and significance of diagnosis
3. To educate students in understanding the metabolic defects of lipids and possible complications
4. Enable student understand the disorders associated with plasma protein, amino acids,nucleic acid metabolism and in disease developments
5. To impart knowledge on diagnostic procedures for gastric,liver and renal function.

COURSE OUTLINE:

UNIT I (12 Hours)

Biological specimen –Types of specimen - Blood, serum, plasma, urine, feces, Cerebrospinal fluid (CSF), amniotic fluid, solid tissues, specific cells, specimen collection and preservation- Different preservents and their role, Anticoagulants and their specific function.

Hematological parameters - packed cell volume (PCV), mean corpuscular volume (MCV), erythrocyte sedimentation rate (ESR), hemoglobin (Hb), mean cell hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC). Blood disorders and diagnosis - Anemia, Thalassemia, sickle cell Anemia.

UNIT II (12 Hours)

Disorders of carbohydrate metabolism – Normal sugar level in blood, renal threshold and regulation of blood glucose, hyperglycemia, hypoglycemia,glycosuria Diabetes Mellitus: Types-T1DM,T2DM,Gestational diabetes, clinical features, acute and chronic complications ,diagnosis - Urine testing, random blood sugar and glucose tolerance test (GTT) and glycated Hb and treatment. Glycogen storage diseases, Galactosemia

UNIT III (12 Hours)

Disorders of lipid metabolism - Plasma lipids and lipoproteins-Normal lipid levels in blood- Triglycerides (TG), very low density lipoprotein (VLDL), low-density lipoprotein (LDL), high-density lipoproteins (HDL),Cholesterol. Introduction Hyperlipoproteinemia-Types I, II, III, IV and V Alphalipoproteinemia.

Hypolipoproteinemia- A beta lipoproteinemia, Hypo beta lipoproteinemia. Tangier's disease and LCAT deficiency. Atherosclerosis, Fatty liver Lipidosis- Niemann Pick's disease, Tay Sach's Disease.

UNIT IV (12 Hours)

Disorders of protein, amino acid, nucleic acid metabolism - Plasma protein abnormalities: Albumin, Globulins Fibrinogen. Abnormal non-protein nitrogen: Urea and Creatinine, Disorders of amino acid metabolism: Tyrosinemia, Phenylketonuria, Alkaptonuria, Hartnurp's disease, Cystinuria, maple syrup disease, Albinism.

Disorders of nucleic acid metabolism – Normal level of uric acid in blood and urine, hyperuricemia and Gout; Hypouricemia – Xanthinuria and Liathiasis. Disorders of pyrimidine metabolism: Orotic acid urea, Disorders of purine metabolism:Lesch Nyhan synrome

UNIT V (12 Hours)

Gastric function test- examination of resting content, fractional gastric analysis using Xylose, mannitol absorption test, stimulation test- alcohol, histamine and insulin. Tubeless gastric analysis.

Kidney function test- Clearance test- urea and creatinine Test for renal plasma flow- Para-amino hippurate test Test for tubular function- Concentration and Dilution tests

Liver function test-, Bilirubin metabolism and jaundice Tests based on abnormalities of bile pigment metabolism,-Serum bilirubin and Vanden Bergh reaction ,Tests based on detoxicating function of liver- hippuric acid test ,Excretory function of liver -BSP retention test,Test based on formation of prothrombin by liver-prothrombin time, Test based on serum enzymes in liver disease – Gamma-glutamyl transferase (GGT), Alkaline phosphatase (ALP), Aspartate aminotransferase (AST) , Alanine aminotransferase (ALT).

RECOMMENDED TEXT BOOKS:

1. Burtis A. Carl and Edward R.Ashwood, Tietz text book of Clinical chemistry W.B.Saunders company, 2nd edition, 1994
2. MN Chatterjea and Rana Shinde, Text Book of Medical Biochemistry, Jaypee Brothers Medical Publishers (P) LTD, New Delhi, 8th Edition,2012

REFERENCE BOOKS:

1. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics,Saunders,6th Edition,2017.
2. Essentials of Medical Biochemistry, Second Edition: With Clinical Cases, N.V.Bhagavan, Chung - Eun Ha, Academic Press, Second Edition,April 2015.
3. Davidson's principles and practice of medicine -John A.A. Hunter, Elsevier Health - UK; 22nd edition (4 February 2014).
4. Biomarkers of Disease –An evidence based approach , by Andrew K. Trull(Editor),

Lawrence M. Demers(Editor), David W. Holt(Editor), Atholl Johnston(Editor), J. Michael Tredger(Editor), Christopher P. Price(Editor) Cambridge University Press; Reprint edition (30 October 2008).

5. Clinical Biochemistry&Metabolic Medicine,Martin A Crook, Hodder Arnold publishing 8th edition,2012.

JOURNALS:

1. Advances in Clinical Chemistry
2. Journal of Clinical Biochemistry and Nutrition
3. Clinical Chemistry and Laboratory Medicine
4. Journal of Nutritional Biochemistry
5. Best Practice and Research in Clinical Haematology

e- LEARNING RESOURCES:

1. https://www.britannica.com/science/metabolic-disease/Disorders-of-carbohydrate-metabolism
2. https://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests
3. https://onlinecourses.nptel.ac.in/noc20_ge13/preview
4. https://www.ncbi.nlm.nih.gov>books
5. https://www.mayoclinic.org

COURSE OUTCOME:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Utilize the knowledge in selecting different biological specimens, its collection and preservation in disease diagnosis; also analyze the hematological parameters in identification of blood disorders.	K1,K2,K3
CO 2	Discuss and explain the metabolic disorders of carbohydrate ,Apply knowledge in analysing and evaluating the Diabetes mellitus through various diagnostic procedure	K2,K3,
CO3	Discuss and explain the metabolic disturbances and inherited disorders associated with plasma lipoprotein and lipid metabolism	K1,K2,K3
CO4	Utilize the knowledge in understanding and applying it in analysing the possible metabolic disorders and complications of plasma protein,amino acid and nucleic acid metabolism	K2,K3
CO5	Apply the knowledge of diagnostic procedures to determine the health status of vital organs gastric , renal and liver function	K2,K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	2	3	3	2
CO5	2	3	2	2	3
AVERAGE	**2.6**	**2.6**	**2.6**	**2.6**	**2.6**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (chalk and talk-OHP-LCD)
2. E content ,videos
3. Group discussion
4. Quiz-seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Total	Special Instructions if any
K1	**Sec A – 10 x 2**	**50**	**100**	**Question number compulsory for all questions.** **Section A - Two questions from each unit** **Section B- Minimum of 1 question from each unit.** **Section C - 4 Questions from 4 different units.**
K1,K2	**B – 5/8 x 8**	**500**		
K2,K3	**C – 2/4 x 20**	**1200**		

SEMESTER-V

HUMAN PHYSIOLOGY

TOTAL HOURS: 60 **COURSE CODE:BC21/5C/HPH**

CREDITS: 4 **L-T-P: 4-0-0**

COURSE OBJECTIVES:

1. To impart Knowledge about Blood composition and function and blood clotting mechanism.
2. To study about the muscular, nervous system and Sensory Mechanism..
3. To appreciate about the components of Urinary system and mechanism of Urine formation
4. To understand the structure and function and different components of Digestive system.
5. To introduce the organization of endocrine system and classification of hormones

COURSE OUTLINE:

UNIT I (12 hours)

Blood- composition & function. Types of blood cells, morphology & function – Red blood cells (RBC), White blood cells (WBC), Platelets. Erythropoiesis, Anticoagulants, Blood coagulation and blood groups (A,B,O'& Rhesus system, Coombs test and Bombay blood group).

UNIT II (12 hours)

Muscular and Nervous system- Types of muscle, its functions & contraction of skeletal muscle. Brief outline of nervous system, structure of brain and spinal cord. Propagation of Nerve Impulses. Reflex Action, Structure of Synapses and Synaptic transmission. Neurotransmitters.

Sensory Mechanism: Physiology of olfaction, gustation, vision ,hearing and equilibrium.

UNIT III (12 hours)

Urinary system – components of the urinary system, Kidney structure and organization. Structure, function and classification of nephrons. Mechanism of urine formation. Micturition. Hormones of the Kidney.

UNIT IV (12 hours)

Digestive system- structure and function of different components of digestive system, Role of hormones and enzymes in digestive process. Digestion of carbohydrates, lipids and proteins. Absorption of vitamins, minerals and water.

UNIT V (12 hours)

General organization of the endocrine system- classification of hormones. Structure & Biological functions - Thyroid, Parathyroid, Insulin, Glucagon, hormones of the adrenal glands and Pituitary - Vasopressin, Growth hormones and gonadal hormones.

RECOMMENDED TEXT BOOKS:

1. Textbook of Medical Biochemistry – MN.Chatterjee and , Rana Shinde, Wife Goes On ,7th edition, 2007.

2. Textbook of Human Physiology-AK. Jain , Avichal Publishing Company; 7th edition (1 January 2017).

REFERENCE BOOKS:

1. Textbook of Medical Physiology – Guyton & Hall , Elsvier- Saunders,11th edition, 2006.
2. Davidson's Principles and Practice of Medicine -John.A.A.Hunter, Elsevier Health (19 Edition) 2003.
3. Human Anatomy & Physiology – Elaine N.Marieb ,Benjamin/Cummings,3rd edition ,1995
4. Essentials of Medical Physiology –Sembulingam , Jaypee Brothers Medical Publishers (P) Ltd,6th Edition,2012.
5. Medical Physiology –Ganong , McGraw-Hill Education / Medical; 26th edition (January 29, 2019).

JOURNALS:

1. National Journal of physiology pharmacy and pharmacology
2. Journal of physiology
3. The Journal of General physiology
4. Journal of Applied Physiology
5. Physiological Reviews

e- LEARNING RESOURCES:

1. https://www.britannica.com/science/blood-biochemistry
2. https://www.uc.edu/content/dam/uc/ce/images/OLLI/Page%20Content/Muscular%20System%20s.pdf
3. https://kidshealth.org/en/parents/brain-nervous-system.html
4. https://www.ncbi.nlm.nih.gov/books/NBK547656/
5. https://courses.lumenlearning.com/boundless-ap/chapter/overview-of-the-urinary- system/

6. https://www.kenhub.com/en/library/anatomy/circulatory-system
7. https://courses.lumenlearning.com/boundless-ap/chapter/overview-of-the-muscular-system/
8. https://courses.lumenlearning.com/boundless-ap/chapter/overview-of-the-respiratory-system/
9. https://www.britannica.com/science/hormone/The-hormones-of-vertebrates
10. https://my.clevelandclinic.org/health/articles/21201-endocrine- system

COURSE OUTCOME:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Recognize and analyze blood cells and blood groups Blood clotting mechanism & Anticoagulants.	K1 K2
CO 2	Outline the muscular and nervous system, Mechanism of muscle contraction and structure of brain and spinal cord. Knowledge about the sensory mechanism.	K1 K2, K3
CO3	Utilise the knowledge about the structure kidney and nephron ,to understand the mechanism of Urine formation and learn the concept of Dialysis,	K1 K2,K3
CO4	Acquire knowledge about the components of Digestive system and Digestion process	K2, K3
CO5	Compile the classification of Hormones and its structure & function.	K1,K2

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	2
CO2	2	1	3	2	3
CO3	2	2	2	2	3
CO4	2	2	2	2	2
CO5	2	3	2	2	3
AVERAGE	**2.0**	**2.0**	**2.2**	**2.0**	**2.6**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk; LCD)
2. Blended Classroom- Videos
3. Quiz, Seminar

QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K1	Sec A – 10X2	50	20	100	Question number compulsory for all questions. Section A - Two questions from each unit Section B- Minimum of 1 question from each unit. Section C - 4 Questions from 4 different units.
K1,K2	B – 5/8 x 8	500	40		
K2,K3	C – 2/4 x 20	1200	40		

SEMESTER V

ELECTIVE - BIOINSTRUMENTATION & BIOSTATISTICS

TOTAL HOURS: 75 **COURSE CODE:BC21/5E1/BIB**

CREDITS: 5 **L-T-P: 5-0-0**

COURSE OBJECTIVES:

1. To impart knowledge about common clinical testing and assays
2. To expose the students to the various diagnostic tests and scans
3. To understand the concept the basics of various life support devices and other therapeutic procedures.
4. To introduce the basics of statistics.
5. To understand and apply the common statistical parameters.

COURSE OUTLINE:

UNIT I (15 hours)

Hematology Analyzer, Estimation of metabolites using enzymes and its significance (Glucose estimation using Glucose oxidase), Kinetic assay of enzymes - LDH, Flame photometry for electrolyte estimation,Immuno Fluorescence and Chemiluminescent methods for assay of hormones,Serological tests-Widal test,Microscopy and Quantitative buffy coat (QBC) for diagnosis of Malarial parasite.

UNIT II (15 hours)

Diagnostic procedures – Histopathology, X-ray, Different types of scan – Ultrasound scan, Computerised Axial Tomography scan. Methods based on electrical activity – electroencephalogram (ECG), electroencephalogram (EEG), Blood pressure measurements, Respiratory gas analyzer.

UNIT III (15 hours)

Therapeutic procedures - Blood banking, Dialysis unit- Hemodialysis and Peritoneal dialysis, Ventilator, Pacemaker, Laser applications in Medicine, Radiotherapy equipment.

UNIT IV (15 hours)

Statistics- Definitions of Biostatistics & Clinical Statistics– Primary and Secondary data, Population and sample.Types of sampling, Collection of data (survey, experiment and observation method) Presentation of data - table, line diagram, bar diagram (simple, subdivided and multiple). Pie diagrams, Pictogram,cartogram.

UNIT V (15 hours)

Measures of Central tendencies- Mean, Median, Mode (individual data, discrete series, continuous series). Measures of dispersion - Range,Coefficient of range,quartile deviation,coefficient of quartile deviation, standard deviation (Individual data, discrete series, continuous series),coefficient of Variation

RECOMMENDED TEXT BOOKS:

1. Introduction to Biostatistics – N.Gurumani, MJP Publishers,2nd edition,2005
2. Bioinstrumentation-L.Veerakumari,MJP Publishers,1st edition,2015.

REFERENCE BOOKS:

1. Handbook of Biomedical instrumentation--R.S.Khandpur, McGraw Hill Education India Pvt Ltd, 2nd edition, 2008.
2. Biostatistics Basics and advanced-MAnjuPandey,Mv Learning Publisher,2015
3. Instrumental Methods of Analysis by Willard. CBS Publishers & Distributors, 7th Edition, 2004**.**
4. Statistical Methods by S. P. Gupta ,Sultan Chand & Sons Publisher, 43rd edition,2012.
5. Bioinstrumentation by MJ Reilly, CBS Publishers and Distributors Pvt. Ltd. 1st Edition, 2016.

JOURNALS:

1. International journal of Instrumentation Technology
2. The international journal of Biostatistics-De Gruyter
3. The Indian journal of Statistics
4. Journal of statistical theory and Practice
5. Medical instrumentation

e- LEARNING RESOURCES:

1. www.stat.isu.edu
2. www.inderscience.com
3. www.degruyter.com
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5453888/
5. https://www.eecs.umich.edu/courses/bme458/download/bme458_notes1.pdf

COURSE OUTCOME:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Analyze the common clinical testings & Assays	K1
CO 2	Discuss about various diagnostic Procedures	K1
CO3	Explain the use of life support devices and understand the therapeutic procedures.	K2,K3
CO4	Explain the Basics of Statistics, Present Datas	K1,K2,K3
CO5	Solve problems involving common statistical parameters	K2,K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	3	3
CO2	2	3	3	2	2
CO3	3	3	3	2	3
CO4	3	3	3	3	3
CO5	2	2	3	3	3
AVERAGE	**2.4**	**2.8**	**3**	**2.6**	**2.8**

KEY: STRONGLY CORELATED -3, MODERATELY CORELATED -2, WEAKLY CORELATED -1, NO CORELATION-0

TEACHING METHODOLOGY:

1. Lecture (chalk and talk)
2. E content ,videos
3. Group discussion
4. Quiz-seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions
K1	A-10X2	50	20	100	Question number compulsory for all questions. Section A - Two questions from each unit Section B- Minimum of 1 question from each unit. Section C - 4 Questions from 4 different unit
K1, K 2	B-5/8x8	500	40		
K2, K 3	C-2/4x20	1200	40		

SEMESTER V

ELECTIVE: HOSPITAL MANAGEMENT

TOTAL HOURS: 75 **COURSE CODE:BC21/5E2/HOM**

CREDITS: 5 **L-T- P: 5-0-0**

COURSE OBJECTIVES:

1. To understand the role of administration in patient care, planning and management
2. To understand the importance of information system in hospitals
3. To understand the policy and ethics in clinical services
4. To understand the challenges, legal and safety aspects in health care services
5. To understand the aspects of counselling and its importance in hospital management

COURSE OUTLINE

UNIT I (15 Hours)

General features and functions of a hospital, various departments –Outpatient department, Casualty and Emergency services, General surgery department ,ICU, Obstetrics department, Clinical laboratory. Supportive services- Admission department, Medical records department, Pharmacy, Food services Housekeeping department, Accreditation Body –NABH.

UNIT II (15 Hours)

Information system in hospital: Computers in Hospital, Communication, Delegation, Decision making, Monitoring, Evaluation, Meetings, Committees and Negotiations; Quality assurance - Impetus for Quality assurance

UNIT III (15 Hours)

Biomedical research: Ethics; consent, nature of consent. Ethics pertaining to blood transfusion, transplantation - Donor categories, confirmation of brain death, live donation, bio medical waste management.

UNIT IV (15 Hours)

Hospital Administration, Hospital ethics, Challenges in hospital administration- Conditions peculiar to Administrative work in Hospitals, Legal aspects, Working conditions, Environmental Safety, Health services , National Health Policy - 2017

UNIT V (15 Hours)

Counselling- Types, Techniques, Function, Development of counselling services, Duties of a counselor. Effective Counselling- A case study.

RECOMMENDED TEXT BOOKS

1. Hospitals-Facilities Planning and Management,K.J.Kunders, Tata Mc graw Hill, New Delhi,2008
2. Hospital Administration and Human Resource Management,R.C.Goyal, Prentice Hall of India Pvt Ltd., 4th Edition, 2005

REFERENCE TEXT BOOKS

1. Hospital Administration and Management: Theory and Practice: R. Kumar S.L. Goel , Deep and Deep Publications, 2007.
2. Hospital Administration and Management: A Comprehensive Guide,Joydeep Das Gupta, Jaypee Brothers,Medical Publishers Pvt. Limited, 2009
3. Principles of Hospital Administration and Planning,BM Sakharkar,Jaypee brothers,Medical Publishers Pvt. Limited,2008
4. Hospital Management,K. V. Ramani , Pearson Education India,2011.
5. Hospital Administration And Human Resource Management, D. K. Sharma, R. C. Goyal, PHI learning Pvt., Ltd., 6th edition,2013.

JOURNALS

1. Journal of Health Politics, Policy and Law
2. The Journal of Healthcare Management
3. The Journal for Healthcare Quality
4. Health Policy and Technology
5. The International Journal for Quality in Health Care
6. Journal of Hospital & Medical Management
7. Journal of Hospital Administration

e- LEARNING RESOURCES:

1. https://shodhganga.inflibnet.ac.in/bitstream/10603/43767/10/10_chapter%201.pdf
2. https://www.asianhhm.com/facilities-operations/environmental-safety-hospitals
3. http://ncert.nic.in/vocational/pdf/keda101.pdf
4. https://www.scribd.com/document/332414371/BM-Sakharkar-Principles-of-Hospital-Administration-and-Planning-2nd-Edition-pdf
5. https://www.pdfdrive.com/hospital-administration-books.html

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Analyze the importance and role of various departments , support services in hospitals	K1, K2,K3
CO 2	Discuss about information system in hospitals and Quality assurance	K1K2,K3
CO3	Communicate about Ethics governing various clinical aspects likeblood transfusion, transplantation	K2,K3
CO4	Aware of health policies, various legal and safety aspects in hospital administration	K2, K3
CO5	Discuss about counselling and analyze the roleof counsellors in Hospital Management	K1, K2

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PS O1	PS O2	PS O3	PS O4	PS O5
CO1	2	3	3	3	3
CO2	2	3	3	2	2
CO3	3	3	3	2	3
CO4	3	3	3	3	3
CO5	2	2	3	3	3
AVERAGE	**2.4**	**2.8**	**3**	2.6	2.8

KEY: STRONGLY CORELATED -3, MODERATELY CORELATED -2, WEAKLY CORELATED -1, NO CORELATION-0

TEACHING METHODOLOGY:

1. Lecture (chalk and talk)
2. E content ,videos
3. Group discussion
4. Quiz-seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K1	Sec A – 10 x 2	50	20	100	Question number compulsory for all questions. Section A – Two questions from each unit Section B- Minimum of 1 question from each unit. Section C - 4 Questions from 4 different units.
K1,K2	B – 5/8 x 8	500	40		
K2,K3	C – 2/4 x 20	1200	40		

SEMESTER V

SELF STUDY - CLINICAL ENDOCRINOLOGY

CREDITS: 2 **COURSE CODE:BC21/5SS/CEN**

COURSE OBJECTIVES:

1. To impart knowledge about various hormones and their mechanism of action
2. To understand the functions and abnormalities of thyroid and parathyroid gland
3. To inculcate the knowledge on adrenal gland
4. To understand the role of pancreatic and gastro intestinal tract hormones
5. To study the disorders associated with reproductive glands.

COURSE OUTLINE:

UNIT I

Hormones, hormone secreted by various glands, tropic hormones of hypothalamus and Pituitary – functions of anterior and posterior pituitary hormones, Classification of hormones (Steroid, Amino acid derivatives, Peptide / Protein hormones), Hormone receptor interaction (Overview), Mechanism of action of hormones (membrane receptor, c-AMP, IP_3-DAG, nuclear chromatin).

UNIT II

Thyroid gland, functions of thyroid hormones, hypothyroidism – Goitre, Myxedema, hyperthyroidism- Exophthalmos, Natural goitrogens.Thyroid function test - diagnosis of T4, 131I Uptake, TSH, T3,Stimulation test, FT4, FTI.

Parathyroid gland, functions of parathyroid hormones, Rickets, Osteomalacia, Osteoporosis.

UNIT III

Adrenal gland, functions of adrenal cortex hormones - cortisol, aldosterone, hypoadrenalism – Addison's disease, hyper adrenalism – Cushing's disease, functions of adrenal medullary hormones – epinephrine, Nor-epinephrine.Interaction of stress hormones with other regulatory pathways

UNIT IV

Pancreas, functions of pancreatic hormones- Insulin, Glucagon, Somatostatin, Diabetes mellitus (Type I & II), Insulinoma.Functions of Gastrointestinal hormones – Gastrin, Cholecystokinin,

Secretin, Ghrelin, Leptin, Motilin, P- substance.

UNIT V

Gonadal glands (Ovary, Testis), functions of gonadal hormones – Testosterone, Estrogen, Progesterone, Functions of Relaxin, Hypogonadism in males, PolyCystic Ovarian Syndrome (PCOS).

RECOMMENDED TEXTBOOKS:

1. Textbook of Medical physiology - Guyton & Hall, Churchill Livingstone, 11th Edition, 2004
2. Text book of Biochemistry with clinical correlations - Thomas M.Devlin, John Wiley & Sons Inc. Publications, 6th Edition, 2004.

REFERENCE BOOKS:

1. William's Text book of Endocrinology- Larsen, Kronenberg, Melmed & Polonsky, Saunders Publishers, 10th Edition, 2003.
2. Mark's Basic Medical Biochemistry- A Clinical Approach, Colleen Smith, Allan D.Marks, Michael Lieberman, Lippincott Williams & Willkins,2nd Edition, 2005.
3. Textbook of Medical Biochemistry – MN Chatterje & Rana Shinde, Jaypee Publishers, 8th Edition, 2013.
4. Human Anatomy & Physiology – Elaine N.Marieb, RN, The Benjamin/ Cummings Publishing Company, 3rd Edition, 1991.
5. Clinical Chemistry Concepts & Applications – Shauna Anderson, Susan Cockayn, W.B.Saunders Publishers, Tokya, 1993.

JOURNALS:

1. Indian Journal of Endocrinology and Metabolism
2. Hormones and Behavior
3. Journal of Endocrinology
4. Molecular Endocrinology
5. The Lancet

e- LEARNING RESOURCES:

1. https://www.news-medical.net/health/What-are-Hormones.aspx
2. https://www.maxhealthcare.in/our-specialities/minimal-access-laparoscopic-surgery/conditions- treatments/thyroid-and-parathyroid-glands
3 .https://www.medicalnewstoday.com/articles/adrenal-gland
4. https://www.sciencedirect.com/topics/veterinary-science-and-veterinary-medicine/gastrointestinal-hormone

5.https://accessmedicine.mhmedical.com/content.aspx?bookid=1193&
Sectionid=6 9110111

COURSE OUTCOMES:

CO/ NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Apply the knowledge in integration of body system by endocrines	K1,K2, K3
CO 2	Analyse the integration of thyroid hormones with metabolism and parathyroid hormones with calcium metabolism.	K1,K2, K3
CO3	Link the relationship between adrenal hormones with, neurotransmission, mineral and energy metabolism	K1,K2, K3
CO4	Discuss the link between pancreatic and gastro intestinal hormones with diseases	K1,K2, K3
CO5	Create awareness on gonadal systems and measures to prevent the reproductive disorders	K1,K2, K3

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K1	**Sec A – 10 x 2**	**50**	**20**	**100**	**Question number compulsory for all questions.** **Section A – Two questions from each unit** **Section B- Minimum of 1 question from each unit.** **Section C - 4 Questions from 4 different units.**
K1,K2	**B – 5/8 x 8**	**500**	**40**		
K2,K3	**C – 2/4 x 20**	**1200**	**40**		

SEMESTER V

SELF STUDY - HEALTH FOR WOMEN

CREDITS: 2 **COURSE CODE:BC21/5SS/HFW**

COURSE OBJECTIVES:

1. To provide basic understanding about the physiology of the female reproductive system and associated ailments.
2. To inculcate knowledge about fetal development, vaccines and diagnostic tests during pregnancy
3. To educate on possible complications of pregnancy and STD
4. To create awareness about health issues of women associated with lifestyle
5. To emphasize on healthy living with a balanced diet and physical fitness.

COURSE OUTLINE:

UNIT I

Study of the female reproductive system and hormones, Menarche, Menstrual cycle, Menopause. Problems associated – Premenstrual syndrome, Amenorrhoea, Dysmenorrhoea, Polycystic ovary and fallopian tube obstruction.

UNIT II

Pregnancy-Vaccines and diagnostic tests during pregnancy. Development of foetus in different trimesters. Parturition – different types, Significance of breastfeeding, Vaccination for infants

UNIT III

Complications associated with pregnancy – Gestational diabetes, Ectopic pregnancy, Eclampsia, Miscarriage and still birth, Contraception methods and Sexually transmitted diseases-AIDS, Syphilis, Gonorrhoea-Symptoms, Diagnosis and Treatment.

UNIT IV

Health problems in women – Anemia, Varicose veins, Cancers – Breast cancer, Cervical cancer and Thyroid disorders - Symptoms, Diagnosis and Treatment.

Health and lifestyle disorders-sleeping disorder-insomnia,sleep apnea, eating disorder-Anorexia nervosa,bulimia nervosa, liposuction, breast implant-Risk and complications

UNIT V

Balanced diet for Women – Nutrition during adolescence, pregnancy,lactation ,infants and older women .Fitness and Health-yoga and meditation

RECOMMENDED TEXT BOOKS :

1. Human Anatomy and Physiology-Elaine .N marieb Pearson publisher 3rd edn, 1995.
2. Understanding nutrition- Eleanor,noss,Whitrney. Wadsworth Publishing; 10 edition
3. Encyclopedia of Women health-Parvesh Handa Atlantic Publishers and Distributors Pvt Ltd

REFERENCE BOOKS:

1. Advanced Text Book On Food & Nutrition - Volume I, Dr. M Swaminathan (Author) The Bangalore Press.

2. Women and Health by Marlene B. Goldman, Kathryn M. Rexrode, Rebecca Trois,Academic press,2012.

3. Reproductive Tract Infections: Global Impact and Priorities for Women's Reproductive Health by Peter Piot, King K. Holmes, Springer,1992

JOURNALS:

1. Women's Health Issues
2. Health care for Women International
3. International Journal of Women's Health
4. Journal of Women's Health and Gynecology
5. Journal of Womens Health Care and Management

e- LEARNING RESOURSES:

1. https://www.cdc.gov/reproductivehealth/contraception/index.htm
2. https://www.rxlist.com/stages_of_pregnancy_slideshow/article.htm
3. https://my.clevelandclinic.org/health/diseases/4148-dysmenorrhea
4. https://my.clevelandclinic.org/health/diseases/9687-ectopic-pregnancy
5. https://www.britannica.com/video/192622/Human-embryonic-development-birth-fertilization

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Apply the knowledge to understand the physiology of female reproductive system	K1,K2
CO 2	Acquire the knowledge on pregnancy and create awareness on child care	K1,K2, K3
CO3	Create Awareness on pregnancy complications and sexually transmitted Diseases	K1,K2, K3
CO4	Create Awareness on health and lifestyle related disorders	K2,K3
CO5	Create awareness on importance of diet in different stages of women	K1,K2, K3

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K1	**Sec A – 10 x 2**	**50**	**20**	**100**	**Question number compulsory for all questions.** **Section A – Two questions from each unit** **Section B- Minimum of 1 question from each unit.** **Section C - 4 Questions from 4 different units.**
K1,K2	**B – 5/8 x 8**	**500**	**40**		
K2,K3	**C – 2/4 x 20**	**1200**	**40**		

SEMESTER VI

MOLECULAR BIOLOGY

TOTAL HOURS: 60 HOURS **COURSE CODE:BC21/6C/MOB**

CREDITS: 4 **L-T- P: 4-0-0**

COURSE OBJECTIVES:

1. To introduce the type of DNA sequences and chromosome structure.
2. To instil the knowledge of the molecular basis of DNA synthesis.
3. To understand the molecular basis of RNA synthesis and modify it into different types of RNA.
4. To discuss the genetic code, molecular basis of protein synthesis & modification.
5. To Comprehend how DNA damage can lead to detrimental effects and how DNA repair systems in the cells try to prevent mutations before being inherited.

COURSE OUTLINE:

UNIT I (12 hours)

Gene Organization - Genes, Deoxyribo nucleic acid (DNA) sequences – Unique and repetitive sequences-types properties and functions, coding, non coding DNA, Satellite DNAs , Concentration Vs time (Cot) Curves , Chromosomes – Types, properties, Gene organization in Prokaryotes and Eukaryotes.

UNIT II (12 hours)

DNA Replication - Chemistry of DNA synthesis, Modes of DNA replication , Semiconservative Replication – Meselson and Stahl experiment, Enzymes of DNA replication – DNA polymerases, Helicases, Primase, Ligases, Topoisomerases, Prokaryotic replication-Initiation, Elongation and Termination .Overview of cell cycle, Brief outline of eukaryotic replication, introduction to cancer biology.

UNIT III (12 hours)

Transcription - Chemistry of Transcription, RNA polymerases, Role of sigma factor, Closed and open promoter complexes, Prokaryotic Transcription-Initiation, Elongation and Termination. Post transcriptional modifications of mRNA – capping, tailing, splicing. Reverse Transcription.

UNIT IV (12 hours)

Genetic Code: Experimental evidence, Basic features and deciphering of the Genetic

code, Genetic code dictionary, wobble hypothesis, Prokaryotic and Eukaryotic Ribosomes.

tRNA structure, Activation of aminoacids, amino acyl tRNA synthetases. Prokaryotic translation-Initiation, elongation and Termination. Post translational modifications.

UNIT V (12 hours)

Mutation and DNA Repair - Mutation – Types, Physical and chemical mutagens, DNA damages and mutations, DNA repair – Direct repair systems, Excision repair – Base and nucleotide excision repair, Mismatch repair.

RECOMMENDED TEXTBOOKS:

1. Biochemistry - Voet Donald and Voet Judith, John Wiley & Sons, 3rd Edition ,2004.
2. Lehninger Principles of Biochemistry – Nelson David and CoxMichael: 2004. W.H.Freeman & Co: New York.

REFERENCE BOOKS:

1. Molecular cell biology – Lodish, Harvey, Berk, Arnold, Zipursky, Lawrence, Matsudaira, Paul, Baltimore : W.H Freeman & Co, 4th Edition,2006 .
2. Lewin's Genes X– Krebs Jocelyn, Lewis Benjamin, Goldstein, Eliottt, Kilpatrick, Stephen : Jones and Bartlett,2009.
3. The world of cell – Becker, Wayne, Kleinsmith, Lewis, Hardin, Jeff, Bertoni, Gregory paul : Pearson Education Inc.,7th Edition, 2009.
4. Essentials of Molecular biology- V.Malathi, First Edition, Pearson Publishers.,2013.
5. The Cell – molecular approach, Geoffrey M. Cooper & Robert E. Hausman, 3rd Edition, 2002.

JOURNALS:

1. Journal of Molecular Biology
2. Journal of Molecular Biology Research
3. Natural Reviews Molecular cell Biology
4. Nature structural and Molecular Biology
5. Molecular Biology and Evolution

e- LEARNING RESOURSES:

1. https://www.sciencedirect.com/topics/medicine-and-dentistry/repetitive-dna
2. Repetitive DNA in the form of satellite DNA | Organization of Genetic Material Repetitive and Unique DNA Sequences (biocyclopedia.com)
3. NPTEL :: Biotechnology - Molecular Cell Biology
4. https://www.onlinebiologynotes.com/dna-replication
5. https://www.nptel.ac.in/content/storage2/courses/104103071/pdf/mo

6. www.bx.psu.edu/~ross/workmg/RepairDNACh7.pdf
7. https://microbiologynotes.org/mutations-introduction-types-causes-and..
8. https://www.khanacademy.org/.../a/overview-of-transcription

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Gain knowledge about the organization of genes to chromosomes in prokaryotes and eukaryote, types of DNA sequences, complexity of DNA sequences determined by renaturation kinetics.	K1, K2,K3
CO 2	Apply the concept gained in mechanism of replication in the field of molecular biology.	K2, K3
CO3	Gain knowledge about different types of RNA and its synthesis leads to understanding protein synthesis and development.	K2, K3
CO4	Apply the knowledge of protein synthesis to create poly peptides for drug development against genetic disorders**.**	K2, K3
CO5	Familiar and able to link the concept with mutation and repair system.	K2, K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO 2	PSO3	PSO 4	PSO 5
CO1	2	2	3	2	3
CO2	3	3	2	2	2
CO3	3	2	3	2	3
CO4	3	3	3	2	3
CO5	3	3	3	3	2
AVERAGE	**2.8**	**2.6**	**2.8**	**2.2**	**2.6**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1 .Lecture (Chalk and Talk-OHP-LCD)
2. E content, Videos
3. Quiz- Seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K1	Sec A – 10 x 2	50	20	100	Question number compulsory for all questions. Section A - Two questions from each unit Section B- Minimum of 1 question from each unit. Section C - 4 Questions from 4 different units.
K1,K2	B – 5/8 x 8	500	40		
K2,K3	C – 2/4 x 20	1200	40		

SEMESTER VI

GENETICS & NUTRITIONAL BIOCHEMISTRY

TOTAL HOURS: 60 **COURSE CODE:BC21/6C/GEB**

CREDITS: 4 **L-T-P: 4-0-0**

COURSE OBJECTIVE:

1. To inculcate the knowledge about Mendel's contribution to Genetics
2. To learn about the genetic disorders, their etiology and diagnosis
3. To compile various Nutrition and balanced diet, various dietary requirements of nutrients. To acquire knowledge about protein calorie malnutrition
4. To revise the facts about Fat and Water soluble vitamins and their importance.
5. To extract facts about Obesity and various lifestyle associated diseases

COURSE OUTLINE:

UNIT I (12 hours)

Mendelian Genetics: Contributions of Mendel , Genotype, Phenotype .Monohybrid cross, Dihybrid cross, , Back Cross, Test cross, Mendel's laws of Inheritance- Law of Dominance, Law of Segregation, Law of Independent assortment , Reciprocal crosses. Incomplete Dominance, Co dominance, Gene Interactions – Complementary, Supplementary genes

UNIT II (12 hours)

Chromosomal genetics - Linkage and crossing over, Chromosomal mapping, Autosomes Brief outline of Autosomal linked diseases, Structure of sex chromosomes , Sex linked inheritance- Haemophilia, Genetic Diseases- Overview of Chromosomal anomalies- Ploidy ,Chromosomal Aberrations. Down's Syndrome, Klinefelter's syndrome, Turner's syndrome.

UNIT III (12 hours)

Nutrition - Balanced diet, Food pyramid, Dietary requirement and functions of Carbohydrates, Lipids and Proteins. Calorific values of food components., Biological value of proteins, NPU. Basal metabolism- Basal metabolic rate, Factors affecting BMR, Respirometer.RQ, SDA. Protein Calorie Malnutrition-Kwashiorkar& Marasmus

UNIT IV (12 hours)

Vitamins – Fat soluble vitamins (A,D,E,K) and Water soluble vitamins (B complex and C) (Sources, biological functions and RDA)

Minerals- Sodium, Potassium, Phosphorus iron, calcium, iodine, selenium (Sources, biological functions and RDA). Nutritional requirements in infancy, childhood, pregnancy and lactation and old age. Nutraceuticals- Introduction and Classification of nutraceuticals.

UNIT V (12 hours)

Obesity – Causes, Anthropometric measurements and Diet management. Dietary management in – Infection, Fever, Constipation, Diabetes mellitus, Peptic Ulcer, PCOS, Hypertension, Cardiovascular diseases, Kidney Stones,Gall stones,Pancreatitis, Cirrhosis and Cancer.Importance of nutrients under stressed conditions,Nutritional therapy for inborn errors of metabolism.

RECOMMENDED TEXT BOOKS:

1. Essentials of Molecular Biology - David Friefelder,Jones and Barlett Publisher,2nd edition,1999
2. Fundamentals of Biochemistry – Donald Voet and Judith Voet,Wiley Publisher,4th edition,2013.

REFERENCE BOOKS:

1. Lewin's Genes X– Krebs Jocelyn, Lewin Benjamin, Goldstein, Eliottt, Kilpatrick, Stephen ,Jones and Bartlett publisher,2009 .
2. Cell biology, Genetics, Molecular Biology, Evolution and Ecology– Verma&Agarwal ,S Chand Publisher,2013.
3. Nutrition and Diet Therapy-Sangeetha Karnik,Scitech publications(India) Pvt Ltd , 1st edition,2006.
4. Nutrition Essentials and diet Therapy-Peckenpaugh, Elsevier Saunders,10th edition,2007.
5. Essentials of Molecular Biology - Dr V Malathi,Pearson Education,1st edition,2012

JOURNALS:

1. Journal of Genetics-Indian Academy of Science
2. Open journal of Genetics- an academic Publisher
3. Journal of Genetics & Genomics-Elsevier
4. Journal of Nutrition and Dietetics
5. The Journal of Nutrition

e- LEARNING RESOURCES:

1. https://courses.lumenlearning.com/suny-biology1/chapter/mendels-experiments-and-the-laws-of-probability/

2. https://medlineplus.gov/geneticdisorders.html 3. 3.

3. https://www.msdmanuals.com/en-in/professional/nutritional-disorders/undernutrition/protein-energy-undernutrition-peu
4. https://www.hsph.harvard.edu/nutritionsource/vitamins/
5. https://www.bmj.com/content/361/bmj.k2234

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Knowing about the Mendel's experiments in Genetics and understanding its concept	K1, K2
CO 2	Exploring facts about the Genetic disorders and to relate it.	K1, K2, K3
CO3	Analyse the role of various nutrients, their dietary allowances and relate in day to day life.	K1, K2
CO4	Revise the Knowledge about the water and fat soluble vitamins and its significance and its functions	K2, K3
CO5	Outline the Knowledge about Obesity and obtaining better results.	K2, K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PS O1	PS O2	PS O3	PS O4	PS O5
CO1	2	2	2	2	2
CO2	2	2	2	3	3
CO3	2	2	2	3	2
CO4	2	3	3	2	2
CO5	2	3	3	2	2
AVERAGE	**2.2**	**2.4**	**2.4**	**2.4**	**2.2**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2	50	20	100	Question number compulsory for all questions. Section A - Two questions from each unit Section B- Minimum of 1 question from each unit. Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8	500	40		
K2, K 3	C-2/4x20	1200	40		

SEMESTER VI

PLANT AND ANIMAL BIOTECHNOLOGY

TOTAL HOURS: 60 **COURSE CODE:BC21/6C/PAB**

CREDITS: 4 **L-T-P: 4-0-0**

COURSE OBJECTIVES:

1. To enable student understand the possible scope and importance of biotechnology for betterment of human life and the basic tools required in recombinant DNA technology

2. To enable student know the basic experimental designs required for a successful transfer of plantlets from labs to farms by plant tissue culture and Understand the concept of in vitro micropropagation Production of haploid plants, Germplasm storage, Embryo rescue, production of secondary metabolites, embryo rescue, and appreciate the benefits of protoplast isolation and fusion

3. Enable student understand the various mechanisms of transfer of desired DNA into plant cells and production of transgenic plants in developing high yielding and good quality crops

4. To instil knowledge on the concept of growing animal cells in vitro and appreciate how animal cell culture has been instrumental in basic research

5. To enable students understand the experimental designs of gene therapy , production of recombinant protein ,tissue engineering and transgenic animals

COURSE OUTLINE:

UNIT I (12 Hours)

Introduction to Biotechnology- Scope and Importance, Tools of R-DNA technology: Restriction endonucleases and other enzymes, Linkers, Adaptors, selectable markers genes, reporter genes Vectors - PBR322, Lambda Phage, Retroviral, and Expression vectors-YAC,Shuttle vector-YEP, Process of r-DNA Technology,PCR-Principle,types-Real time PCR,RT-PCR,nested PCR and applications

UNIT II (12 Hours)

Plant tissue culture: Stages of plant tissue culture, Requirements for plant tissue culture Nutritional Medium and culture condition, Types of culture- Callus culture , Suspension culture, Organ culture, Meristem culture ,Protoplast cultur te-production of protoplast ,Protoplast fusion Applications of plant tissue culture-Micropropagation, Production of haploid plants, Germplasm storage, Embryo rescue, production of secondary metabolites

UNIT III (12 Hours)

Genetic engineering of plant cells: Gene Transfer in plants: vector based- Agrobacterium mediated gene transfer Ti plasmid ,Ri plasmid,non vector based- Particle bombardment, electroporation, microinjection; selection of recombinant Transgenic plants for crop improvement and food quality - Herbicide resistant plants-Glyphosate resistant crop, Insect resistance plants-Bt cotton, Improved nutrition-Golden rice,Biopharming-plants as bioreactors

UNIT IV (12 Hours)

Animal cell culture: Requirement for animal tissue culture- nutrition medium and culture condition, cell culture- Primary explant cultures; Secondary cultures and Established cell lines; commonly used cell lines: origin and characteristics, stem cell culture and embryonic stem cell culture. Applications of animal cell culture. Artificial insemination and embryo transfer, Invitro fertilization (IVF), Embryo cloning

UNIT V (12 Hours)

Genetic engineering in animal cell: Gene therapy-Introduction and Methods, Gene targeting and silencing, Gene therapy in the treatment of diseases, Challenges and future of gene therapy, Recombinant proteins from cell cultures-Insulin, Interferons,DNA vaccines,Basics of Tissue engineering:-artificial skin, transgenic animals-Mice, Sheep, Fish; use and applications

RECOMMENDED TEXTBOOKS:

1. Biotechnology – U.Sathyanarayana , Books and Allied Pvt Ltd, 8th Print, 2013.
2. Textbook of Biotechnology- Dr.PRakash S. Lohar, MJP publisher, 2012
3. D. Balasubramanian and others, Concepts in Biotechnology, Universal press India 1996.
4. Walsh Gary and Headon R. Denis, Protein Biotechnology. John Wiley publishers, 1994

REFERENCE BOOKS:

1. Molecular Biotechnology Principles and Applications of Recombinant DNA- BernardR Glick and Jack J Pasternak,3rd edition,2003.
2. Essentials of Biotechnology-Michael Crichton, Medtech (6 July 2014).
3. Biotechnology-Ellyn Daugherty, Medtech (6 July 2014).
4. Textbook of Biotechnologyby Lydell Norris, Syrawood Publishing House,2016.
5. Molecular Biotechnology: Principles and Practices by Channarayappa, CRC Press; 1st edition, 2007.

JOURNALS:

1. Applied Biochemistry And Biotechnology

2. Biotechnology And Applied Biochemistry
3. Biotechnology & Genetic Engineering Reviews
4. Journal Of Biotechnology
5. Journal Of Plant Biochemistry And Biotechnology

e- LEARNING RESOURCES:

1. http://www.hixonparvo.info/Gene%20Cloning.pdf
2. https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod3.pdf
3. https://www.slideshare.net/Hemathangavel/massively-parallel-signature-sequencing-mpss?qid=cf12fac4-0c74-4ee0-bf34-4d2b9fa77817&v=&b=&from_search=1
4. https://nptel.ac.in/courses/102/103/102103016/
5. https://nptel.ac.in/courses/102/104/102104059/

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Discuss the possible scope and importance of biotechnology for betterment of society and outline the basic tools of recombinant DNA technology	K1,K2,K3
CO 2	Understand the concept of in vitroo micropropagation, Production of haploid plants, Germplasm storage, Embryo rescue, production of secondary metabolites,embryo rescue, and appreciate the benefits of protoplast isolation and fusion there by gain the knowledge of successful transfer plants from lab to fields	K1,K2,K3
CO3	Gain knowledge on benefits of transgenic plants ,contributing towards developing high yielding and good quality crops to meet demands of the farmers and population	K1,K2
CO4	Becomes a skilled personnel in animal cell culture labs by understanding the concepts of growing of animal cells in vitro	K1,K2,K3
CO5	Appreciate how rDNA technology enable production of cloned products necessary for medical and pharmaceutical applications	K1,K2

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	2	3	2
CO3	2	2	3	2	3
CO4	3	3	2	3	3
CO5	3	3	3	3	3
AVERAGE	**2.8**	**2.8**	**2.6**	**2.8**	**2.8**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (chalk and talk)
2. E content ,videos
3. Group discussion
4. Quiz-seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if Any
K1	**Sec A – 10 x 2**	**50**	**20**	**100**	**Question number compulsory for all questions.** **Section A – Two questions from each unit** **Section B- Minimum of 1 question from each unit.** **Section C - 4 Questions from 4 different units.**
K1,K2	**B – 5/8 x 8**	**500**	**40**		
K2,K3	**C – 2/4 x 20**	**1200**	**40**		

SEMESTER VI

ELECTIVE - BASIC IMMUNOLOGY

TOTAL HOURS: 75 **COURSE CODE:BC21/6E/BIM**

CREDITS: 5 **L-T- P: 5-0-0**

COURSE OBJECTIVES:

1. To Impart Knowledge about the types and the various determinants of immunity.
2. To expose the students to different types of lymphoid organs and to the cellular basis of immunity.
3. To introduce antigen, antibody classes and mechanism of cell mediated and humoral mediated immune responses
4. To understand the diagnostic methods of immunology.
5. To study the disorders associated with immunological processes.

COURSE OUTLINE:

UNIT I (15 hours)

Infection – Types, causes and sources of infection, Immunity – Innate Immunity, Mechanisms of Innate immunity. Inflammation, Mechanism of Phagocytosis, Acquired Immunity- Active, Passive, Natural and Artificial immunity, Attributes of adaptive immunity

UNIT II (15 hours)

Cells involved in Immune response – Hematopoiesis- an overview, Lymphoid cells- T, B, NK, dendritic cells, mononuclear phagocytes and Granulocytic cells. Structure and functions of Primary lymphoid organs - Thymus, Bone Marrow, Secondary lymphoid organs
- Spleen, Lymph nodes, Mucosal Associated Lymphoid Tissue, Gut Associated Lymphoid Tissue and Cutaneous Associated Lymphoid Tissue

UNIT III (15 hours)

Antigen- Determinants of Antigenicity, Biological classes of antigens, Epitope, Haptens , Adjuvants. Clonal Selection theory, Structure of antibody, Immunoglobulin - Classes, Structure and Biological function. Abnormal immunoglobulins, Humoral immunity and cell mediated Immunity.

UNIT IV (15 hours)

Characteristics of Ag-Ab interactions – Affinity, Avidity, Precipitation – Mechanism and applications of Precipitation reaction, Agglutination reaction and its applications,

Opsonisation, Principle and applications of ELISA, RIA and Immunoelectrophoresis Monoclonal Ab production- Hybridoma technology and its applications

UNIT V (15 hours)

Hypersensitivity – Gel- Coomb's classification, Causes and pathology of Immediate Type – I (Allergic Asthma), II (Erythroblastosis Foetalis), III & Delayed Type – IV (Contact Dermatitis). Autoimmune Diseases – Causes and pathology of Hashimotos Thyroiditis and Rheumatoid arthritis

RECOMMENDED TEXTBOOKS:

1. Text book of Microbiology-Ananthanarayanan and Panickar, The Orient Blackswan, 9th edition, 2013.
2. Immunology -Janis Kuby, W. H. Freeman, 2002, 5th edition, 2003.

REFERENCE BOOKS:

1. Immunology- Peter ,Alex and Micheal,2nd edition,2004
2. Fundamentals of Medical Immunology-Venugopal Jayapal,2007
3. A Textbook Of Immunology-P Madhavee Latha 1st Edition, S.Chand,2012
4. A Textbook of Immunology & Immuno Technology- B. Annadurai, S.Chand, 2010
5. Immunology: A Short Course-Richard Coico, Geoffrey Sunshine, Wiley Blackwell, 7th Edition, 2015.

JOURNALS:

1. Journal of Immunology Research
2. Open journal of Immunology-scientific Research Publishing
3. Journal of Immunology and Immunopathology
4. Research & Reviews: A Journal of Immunology
5. The Journal of Clinical Immunology

e- LEARNING RESOURCES:

1. https://www.medicalnewstoday.com/articles/320101
2. https://slideplayer.com/slide/13145599/
3. https://microbiologyinfo.com/category/immunology/
4. http://www.ispybio.com/search/protocols/immunochemical-methods.pdf
5. https://www.amboss.com/us/knowledge/Hypersensitivity_reactions/
6. www.immunologylink.com
7. www.hindawi.com

COURSE OUTCOMES:

CO/ PSO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Apply and practice the methods to improve immunity	K1,K2, K3
CO 2	Appreciate and analyse the integration of immune cells and organs	K2, K3
CO3	Apply the knowledge on the antigen and antibody classes	K1,K2, K3
CO4	Analyse and diagnose the various immune disorders through immunotechniques	K1,K2, K3
CO5	Preventive measures for allergy and other hypersensitivity reactions	k2, K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	3
CO2	2	2	3	2	3
CO3	2	3	2	3	2
CO4	2	3	2	3	2
CO5	3	3	2	3	2
AVERAGE	**2.4**	**2.6**	**2.4**	**2.6**	**2.4**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (chalk and talk)
2. E content ,video
3. Quiz-seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20	100	Question number compulsory for all questions. Section A - Two questions from each unit Section B- Minimum of 1 question from each unit. Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8 marks	500	40		
K2, K 3	C-2/4 x20 marks	1200	40		

SEMESTER VI

ELECTIVE- BASICS OF BIOINFORMATICS

TOTAL HOURS: 75 **COURSE CODE:BC21/6E1/BOB**

CREDITS: 5 **L- T- P: 5-0-0**

COURSE OBJECTIVES:

1. To impart knowledge about the basics of Internet communication.
2. To expose the students to the use of biological databases
3. To understand the concept of Sequence alignment & gene prediction.
4. To enable students to understand protein structural organization, structure prediction and visualization.
5. To understand the basics of Protein expression and interaction studies & Drug designing.

COURSE OUTLINE:

UNIT I (15 hours)

Bioinformatics- Introduction & Definition, Comparison between Computers and Biology; Principles, Applications and Challenges of Bioinformatics. Introduction to Internet – IP address, URL, www, web browsers, Search Engines; Networks - local-area network (LAN), wide area network (WAN); Communication protocols – Transmission Control Protocol (TCP), Internet Protocol (IP), File Transfer Protocol (FTP), Hypertext Transfer Protocol (HTTP).

UNIT II (15 hours)

Types of Databases - Flat files, Relational & Object-oriented databases. Biological database- Primary, secondary and composite databases

Overview of databases and tools of NCBI, Literature database – PubMed; Data retrieval systems – Entrez.

Nucleic acid database - INSDC, GenBank, Protein sequence databases- Uniprot, Protein structure database – PDB, Metabolite database - KEGG pathway database (Including demonstration of use of above mentioned databases)

UNIT III (15 hours)

Introduction to Sequence Alignments, Type of Alignments and their Significance, Dot plot, Pairwise alignment –BLAST and Multiple Sequence Alignment -Clustal W algorithm. Basics of Phylogenetic analysis including Definitions of Homologs, Orthologs, Paralogs and Xenologs.

Genomics – Structural genomics-Gene prediction, Functional Genomics- Introduction to Microarray.

Human Genome Project and its significance.

UNIT IV (15 hours)

Protein Structure: Primary, Secondary, Super Secondary, Tertiary, Quaternary, Peptide bond, phi, psi and chi torsion angles, Significance of Ramachandran plot; Motif and Domain. 3D Protein structure prediction (Homology Modelling) and Structure Visualization - RASMOL.

UNIT V (15 hours)

Protein expression studies – Basics of 2D PAGE, Interact omics- Protein interaction studies – Yeast 2 hybrid system

Basic Steps in drug development- Stages, Phases of Clinical Trials, and Approaches in Structure based drug designing. Basics of Pharmacogenomics

RECOMMENDED TEXTBOOKS:

1. Text book of Bioinformatics-Sharma & Munjal , Rastogi Publications, 1st Edition 2008.
2. Bioinformatics Data bases & Algorithms- N.Gautham, Narosa Publishing, Reprint 2009.

REFERENCE BOOKS:

1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004
2. Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009
3. Introduction to Bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999
4. Bioinformatics Concepts, Skills and Applications , by S. C. Rastogi,Namita , Mendiratta & Parag Rastogi, CBS; 2 edition 2009)
5. Essential Bioinformatics – Jin Xiong, Cambridge University Press, 2006

JOURNALS:

1. BMC Bioinformatics
2. Bioinformatics(Oxford Academic)
3. Indian Journal Of Bioinformatics And Biotechnology
4. Computers in Biology & Medicine
5. Journal of Proteomics & Bioinformatics

e- LEARNING RESOURCES:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5421137/
2. https://courses.lumenlearning.com/zeliite115/chapter/reading/
3. https://www.ks.uiuc.edu/Training/Tutorials/science/bioinformatics-tutorial/bioinformatics.pdf
4. https://zhanglab.ccmb.med.umich.edu/papers/2009_8.pdf
5. https://www.cl.cam.ac.uk/teaching/1213/Bioinfo/materials.html

COURSE OUTCOMES:

CO . NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Explain the basics of Internet communication and the applications of Bioinformatics	K1,K2
CO 2	Discuss about the different types of biological databases	K2,K3
CO3	Align sequences,Utilize sequence alignment tools, Gene prediction, Microarray	K2,K3
CO4	Discuss about protein structural organization, predict protein Structure and utilize structure prediction & visualization tools	K2,K3
CO5	Explain about Protein expression & Interaction studies and discussion about Drug designing.	K2,K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO 2	PSO3	PSO4	PSO5
CO1	2	3	2	3	3
CO2	3	3	3	3	3
CO3	2	3	3	3	3
CO4	3	3	3	3	3
CO5	2	3	3	2	3
AVERAGE	2.4	3	2.8	2.8	3

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (chalk and talk)
2. E content ,videos
3. Group discussion
4. Quiz-seminar

.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20	100	Question number compulsory for all questions. Section A – Two questions from each unit Section B- Minimum of 1 question from each unit. Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8 marks	500	40		
K2, K 3	C-2/4 x20 marks	1200	40		

SEMESTER VI

ELECTIVE- PLANT BIOCHEMISTRY

TOTAL HOURS: 75 **COURSE CODE:BC21/6E2/PBI**

CREDITS: 5 **L-T- P: 5-0-0**

COURSE OBJECTIVES:

1. To understand the plant cell physiology and medicinal value of phytochemicals.
2. To impart knowledge about carbohydrate metabolism in plants.
3. To appreciate various lipids and nutrients essential in growth and development of plants.
4. To impart knowledge about the plant products & role of enzymes in nitrogen fixation.
5. To understand seed germination.

COURSE OUTLINE

UNIT I (15 Hours)

Plant Physiology-Diffusion and Osmosis in plants and their significance. Mechanism of water absorption, Ascent of Sap. Transpiration- Types, mechanisms and factors affecting transpiration. Plant hormones.

UNIT II (15 Hours)

Carbohydrates metabolism in plants-storage carbohydrates-sucrose-transport and mobilization, sucrose as regulator, sucrose derivatives, trehalose in plants-synthesis, catabolism and symbiotic association. fructans - synthesis and metabolism. structural carbohydrates-Plant cell wall architecture, structural components-cellulose, hemi Cellulose, pectin-synthesis.

UNIT III (15 Hours)

Lipid metabolism in plants- Plant membrane lipids , plant lipids as second messenger's - cutins , suberins, waxes.
Plant nutrition-specific roles of essential elements and their deficiency symptoms in plants.
Macronutrients:Carbon,hydrogen,oxygen,nitrogen,sulphur,phosphorus,calcium,potassium magnesium .
Micronutrients: Manganese, Boron, copper, Zinc, molybdenum, Iron and chlorine.

UNIT IV (15 Hours)

Nitrogen metabolism and nitrogen cycle- Nitrogen in soil, Nitrate reduction in plants - Ammonification,nitrification, nitrate Reduction and Denitrification. Nitrogen fixation- Symbiotic and non-symbiotic nitrogen fixation. Sulphur cycle, Phosphorous cycle and carbon cycle. Medicinal value of phytochemicals - alkaloids, flavonoids, tannins, quinine, terpenes, liginins and non- protein amino acids.

UNIT V (15 Hours)

Seed germination physiology of seed germination. Factors affecting seed germination-water stress, salinity stress, temperature and light .Biochemical changes during germination. natural growth hormones. Auxins, gibberellins cytokines, ethylene and abscisic acid. Synthetic growth hormones. Effect of growth regulators on seed germination.

RECOMMENDED TEXTBOOKS:

1. A textbook of plant physiology biochemistry and biotechnology-Dr.S.K.Verma& Mohit Verma, S. Chand Publishing,Illustrated, 2008.
2. Plant physiology-Frank B. Salisbury, Cleon W. Ross,Wadsworth Publishing Company, 3rd Edition,1985.
3. Key notes on Plant Biotechnology-Venkatam R .prakash reddy,Daya Publishing House,2020.
4. Plant biochemistry – Ayush aggarwal,Pacific Book International,2013.
5. Plant Biochemistry - Hans-Walter Heldt Professor Em &Birgit Piechulla (Author), Academic Press, 4th Edition, 2010.

REFERENCE BOOKS:

1. Outline of Plant Physiology, Robert M.Devlin, Cambridge University Press,2017.
2. Introduction to Plant Biochemistry- Goodwin& Mercier,Cbs publication,2005.
3. Physiology & Biochemistry of seeds in relation to Germination-J. Derek Bewley Michael Black,Springer link,1982.
4. Plant Biochemistry- P.M.Dey & J.B. Harborne , Elsevier,1997.
5. Advances in Plant Biochemistry- Tomar R A S, KOROS press, 2017.

JOURNALS:

1. Journal of Plant Biochemistry and Biotechnology-Springer link
2. Journal of Plant Biochemistry and Biotechnology-Scimago
3. Annual Review of Plant Biology
4. Natural Plants
5. Plant Physiology

e- LEARNING RESOURCES:

1. https://study.com/academy/lesson/what-is-plant-physiology-definition..
2. https://www.cell.com/trends/plant-science/pdf/S1360-1385 (98)0132… · 3. https://www.mdpi.com/2223-7747/9/7/871/pdf
4. https://onlinelibrary.wiley.com/doi/abs/10.1002/9780470015902.a0001306.pub2
5. https://nptel.ac.in/content/storage2/courses/122106030/Pdfs/1_1.pdf
6. https://www.biologydiscussion.com/seed/germination/germination-in...

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Videos-
3. Quiz- Seminar

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To understand plant physiology and essentials of hormones .	K1,K2,
CO 2	To Impart knowledge on how energy sources are utilised in carbohydrate metabolism by plants.	K1,K2, K3
CO3	To gain knowledge on lipids and nutrients essentials in plants	K2,K3
CO4	To Impart knowledge on various plant products and the role of enzymes in nitrogen fixation.	K2, K3
CO5	Consider the role of various factors affecting seed germination and hormones involved in seed germination.	K2, K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3
CO2	2	3	3	3	3
CO3	2	3	3	2	3
CO4	2	3	3	2	3
CO5	2	3	3	3	3
AVERAGE	**2**	**2.8**	**2.8**	**2.4**	**3**

KEY: STRONGLY CORELATED -3, MODERATELY CORELATED -2, WEAKLY

CORELATED -1, NO CORELATION-0

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if Any
K 1	A-10X2 marks	50	20	100	Question number compulsory for all questions. Section A – Two questions from each unit Section B- Minimum of 1 question from each unit. Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8 marks	500	40		
K2, K 3	C-2/4 x20 marks	1200	40		

SEMESTER –V & VI

CORE PRACTICAL –III

TOTAL HOURS: 120 **COURSE CODE: BC21/6C/PR3**

CREDITS: 3 **LTP: 0-0-4**

COURSE OBJECTIVES:

1. To enable students to take up jobs in Diagnostic laboratories.
2. To pursue career /research in Clinical Biochemistry
3. To train students in isolation of Biomolecules from biological samples.

COURSE OUTLINE:

I. HEMATOLOGY (Group Experiments)

a) Collection and preservation of urine and blood sample
b) Total count of RBC, WBC and Platelets
c) Differential count of WBC
d) Hematocrit and ESR
e) Estimation of Hemoglobin (Drabkin's reagent)

II. COLORIMETRY

a) Estimation of Creatinine (Blood and urine)
b) Estimation of Urea (Blood and Urine)
c) Estimation of Cholesterol
d) Estimation of Glucose (Orthotoluidine method)
e) Estimation of total Protein and A/G ratio (Lowry method)
f) Estimation of Vitamin C

III. DEMONSTRATION EXPERIMENTS

a) Isolation of DNA from Spleen
b) Extraction of pectin from Orange peel
c) Extraction of Lecithin from egg yolk

COURSE OUTCOMES:

1. Estimating the biomolecules,trace elements and vitamins using colorimetry
2. Demonstrating students to know about the counting of blood cells and Hamoglobin estimation which rises in pathological condition

3. Impact the students to learn and train the isolation techniques of compounds from various samples.

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
AVERAGE	**3**	**3**	**3**	**3**	**3**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Hands on Training
2. Demonstration of Experiments

SEMESTER –V & VI

CORE PRACTICAL –IV

TEACHING HOURS: 135 **COURSE CODE:BC21/6C/PR4**

CREDITS: 3 **L-T-P: 0-0-5 (V semester)**

0-0-4(VI semester)

COURSE OBJECTIVES:

1. To develop practical and analytical skills in handling biological samples
2. To enable students analyze the experimental data
3. To determine the abnormal and normal constituents of urine

COURSE OUTLINE:

I. QUANTITATIVE ANALYSIS

1. Estimation of DNA (Diphenylamine method)

2. Estimation of RNA (Orcinol method)

3. Estimation of xylose (Orcinol method)

II. ENZYMOLOGY

Activity of

i) SGOT
ii) SGPT
iii) LDH
iv) Specific activity of ALP
v) Effect of Temperature, pH, & Substrate concentration of Salivary amylase.

III. URINE ANALYSIS

a) Analysis of normal and abnormal constituents

COURSE OUTCOMES:

1. Estimate the nucleic acid and biomolecules using colorimetry
2. Determine the specific activity of marker enzymes and salivary enzyme
3. Analyse and report the normal and abnormal compounds of urine

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
AVERAGE	**3**	**3**	**3**	**3**	**3**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Hands on Training
2. Demonstration of Experiments

SEMESTER I

ALLIED BIOCHEMISTRY I

(For I B.Sc. Microbiology)

TOTAL HOURS: 60 **COURSE CODE:BC21/1A/BI1**

CREDITS: 4 **L-T-P: 4-0-0**

COURSE OBJECTIVES:

1. To demonstrate the importance and the properties of Carbohydrates
2. To learn the types of lipids in detail and understanding their properties
3. To learn the amino acids and its classification based on various criteria
4. To discuss the importance and its classification and functions of Proteins.
5. To explain the concept of metabolic activities

COURSE OUTLINE:

UNIT I (12 hours)

Carbohydrates – Definition, Biomedical importance of carbohydrates, Classification of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides), Vant Hoff's rule, Stereoisomerism, Optical isomerism, Mutarotation, Epimers, Aldose, Ketose. Monosaccharides- Linear structure and Haworth structure of Glucose and Fructose, Disaccharides – Lactose and Sucrose, Inversion of Sucrose , Polysaccharides – Homoglycans- Structure of Starch and Glycogen, Heteropolysaccharides – Chondroitin sulphate .

UNIT II (12 hours)

Lipids- Biomedical importance of Lipids, Bloor's classification of lipids (Simple, Compound and Derived), Saturated and Unsaturated fatty acids, Essential fatty acids (EFA) and their functions, Deficiency manifestation of EFA, Properties- Saponification and Rancidity, Iodine number, Acetyl number.Phospholipids- Functions, Biological importance of Cholesterol, Bile acids and Bile salts.

UNIT III (12 hours)

Amino acids- Functions of amino acids, Classification of Amino acids based on side chain, Essential, Semi-essential and Non-essential amino acids, Zwitter ion, Amphoteric nature and Isoelectric point, Transamination, oxidative and non-oxidative deamination, decarboxylation.

UNIT IV (12 hours)

Proteins- Biomedical importance of Protein, Classification based on Shape and Size (Fibrous and Globular), Based on Function and Based on Physical properties. Structural organization of Proteins- Primary, Secondary, Tertiary and Quaternary structure, - Basic concepts, Forces involved in tertiary structure.

UNIT V (12 hours)

Definition of Catabolism, Anabolism and Amphibolic cycle. Glycolysis and TCA cycle with energetics, Lipid metabolism: Beta and omega oxidation, Biosynthesis of Saturated fatty acids, Urea cycle Interrelationship between carbohydrates, proteins and fat metabolism, Structure not required for metabolic pathways.

RECOMMENDED TEXTBOOKS:

1. Fundamentals of Biochemistry by J L Jain, Sunjay Jain and NithinJain . S.Chand Publisher, 7th Edition,2016.
2. Biochemistry - U Satyanarayana. Elsevier India Publisher, 4th Edition, 2013.

REFERENCE BOOKS:

1. Biochemistry - Lubertstryer,W.H .Freeman & company Publisher,5th Edition,2001.
2. Biochemistry - Voet, D.andVoet .J.G.,John Wiley and Sons Inc Publisher, 3rd Edition,2004.
3. Textbook of Biochemistry – Zubey, WCB Publishers,4th edition,1998
4. Textbook of Medical Biochemistry-M.N.Chatterjea and Rana Shinde,Jaypee Brothers Medical Publishers Pvt Ltd,7th edition,2008.
5. Principles of Biochemistry - Lehninger, A.L, Publisher: W.H.Freeman, New York, 4th Edition,2005.

JOURNALS:

1. Journal of Biomolecules-Open access
2. International journal of Biological macromolecules-Elsvier
3. Journal of Biomolecules- Wiley
4. Journal of Biomolecular Techniques
5. Biomolecules -Open access

e- LEARNING RESOURCES:

1. www.phschool.com/science/biology_place/
2. www.wtec.org/te/usws/usws
3. https://my.clevelandclinic.org/health/articles/15416-carbohydrates
4. https://www.news-medical.net/life-sciences/What-are-Lipids.aspx#:~:text=Lipids%20are%20molecules%20that%20contain,not%20made%20up%20of%20protein.
5. https://www.britannica.com/science/amino-acid
6. https://www.nature.com/scitable/topicpage/protein-structure-14122136/
7. https://meatscience.org/docs/default-source/publications-resources/rmc/1963/metabolic-interrelationships-of-fats-proteins-and-carbohydrates.pdf?sfvrsn=

COURSE OUTCOME

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	To utilise the importance of Carbohydrates in life To assess the types of Carbohydrates in detail. Exploring the application of Sucrose day to day life	K1,K2
CO 2	Utilize knowledge about the importance of Lipids and its classification. Knowing the various properties of lipids	K3
CO3	Compile the various aminoacids and applying the knowledge about the essential and semi essential amino acids	K1,K2,K3
CO4	Identifying the Primary,Secondary and Tertiary types of Proteins.	K1,K2
CO5	Applying the knowledge of various metabolic activities in the body	K1,K2

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	2
CO2	2	2	2	2	2
CO3	2	2	2	2	2
CO4	2	2	2	2	2
CO5	3	3	3	2	2
AVERAGE	**2.0**	**2.2**	**2.2**	**2.0**	**2.0**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)
2. Blended Classroom-E Content, Videos
3. Quiz, Seminar
4. Peer Learning

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special instructions if any
K 1	A-10X2	50	20	100	Question number compulsory for all questions. Section A - Two questions from each unit Section B- Minimum of 1 question from each unit. Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8	500	40		
K2, K3	C-2/4x20	1200	40		

SEMESTER II

ALLIED BIOCHEMISTRY II

(For I B.Sc. Microbiology)

TOTAL HOURS: 60 **COURSE CODE:BC21/2A/BI2**

CREDITS: 4 **LTP: 4-0-0**

COURSE OBJECTIVES:

1. To understand the concept of DNA, DNA types, physical and chemical properties of DNA and the types of RNA
2. To learn about the central dogma of molecular biology
3. To learn the types of various classes of Hormones and different types of Vitamins
4. To Know the characteristics of enzymes and its activity
5. To acquire knowledge about acids, bases and buffers in detail and instrumentation of colorimetry and chromatography

COURSE OUTLINE:

UNIT I (12 hours)

Nucleic acids-Purine and Pyrimidine bases with structures, Nucleosides, Nucleotides, DNA- Structure (Watson and Crick model), Chargaff's rule,Types of DNA- A , B and Z DNA. Physical properties of DNA – Shape, Size, Effect of Temperature, Denaturation and Renaturation of DNA, Chemical properties of DNA – Hydrolysis by acids, alkali, enzymes and pH.

RNA- types of RNA- m-RNA, r-RNA and t-RNA, Clover leaf model of t- RNA. Biological importance of RNA.

UNIT II (12 hours)

Central dogma of Molecular biology, Semiconservative nature of DNA replication(Messelson and Stahl's experiment),Replication machinery in Prokaryotes,Transcription - RNA polymerase, initiation, elongation and termination of transcription in prokaryotes with E. coli as model system. Ribosome structure and assembly, initiation, elongation and termination of protein synthesis in bacteria.

UNIT III (12 hours)

Hormones – Classification, Pituitary hormones, Thyroid, Parathyroid hormones, Insulin, Glucagon, Adrenocortical hormones, Testosterone and Estrogen (Biological Significance only).

Vitamins - Introduction, sources, RDA, functions and deficiency diseases of fat soluble and water soluble vitamins

UNIT IV (12 hours)

Enzymes- Definition of enzyme, Active site, Holoenzyme, Apoenzyme, Coenzyme, Exo and Endo enzymes, Zymogen, Turnover number. Specificity of enzymes, Industrial applications of enzymes, Factors affecting enzyme activity- pH, Temp, substrate. Enzyme inhibition- Competitive, Non-competitive and Uncompetitive inhibition (no derivation).

UNIT V (12 hours)

Acids and bases: Basis of acidity and basicity, pH, determination of pH, Henderson - Hasselbalch equation, buffer systems of human body. Biochemical Techniques: Principles, technique and Applications of Paper chromatography ,Thin layer Chromatography and Colorimetry.

RECOMMENDED TEXTBOOKS:

1. Fundamentals of Biochemistry by J L Jain, Sunjay Jain and NithinJain S.Chand Publisher, 7th Edition, 2016.
2. Biochemistry - U Satyanarayana. Elsevier India Publisher, 4th Edition, 2013.

REFERENCE BOOKS:

1. Biochemistry - Lubertstryer,W.H .Freeman & company Publisher,5th Edition,2001
2. Biochemistry - Voet, D.andVoet .J.G.,John Wiley and Sons Inc Publisher, 3rd Edition,2004
3. Textbook of Biochemistry – Zubey, WCB Publishers, 4th edition,1998
4. Textbook of Medical Biochemistry-M.N.Chatterjea and Rana Shinde,Jaypee Brothers Medical Publishers Pvt Ltd,7th edition,2008.
5. Principles of Biochemistry - Lehninger, A.L, Publisher: W.H.Freeman, New York, 4th Edition, 2005.

JOURNALS:

1. Journal of Biomolecules
2. International Journal of Biological macromolecules
3. Journal of Biomolecules
4. Journal of Biomolecular Techniques

5. Biomolecules

e- LEARNING RESOURCES:

1. https://www.britannica.com/science/nucleic-acid
2. https://onlinelibrary.wiley.com/doi/full/10.1038/npg.els.0000812
3. https://www.thewellforhealth.com/blog/5-important-hormones-and- how-they-help-you-function
4. https://www.medicalnewstoday.com/articles/195878
5. https://www.britannica.com/science/enzyme
6. https://www.smithers.com/services/testing/test-capabilities/chemistry/chromatography-and-spectrometry

COURSE OUTCOMES

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Demonstrate the composition of Nucleic acid and Watson and crick model of DNA Learning the various properties of DNA and the various types of RNA and its compostion	K1,K2
CO 2	To demonstrate the central dogma of molecular biology	K3
CO3	To learn about the Types and functions of Hormones and Vitamins	K1,K2
CO4	Compute the various types of enzymes and the factors affecting its activity and apply them practically	K1.K2
CO5	Outline the concepts of acids,bases and buffers and also to know about the principle and techniques of chromatography and colorimetry	K1,K2

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	2
CO2	2	2	2	2	2
CO3	2	2	2	2	2
CO4	2	2	2	2	2
CO5	3	3	3	2	2
AVERAGE	**2.0**	**2.2**	**2.2**	**2.0**	**2.0**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)
2. Blended Classroom-E Content, Videos
3. Quiz, Seminar
4. Peer Learning

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special instructions if any
K1	A-10X2	500	20	100	Question number compulsory for all questions. Section A - Two questions from each unit Section B- Minimum of 1 question from each unit. Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8		40		
K2, K 3	C-2/4x20	1200	40		

SEMESTER I & II

ALLIED BIOCHEMISTRY PRACTICAL

TOTAL HOURS: 60 **COURSE CODE:BC21/2A/ABP**

CREDITS: 2 **LTP: 0-0-2**

COURSE OBJECTIVES:

1. To understand the properties of Carbohydrates and amino acids
2. To explore the facts about Various Biochemical Instrumentation
3. To impact the students to train the preparations of starch and casein

COURSE OUTLINE:

I Qualitative Analysis of carbohydrates

Monosaccharides - Glucose, fructose

Disaccharides - Maltose, Sucrose

Polysaccharides - Starch

II Qualitative Analysis of Amino acids

Arginine, Cysteine, Tryptophan, Tyrosine

III Spotters –

pH meter, Colorimeter, Electrophoretic apparatus (horizontal and vertical unit), UV Visible Spectrophotometer, Fluorimeter, Flame Photometer, Micro Centrifuge,Transilluminator

IV Group experiment

Preparation of starch from potato

Preparation of casein from milk

V Demonstration experiment

Seperation of aminoacids by paper chromatography

Isolation of DNA from spleen

Estimation of Protein by Biuret Method - Colorimetry

COURSE OUTCOMES:

1. Able to identify the Carbohydrates and aminoacids
2. Applying the facts of biochemical instrumentation in practically
3. Acquire the knowledge of preparation of compounds from samples

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	2
CO2	2	2	2	2	2
CO3	2	2	2	2	2
AVERAGE	2	2	2	2	2

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Hands on Training
2. Demonstration **o**f Experiments

SEMESTER -I

ALLIED BASIC CHEMISTRY-I

(For I B.Sc. Clinical Nutrition and Dietetics)

TOTAL HOURS: 60 **COURSE CODE:BC21/1A/AC1**

CREDITS: 4 **LTP: 3-1-0**

COURSE OBJECTIVE

1. The introduction of how atoms bond together to form molecules and compounds are how these particles arrange themselves in all the matter around us.
2. The classification of organic reaction is introduced. To interpret and use the terminology associated with organic reactions.
3. To learn the various concepts of Acids and bases. Introducing pH, and buffers.
4. Identifying the buying practice of food items and the extent of awareness related to selected food products.
5. To understand various types of volumetric titrations and the chemical reaction associated with each type of volumetric titration.

COURSE OUTLINE:

UNIT I (12 hours)

a. Chemical bonding- Definition- Types of bonds - Formation of different bonds with examples --Ionic bond – NaCl, KCl -Covalent bond- Single bond- H2S,HCl, Multiple bond , Molecular orbital theory, Bonding, Non Bonding, Anti Bonding orbitals., Molecular orbital Configuration of Nitrogen, Oxygen and Flourine. Bond order, Diamagnetism and Paramagnetism.Co ordinate bond –Hydronium ion, ammonium ion--Hydrogen bond – Inter and Intramolecular Hydrogen bonding e.g. O & P Nitrophenol-- Vanderwaals force.

b. Shapes of molecules – VSERR Theory & Hybridization CH4, H2O, NH3, BrF3, SF6 ,IF5 , IF7.

UNIT II (12 hours)

Mechanistic basis of organic reactions – Electronic displacement results- Inductive, Resonance and Steric effects. Definition of substrates – Electrophiles , Nucleophiles – Elementary treatments of Substitution reactions SN1 , SN2 Walder inversion - Aromatic Electrophilic substitution (Nitration, sulphonation) - Elimination Reaction- E1 , E2 Hoffmann and saytzeff rule- Addition Reaction – Markonikoff's rule and Kharash effect.

UNIT III (12 hours)

Food chemistry- Quality of lipids- rancidity, acid number, iodine number, saponification number. Food adulteration – Definition – Intentional addition and incidental addition – Common adulteration/contaminants in food – Food simple screening test for the detection of adulterants – Diseases or health effects caused by the adulterants – Prevention of Food Adulteration Act -1954. Toxicology - Risk assessment studies - safety & quality evaluation of additives and contaminants. NOAEL (No Observed Adverse Effect level) - Definition- LD50 & LC50 Definition.

UNIT IV (12 hours)

Acids and bases – Arrhenius concept- Bronsted-Lowry concept- conjugate acids and bases – Lewis concept Concept of pH and pOH – Determination of pH using Potentiometric method (pH meter) –Buffer examples for acidic and basic buffer – Buffer action – Biological applications of buffers. Application of Buffers in food industry.

UNIT V (12 hours)

Volumetric analysis – Advantages of Volumetric analysis over other quantitative analysis – Preparation of solutions – Primary and Secondary Standards – (examples) – Definition of Mole - using the mole in mass calculation, Molarity, Molality, Normality, Formality Dilution – Difference between end point , equivalence point - Types of volumetric analysis – Acidimetry and Alkalimetry – Examples & Indicators used Strong acid Vs Strong base , Strong acid Vs Weak base, Weak acid Vs Strong acid , Weak acid Vs Weak base – Redox Titrations – Permanganometry ,Dictromatery,IodometryIodimetry – Complexometry – EDTA Titrations.

RECOMMENDED TEXTBOOKS:

1. Allied Chemistry-Gopalan and Sundaram, Published by Sultan Chand & Sons (P) Ltd., 3rd edition, 2006.
2. Text Book of Allied Chemistry-Dr.V.Veeraiyan,Highmount Publishing House,2008.

REFERENCE BOOKS:

1. Modern Inorganic Chemistry-R.D.Madan, Satya Prakash ,Published by S Chand & Co Ltd, 1987.
2. Textbook Organic Chemistry-P.L.Soni,H.M.Chawla, Sultan Chand and Company , 29th edition ,2007.
3. Principles of Physical Chemistry- Puri B.R., Sharma and Pathania,Vishal Publishing Co.,2006.
4. Food Chemistry – Alex V.Ramani, MJP Publishers, 2009.
5. Chemistry for degree students – RL Madan, S.Chand Publishers, 2010

JOURNALS

1. Indian Journal of Chemistry
2. Journal of Saudi Chemical Society
3. New Journal of Chemistry
4. Chemical reviews
5. Nature chemistry

e- LEARNING RESOURCES:

1. http://www.chemistry.org
2. http://www.chemhelper.com
3. MATLAB
4. https://swayam.gov.in
5. https://nptel.ac.in

COURSE OUTCOME

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Gain knowledge on the types of bonds, understand VB and MO theories Understand the concept of intermolecular forces. Deduce the shape of different polyatomic molecules.	K1, K2
CO 2	Able to describe the mechanism of electrophilic and nucleophilic substitution reactions. Learn how to apply rules in addition and elimination reactions.	K1, K2, K3
CO 3	ses and effects of Food adulteration and awareness to select ndnon adulterated food.	K1, K2
CO4	Able to explain qualitatively the difference in behavior between strong and weak acids and bases and the pH values of their aqueous solution e to apply the uses of buffer.	K2, K3
CO5	To familiarize with term molarity, molality normality and formality and indicators. Based on law of mass action to arrive at the amount of substance in a unknown solution.	K2,K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3
CO2	2	2	2	2	2
CO3	2	2	2	2	2
CO4	2	2	2	2	2
CO5	2	2	2	2	2
AVERAGE	**2**	**2**	**2**	**2**	**2.2**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)
2. Videos
3. Quiz, Seminar

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total	Special Instruction if any
K 1	A-10X2 marks	50	20	100	Question number compulsory for all questions Section A - Two questions from each unit Section B - Minimum of 1 question from each unit Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8 marks	500	40		
K2, K 3	C-2/4x20 marks	1200	40		

SEMESTER – II

ALLIED BASIC CHEMISTRY-II

(For I B.Sc. Clinical Nutrition and Dietetics)

TOTAL HOURS: 60 **COURSE CODE: BC21/2A/AC2**

CREDITS: 4 **L-T-P: 3-1-0**

COURSE OBJECTIVES:

1. To know the condition for co-ordinate bond and chelate formation.
2. To learn the definition and classification of fuel gases, synthetic inorganic polymers and dyes.
3. To understand the definition and classification of drugs.
4. To understand the definition and classification of food additives.
5. To discuss more common methods of securing pure organic compound from natural source or from reaction product mixture.

COURSE OUTLINE:

UNIT I (12 hours)

Co–ordination Chemistry – Difference between Double salt and Co-ordination Compounds. Nomenclature Werner's theory, Definition and Biological importance of Chelates – Haemoglobin, Application of chelates – medicinal and analytical –Determination of hardness of water and softening of water.

UNIT II (12 hours)

Industrial Chemistry – Fuels, Classification, Fuel Gas – natural gas, Water gas, Semi water gas, Carbureted Water gas, Producer gas, Oil gas, Gobar gas and LPG- Composition and uses. Polymers - monomer & polymer definition example.Inorganic Polymer- Silicones – Preparation, properties and uses. Synthetic Dyes – Classification of Dyes, Azo, Triphenylmethane, Vat and Mordant Dyes and their preparation.

UNIT III (12 hours)

Drug Chemistry – Classification of drugs, Preparation and Properties of Sulpha drugs, Sulpha pyridine, Prontosil, Sulpha diazine and Sulpha furazole. Mode of action of Sulpha drugs.

Antibiotics – Penicillin, Chloramphenicol.Definition, example each for analgesics, antipyretics, tranquillizers, sedatives, hypnotics, local and general anaesthetics. Steroidal drugs and Non -Steroidal inflammatory drugs.

UNIT IV (12 hours)

Food Chemistry – Food additive – Definition – Purpose of addition – Examples – Food colours - Definition, Example & E Numbers– Flavours – Sweeteners – Fat emulsifiers – Stabilizing agents – Flour improvers- Anti staling agents – antioxidants- Introduction, Natural & Synthetic antioxidants & mechanism of action – Preservatives- Nutritional supplements – Food Fortification – Major & Minor minerals, Toxic minerals in Food- Biological importance of Sodium (Na), Potassium (K),Calcium (Ca),Magnesium (Mg),Potassium(P).

UNIT V (12 hours)

Isolation and Purification of Organic Compounds – Extraction , Differential extraction, Distillation, Fractional distillation , Steam distillation Crystallization, Sublimation, Separation Technique – Chromatography – Paper , TLC ,Column and Ion exchange.

RECOMMENDED TEXTBOOKS:

1. Allied Chemistry-Gopalan and Sundaram, Published by Sultan Chand & Sons (P) Ltd., 3rd edition, 2006.
2. Text Book of Allied Chemistry-Dr.V.Veeraiyan, Highmount Publishing House,2008.

REFERENCE BOOKS:

1. Modern Inorganic Chemistry-R.D.Madan, Satya Prakash , Published by S Chand & Co Ltd, 2008
2. Textbook Organic Chemistry-P.L.Soni,H.M.Chawla, Sultan Chand and Company,29th edition ,2007.
3. Principles of Physical Chemistry-P.L.Soni,U.N.Dash, Sultan Chand and Sons,23rd revised edition,2007.
4. Food Chemistry – Alex V.Ramani, MJP Publishers, 2009.
5. Chemistry for degree students – RL Madan, S.Chand Publishers, 2010

JOURNALS:

1. Indian Journal of Chemistry
2. Journal of Saudi Chemical Society
3. New Journal of Chemistry
4. Chemical reviews
5. Nature chemistry

e- LEARNING RESOURCES:

1. https://www.chemistry.org
2. https://www.chemhelper.com
3. MATLAB
4. https://swayam.gov.in
5. https://nptel.ac.in

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO1	Able to name different co-ordinate compounds. Familiarize with the application of chelates in the biological system and thereby their application in the field of medicine.	K1, K2
CO2	To apply the usage of fuel gas and dyes in daily life.	K1, K2, K3
CO3	Able to describe the mode of action of different drugs.	K1, K2
CO4	Able to analyse purpose of additives and to know their limits	K2, K3
CO5	Develop extraction knowledge on the relation between the structure and properties of compounds. Various methods used to separate mixtures of compounds and identify their compounds.	K2,K3

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3
CO2	2	2	2	2	2
CO3	2	2	2	2	2
CO4	2	2	2	2	2
CO5	2	2	2	2	2
AVERAGE	**2**	**2**	**2**	**2**	**2.2**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)

2. Videos
3. Quiz, Seminar

QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total	Special Instruction if any
K 1	A-10X2 marks	50	20	100	Question number compulsory for all questions Section A - Two questions from each unit Section B - Minimum of 1 question from each unit Section C - 4 Questions from 4 different units.
K1, K 2	B-5/8x8 marks	500	40		
K2, K 3	C-2/4x20 marks	1200	40		

SEMESTER I

YOGA AND DIET

(For Other Department Students)

TOTAL HOURS: 30 **COURSE CODE:BC21/3N/YOG**

CREDITS: 3 **LTP: 2-0-0**

COURSE OBJECTIVES

1. To learn the types and importance of Yoga and to understand the concept of Workplace yoga
2. To understand the various asanas and their benefits
3. To understand the different classes of Nutrients present in food and the diets

COURSE OUTLINE

UNIT I (10 hours)

Yoga-definition, Prerequisites for Yoga, Essentials of yoga practices,Workplace yoga. Relevance of yoga in modern age and scope and Misconceptions about yoga. Brief Introduction of Hatha yoga, Raja yoga, Karma yoga, Gyana Yoga, Bhakti yoga

UNIT II (10 hours)

Pranayama and Benefits in treating respiratory disorders, Basic Asanas and their Benefits. Padmasana, Vajrasana, Bhujangasana,Dhanurasana,Shavasana.(Demonstration of Yogic Practices.

UNIT III (10 hours)

Energy requirement and its calculation, Balanced diet, Different classes of Nutrients in food, Sources and their Basic functions, Food pyramid, Types of diets.

RECOMMENDED TEXTBOOKS:

1. Yoga– Master the Yogic Powers – Jack Peter, Abishek Publications,First Edition, 2006
2. Nutrition Essentials and Diet Therapy – Nancy Pecken Paugh, Saunders Elsevier, 11th edition, 2009.
3. Yoga in Daily Life -K.S. Joshi, Orient paperback publication,First Edition,New Delhi, 1985.

REFERENCE BOOKS:

1. Science of Yoga by Annswanson, DK Publishing, 2019
2. The Complete Illustrated Book of Yoga by Swami Vishnu Devananda, 1995
3. Yoga – a gem for women by Geetha S Iyengar,Zaccheus entertainment,1st Edition,1983.

e- LEARNING RESOURCES:

1. https://yogamedicine.com/guide-types-yoga-styles/
2. https://www.femina.in/wellness/fitness/benefits-of-different-types-of-asanas-185621.html
3. https://www.medicalnewstoday.com/articles/160774

COURSE OUTCOMES:

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO1	Acquiring knowledge about the various types of Yoga and how carrying out yoga in day to day life to attain self control and peace	K1,K2
CO2	Exploring the various asanas and acquiring their benefits	K2
CO3	Learning the classes of Nutrients and applying it to have a balanced diet ,there by having benefitted	K1,K2

MAPPING OF COURSE OUTCOMES WITH PROGRAMME SPECIFIC OUTCOMES

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	2
CO2	2	2	2	2	2
CO3	2	2	2	2	2
AVERAGE	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)

2. Blended Classroom-E Content, Videos
3. Quiz, Seminar
4. Peer Learning

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K1, K2,K3	A - 5 X10	350	50	50

SEMESTER II

LIFE STYLE DISEASES IN WOMEN

(For Other Department Students)

TOTAL 1 HOURS: 30 **COURSE CODE:BC21/4N/LSD**

CREDITS: 3 **LTP: 2-0-0**

COURSE OBJECTIVES

1. To acquire knowledge about the reproductive mechanism and child health
2. To understand the different health problems in Women
3. To know about the lifestyle associated with this problem and its adverse effects.

COURSE OUTLINE

UNIT I (10 hours)

Woman's Physical composition and the Body image, Reproductive health - Hormonal cycle and its Psycho-somatic implications,Sexual Health -Childbirth,Child care, lactation Significance of breastfeeding.

UNIT II (10 hours)

Balanced diet for Women,Eating disorders-Anorexia and Bulimia nervosa .Health problems in Women - Obesity, Anaemia.PCOS – Symptoms,Diagnosis and Treatment, Cancer-Breast cancer, Cervical cancer-Symptoms, Diagnosis and Treatment.

UNIT III (10 hours)

Skin and Hair problems,Adverse effects of Junk food, Modern lifestyle habits - Health Hazards of Smoking and Alcoholism, Tight clothing, High heels, Hair coloring, Face bleach, Tattooing, Mobile phone radiation.

RECOMMENDED TEXTBOOKS:

1. Understanding Nutrition-Eleanor, Noss, Whitney,Wadsworth publishing,2004
2. Encyclopedia of Women health-Parvesh Handa,Gyan publishing house,2006
3. Healthy Diet and Nutrition for Women: The Complete Guide Kindle Edition Susan M. Lark MD, Womens Wellness Publishing, 2013.

REFERENCE BOOKS:

1. Clinical Biochemistry and metabolic medicine-Martin Andrew Crook,8th edition,2012.
2. Davidson's Principles and Practice of Medicine-Boon, Colledge & Walker, Elsevier 20th Edition 2006.
3. Textbook of Medical Biochemistry Paperback – Shinde Rana Chatterjee , Jaypee Brothers Medical Publishers,15 Apr 2007.

e- LEARNING RESOURCES:

1. https://www.betterhealth.vic.gov.au/campaigns/womens-sexual-and-reproductive-health
2. https://pubmed.ncbi.nlm.nih.gov/26320465/
3. https://medcraveonline.com/JCCR/lifestyle-diseases-consequences-characteristics-causes-and-control.html

COURSE OUTCOME

CO NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Exploring the reproductive mechanism and child health	K1,K2
CO 2	Getting to know the health problems faced by women and the methods of diagnosis and treatment	K1,K2
CO 3	Learning the skin and hair problems and exploring the knowledge about smoking and alcoholism and its adverse effects.	K1,K2

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	2
CO2	2	2	2	2	2
CO3	3	3	3	2	3
AVERAGE	**2.3**	**2.3**	**2.3**	**2.0**	**2.3**

KEY: STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1, NO CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-LCD)
2. Blended Classroom-E Content, Videos
3. Quiz, Seminar
4. Peer Learning

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K1, K2,K3	**A= 5 X10**	**350**	**50**	**50**

CERTIFICATE COURSE

HERBAL REMEDIES

Course Duration: 45 hours

1. Herbal remedies for facial problems (1+3 hrs)
2. Herbal remedies for hair problems (1+3hrs)
3. Herbal remedies for management of Diabetes Mellitus(1+2hrs)
4. Herbs for Skin care(1+2hrs)
5. Herbal remedies for management of joint pain(1+3hrs)
6. Herbal remedies for management of respiratory illness(1+2hrs)
7. Herbal remedies for management of menstrual problems and nutritional anaemia(1+3hrs)
8. Herbal remedies for management of GI tract disorders(1+3hrs)
9. Herbal remedies for management of obesity(1+3hrs)
10. Herbs used during pregnancy and lactation(1+3hrs)
11. Herbal medicines for healthy liver and kidney(1+3hrs)
12. Herbs as Immunostimulants (1+3hrs)

CERTIFICATE COURSE

ADVANCED BIOCHEMICAL TECHNIQUES

Course Duration: 60 hrs

1. Introduction to Biosafety, Bioethics and Intellectual Property Rights (3 hrs)
2. Infra-Red Spectroscopy (1+2 hrs)
3. Gas Liquid Chromatography (1+2 hrs)
4. Immunological Techniques (1+4 hrs)
5. High Performance Liquid Chromatography (1+3 hrs)
6. Conductometric Titration (1+3 hrs)
7. Agarose Gel Electrophoresis (1+3 hrs)
8. Isolation and Estimation of DNA from Animal Tissue (1+3 + 3 hrs)
9. Melting temperature of DNA (1+3 hrs)
10. Gravimetry- Estimation of Calcium from milk (1+3 hrs)
11. Different methods of extraction of compounds from plants (1+5 hrs)
12. ELISA (Enzyme Linked Immunosorbant Assay) (1+5 hrs)
13. Plant Tissue Culture – Callus culture (1+6 hrs)