KANNUR UNIVERSITY

(Abstract)

B Sc Chemistry/ B.Sc.Biochemistry/B.Sc.Polymer Chemistry Programmes -Scheme, Syllabus and Pattern of Question Papers of Core, Complementary Elective and Generic Elective Course under Choice Based Credit and Semester System (Outcome Based Education System-OBE) in Affiliated colleges with effect from 2019 Admission-Implemented-Orders issued.

Academic Branch

No.Acad/C2/12380/2019/I Civil Station P.O Dated 20/06/2019

Read:- 1. U.O.No.Acad.C2/429/2017 dt.10-10-2017

2. The Minutes of the Meeting of the Curriculum Restructuring Committee held on 28-12-2018.
3. U.O No.Acad.C2/429/2017 Vol.II dt.03-06-2019
4. The Minutes of the meeting of the Board of Studies in ChemistryUG held on 07-06-2019
5. The Syllabus submitted by the Chairperson, Board of Studies in Chemistry (UG)dated 13/06/2019

ORDER

1. A Curriculum Restructuring Committee was constituted in the University vide the paper read (1) above to co-ordinate the activities of the Syllabus Revision of UG programmes in Affiliated colleges of the University.

2. The meeting of the Members of the Curriculum Restructuring Committee and the Chairpersons of different Boards of Studies held, vide the paper read (2) above, proposed the different phases of Syllabus Revision processes such as conducting the meeting of various Boards of Studies, Workshops and discussions.

3. The Revised Regulation for UG programmes in Affiliated colleges under Choice Based Credit and Semester System (in OBE-Outcome Based Education System) was implemented with effect from 2019 Admission as per paper read (3) above.

4. Subsequently, as per paper read (4) above, the Board of Studies in Chemistry (UG) finalized the Scheme, Syllabus & Pattern of Question Paper for Core, Complementary Elective & Generic Elective Course of B.Sc.Chemistry/B.Sc. Biochemistry/ B.Sc.Polymer Chemistry Programmes to be implemented with effect from 2019 Admission.

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5. As per paper read (5) above, the Chairperson, Board of Studies in Chemistry (UG) has submitted the finalized copy of the Scheme, Syllabus & Pattern of Question Papers of B.Sc. Chemistry/ B.Sc Biochemistry/ B.Sc Polymer Chemistry programmes.
6. The Vice Chancellor after considering the matter in detail and in exercise of the powers of the Academic Council conferred under Section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with accorded sanction to implement the Scheme, Syllabus & Pattern of Question Paper(Core/Complementary Elective/Generic Elective Course) of B.Sc Chemistry, B.Sc Biochemistry and B.Sc Polymer Chemistry programme under Choice Based Credit and Semester System(in OBE-Outcome Based Education System) in Affiliated colleges with effect from 2019 Admission, subject to reporting to the Academic Council.

7. The Scheme, Syllabus & Pattern of Question Papers of B.Sc Chemistry/ B.Sc Biochemistry/ B.Sc Polymer Chemistry Programmes are uploaded in the University website (www.kannuruniversity.ac.in)

Orders are issued accordingly.

Sd/-
DEPUTY REGISTRAR(ACADEMIC)
for REGISTRAR

To

The Principals of Colleges offering B.Sc Chemistry/ B.Sc Biochemistry/ B.Sc Polymer Chemistry programme

Copy to:-

1. The Examination Branch (through PA to CE)
2. The Chairperson, Board of Studies in Chemistry (UG)
3. PS to VC/PA to PVC/PA to Registrar
4. DR/AR-I, Academic
5. The Computer Programmer(for uploading in the website)
6. SF/DF/FC

KANNUR UNIVERSITY
CIVIL STATION P.O.
KANNUR
Pin-670 002
THAVAKKARA

Forwarded/By Order

SECTION OFFICER

KANNUR UNIVERSITY

BOARD OF STUDIES, CHEMISTRY (UG)

SYLLABUS FOR BIOCHEMISTRY CORE COURSE

COMPLEMENTARY ELECTIVE COURSE AND GENERIC ELECTIVE COURSES

FOR BSc BIOCHEMISTRY PROGRAMME

CHOICE BASED CREDIT AND SEMESTER SYSTEM

(2019 ADMISSION ONWARDS)

ANNEXURE (i)

KANNUR UNIVERSITY

VISION AND MISSION STATEMENTS

Vision: To establish a teaching, residential and affiliating University and to provide equitable and just access to quality higher education involving the generation, dissemination and a critical application of knowledge with special focus on the development of higher education in Kasargode and Kannur Revenue Districts and the ManandavadyTaluk of Wayanad Revenue District.

Mission:

- To produce anddisseminate new knowledge and to find novel avenues for application of such knowledge.
- To adopt critical pedagogic practices which uphold scientific temper, the uncompromised spirit of enquiry and the right to dissent.
- To uphold democratic, multicultural, secular, environmental and gender sensitive values as the foundational principles of higher educationand to cater to the modern notions of equity, social justice and merit in all educational endeavors.
- To affiliate colleges and other institutions of higher learning and to monitor academic, ethical, administrative and infrastructural standards in such institutions.
- To build stronger community networks based on the values and principles of higher education and to ensure the region's intellectual integration with national vision and international standards.
- To associate with the local self-governing bodies and other statutory as well as non-governmental organizations for continuing education and also for building public awareness on important social, cultural and other policy issues.

ANNEXURE (ii)

KANNUR UNIVERSITY

PROGRAMME OUTCOMES (PO)

PO 1.Critical Thinking:

1.1. Acquire the ability to apply the basic tenets of logic and science to thoughts, actions and interventions.

1.2. Develop the ability to chart out a progressive direction for actions and interventions by learning to recognize the presence of hegemonic ideology within certain dominant notions.

1.3 Develop self-critical abilities and also the ability to view positions, problems and social issues from plural perspectives.

PO 2.Effective Citizenship:

2.1. Learn to participate in nation building by adhering to the principles of sovereignty of the nation, socialism, secularism, democracy and the values that guide a republic.

2.2. Develop and practice gender sensitive attitudes, environmental awareness, empathetic social awareness about various kinds of marginalisation and the ability to understand and resist various kinds of discriminations.

2.3. Internalise certain highlights of the nation's and region's history. Especially of the freedom movement, the renaissance within native societies and the project of modernisation of the post-colonial society.

PO 3.Effective Communication:

3.1. Acquire the ability to speak, write, read and listen clearly in person and through electronic media in both English and in one Modern Indian Language

3.2. Learn to articulate, analyse, synthesise, and evaluate ideas and situations in a well-informed manner.

3.3. Generate hypotheses and articulate assent or dissent by employing both reason and creative thinking.

PO 4.Interdisciplinarity:

4.1. Perceive knowledge as an organic, comprehensive, interrelated and integrated faculty of the human mind.

4.2. Understand the issues of environmental contexts and sustainable development as a basic interdisciplinary concern of all disciplines.

4.3. Develop aesthetic, social, humanistic and artistic sensibilities for problem solving and evolving a comprehensive perspective.

PREFACE

The syllabus is prepared based on an interdisciplinary approach and aim to provide the students a deep understanding of the basic concepts of chemical sciences by acquiring the knowledge of terms, facts, concepts, processes, techniques and principles of the subject. It attempts to equip the students to cater to the industrial needs and to utilise them in the utmost practical manner.

The updated syllabus is prepared based on Kannur University Regulations for Choice Based Credit and Semester System for Under-Graduate Programme 2019" (in OBE – Outcome Based Education – system) (KUCBCSSUG 2019)with a view to implement outcome based education (OBE) and curriculum from the academic year 2019 -20 onwards as proposed by higher education agencies .

An OBE curriculum means, starting with a clear picture of what is important for students to be able to do, then organizing the curriculum, instruction and assessment to make sure this learning ultimately happens. Intended learning outcomes (POs, PSOs and COs) which specify what graduates completing BSc Biochemistry programme are expected to know, understand and be able to do at the end of their programme of study were discussed at various stages in three day OBE workshop conducted by KSHEC Trivandrum associated with Kannur University. These learning outcomes (POs,PSOs and COs) were further discussed along with content of the syllabus and assessment methods at the workshops conducted for faculty members and other stakeholders for restructuring curriculum by Kannur University and finalised after consulting with intellectuals, academicians, faculty members , researchers and students

The B Sc degree programme in Biochemistry designed for students to attain the intended learning outcomes which specified as PSOs (Programme Specific Outcome) and COs(Course Outcome) are clearly stated in the syllabus.

The mission and vision statements and PO statements of the University were givenin the beginning of the syllabus and PSO statements before the scheme of the syllabus . The CO statements are given inthe beginning of each courses. Teachers need to aware these statements as these describe the desired educational accomplishments of the degree programs.The reference materials have been recommended after a thorough study. The revised course pattern, distribution of credits, scheme of evaluation and syllabus approved by the board are given.

Saheed VK

Chairperson

Board of Studies, Chemistry(UG)

Kannur University

BSc Biochemistry Programme

Programme Specific Outcomes (PSOs)

After successful completion of three year degree program in Biochemistry a student should be able to;

PSO 1 Understand the fundamental concepts, principles and processes underlying the academic field of Biochemistry, its different subfields (clinical, nutritional, molecular biology), and its linkages with related disciplinary areas/subjects;

PSO 2 Demonstrate procedural knowledge that creates different types of professionals in the field of Biochemistry and related fields such as research, pharmaceuticals, Food industry, Clinical laboratories, Teaching, product quality, cosmetics industry, etc.;

PSO 3 Employ critical thinking and the scientific method to design, carry out, record and analyze the results of Biochemical experiments and get an awareness of the impact of Biochemistry on the Health and society.

PSO 4 Understand safety of chemicals, transfer and measurement of chemical, preparation of solutions.

PSO 5 Create an awareness of the impact of Biochemistry on the Health,society, and development outside the scientific community

COURSE STRUCTURE FOR BIOCHEMISTRY (UG) PROGRAMME

2019 ADMISSION

SEMESTER1

No.	Title of the Course	Hours /week	Credit	Marks		
				CE	ESE	TOTAL
1	EnglishCommon CourseI	5	4	10	40	50
2	EnglishCommon Course II	4	3	10	40	50
3	Additional Common Course-Course 1	5	4	10	40	50
4	**Core Course1**	3	3	10	40	50
5	Complementary Elective I - Course 1	4	2	8	32	40
6	Complementary Elective II - Course 1	4	2	8	32	40
	Total	**25**	**18**	**56**	**224**	**280**

SEMESTER II

No.	Title of the Course	Hours /week	Credit	Marks		
				CE	ESE	TOTAL
1	EnglishCommon Course III	5	4	10	40	50
2	EnglishCommon Course IV	4	3	10	40	50
3	Additional Common Course II-	5	4	10	40	50
4	**Core Course2**	3	3	10	40	50
5	Complementary Elective 1-Course 2	4	2	8	32	40
6	Complementary Elective II-Course 2	4	2	8	32	40
	Total	**25**	**18**	**56**	**224**	**280**

SEMESTER III

No	Title of the Course	Hours /week	Credit	Marks		
				CE	ESE	Total
1	General Awareness CourseI	4	4	10	40	50
2	General AwarenessCourseII	4	4	10	40	50
3	**Core Course3**	**3**	3	10	40	50
4	**Corecourse4PracticalI PartI** **Corecourse5Practical IIPart I**	4	-		-	-
5	Complementary Elective 1 - Course 3	3	2	8	32	40
6	Complementary Elective 1- Practical	2	-	-	-	-
7	Complementary Elective II - Course 3	3	2	8	32	40
8	Complementary Elective II - Practical	2	-	-	-	-
	Total	**25**	**15**	**46**	**184**	**230**

SEMESTER IV

No	Title of the Course	Hours /week	Credit	Marks		
				CE	ESE	Total
1	General AwarenessCourseIII	4	4	10	40	50
2	General AwarenessCourseIV	4	4	10	40	50
3	**Core Course6**	3	3	10	40	50
4	**Core course4Practical , PartIICorecourse5Practica lI, Part II**	4	3+4	10 + 20	40+ 80	50+ 100
5	Complementary Elective 1- Course 4	3	2	8	32	40
6	Complementary Elective1 - Practical	2	4	8	32	40
7	Complementary Elective II - Course 4	3	2	8	32	40
8	Complementary ElectiveII - Practical	2	4	8	32	40
	Total	**25**	**30**	**92**	**368**	**460**

SEMESTER V

No	Title of the Course	Hours /week	Credit	Marks		
				CE	ESE	Total
1	Generic Elective Course	2	2	5	20	25
2	Core Course7	4	4	10	40	50
3	Core Course8	4	4	10	40	50
4	Core Course9	4	4	10	40	50
5	Core Course10	4	4	10	40	50
6	Core course11Practical3,PartI Core course12Practical4,PartI	7	-	-	-	-
	Total	**25**	**18**	**45**	**180**	**225**

SEMESTER VI

No	Title of the Course	Hours /week	Credit	Marks		
				CE	ESE	Total
1	Core Course13	4	4	10	40	50
2	Core Course14	4	4	10	40	50
3	Core Course15	4	4	10	40	50
4	Core Course11Practical3,PartII Core Course12Practical4,PartII	5+4	4+3	20+10	80+40	100+50
5	Core Course16Project & Industrial Visit	4	2	4	16+5	20+5
	Total	**25**	**21**	**64**	**261**	**325**

TotalCredit120

Total Marks 1800

Credit &Mark distribution of BSc BioChemistryProgramme

Total credits for the BSc BioChemistryprogrammewill be 120 &total marks: 1800 distributed through six semesters with the following details.

Course	No.ofPapers	Marks perpaper	TotalMarks
Common EnglishCourse–	4	50	200
Addl.CommonCourse-	2	50	100
Common Course-General Awareness Course BioChemistry	4	50	200
ComplementaryElective Course–1Microbiology	5(4Theory +1Practical)	40	200
Complementary Elective Course-2Biotechnology	5(4Theory +1Practical)	40	200
Core Course-BioChemistry	15(11Theory +2(3hr)Practicals +2(6hr)Practicals	50 50 100	850
Project	1	25	25
Generic ElectiveCourse	1	25	25

Credit distribution of BSc BioChemistryProgramme

Programme	Sem.	Common*		General Awareness Course	Core	ComplementaryElective Couse*		Generic Elective	Total
		Eng	Addl		Biochemistry	**Microbiology**	**Biotechnology**		
BSc Biochemistry	I	4+3	4	-	3	2	2		18
	II	4+3	4	-	3	2	2		18
	III	-	-	4+4	3	2	2		15
	IV	-	-	4+4	3+3+4	2+4	2+4		30
	V	-	-	-	4+4+4+4	-	-	2	18
	VI	-	-	-	4+4+4+4+3+2	-	-	-	21
	Total	14	8	16	56	12	12	2	120

*Detailed distribution of credits will be done by the concerned Board of Studies.

SCHEME OF CORE COURSE- BIOCHEMISTRY

No	Semester	Course Code	Title of the course	Credits	Contact hr/week
1	I	1B01BCH	Bio molecules I	3	4
2	II	2B02BCH	Bio molecules II	3	4
3	III	3B03BCH	Molecular Biology	3	**3**
4	III	3A11BCH	Cellular Biochemistry	4	4
5	III	3A12BCH	Enzymology	4	4
6	III	3B04BCH & 3B05BCH	Core course 4 Practical1, Part I Core course 5 Practical 2,PartI	-	**4**
7	IV	4B06BCH	Plant Biochemistry	3	**3**
8	IV	4A13BCH	Biophysical and Biochemical Techniques	4	4
9	IV	4A14BCH	Physiological Aspects of Biochemistry	4	4
10	IV	4B04BCH & 4B05BCH	**Core course 4 Practical 1, Part II** **Core course 5 Practical 2, Part II**	3+4	4
11	**V**	**5B07BCH**	**Metabolism 1**	**4**	**4**
12	V	5B08BCH	Biochemistry of Health and Nutrition	4	4
13	V	5B09BCH	Immunology & Immunological Techniques	4	4
14	V	5B10BCH	Clinical Biochemistry	4	4
15	V		Generic Elective Course		2
16	V	5B11BCH & 5B12BCH	**Core course 11 Practical 3, Part I** **Core course 12 Practical 4, Part I**	-	**7**
17	VI	6B13BCH	Metabolism II	4	4
18	VI	6B14BCH	Genetics	4	4

19	VI	6B15BCH-A	Pharmaceutical chemistry	4	4
20	VI	6B15BCH-B	Endocrinology		
21	VI	6B15BCH-C	Computational Techniques in Biochemistry (Elective)		
22	VI	6B11BCH & 6B12BCH	**Core course 11 Practical 3, Part II** **Core course 12 Practical 4, Part II**	4+3	9
23	VI	6B16BCH	**Core course 16** Project / Industrial visit	2	4

The Common course will be conducted during semester I & II, Complementary Electivecourses during semester I to IV, the General Awareness Course during semester III & IV and the Core courses from semester I to VI. Generic Elective Course will be conducted during V semester.

Scheme-Discipline Specific Elective course

No	Semester	Course code	Title of the course	Contact hour/ Week	Credit
1	VI	6B15BCH-A	Pharmaceutical chemistry	4	4
2	VI	6B15BCH-B	Endocrinology	4	4
3	VI	6B15BCH-C	Computational techniques in Biochemistry	4	4

Scheme of Generic Elective Course

The Generic Elective Courseis meant for all the students in the institution except the students of BSc Biochemistry programme. External examination will be conducted at the end of V semester.

Options available for Generic Elective course - (Biochemistry)

No	Semester	Course Code	Title of the course	Contact hour/Week	Credit
1	V	5D01BCH	Nutritional Biochemistry	2	2
2	V	5D02BCH	Plant Biochemistry	2	2
3	V	5D03BCH	Biomolecules of life	2	2
4	V	5D04BCH	Tools and techniques in Biochemistry	2	2
5	V	5D05BCH	Clinical Biochemistry	2	2

Scheme of General Awareness Course

No	Semester	Course Code	Title of the course	Contact Hr/week	Credit
1	3	3A11BCH	Cellular Biochemistry	4	4
2	3	3A12BCH	Enzymology	4	4
3	4	4A13BCH	Biophysical and biochemical techniques.	4	4
4	4	4A14BCH	Physiological aspects in biochemistry	4	4

Evaluation pattern

Mark system will be followed instead of direct grading for each question. For each course in the semester letter grade, grade point and % of marks are introduced in 7-point indirect grading system as per KUCBCSSUG2019.Accordingly 20% of the total marks in each course are for internal evaluation and the remaining 80% for external evaluation.

Internal Evaluation (Core Course,Complementary ElectiveCourse &Generic Elective Course)

Components with percentageof marks of Internal Evaluation of Theory

Test Paper 60%

Viva/Seminar 40%

Internal evaluation is conducted by the concerned Department in marksystem. Marks secured for internalevaluation need be send to University

External Evaluation (Core Course,Complementary ElectiveCourse &Generic Elective Course)

External assessment will include Theory, Practical and Project evaluation conducted by University after the completion of a semester. Duration of theory examination for Core &Complementary Elective Courses will be 3 hours, whereas for Generic Elective Courseis 2 hours. The practical examination for Core &Complementary will be of 3/6 hour duration.

Project work:

Project works will be carried out in fifth and sixth semesters. Not more than five students can form a group and undertake a project. Each individual student should submit a copy of the project report duly attested by the supervising teacher and Head of the department. The report has to be presented at the time of practical examination conducted at the end of VI semester for evaluation.

Study tour:

Students are required to visit a factory/ Laboratory/ Research Institute of repute during the course and have to submit the report of the study tour at the end of the sixth semester during the time of practical examination. No credit will be separately given for study tour report.

Practical record, Project report &Study tour report must be certified by the teacher incharge and countersigned by the Head of the Department. Students should submit certified record of respective practical work at the time of University practical examination.

Mark distribution

Table1: Internal and External marks for Core and Common (General Awareness Course)

Item	Marks		Total
	Internal	External	
Theory	10	40	50
Practical	10	40	50
Industrial visit	--	5	5
Project	4	16	20

Table2: Internal and External marks for Complementary Elective Course-Biochemistry

Item	Marks		Total
	Internal	External	
Theory	8	32	40
Practical	8	32	40

Table3: Internal and External marks for Generic Elective Course

Item	Marks		Total
	Internal	External	
Theory	5	20	25

Table4: Distribution of Internal marks for Theory courses (Core Course,Complementary Elective Course & Generic Elective Course)

Seminar/Viva	40%
*Test paper	60%

*At least two test papers are to be conducted and average of these two is to be taken for awarding mark.

Table5: Distribution of Internal marks for Practical courses

Record + Lab involvement*	50%
Test papers	50%

*On completion of each experiment, a report should be presented to the course teacher. It should be recorded in a bound note-book. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, and tables of data collected, equations, calculations, graphs, and other diagrams etc. as necessary and final results.

Table6: Distribution of internal and external marks for Project

Internal(20%ofTotal)	%	External(80%oftotal)	%
Punctuality	20%	Relevance of Topic/Statement of Objectives and Methodology	20%
Use of data	20%	Presentation/Quality of Analysis and findings	30%
Scheme and Organization of Report	30%	Viva Voce	50%
Viva Voce	30%		

Distribution of Marks &type of questions for Core, Common, ComplementaryElective&Generic Elective Courses

Table7. Type of questions &Marks for External Examination – Core and Common(General Awareness Course)-Biochemistry

	Total Questions	No. Of Questions to be answered	Marks for each question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

Table8. Type of Questions &Marks for External Examination – Complementary Elective -Biochemistry

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very shortanswer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

Table9. Type of Questions & Marks for External Examination –Generic Elective Course-Biochemistry

	Total Questions	No. ofQuestions to be answered	Mark for each Question	Total Marks
Very short	5	5	1	5
Short answer	5	3	2	6
Short	5	3	3	9
Total	15	11		20

Distribution of marks for the practical examination:

The distribution of marks will be decided by the concerned Board of Examinations.

Guidelines for the Evaluation of Projects

1. PROJECT EVALUATION

1. Evaluation of the Project Report shall be done under Mark System.

2. The evaluation of the project will be done at two stages:

a) Internal Assessment (supervising teachers will assess the project and award internal Marks)

b) External evaluation (external examiner appointed by the University)

c) Marks secured for the project will be awarded to candidates, combining the internal and external marks.

3. The internal to external components is to be taken in the ratio 1:4. Assessment of different components may be taken as below

Internal(20%oftotal)	
Components	**%of internal Marks**
Punctuality	20
Use of Data	20
Scheme/Organization of Report	30
Viva-Voce	30

External(80%ofTotal)	
Components	**%of external Marks**
Relevance of the Topic, Statement of Objectives, Methodology (Reference/Bibliography)	20
Presentation, Quality of Analysis/Use of Statistical tools, Findings and recommendations	30
Viva-Voce	50

4. Internal Assessment should be completed 2 weeks before the last working day of VI semester.

5. Internal Assessment marks should be published in the department.

6. Project evaluation shall be done in the VI semester along with practical exams.

7. Chairman Board of Examinations, may at his discretion, on urgent requirements, make certainexception in the guidelines for the smooth conduct of the evaluation of project.

2. PASS CONDITIONS-

1. Submission of the Project Report and presence of the student for viva are compulsory for internal evaluation. No marks shall be awarded to a candidate if she/he fails to submit the Project Report for external evaluation.

2. The student should get a minimum of 40% marks for pass in the project.

3. There shall be no improvement chance for the Marks obtained in the Project Report.

4. In an instance of inability of obtaining a minimum of 40% marks, the project work may be re-done and the report may be re-submitted along with subsequent exams through parent department.

SEMESTER I

1B01BCH- Biomolecules I

Credit: 3

Total hours of instruction: 54

Hours/Week: 3.

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: State the definition and branches of Biochemistry

CO2: Understand the nature of biomolecules and analyse the structure.

CO3: Summerisestructure , isomerism and functions of different biomeolecules.

Module 1:INTRODUCTION TO BIOCHEMISTRY(12 hrs)

Definition-Branches of Biochemistry, brief study of the foundations of biochemistry (cellular, chemical and physical foundations-fundamental study only).Biochemistry as a molecular logics of living organism. Role and scope of Biochemistry.

Module 2: WATER, SOLUTIONS &BUFFERS(12hrs)

Water-structue, role of water in life. H-bond, pH-pOH, pka ,Henderson-Hasselbalchequation.solutions-normality,molarity,molality.buffers,Biological buffer system

Module 3: CARBOHYDRATES (15hrs)

Definiton and classification.Monosaccharides- structure, occurrence, chemistry& functions, linear and cyclic structure (glucose, galactose, mannose, ribose and fructose).Isomerism of carbohydrates: glyceraldehyde, examples of epimers, anomers, mutarotation.

Disaccharides- structure, occurrence, chemistry and functions of sucrose, lactose, maltose, isomaltose and cellobiose.

Polysaccharides: structureand functions of cellulose, starch, glycogen, Hyaluronicacid, chondroitinsulphate, heparin.

Module 4: LIPIDS(15hrs)

Definition, classification, biochemical functions of lipids, classification of fatty acids: Essential and non-essential fatty acids with examples. Physical and chemical properties of fattyAcids, saponification number, acid number, rancidity of fats and iodine number- their applications. Compound lipids: storage and membrane lipids. Structure and functions of phospholipids and glycolipids, Steroids: Structure of steroid nucleus, Cholesterol.

References

1. J L Jain Text book of biochemistry,S. chand and company Ltd.NewDelhi.

2Text book of Biochemistry:E S West,W R Todd, H S Mason and J T Van Bruggen.

3. Lehninger's Principles of Biochemistry.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
1	12
2	14
3	18
4	18

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER II

2B02BCH: Biomolecules II

Credit: 3

Total hours of instruction: 54

Hours/Week: 3.

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: State the definition and branches of Biochemistry

CO2: Understand the nature of biomolecules and analyse the structure.

CO3: Summerisestructure ,isomerism and functions of different biomeolecules.

Module 1 : AMINO ACIDS AND PROTEINS (15Hrs.)

Amino acids: Definition, structure&Three letter and single letter abbreviations of

amino acids, classification of amino acids based on charge and polarity, general reactions of amino acids-side chain, carboxyl and amino group- essential and non-essential amino acids.

Proteins: Peptides- Formation of peptide bond. Elementary study of primary, secondary, tertiary and quaternary structure of proteins- (E.g.Hemoglobin and Myoglobin), forcesstabilizing the structure of protein, Classification of proteins based on solubility, shape and function..

Module 2:.NUCLEIC ACIDS (12Hrs.)

Nucleic acids: types, structural components of DNA &RNA -nucleosides, nucleotides, Stability and formation of Phosphodiester linkages, Effect of acids, alkali and nucleases on DNA and RNA.

Module 3 :MINERALS(12hrs)

Source and functions of macro (Ca,Mg,Na,K&P)and microminerals:. Fe,I,Cu,Zn

Module 4: VITAMINS (15hrs)

Vitamins: Definitions-classifications& functions of-fat soluble and water soluble-sources-chemical nature (without structure)

References

1. J L Jain Text book of biochemistry,S. chand and company Ltd.NewDelhi.

2Text book of Biochemistry:E S West,W R Todd, H S Mason and J T Van Bruggen.

3. Lehninger's Principles of Biochemistry: - D. L.Nelson and M.M. Cox

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
1	18
2	15
3	13
4	16

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER III

3B03BCH Molecular Biology (CORE)

Credit: 3

Total hours of instruction: 54

Hours/Week: 3.

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: Determine the structure, function and importance of genetic materials.
CO 2: Understand mutation, causes, and DNA repairing
CO 3: Comprehend basic principles behind replication, transcription, and translation.
CO4: Understand the gene expression mechanism and its regulation.

Module -I. DNA REPLICATION IN PROKARYOTES: (12Hrs.)

Central dogma of molecular biology, DNA replication – conservative, semiconservative and dispersive types. DNA replication in prokaryotes: other enzymes andprotein factors involved in replication. Mechanism of replication. DNArepair, damage:excision,recombination,sos repair

Module -2: TRANSCRIPTION IN PROKARYOTES (12Hrs.)

RNA polymerase, promoters, initiation, elongation and termination of RNA synthesis,inhibitors of transcription. Reverse transcriptase, post transcriptional processing of RNA ineukaryotes.Genetic code –

Module -3: MECHANISM OF TRANSLATION IN PROKARYOTES (18 Hrs.)

Charged RNA, f-met – tRNA, initiator codon, Shine-Dalgarno consensus sequence, formation of 70S initiation complex, role of EF-Tu, EF-Ts,EF-G and GTP, non-sense codons and release factors, RF1 and RF2.

Module -4: REGULATION OF GENE EXPRESSION (12Hrs.)

Regulation of gene expression in prokaryotes – Enzyme induction and repression, Operon concept, Lac operon, Trp operon.

References:

1. Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and

V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd.

2. Molecular Biology of the Gene by James D Watson, Tania A Baker, Stephen P.

3. Cell and Molecular Biology, 3e (2003) by Karp.

4. Lehninger's principles of Biochemistry -: D. L. Nelson and M. M. Cox , Worth

Publishers, 41 Madisons Avenue New York, USA.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	15
II	20
III	15
IV	12

Type of questions &Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER III

3A12BCH Enzymology(GENERAL AWARENESS COURSE II)

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: Understand the basic features of enzymes.
CO 2: Comprehend different classes of enzymes, enzyme activity etc.
CO 3: Understand expression of enzyme action
CO 4: Explain the application of enzymes in different fields.

MODULE-1. (22Hrs.)

Introduction to enzymes: Holoenzyme, apoenzyme, and prosthetic group. Interaction between enzyme and substrate- lock and key model, induced fit model, Features of active site, activation Energy. Enzyme Commission system of classification and nomenclature of enzymes (Class and subclass with one example) Ribozymes. Structure of the following coenzymes and thereactions where these participate with one example.- NAD, NADP+, FAD, FMN, lipoicacid,TPP, pyridoxal Phosphate and biotin.

MODULE-2. (10Hrs.)

Measurement and expression of enzyme activity-enzyme assays. Definitions of IU, Katal, and enzyme turn over number. Factors affecting enzyme activity: enzyme concentration, substrate concentration, pH and temperature. Derivation of Michaelis –Menten equation for uni-substrate reactions. Km and its significance.LineWeaver-Burk plot (Only for single substrate enzyme catalyzed reaction)

MODULE-3. (10Hrs.)

Enzyme inhibition: Reversible and irreversible – examples. Reversible- competitive,

noncompetitive and uncompetitive inhibition- explanation of inhibition types with doublereciprocal plot and examples of each type of enzyme inhibition. Brief study of activation of zymogen form of enzyme with eg: as chymotrypsin. Allosteric enzymes –aspartyltranscarbamylase as an allosteric enzyme.

MODULE-4.(16 Hrs.)

Enzyme specificity-an example each for substrate specificity, stereo specificity, cofactor

specificity of enzymes. Methods for isolation, purification and of enzymes.

MODULE-5.(14 Hrs.)

Immobilization of enzymes, methods of immobilization. Industrial uses of enzymes: in food,leather and detergent industry. Diagnostic and therapeutic enzymes (brief study of name ofenzyme and role in diagnosis and therapy)

References:

1. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by Trevor Palmer, Philip

Bonner ,Publisher: Horwood Publishing Limited.

2. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins

by Nicholas C. Price, Lewis Stevens, and Lewis Stevens, Publisher: Oxford University

Press, USA.

3. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008)

Publishers: S. Chand & Co Ltd.

4. Text Book of Biochemistry: E.S.West, W.R.Todd, H.S. Mason andJ .T. Van Bruggen,

Oxford & IBH publishing Co-Pvt. Ltd.

5. The Chemical Kinetics of Enzyme action by K.J. Laidler and P.S. Bunting, Oxford

University Press London.

Distribution of Marks for External Examinations

<u>Marks including choice</u>:

Unit	Marks
I	12
II	14
III	14
IV	10
V	12

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER III

3A11BCH CELLULAR BIOCHEMISTRY(GENERAL AWARENESS COURSE -I)

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: Understand the structure of cell and different cell organelles.
CO 2: Comprehend the mechanism of transport across membrane.
CO 3: Analyze cell division and its regulation.
CO 4:Explain in detail about cancer, treatment etc.

MODULE -1.CELL- STRUCTURAL ORGANIZATION AND FUNCTIONS OF INTRACELLULAR ORGANELLES (15HRS.)

Discovery of cell and Cell Theory, Comparison between plants, animal and microbial cells.Cell wall, Nucleus, mitochondria, chloroplast, ribosomes, endoplasmic reticulum, Golgibodies, lysosomes and peroxysomes.

MODULE -2. MEMBRANE STRUCTURE AND FUNCTIONS (15 HRS.)

Plasma membrane- structure and composition -Fluid mosaic model, lipid bilayer. Transport across membranes. Exocytosis, Endocytosis, Simple diffusion, facilitated transport- definition, types with

examples. Symport, uniport and antiport, Active transport- Primary active transport, secondary active transport, sodium/potassium-ATPase.

MODULE -3. CELL DIVISION AND CELL CYCLE (10 HRS.)

Mitosis and meiosis, their regulation, steps in Cell cycle and control of cell cycle.

MODULE -4.CELLULAR COMMUNICATION (16 HRS.)

Cell- cell interaction and cell matrix interaction, extracellular matrix, proteoglycan and

collagen, Cell – cell adhesion, catherins, desmosomes, gap junction and tight junction.

MODULE –5.CANCER (16 HRS.)

Apoptosis- Difference between apoptosis and necrosis, outline study of apotoptic pathways, role of Caspases proteins in apoptotic pathways, malignant cells-Properties of malignant cells.

References

1. Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. verma and

V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd, New Delhi.

2. Cell and Molecular Biology: E.D.P. Robertis and De Robertis

3. Molecular Cell Biology: H. Lodish, J. Parnell and C. A. Kaiser ,WH. Freeman and

company New York and London

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	10
II	15
III	15
IV	12
V	10

. Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER IV

(4B06BCH PLANT BIOCHEMISTRY)

Total hours of instruction:54
Hours/Week: 3.
Credits 3

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: Understand the plant cell structure.
CO 2: Comprehend photosynthetic mechanism.
CO 3: Explain plant hormones.
CO4:Understand the stress physiology of plants.

MODULE- I (12HRS)

INTRODUCTION TO PLANT CELLS Photosynthesis: Chloroplast- structure and function; Photosynthetic pigments andlight harvesting complexes, photophosphorylation,CO2 fixation,-C3,c4&CAM Pathways., glyoxlate cycle .

MODULE– II (20 HRS)

NITROGEN METABOLISM:

Physical and biological nitrogen fixation, Ammonification,

Nitrification, Denitrification, molecular biology of nitrogen fixation- nod,nif&fix genes.

Ammonium assimilation**.**

MODULE- III-PLANT HORMONES: (10HRS)

Biosynthesis and functions ofAuxins, Gibberellic acids, Cytokinins, Abscisic acid, Ethylene, BrassinosteroidsandPolyamines.

MODULE – IV-PLANT STRESS PHYSIOLOGY: (12HRS)

Plant stress, Plant responses to abiotic and biotic stresses,Water deficit and drought resistance, Flooding, Temperature stress, Salt stress, Iontoxicity, Pollution stress and potential biotic stress (insects and diseases).

Reference:

Text Book: 1.Mukherji, S and Gosh A. K. Plant Physiology.

New Central Book Agency, Kolkata, 2005.2.Slater A, NW Scott, MR Fowler. Plant bio technology, 2nd ed. Oxford University Press, 2008.

Hopkins, W. G and Huner, N. P. A. Introduction to Plant Physiology.3 rd ed. John Wiley & Sons Inc.New York, 2004.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	18
II	14
III	16
IV	14

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER IV

4A14BCH PHYSIOLOGICAL ASPECTS OF BIOCHEMISTRY(GENERALAWARENESS COURSE IV)

Total hours of instruction: 72
Hours/Week: 4.

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1:Comprehend physiology of circulatory system .
CO 2: Understand respiratory system.
CO 3:Understand urine formation, neuron structure.

MODULE-1.(18 HRS.)

Biochemistry of Blood: Constituents of blood, types of cells: Erythrocytes - structure and function, WBC - types, differential count, functions. Platelets and functions. Components of plasma, types of plasma proteins and function, Blood groups: the ABO system, the Rh-system. Mechanism of blood clotting (intrinsic and extrinsic pathway) Clotting factors, anticoagulants, fibrinolysis**.**

MODULE-2.(12 HRS.)

Structure of respiratory system.transport of oxygen , role of hemoglobin, dissociation curve of oxyhemoglobin and its significance, transport of CO2 and chloride shift. Bohr's effect, Haldane'seffect.Various buffer systems of the blood: Acidosis and alkalosis, role of lung and kidney in regulation of acid-base balance.

MODULE- 3 (15 HRS.)

Structure of nephron, composition and mechanism of urine formation, glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion.Regulation of waterand electrolyte balance, role of kidneys and hormones in their maintenance.

MODULE-4. (12HRS.)

Classification of muscles- Structure of skeletal, smooth and cardiac muscles. Actin, myosin, tropomyosin, troponin, Z disc and H line components. The sliding filament mechanism and subcellular ion movements during the contraction cycle in skeletal muscles.

MODULE-5: (15HRS.)
Neurons- structure, mechanism of nerve impulse transmission, neurotransmitters, synapses:chemical and electrical synapses, the reflex action and reflex arc.

References:
1. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008)
Publishers: S. Chand & Co Ltd .
2. Essentials of Medical Physiology, by K.Sambulingam&P.Sambulingam, jaypee

brothers New Delhi.
3. Human Physiology (2001) by Bipin Kumar Publisher: Campus Books International**.**

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	12
II	15
III	14
IV	13
V	8

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER IV

4A13BCH BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES(GENERAL AWARENESS COURSE III)

Total hours of instruction: 72
Hours/Week: 4.
Credit 4

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: Determine different biochemical techniques.
CO 2: Understand chromatography technique.
CO 3: Understand basic principles behind electrophoesis.
CO 4: Explain the sedimentation technique, and spectroscopic techniques.
CO 5: Familiarise the applications and use of radioisotopes

MODULE - I. (10 HRS.)
Methods of tissue homogenization (tissue homogenizer).fractionation, lyophilization. Dialysis, ultra filtration.

MODULE -II.(12 HRS.)
Chromatography:- principle, types of chromatography -adsorption chromatography, ionexchange chromatography, gel chromatography, affinity chromatography, GLC and HPLC.

MODULE- III. (10 HRS.)
Electrophoresis- theory. Paper electrophoresis, Agarose gel electrophoresis, SDS-PAGE,Immuno electrophoresis, Isoelectric focussing. Gel documenter, Autoradiography.

MODULE -IV. (12HRS.)
Centrifugation: - Principle of sedimentation technique. Principle, procedure and application of differential centrifugation, density gradient centrifugation, ultracentrifugation.

MODULE -V. (16HRS.)
UV and visible absorption spectra, Laws of light absorption- Beer - Lambert's law.Lightabsorption and its transmittance, application of visible and UV spectroscopic techniques, Principle and applications of NMR, ESR, Mass spectroscopy, Fluorescent and emissionspectroscopy.

MODULE -VI. (12HRS.)
Important stable radioisotopes used in biochemical research. P32, I125, I 131, Co 60, C14 etc.Radiation hazards and precautions taken while handling radioisotopes.Measurement of radioactivity by GM counter and Scintillation counter.

References:
1. Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand &Company .
2. A text book of Biophysics by R.N. Roy, New Central Book Agency Pvt. Ltd, Calcutta.
3. Biophysical Chemistry by Upadhyay, Upadhyay&Nath , Himalaya Publishing House, Bangalore.

4. Biophysics by Mohan Arora, Himalaya Publishing House, Bangalore.
5. Separation chemistry by R.pBudhiraja, New age international (P) Ltd, New Delhi.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	6
II	13
III	13
IV	10
V	14
VI	6

. Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER V

5B07BCH METABOLISM I

Total hours of instruction: 72

Hours/Week: 4.

Credit 4

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: Understand the basic principles of metabolism.
CO 2: Comprehend carbohydrate metabolism and its regulation.
CO 3: Understand protein metabolism.
CO 4: Analyseporphyrin metabolism.

MODULE -1: INTRODUCTION TO METABOLISM: (18 HRS.)

General features of metabolism, principles of bioenergetics-bioenergetics &thermodynamics laws-entropy, enthalpy, standard free energy change &equilibrium constant.high energy compounds. &ATP.

MODULE-2: CARBOHYDRATE METABOLISM: (18HRS.)

Reaction and energetic of glycolysis.Alcoholic and lactic acid fermentation.Reactions and energetic of TCA cycle.Gluconeogenesis, Glycogenesis and glycogenolysis. Regulation of glycolysis,TCA cycle& glycogen metabolism,.Reactions and physiological significance of pentose phosphate pathway.

MODULE: 3 METABOLISM OF PROTEINS: (18HRS.)

Digestion and absorption of proteins, Protein turn over, proteolytic enzymes.trasamination,oxidative deamination, reductive amination, aminoacid metabolism-essential non essential(without structure)non-oxidative deamination and decarboxylation of amino acids. Urea cycle.

MODULE4: METABOLISM OF PORPHYRIN(18HRS)

Biosynthesis and degradation of Porphyrin, Heme formation, Biosynthesis of Bilirubin, transport and excretion of bile pigment

References:

1. Lehninger's Principles of Biochemistry: - D. L.Nelson and M.M. Cox, Worth

Publishers, 41 Madisons Avenue New York, USA.

2. Text Book of Biochemistry: E.S.West, W.R.Todd, H.S. Mason andJ .T. Van

Bruggen,Oxford& IBH publishing Co-Pvt.Ltd.

3. The text book of biochemistry (for medical students) DM Vasudevan, Sreekumari S, JAYPEE Brothers New Delhi.

4. Principles of Biochemistry Geoffrey L Zubey, William W parson Pennis E Vance,WMC Brown publishers.

5. Biochemistry: LubertStryer. and Hall, J.E., Library of congress cataloguing-in publication Data, Bery, Jeremy mark ISBN.

6. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	18
II	15
III	18
IV	11

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER V

5BO9BCH IMMUNOLOGY AND IMMUNOLOGICAL TECHNIQUES

Total hours of instruction: 72

Hours/Week: 4

Credit: 4

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: Understand basics of immune system.
CO 2: Comprehend ANTIGEN-ANTIBODY reaction.
CO 3: Understand different autoimmune diseases..

MODULE -1 INTRODUCTION TO IMMUNE SYSTEM:(10 HRS.)

Components of immunity: Innate immunity- Anatomic, physiological, phagocytic and inflammatory barriers; Adaptive immunity, Active and passive immunization, types of vaccines.

MODULE-2 ORGANS OF IMMUNE SYSTEM:(12 HRS.)

Central and peripheral lymphoid organs.Cells of Immune system stem cells, MHC, maturation of B and T lymphocytes, macrophages, natural killer cells.Primary and secondary immune responses.A brief account on Humoral and cell-mediated immune responses.

MODULE -3 ANTIGENS: (12 HRS.)

Factors that influence antigenicity, epitopes, haptens, Immunoglobulins- Structure of immunoglobulins, Classes of immunoglobulins and their functions. Monoclonal antibody and hybridoma technology.Abzymes.

MODULE 4 ANTIGEN-ANTIBODY INTERACTIONS:(14 HRS.)

Precipitation reaction;-lattice hypothesis, applications (immunodiffusion, immuno electrophoresis and VDRL test) Agglutination reaction and itsapplications(ELISA, RIA, Immunofluorescence, widal and CFT)

MODULE 5 COMPLEMENT SYSTEM: (12 HRS.)

The function of complement, complement activation. Hyper-sensitivity-Gell and Coombs classification-type I: Anaphylactic hypersensitivity, type II: antibody mediated cytotoxic hypersensitivity, type III: Immune complex mediated hypersensitivity, type IV: cell mediated delayed hypersensitivity.

MODULE 6 AUTOIMMUNE DISEASES- (12 HRS.)

Definition, causes and types of immune diseases like systemic lupuserythematosus, hemolyticanemia, Rheumatoid arthritis, Insulin depended diabetic mellitus.

References:

1. Immunology – Kubey

2. Essential Immunology –Peter J Delves, Seamus J. martin, Dennis R Burton, Ivan M. Roitt,

Blackwell Publishing, Massachustts, USA.

3. Elements Of Immunology by S C Rastogi (2006):Publisher: CBS Publishers &

Distributors.

4. Text book of Microbiology by Ananthanarayan and C K J Paniker: Publishers: Orient

Longman.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	6
II	13
III	13
IV	10
V	14
VI	6

. Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER V

5B08BCH- BIOCHEMISTRY OF HEALTH AND NUTRITION

Total hours of instruction: 72

Hours/Week: 4

Credit-4

COURSE OUTCOME(5B08BCH-B BIOCHEMISTRY OF HEALTH AND NUTRITION)

On successful completion of this course, students should be able to

CO 1: Understand nutritional requirements of body.
CO 2: Comprehend nutritioal significance of different biomolecules.
CO 3: Explain the effect of food processing on nutrition.

MODULE-1(15HRS)

Nutrition-Concepts of macro and micro nutrients.Food as source of energy- methods of determining energy value of foods- calorimetry, physiological fuel value, and daily requirement of energy, high and low calorie diets.reespiratory quotient, Basal metabolic rate (BMR) factorsBMR.

MODULE-2: (15 HRS)

Nutritional aspects of the carbohydrates-- Different dietary types, requirements, utilization and functions.Special role of the non-starch polysaccharides.Nutritional aspects of the lipids-- Different dietary types, requirements, utilization and functions. Essential fatty acids.

MODULE-3(12 HRS)

Nutritional aspects of the proteins—nutritional classification of amino acids and proteins, essential amino acids, nitrogen imbalance, protein requirements. Protein Energy Malnutrition

MODULE-4: (15 HRS)

Minerals: Nutritional significance. Dietary Macro elements: Calcium, Phosphorus, Magnesium,Na& K Trace Elements: Iron, Iodine, Zinc, Copper etc. Iron deficiency anemia.

Vitamins- Nutritional significance- fat soluble and water soluble vitamins (source,function,deficiency)

MODULE-5(15 HRS)

Food processing and loss of nutrients during processing and cooking.Naturally occurring Antinutrients. Balanced diet- Recommended dietary allowances for different categories of the human beings. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary/lifestyle modifications

References:

1) Nutrition and dietetics Davidson S and Pasmor J.R
2) Essentials of food and nutrition M Swaminathan Vol. II, Applied aspects (1974), Ganesh Pub, Madras.
3) Preventive and social medicine: K. Park
4) Food science B. Sreelakshmi
5) The text book of biochemistry (for medical students) DM Vasudevan, Sreekumari S, JAYPEE Brothers New Delhi.
6) Food facts and principles - SakunthalaManay, Sadhakshara Swami.
7) Modern Nutrition Health and Diseases - Goodheart.
8) Text book of Biochemistry - White, Handler and Smith.
9) Basic & Clinical Pharmacology by Bertram G. Katzung (2006) Publisher: McgrawhillMedical Publishing.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	12
II	15
III	14
IV	13
V	8

. Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER V

5B10BCH Clinical Biochemistry

Total hours of instruction: 72

Hours/Week: 4.

Credit 4

COURSE OUTCOME(5B10BCH Clinical Biochemistry)

On successful completion of this course, students should be able to

CO 1: Understand clinical aspects of biochemistry.
CO 2: Comprehend clinical enzymology
CO 3: Understand different organ function tests.

MODULE-1.BASIC CONCEPTS OF CLINICAL BIOCHEMISTRY (12 HRS.)

Collection and preservation procedures of blood, plasma, serum, cerebrospinal fluid, urine, faeces, pleural fluid, peritoneal fluid and semen.

MODULE-2. DISEASES RELATED TO METABOLISM (15 HRS.)

Carbohydrate Metabolism: Hypo and hyperglycemia, glycogen storage disease, DiabetesMellitus .GTT (Glucose Tolerance Test), galactosuria ,fructosuria.Amino Acid Metabolism: Phenyl Ketonuria, alkaptonuria, cystinuria, tyrosinemia, Albinism.Lipid Metabolism: Disorders of lipid metabolism- plasma lipoproteins, lipoproteinemias, fattyliver, hyper cholesterolemia, atherosclerosis.

MODULE-3. BLOOD ANALYSIS AND HEMATOLOGY: (15 HRS.)

Principles of estimation, normal values and clinical significance of the following parameters ofblood - glucose, hemoglobin, uric acid, lipid profiles, acid phosphatase,Na+, K+,Cl- andphosphate. Principles of determination, clinical significance of the following parameters- Totalcount, Differential count, Erythrocyte sedimentation rate, packed cell volume and prothrombintime.

MODULE-4. ORGAN FUNCTION TESTS: (18 HRS.)

Liver Function Test: Jaundice, Types, Clinical Features – Test based on bile pigments – plasmaproteins in health and diseases – PT, PTT, INR. Gastric Function Test: Examination of gastric residium, Kidney Function Test: Clearance test – Urea, Creatinine, PAH test, concentration and dilution tests. Normal and abnormal constituents of urine.

MODULE-5.CLINICAL ENZYMOLOGY (12 HRS.)

Isoenzymes and diagnostic tests. Enzyme pattern in health and diseases with special reference toplasma lipase, amylase, choline Esterase, SGOT, SGPT, LDH and CPK.

Reference:

1. Clinical Chemistry First Edition (1999), MN.Chatterjea ,Jaypee Publications.

2. Harpers Illustrated Biochemistry 26th Edition (2003) Robert K.Murray, DarnylK.Granner, Peter A.Mayes& Victor W.Rodwell, McGraw Hill.

3. A Handbook of Practical and Clinical Immunology 2nd ed G.P. Talwar and S.K. Gupta(eds) (2005) Publishers: CBS Publishers and distributors.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	8
II	15
III	15
IV	15
V	9

. Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER VI

6B13BCH METABOLISM II

Total hours of instruction: 72

Hours/Week: 4

Credit 4

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: Understand metabolic pathways.
CO 2: Comprehend lipid metabolism
CO 3: Understand nucleic acid metabolism.
CO 4Analyseporphyrin metabolism.

MODULE1: METABOLISM OF LIPIDS: (18 HRS.)

Introduction, hydrolysis of triacylglycerols, Synthesis oftriglycerides, transport of fatty acid into mitochondria, ß oxidationof fatty acids, ATP yield from fatty acid oxidation, De novo synthesis of fatty acids.. Metabolism of ketone bodies.

MODULE2: METABOLISM OF NUCLEIC ACID:(18HRS)

Purine and pyramidine metabolism.-biosynthesis and breakdown-salvage pathway

MODULE 3: XENOBIOTIC METABOLISM,(18 HRS)

Absorption and distribution-phase 1 reactions.oxidation,reduction,hydrolysis and hydration. Phase2 reaction/conjugation:methylation,glutathione and aminoacid conjugation-detoxification.

MODULE-4 METABOLIC REGULATION-(18 HRS)

Regulation of carbohydrate metabolism- Glycogen metabolism- TCA cycle regulation, Regulation of lipid metabolism-Regulation of fatty acid biosynthesis- Regulation of cholesterol biosynthesis-Regulation of fatty acid oxidation, Regulation of purine and pyrimidne biosynthesis.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	16
II	15
III	11
IV	10
V	10

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

REFERENCE

1. Nelson.D.L, Cox. M. M. Lehninger s Principle of Biochemistry. 5th ed. Freeman, 2008

2. Murray. R.K, Granner.D.K, Mayes. P. A, Rodwell. V. W. Harper s Biochemistry.

27th ed. McGraw Hill, 2006.

Suggested Reading:

1. Berg.J.M, Tymoczko.J.L, Stryer, L. Biochemistry. 6th ed. Freeman, 2006.

2. Zubay. Biochemistry. 4th ed. William C. Brown Publication, 1998

3. Voet and Voet. Biochemistry.4th edition, John Wiley, 2010

SEMESTER VI

6B14BCH Genetics

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

COURSE OUTCOME6B14BCH Genetics)

On successful completion of this course, students should be able to

CO 1: Understand basic principles of genetics.
CO 2: understand genetic engineering techniques.
CO 3: understand applications of r DNA technology.

MODULE 1(15 HRS.)

Introduction: Scope and importance of genetics, Brief explanation of the following terms- gene, alleles, genotype, phenotype, genome, homozygous and heterozygous, wild type and mutantalleles, dominant and recessive traits, test cross and back cross, reciprocal cross, Mendals laws ,Mendelian traits in man Chromosome theory of heredity. Gene interaction.

MODULE 2:(12 HRS.)

Linkage and crossing over, chromosomal mapping, Human genome project.Population genetics- gene pool, gene frequency, Hardy-Weinberg law, allele frequency, geneticDrift.Genetic disorders in Man Chromosomal anomalies Autosomal (eg.Downsyndrome) Sex chromosomal anomalies (Kline felters syndrome, and Turners syndrome) Autosomal single gene disorders (Sickle cell anaemia).

MODULE 3(15 HRS)
Introduction to genetic engineering..Restriction endonucleases, ligases. Gene transfer methods-physical, chemical and vector mediated methods-Vectors-properties. Plasmid vectors (pBR322, phage M13 and lamdavector, cosmid)

MODULE 4(15 HRS.)
Screening of recombinant cells-genetic methods, immunological method, nucleic acidhybridization, HRT & HART.

MODULE 5(15HRS.)
DNA sequencing methods, DNA amplification-PCR, DNA finger printing in forensic medicine, Applications of recombinant DNA technology for human welfare.
Gene therapy, types of gene therapy (somatic cell gene therapy, germ line gene therapy).
Transgenic animals and transgenic plants

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	10
II	6
III	15
IV	15
V	16

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

REFERENCE

1. A text book of Biotechnology,RCDubey, S Chand and Company Ltd, New Delhi.
2. Principles of Gene Manipulation and Genomics, by R.N Old, S B Primrose and ThymanBackwell Publishing, UK.
3. Biotechnology, B D Singh, KalyaniPublishers, New Delhi.
4. Genetics, P K Guptha, Rasthogi Publications, Meerut.
5. Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P S Vermaan, V KAgarwal (2008) Publisher: S Chand and Company Ltd.
6. Gene Cloning and DNA Analysis (fifth edition) T A Brown, Blackwell Publishing

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE COURSES

6B15BCH-A PHARMACEUTICAL CHEMISTRY

Total hours of instruction: 72

Hours/Week: 4.

COURSE OUTCOME (6B15BCH-A Pharmaceutical Chemistry)

On successful completion of this course, students should be able to

CO 1: Understand drug dosage and routes of administration.
CO 2: Understand mode of action of drugs.

MODULE-1: (15 HRS)

Introduction to pharmacology, sources of drugs, dosage forms & routes of administration. Classification of drugs based on sources: mode of administration, site of action, and absorption of drugs

MODULE-2:(15HRS)

Drugs distribution and elimination, Role of kidney in elimination Drug metabolism: chemical pathways of drug metabolism, Phase I and Phase II reactions, role of cytochrome P450.

MODULE-3: (12 HOURS)

Adverse responses and side effects of drugs: allergy, Drug intolerance, Drug addiction, drugs abuses and their biological effects.

MODULE-4: (15 HOURS)

Chemotherapy: General Principles of Chemotherapy: Chemotherapy of Parasitic infections-Tuberculosis, Leprosy, Malaria, Fungal infections, viral diseases.

MODULE- 5: (15HOURS)

Mode of action and uses of the following classes of Drug (structure not expected)Adrenocorticoids – Prednisolone, Dexamethasone, Betamethasone. Antibiotics-Penicillins, Semi-synthetic, penicillins, streptomycin, tetracyclines,ØCephalosporins,Chloramphenicol.

Reference:

1) Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: Jaypee Brothers

2) Organic Chemistry Vol-1 6th Edition (s) by FinarII (2008) Publisher: Dorling Kindersley

(India) Pvt Ltd

3) Principles Of Organic Medicinal Chemistry by Rama RaoNadendla (2004) Publisher: New Age International (p) Limited.

4) Basic & Clinical Pharmacology by Bertram G. Katzung (2006) Publisher: Mcgraw-hill Medical Publishing.

Suggested websites:

· www.drugbank.ca

· www.ccdc.cam.ac.uk/products/csd/

Marks including choice:

Unit	Marks
I	15
II	6
III	9
IV	16
V	16

Table 8. Type of questions & Marks for External Examination -

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

SEMESTER VI

6B15BCH-B ENDOCRINOLOGY

CREDIT 4

TOTAL HOURS OF INSTRUCTION-72

Hours/Week: 4.

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: familiarise different hormones of human body, function synthesis etc
CO 2: Understand hormonal imbalances and related disorders.

MODULE I (14 HOURS)

History of endocrinology, classification of hormones, over view of circulation. Target tissue feed backcontrol. Hormone receptors - general features, structure and regulation.Mechanism of hormone action. General classes of chemical messengers ,signal transduction - Role of plasma membrane receptors-G protein coupled receptors ,Receptor protein tyrosine kinase, Non Receptor protein tyrosine kinase, steroid hormone receptors, inositol phosphates and calcium**.**

MODULE II (11 HOURS)

Hypothalamus – hormones ,controle of hypothalamic –hypophysial hormone secretion

Pituitary gland –anatomy,anterior and posterior pituitary hormones

and their biological action and disorders .

MODULE III (12HOURS)

Thyroid gland –structure and function , thyroid hormones, biosynthesis and biological actions and it's disorders

Parathyroid gland –structure and function , parathyroid hormones: parathormone , calcitonin, calcitriol-biosynthesis and biological actions and it's disorders .regulation of calcium and phosphorus metabolism.

MODULE IV (19 HOURS)

Pancreas –endocrine parts of pancreas , pancreatic hormones-insulin ,glucagon and somatostatin-biosynthesis ,secretion ,regulation ,biological actions and it's disorders . insulin receptor – intracellular mediators , insulin signaling pathway.

Adrenal gland –adrenal cortex:glucocorticoids- mineralocortiocoidsbiosynthesis,secretion ,transport,metabolicfate and biological action and mechanism of action. adrenal medulla – epinephrine , norepinephrine , dopamine;biosynthesis,storage , metabolism ,regulation and it's biological actions .

MODULE V (16 HOURS)

Testes – structure , cell types ,spermatogenesis, steroidogenesis, endocrine controle of testicular function , biological actions of androgens and it's disorders.

Ovaries -structure , cell types ,ovarian cycle , ovarian steroid hormones , biological actions of ovarian steroid hormones and it's disorders.

Marks including choice:

Unit	Marks
I	15
II	6
III	9
IV	16
V	16

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

Reference:

1. MEDICAL BIOCHEMISTRY- Dr. M.N.Chattejee III Edition ,1998 JAYPEE BROTHERS ,Medica publishers (p) LTD ,New Delhi.
2. Human physiology-Guyton and Hall, Prism books (p) LTD , Bangalore.
3. Harpers biochemistry – Harper.

SEMESTER VI

6B15BCH-C COMPUTATIONAL TECHNIQUES IN BIOCHEMISTRY

Credit: 4
Total hours of instruction: 72
Hours/Week: 4.

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: Understand baic principles of computationl techniques.
CO 2: Understand applications of bioinformatics in lifescience

MODULE: 1 OVERVIEW OF INFORMATION TECHNOLOGY: (18 HRS)

Introduction to Computer, structural organization of computer, software, different types of software, hardware, Flow chart, operating system, different type of operating system, programming languages, Internet, TCP/IP address, WWW, HTTP, HTML & URLs

MODULE: 2 BASIC BIOINFORMATICS (17 HRS)
introduction to bioinformatics, its importance and scope, pattern recognition and prediction,data submission tools (webin, sequin, bankit)and data retrieval tools(dbget, biors),datamining of biological databases and its methods.

MODULE: 3. GENOME ANALYSIS (18HRS)
Comparative genomics- Sequence alignment and analysis, pairwise alignment (BLAST, flavors of BLAST& FASTA), MSA(ClustalW), scoring matrices, alignment algorithms, tools foralignment of sequences

MODULE: 4 APPLICATION OF BIOINFORMATICS (19HRS)
Docking, Molecular docking, Homology modeling, structure based drug designing.
Databases of drugs: drug bank, Cambridge structural database (CSD). Virtual screening, Application of bioinformatics in drug designing process
Reference

Ø www.drugbank.ca
Ø www.ccdc.cam.ac.uk/products/csd/
Reference:
1. Introduction to Bioinformatics: T.K. Attwood, D.J. Parry-Smith ,PEARSON Education Ltd.
2. Bioinformatics: Sequence and Genome analysis. David W. Mount
3. Bioinformatics: Genes, proteins and computers. C.A. Orengo, D.T.Jones and J.M. Thornton

Marks including choice:

Unit	Marks
I	10
II	10
III	15
IV	12
V	15

. Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	4	4	1	4
Short answer	10	7	2	14
Short essay/Problems	6	4	3	12
Essay	4	2	5	10
	24	17		40

GENERIC ELECTIVE COURSE

5D01BCH NUTRITIONAL BIOCHEMISTRY

Total hours of instruction: 36

Hours/Week: 2.

Module-I: (8 Hrs.)

Nutrition - Concepts of macro and micro nutrients, essential nutrients and their classification. Food as source of energy, physiological fuel value, and daily requirement of energy, high and low calorie diets, respiratory quotient, Basal metabolic rate
(BMR) factors affecting BMR.

Module-II: (10 Hrs.)

Nutritional aspects of the carbohydrates- Different dietary types, requirements, utilization and functions. Special role of the non starch polysaccharides.
Nutritional aspects of the lipids- Different dietary types, requirements, utilization and functions. Essential fatty acids.

Module-III: (8 Hrs.)

Nutritional aspects of the proteins- essential amino acids, nutritive value of proteins , amino acid imbalance, protein requirements, Protein Energy Malnutrition.

Module-IV: (10 Hrs.)

Balanced diet- Recommended dietary allowances for different categories of the human beings. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary/lifestyle modifications.

References:

1. Nutrition and dietetics Davidson S and Pasmor J.R

2. Essentials of food and nutrition M Swaminathan Vol. II, Applied aspects (1974), Ganesh Pub, Madras.

3. Food science B. Sreelakshmi

4. The text book of biochemistry (for medicalstudents) DM Vasudevan, Sreekumari S, JAYPEE Brothers New Delhi.

5. Food facts and principles - SakunthalaManay, Sadhakshara Swami.

6. Modern Nutrition Health and Diseases - Goodheart.

Marks including choice:

Unit	Marks
I	6
II	9
III	6
IV	9

Type of questions & Marks for External Examination

	Total Questions	No. OfQuestions to beanswered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	5	3	2	6
Short essay/Problems	5	3	3	9
Total	15	11		20

5D02BCH PLANT BIOCHEMISTRY

Total hours of instruction: 36

Hours /Week: 2.

Module-I: (8 Hrs.)

Photosynthesis : Ultrastructure and organisation of chloroplast membranes, light hartvesting complexes; mechanism of electron transport, photoprotective mechanisms; carbon dioxide fixation-C3,C4 and CAM pathways.

Module-II: (8 Hrs.)

Nitrogen Metabolism : Nitrogen fixation, nitrogenase complex and mechanism of action of nitrogenase. Molecularbiology of nitrogen fixation-nod, nif and fix genes.

Module-III: (10Hrs.)

Distinction between primary and secondary metabolites.

Importance of secondary metabolites-Protection of the producer plant from predators and insect.

A brief account of the following classes of secondary metabolites: Alkaloids, terpenoids, flavonoids, phenolics, steroids, quinines and acetylenes (Structures not necessary). Give examples of the compounds and the plants in which present and their importance.

Module-IV: (10Hrs.)

Uses of secondary metabolites to man as drugs, precursors of drugs in pharmaceutical industry, as natural pesticides/insecticides; other uses of secondary metabolites.

References:

1. Plant Metabolism: H.D. Kumar and H.N. Singh. Affiliated East-West Press Pvt. Ltd., New

Delhi, Madras, Hyderabad and Bangalore. (1993; 2nd edition)

2. Plant Biochemistry: P.M. Dey and J.B. Harborne. (Editors.) Harcourt Asia

PTE Ltd. Academic Press. (Indian Edition, 2000)

3. Plant Metabolism: D.T. Dennis, D.H. Turpin, D.D.Lefebvre and D.B. Layzell (Editors). Addison Wesley Longman Ltd., 2nd Edition, 1997

Marks including choice:

Unit	Marks
I	6
II	6
III	9
IV	9

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very shortanswer	5	5	1	5
Short answer	5	3	2	6
Short essay/Problems	5	3	3	9
Total	15	11		20

5D03BCH BIOMOLECULES OF LIFE

Total hours of instruction: 36

Hours /Week: 2.

MODULE 1(4 Hrs.)

An introduction to biochemistry –definition and scope of biochemistry

.**MODULE 2 (8 Hrs.)**

Crbohydrates- definition ,function and classification(with out structure)

MODULE 3(8 Hrs.)

Amino acids and proteins- 20 amino acid (without structure) E ssential and non essential amino acid.Classification of protein.

MODULE 4(8 Hrs.)

Lipids – definition- function and classicfication

MODULE 5(8 Hrs.)

Nucleic acid-Central dogma of molecular biology,nucleotide and nucleoside.Watson and crick model of DNA

References

1. J L Jain Text book of biochemistry,S. chand and company Ltd.NewDelhi.

2Text book of Biochemistry:E S West,W R Todd, H S Mason and J T Van Bruggen.

3. Lehninger's Principles of Biochemistry.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	6
II	6
III	6
IV	6
V	6

Type of questions & Marks for External Examination

	Total Questions	No. OfQuestions to beanswered	Mark for each Question	Total Marks
Very shortanswer	5	5	1	5
Short answer	5	3	2	6
Shortessay/Problems	5	3	3	9
Total	15	11		20

5D04BCH TOOLS AND TECHNIQUES IN BIOCHEMISTRY

Total hours of instruction: 36

Hours /Week: 2.

MODULE1: calorimeter-principle-beer lamberts law,phmeter,spectrophotometer- principle a nd application.(4 Hrs.)

Module2:Homogenizer,centrifuge,dialyser, principle and application(8 Hrs.)

Module3:Autoanalyser-principle and application.(8 Hrs.)

Module4:Chromatography-TLC,paper –principle and application(8 Hrs.)

Module5;Electrophoresis-agarose and PAGE-principle and application(8 Hrs.)

References:

1. Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand &Company .
2. A text book of Biophysics by R.N. Roy, New Central Book Agency Pvt. Ltd, Calcutta.
3. Biophysical Chemistry by Upadhyay, Upadhyay&Nath , Himalaya Publishing House, Bangalore.
4. Biophysics by Mohan Arora, Himalaya Publishing House, Bangalore.
5. Separation chemistry by R.pBudhiraja, New age international (P) Ltd, New Delhi.

Marks including choice:

Unit	Marks
I	6
II	6
III	6
IV	6
V	6

Type of questions & Marks for External Examination

	Total Questions	No. OfQuestions to beanswered	Mark for each Question	Total Marks
Very shortanswer	5	5	1	5
Short answer	5	3	2	6
Short essay/Problems	5	3	3	9
Total	15	11		20

5D05BCH ClinicalBiochemistry

Total hours of instruction: 36

Hours /Week: 2.

(36 Hrs.)

Module1; Basic concept of clinical biochemistry-collection of blood, plsma&serum,components of blood-normal values-blood grouping-principle and procedure(8 Hrs.)

Module2: Disease related to carbohydrayte metabolism –diabetes mellitus-hyper and hypoglycemia, fasting,random and post prandial blood sugar values,GTT.(10 Hrs.)

Module3 Diseases related to lipid metabolism.lipd profile-LDL,HDL,TG,atherosclerosis,fatty liver.

(8 Hrs.):

Module4;Organ function test-functions of liver-bilirubin,jaundice,importnce of LFT.functions of kidney-uea,creatine.imortance of RFT-,normal and abnormal constituents of urine.(10 Hrs.)

Reference:

1. Clinical Chemistry First Edition (1999), MN.Chatterjea ,Jaypee Publications.

2. Harpers Illustrated Biochemistry 26th Edition (2003) Robert K.Murray, DarnylK.Granner,

Peter A.Mayes& Victor W.Rodwell, McGraw Hill.

3. A Handbook of Practical and Clinical Immunology 2nd ed G.P. Talwar and S.K.

Gupta(eds) (2005) Publishers: CBS Publishers and distributors.

Marks including choice:

Unit	Marks
I	6
II	9
III	6
IV	9

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	5	3	2	6
Short essay/Problems	5	3	3	9
Total	15	11		20

SEMESTER III & IV

BIOCHEMISTRY PRACTICALS

3BO4BCH BIOCHEMISTRY PRACTICAL -1

PART I

Credit: 0

Hours/Week: 2.

1) Preparation of solutions:

a) Percentage solutions,

b) Molar solutions

c) Normal solutions

d) Preparation of buffers.

2) Standardization of pH meter

3) Measurements of pH of solutions using pH meters

4) Principles of colorimetry and verification of Beer-Lambert law.

5) Identification of different stages of mitosis and study of morphology of metaphase chromosomes from Onion root meristems.

References:

1) Practical Biochemistry: Plummer

2) Practical Biochemistry: K.E. Van Holde.

3) Introductory Practical Biochemistry (2001). Ed. S.K. Sawhney and Randhir Singh,

Narosa Publishing House, New Delhi.

4) Practical Biochemistry Sadasivam and Manickam.

5) The chemical analysis of food and food products: Morris B.Jacobs, CBS-New Delhi.

6) Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers,

Ludhiana.

3BO5BCH BIOCHEMISTRY PRACTICAL -II
PART I

Credit: 0
Hours/Week: 2.

1) Qualitative analysis of Carbohydrates: - Fehling's test, Benedict's test, Barfoed's test, Molisch's test, Bial's test, Seliwanoff test, Iodine test, Osazone test.
2) Qualitative analysis of Amino acid: - Million's test, Xanthoproteic reaction, Pauly's test, Sakaguchi reaction, Sulphur reaction, Ninhydrin, Biuret.
3) Verification of Beer- Lambert's Law.
4)Quantitative tests
i) Estimation of Glucose
ii Estimation of Amino acid
iii) Estimation of reducing sugars
iv) Estimation of Protein
v) Estimation of Cholesterol

References:

1. Practical Biochemistry: Principles and techniques: K. Wilson and J. Walker.
2. Practical Biochemistry by David Plummer
3. Introductory Practical Biochemistry by S.K. Sawhney and R.Singh.
4. Biochemical methods by S.Sadasivan, A.Manickam, New Age international publishers.

SEMESTER IV

4BO4BCH BIOCHEMISTRY PRACTICAL-I
PART II

Credit: 3

Hours/Week: 2

1) Assay of salivary amylase activity in saliva.
2) Calculation of specific activity of acid phosphatase .
3) Effect of enzyme concentration on salivary amylase enzyme activity.
4) Effect of substrate concentration on salivary amylase activity and determination of its Km value.
5) Effect of pH on enzyme activity and determination of optimum pH.
6) Effect of Temperature on Enzyme activity.

*Enzyme Assay: Enzyme can be extracted from:

Ø ß - amylase from Sweet potato (*Ipomoea batates*)
Ø Catalase from Bovine /Porcine liver
Ø Urease from Horse gram.

References:

1. Introductory Practical Biochemistry by S.K.Sawhney& R. Singh (2000). Narosa Publishers
2. Practical Biochemistry by David Plummer (1990). Tata Mc-Graw Hill
3. Biochemical Methods by Sadasivam&Manickam (1996) New Age International (P) Ltd.
4. Modern Experimental Biochemistry, 3rd edition, by R. Boyer (2002) Addison-Wesley Longman.
5. A Lab. Manual in Biochemistry by J. Jayaraman (1996) New Age International (P) Ltd.

SEMESTER IV

4BO5BCH BIOCHEMISTRY PRACTICAL- II
PART II

Credit: 4
Hours/Week: 2.

1Qualitative analysis of lipids
Cholesterol,Glycerol
2. Separation of amino acids and sugars using paper chromatography
3. Separation of amino acids and sugars using thin layer chromatography
4. Separation of proteins by agarose gel electrophoresis (Demonstration)
5. Estimation of reducing sugars by dinitrosalicylate method
6. Determination of fructose by Roe's resorcinol method
7. Determination of saponification value of fats
8. Determination of iodine number of oil
.

References:

1. Practical Biochemistry: Principles and techniques: K. Wilson and J. Walker.
2. Practical Biochemistry by David Plummer
3. Introductory Practical Biochemistry by S.K. Sawhney and R.Singh.
4. Biochemical methods by S.Sadasivan, A.Manickam, New Age international publishers.
5. Modern Experimental Biochemistry, 3rd edition, by R. Boyer (2002) Addison-Wesley Longman.
6. A Lab Manual in Biochemistry by J. Jayaraman (1996) New Age International (P) Ltd.

SEMESTER V & VI

SEMESTER V
5B11BCH BIOCHEMISTRY PRACTICAL III
PART I

Credit: 0

Hours/Week: 3

1. Experiments on saliva :Digestion of starch by salivary amylase
2. Estimation of protein –Bradford's method.
3. Demonstration of Enzyme linked immunosorbant assay (ELISA)-dot ELISA
4. Purification of proteins by ammonium sulfate precipitation
5. Dialysis for protein purification.
6 Total count of RBC using haemacytometer.
7. Differentialcont of WBC using haemocytometer
8. Determination of human blood group antigens.
9. Determination of human blood Rh antigen

SEMESTER V
5B12BCH BIOCHEMISTRY PRACTICAL IV
Part I

Credit: 0
Hours /Week : 4

Biochemical analysis of blood;

1. Quantitative estimation of glucose
2. Urea
3. total protein
4. cholesterol
5. Creatinine
6. bilirubin (Conjugated and unconjugated)

Serum enzyme analysis

7. Quantitative estimation of AST
8. ALT
9. ALP

SEMESTER VI
6B11BCH BIOCHEMISTRY PRACTICAL III
PART II

Credit: 4
Hours/Week: 5

1. Separation of photosynthetic pigments using TLC
2. Immuno electrophoresis-Double immunoelectrophoresis(demo only)
3. Widal test
4. Determination of free amino acid content in germinating seeds.
5. Estimation of DNA by diphenylamine method.
6. Estimation of RNA by resorcinol method.
7. Estimation of vitamin –A
8. Estimation of ascorbic acid in Lemon juice

References:

1) Introductory Practical biochemistry, S. K. Sawhney&Randhir Singh (eds) Narosa Publishing House, New Delhi.
2) Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers,Ludhiana .
3) Practical biochemistry,R.C. Guptha,S.Bhargava,CBS publishers, New Delhi.
4) Biochemical Methods by Sadasivam&Manickam (1996) New Age International (P) Ltd.
5) A Handbook of Practical and Clinical Immunology 2nd ed G.P. Talwar and S.K. Gupta (eds) (2005) Publishers: CBS Publishers and distributors.

SEMESTER VI 6B12 BCH BIOCHEMISTRY PRACTICAL IV
PART II

Credit: 3

Hours /Week:4

Biochemical analysis of urine;
1. Heat& acetic acid test
2. Benedict's test
3. Fouchet's test
4. Hay's test

Hematology;
5. Determination of hemoglobin
6. Erythrocyte sedimentation rate
7. Clotting time.
8 **Liver function test-SGPT & SGOT**
9 **Paper electrophoresis of serum proteins.**
10 **Transformation and selection of transformed cells (demo only)**
(Conduct Practicals related to elective paper)

References:

1) Introductory Practical biochemistry, S. K. Sawhney&Randhir Singh (eds) Narosa Publishing House, New Delhi.
2) Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers,Ludhiana .
3) Practical biochemistry,R.C. Guptha,S.Bhargava,CBS publishers, New Delhi.
4) Biochemical Methods by Sadasivam&Manickam (1996) New Age International (P) Ltd.
5) A Handbook of Practical and Clinical Immunology 2nd ed G.P. Talwar and S.K. Gupta (eds) (2005) Publishers: CBS Publishers and distributors.

VIVA VOCE

Viva voce examination based on practical will beconducted along with every practical examination.

STUDY TOUR

Students are required to visit atleastone Laboratory/ factory/ Research Institute of eminence during the course and submit the Study tour report separately along with practical

Records at the time of practical Exam (6^{th} semester)

PROJECT REPORT:

Students should undertake a group project work related to chemistry and submit the report along with practical records during VI semester practical.

General Guidelines of Project Work

1. Students should undertake the project work related to Biochemistry only.
2. The UG level project work is a group activity, maximum number of students being limited to five. However each student should prepare and submit the project report separate.

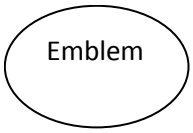
3. The matter should be typed on A-4 size paper with Times New Roman font of size 12 points, with double spacing between the lines and margins of 1.5' at the left, 1'at the right,1'each at the top and bottom.

4. Thereport should be printed in plain white paper in black ink only. Color inks for charts and graphs can be used, provided it does not hamper the readability. The logo of the college can be displayed in the report.

5 The project report should be hardbound/ spiralbound/ paperback.

Format of the Project Report

Title



Name of the student

Department

College

Month & Year

Emblem

Submitted to Kannur University in partial fulfillment

for the B.Sc Degree (Biochemistry)

By

Name of the student

Reg. No.

Name & Designation Project Guide:

Signature and Name of Head of the Dept.

Examiners

PageI:Certificate(ByProjectGuide)

Page2:Declaration(Bystudent)

Page3.Acknowledgement

Page4.Contents

SEMSTER I

Degree(CBCSS-Regular/Supple./Improvement) Examination

1B01BCH -BIOMOLECULES I

Time:: 3Hrs Maximum Marks: 40

SECTION A

Answer **all**the questions. Each carries **one** mark.

1. What are steroids?

2. Explain the term acid number?

3. Give any 2 example for buffer

4. Define PH(4×1=4)

SECTION B

Answer **any seven** questions. Each carries **two** marks.

5. Give note on physical and chemical property of water

6. what are disaccharides ,give example

7. Define normality

8. Define saponification number

9. What are epimers

10. Draw the structure of cholesterol

11. Define mutarotation

12. Give note on structure and function of heparin

13. Define Pka

14. Write the structure of maltose (7×2=14)

SECTION C

Answer any**four** questions. Each carries **three** marks.

15. Give a brief note on heteropolysaccharides

16. Give notes on role of water in life

17. Describe phospholipids

18. Give notes on essential fatty acids and give example

19. Write a short note on structure and function of starch

20. Explain Hydrogen bond. (4×3=12)

SECTION D

Answer any **two** questions. Each carries **five** marks.

21. Derive Henderson -Hasselbalch equation and give it's application.

22. Discuss about classification of carbohydrates.

23. Give a brief account on the classification of lipids

24. Discuss about the role and scope of biochemistry. (2×5=10)

SEMSTER II

Degree(CBCSS-Regular/Supple./Improvement) Examination

2B02BCH -BIOMOLECULES II

Time:: 3Hrs Maximum Marks: 40

SECTION A

Answer **all**the questions. Each carries **one** mark.

1. Explain the term provitamin

2. Name the functionaly active form of vitamin D

3. Give any 2 example for non essentialaminoacid

4. Define nucleoside(4×1=4)

SECTION B

Answer **any seven** questions. Each carries **two** marks.

5. Give note on nucleotides

6. what are aromatic acids

7. Explain the structural components of DNA

8. Give note copper

9.Explain the chemical nature of biotin

10. Give note on basicaminoacids

11. Give note on essential aminoacids and give example

12. Give note on biochemical functions of niacin

13. What are purines ,write the structure

14. Write the structure of phenylalanine (7×2=14)

SECTION C

Answer any**four** questions. Each carries **three** marks.

15. Give a brief note on denaturation of nucleic acid

16. Give note vitamin A

17. Describe phosphodiester bond

18. Give note on side chain reactions of aminoacids

19.Whatarethefeaturesofpeptidebond?

20. Give account on forces stabilising the structure of protein

(4×3=12)

SECTION D

Answer any **two** questions. Each carries **five** marks.

21 Give a brief account on the classification of aminoacids

22. Discuss about classification of protein with example

23. Give a brief account on the classification and function of vitamins

24. Discuss about thefunctionand dietary source of macrominerals (2×5=10)

K A N NU R U N I V E R S I T Y
COURSE STRUCTURE
&
SYLLABUS FOR BIOCHEMISTRY
(COMPLEMENTARY ELECTIVE COURSE)
UNDER CHOICE BASED CREDIT SEMESTER SYSTEM

Scheme--- Complementary ElectiveCourse (Biochemistry)

SEMESTER I

1C01BCH Biochemistry –I

Hours/week:4

Total hours of instruction: 72

Credits:2

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: State the definition and branches of Biochemistry

CO2: Understand the nature of biomolecules and analyse the structure of carbohydrates

CO3: Summerisestructure ,isomerism and functions of different biomeolecules.

CO4: Analyze importance of water.

CO5: Understand the fundamental concepts ,principle and processes underlying in the field of biochemistry,its different subfield and its link with related disciplinary areas/subject.

MODULE 1:INTRODUCTION TO BIOCHEMISTRY(15hrs)

Definition-Branches of Biochemistry,brief study of the foundations of biochemistry(cellular,chemical and physical foundations-fundamental study only).Biochemistry as a molecular logics of living organism.Role and scope of Biochemistry.

MODULE 2 WATER THE SOLVENT OF LIFE:(15Hrs)

Water- introduction,physical properties of water,structure of water molecules,role of water in life.pH,phscale,buffer, Henderson and Hasselblachequation,biological buffer system .

MODULE 3 SOLUTIONS (15 Hrs)

Solutions:truesolution,colloidal solution and suspensions, normality ,molarity ,molality.simple numerical problems.

MODULE 4 BIOMOLECULES (15 hrs)

Carbohydrates-Classification, Occurrence; Structure and function of monosaccharides, oligosaccharides and polysaccharides.

MODULE 5VITAMINS-**(12hrs)**

Fat soluble and water soluble-source and function (without structure)

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	8
II	12
III	5
IV	17
V	10

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

SEMESTER II

2C02BCH Biochemistry –II

Hours/week:4

Total hours of instruction: 72

Credits:2

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: State the definition and branches of Biochemistry

CO2: analyze the structure of aminoacids and proteins

CO3: Comprehend the nature of biomolecules and analyse the structure of lipids

CO4: Analyse the nature and structure of nucleic acids

Module I (12 Hrs)

Amino acids:-general structure of aminoacids,Classification of aminoacids based on composition of side chain,polarity.essentialaminoacids, amphoteric property of amino acids, peptide formation,role of peptides.

Module II PROTEIN (15 Hrs)

Classification based on source,shape,biological function, composition and solubility .

Module IIILIPIDs(15Hrs)

Importance,definition,Classification of lipids- simple ,compound and derived lipids

Essential fatty acids and its importance.

Module IV NUCLEIC ACIDS(17 Hrs)

Introduction,definition,types,structural components of DNA&RNA, Nucleosides and nucleotides,Watson and Crick model of DNA. Different forms of DNA.RNA-An account of their structure and function(rRNA,mRNA,t RNA).

Module V BIOCHEMICAL TECHNIQUES (13Hrs)

Homogenization, centrifugation,chromatography-adsorption and partition

(TLC, Paper,GC,HPLC).Electrophoresis,colorimeter& spectrophotometer

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	10
II	10
III	12
IV	12
V	8

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

SEMESTER III

3CO3BCH Biochemistry –III

Hours/week:3

Total hours of instruction: 54 Hours

Credits:2

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1:Understand the basic principles of metabolism.
CO 2: Understand carbohydrate metabolism and its regulation.
CO 3: Understand protein metabolism.
CO 4: Understand porphyrin metabolism.

Module 1 (10Hrs)

Principles of bioenergetics-bioenergetics and thermodynamics. Entropy-standard free energy

change and equilibrium constant-phosphorylated compounds and thioesters-ATP

energetics. Module 2 (10Hrs)

Metabolism-definition, major enzymes,reactionsteps,energetic and regulation involved in carbohydratemetabolism:Glycolysis, citric acid cycle,gluconeogenesis ,glycogenesis and glycogenolysis.oxidative phosphorylation-ETC

Module 3 (10Hrs)

Metabolism of amino acids- transamination,oxidativedeamination.urea cycle

Outline study of non essential amino acids biosynthesis and breakdown (without structure)

Module 4 (12Hrs)

Biosynthesis and breakdown of nucleotides. Salvage pathway(without structure)

Module 5(12Hrs)

Fatty acids metabolism-transport of fatty acid ,betaoxidation,Denovo pathway of biosynthesis of fatty acid and its regulation.

Distribution of Marks for External Examinations

Marks including choice:

Unit	Marks
I	11
II	15
III	10
IV	8
V	8

.Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

SEMESTER IV

4C04BCH Biochemistry –IV

Hours/week:3

Total hours of instruction: 54

Credits:2

COURSE OUTCOME

On successful completion of this course, students should be able to

CO 1: Understand the basic features of enzymes.
CO 2:Comprehend different classes of enzymes,enzyme activity etc.
CO 3: Understand expression of enzyme action
CO 4: Explain the application of enzymes in different fields.

Module 1(12hrs)

Introduction to Enzymes:-holo enzyme , apo enzyme, IUB classification and nomenclature of enzymes(class and subclass with one example),biological roles of enzymes,specificity of enzyme action,Cofactors and coenzymes, active site –intraction between enzyme and substrate -lock and key model, induced fit model,Factors effecting enzyme activity. diagnostic andtheraputic enzymes(brief study of name of enzyme and role in diagnosis and therapy)

Module 2(18hrs)

Enzyme kinetics. Energy mechanics of enzymatic reactions ,the MM equation-LB plot,types of inhibition and change in enzyme kinetics reference to inhibition. allosteric enzymes-aspartyltranscarbamylaseas an allosteric enzyme ,Brief study of activation of zymogen form of enzyme with eg as chymotrypsin.

Module 3(10hrs)

Hormonal Biochemistry- animal hormone- definition- steroid hormones,peptide hormones and aminoacid hormones-structure,biosynthesis,functions of following estrogen,testosterone, ,insulin,glucagone,thyroid hormones,

Module 4(14hrs)

Plant biochemistry:Plant hormones- definition,biosynthesis,physiological roles of following auxins,gibberellins,cytokininins,ethylene.

Marks including choice:

Unit	Marks
I	16
II	16
III	10
IV	10

Type of questions & Marks for External Examination

	Total Questions	No. Of Questions to be Answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

4C05BCH Biochemistry (Practical)-I

Hours/week:2

Credits:0

1. Determination of pH of a solution by using pH paper and pH meter.

2. Preparation of different buffers-phosphate buffer, citrate buffer, acetate buffer

3. To prepare molar,normal and percentage solution.

4. Qualitative analysis of carbohydrates.

General reaction of carbohydrates – molisch's test, benedict's test alkaline picrate, barfoed'stest,Seliwanoff'sNylandar's test ,Fehling's test and Osazone test. Glucose, fructose,lactose,maltose

5. Qualitative analysis amino acids- Ninhydrin, xanthoproteic test, millon's test

glyoxilic acid test, nitroprusside test, folin-phenol test,Sakaguchi's test.-arg,tyr,phe,cysetc

6. Paper chromatography of amino acids

7. Separation of aminoacids by TLC.

8. Kunhe's fermentation experiment(demo).

9. Experiment to show anaerobic respiration(demo).

4C05BCH Biochemistry (Practical)-II

Hours/week:2

Credits:4

1. Quantitative analysis of sugars in given solution.
2. Estimation of protein by Lowry's method
3. Determination of A/G ratio in serum.
4. Estimation of proteins by biuret method
5. Qualitative Assay of salivary enzymes.
6. Determination of Urea
7. Determination of creatine
8. Determination of hemoglobin in blood.
9. Estimation of ascorbic acid in orange juice.
10. Estimation of reducing sugar

I SEMESTER B.ScDegree(C.B.C.S.S.-Reg./Supple./Improv.)

Examination,November

COMPLEMENTARY ELECTIVE COURSE IN BIOCHEMISTRY

1C01BCH: Biochemistry -1

Time : 3 Hours Max Marks:32

SECTION -A

Answer all questions. Each carries 1 mark.

1. Define epimer.

2. What is a colloidal solution?

3. Define solvent.

4. What are anomers?

5. Define true solution.

SECTION-B

Answer any four of the following. Each question carries 2 marks.

6. Explain about vitamin A.

7. What is PPL.

8. Difference between molarity and molality.

9. Write about disaccharides.

10. What is the function of vitamin E?

11. Define pH scale.

SECTION-C

Answer any three of the following. Each question carries 3 marks.

12. Explain about the function of carbohydrate.

13. Derive HH equation.

14.Explain about the various branches of Biochemistry.

15.What is DL isomer?

16. Explain about the deficiency of fat soluble vitamins.

SECTION-D

Write an essay on any two of the following. Each question carries 5 marks.

17. Write in detail about the source and function of water soluble vitamins.

18. Explain about heteropolysaccharides with examples.

19. Explain about biological buffer.

20. Write about the role and scope of Biochemistry.

Sd/-

Chairman, Board of Studies in Chemistry (UG)