

SRI SANKARA ARTS AND SCIENCE COLLEGE

(Autonomous)

DEPARTMENT OF BIOCHEMISTRY

BACHELOR DEGREE COURSE IN BIOCHEMISTRY

CHOICE BASED CREDIT SYSTEM (CBCS)

(With effect from the academic year 2020-2021)

REGULATIONS

1. DURATION OF THE PROGRAMME

1.1 Three years (six semesters)

1.2 Each academic year shall be divided into two semesters. The odd semesters shall consist of the period from June to November of each year and the even semesters from December to May of each year.

1.3 There shall be not less than 90 working days for each semester.

2. ELIGIBILITY FOR ADMISSION

2.1 Candidate for admission to the first year of B.Sc. Degree Course in Bio-Chemistry shall be required to have passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry.

3. CREDIT REQUIREMENTS AND ELIGIBILITY FOR AWARD OF DEGREE

3.1 A Candidate shall be eligible for the award of the Degree only if he/she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than three academic years and passed the examinations of all the Six Semesters prescribed earning a minimum of **140 credits as per the distribution given in Regulation for Part I, II, III, IV & V** and also fulfilled such other conditions as have been prescribed thereof.

4. COURSE OF STUDY, CREDITS AND SCHEME OF EXAMINATION

4.1 The Course Components and Credit Distribution shall consist of the following:

(Minimum Number of Credits to be obtained)

Course Component	Name of the Course	Credits allotted for Four Semester Language Papers *
PART I	Tamil or Other Languages	12
PART II	English	12
PART III	Core Courses	60
	Allied Courses	20
	Project/ Three Elective Courses	15
PART IV	i. Basic Tamil/ Advanced Tamil/ NME	04
	ii. Soft Skill Courses	12
	iii. Environmental Studies	02
	iv. Value Education	02
PART V	Extension Activities	01
Total Credits		140

4.2 DETAILS OF COURSE OF STUDY OF PARTS I – V

4.2.1 PART I: Tamil and Other Languages: Tamil or Sanskrit (Classical language) at the option of candidates and according to the syllabus and text-books prescribed from time to time:

4.2.2 PART II: English: According to the syllabus and text-books prescribed from time to time

4.2.3 PART III: Core, Allied and Project/Three Elective Courses: As prescribed by the concerned Board of Studies

4.2.4 PART IV:

i. Basic Tamil/ Advanced Tamil/ NME:

- a. Students who have not studied Tamil up to XII STD and have taken any Language other than Tamil in Part I shall take Basic Tamil comprising of Two Courses (level will be at 6th Standard).
- b. Students who have studied Tamil up to XII STD and have taken any Language other than Tamil in Part I shall take Advanced Tamil comprising of Two Courses.
- c. Students who have studied Tamil up to XII STD and also have taken Tamil in Part I shall take Non-Major Elective comprising of Two Courses.

ii. Soft Skill Courses

iii. Environmental Studies

iv. Value Education

4.2.5 PART V: Extension Activities:

Students shall be awarded a maximum of 1 Credit for Compulsory Extension Service. All the Students shall have to enroll for NSS /NCC/ NSO (Sports & Games) Rotract/ Youth Red Cross or any other Service Organizations in the College and shall have to put in compulsory minimum attendance of 40 hours which shall be duly certified by the Principal of the College before 31st March in a year. If a student lacks 40 hours attendance in the first year, he or she shall have to compensate the same during the subsequent years.

Those students who complete minimum attendance of 40 hours in one year will get 'half-a- credit and those who complete the attendance of 80 or more hours in Two Years will get 'one credit'. Literacy and Population Education and Field Work shall be compulsory components in the above extension service activities.

4.2.6. SCHEME OF EXAMINATIONS
SEMESTER - I

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part –I - Language Paper -I	3	25	75	100
Part –II - English Paper -I	3	25	75	100
Part-III Core Paper-I: Nutritional Biochemistry	5	25	75	100
Allied Paper- I	3	25	75	100
Part-IV * Basic Tamil/Adv. Tamil/ Non Major Elective -I: Medicinal Chemistry	2	25	75	100
Soft Skills –I	3	50	50	100

SEMESTER - II

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part –I – Language Paper -II	3	25	75	100
Part –II - English Paper –II	3	25	75	100
Part-III Core Paper -II: Cell Biology	5	25	75	100
Core Paper – III: Core Practical –I	4	40	60	100
Allied paper- II	3	25	75	100
Allied Practical –I &II	4	40	60	100
Part-IV * Basic Tamil/Adv. Tamil/ Non Major Elective -II: Human diseases and Preventive Aspects	2	25	75	100
Part-IV Soft Skills –II	3	50	50	100

* (a) Non-Tamil Students up to XII Std must studied “Basic Tamil” comprising of two course in degree level

(b) Tamil Students up to XII Std, taken Non-Tamil Language under Part-I at degree level, shall be taken “Advanced Tamil” comprising of two courses.

(c) Tamil Students up to XII Std and taken Tamil under Part-I Language at degree level, shall be choose “Non- major Electives” at degree level

SEMESTER - III

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part –I – Language Paper -III	3	25	75	100
Part –II – English Paper -III	3	25	75	100
Part-III Core paper-IV: Chemistry of Biomolecules I	5	25	75	100
Allied paper- III	3	25	75	100
Part-IV Soft Skills –III	3	50	50	100

SEMESTER – IV

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part –I - Language Paper -IV	3	25	75	100
Part –II - English Paper -IV	3	25	75	100
Part-III Core paper-V: Chemistry of Biomolecules- II	5	25	75	100
Core Paper VI : Core Practical II	4	40	60	100
Allied paper- IV	3	25	75	100
Allied Practical –III & IV	4	40	60	100
Part-IV- Environmental Studies	2	25	75	100
Soft Skills-IV	3	50	50	100

SEMESTER - V

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part-III Core Paper-VII: Enzymes	5	25	75	100
Core Paper -VIII: Metabolism	5	25	75	100
Core Paper-IX: Analytical Biochemistry	5	25	75	100
Core Elective Paper -I: Human Physiology	4	25	75	100
Part-IV- Value Education	2	25	75	100

SEMESTER -VI

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part-III Core Paper-X: Clinical Biochemistry	5	25	75	100
Core Paper -XI: Molecular Biology	5	25	75	100
Core Paper XII – Core Practical III	4	40	60	100
Core Paper XIII – Core Practical IV	4	40	60	100
Core Elective Paper II : Immunology	5	25	75	100
Core Elective Paper III: Biotechnology	4	25	75	100
Part-V Extension Activity	1			

4.3 Inclusion of the Massive Open Online Courses (MOOCs) available on SWAYAM and NPTEL

4.3.1 Students can choose the MOOC course available on SWAYAM and NPTEL under Core, Elective or Soft Skill category. He/she will be awarded degree only after producing valid certificate of the MOOC course for credit mobility.

5. INSTRUCTIONAL (TEACHING) HOURS

5.1. For First, Fourth Second, Third and semesters:

Course	B. Sc Biochemistry
Language	4 + 2 hours *
English	4 + 2 hours @
Core Course I	5hours Theory 3hours Practical
Core Course II	-
Allied Course	
NME Course	2 hours
Total	30 hours

* 2 hours for Part IV Basic Tamil/ Advanced Tamil/ Non-Major Elective Courses

@ 2 hours for Soft Skills Courses.

5.2. For Fifth and Six Semesters:

Course	B.Sc Biochemistry
Core Course (each)	6 hours
Elective Course (each)	5 hours

6. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER

6.1 Eligibility: Students shall be eligible to go to subsequent semester only if they earn sufficient attendance as prescribed by the Syndicate from time to time.

6.2 Attendance: All Students must earn 75% and above of attendance for appearing for the University Examination. (Theory/Practical)

6.3 Condonation of shortage of attendance: If a Student fails to earn the minimum attendance (Percentage stipulated), the Principal shall condone the shortage of attendance up to a maximum limit of 10% (i.e. between 65% and above and less than 75%) after collecting the prescribed fee of Rs.250/-each for Theory/Practical examination separately, (Theory Rs.250/- Per semester/Per Student: Practical Rs.250/- Per semester/Per Student) towards the condonation of shortage of attendance. Such fees collected and should be remitted to the college.

6.4 Non-eligibility for condonation of shortage of attendance: Students who have secured less than 65 % but more than 50 %of attendance are NOT ELIGIBLE for condonation of shortage of attendance and such Students will not be permitted to appear for the regular examination, but will be allowed to proceed to the next year/next semester of the program and they may be permitted to take next University examination by paying the prescribed condonation fee of Rs.250/- each for Theory/Practical separately. Such fees shall be remitted to the College. Name of such Students should be forwarded to the Principal along with their attendance details in the prescribed format mentioning the category (3 copies) Year wise/Branch wise/Semester wise together with the fees collected from them, so as to enable them to get permission from the College and to attend the Theory/Practical examination subsequently without any difficulty.

6.5 Detained students for want of attendance: Students who have earned less than 50% of attendance shall be permitted to proceed to the next semester and to complete the Program of study. Such Students shall have to repeat the semester, which they have missed by rejoining after completion of final semester of the course, by paying the fee for the break of study as prescribed by the College from time to time.

6.6 Condonation of shortage of attendance for married women students: In respect of married women students undergoing UG programs, the minimum attendance for condonation (Theory/Practical) shall be relaxed and prescribed as 55% instead of 65% if they conceive during their academic career. Medical certificate from the Doctor (D.G.O) attached to the Government Hospital and the prescribed fee of Rs.250/- therefore together with the attendance details shall be forwarded to the College to consider the condonation of attendance mentioning the category.

6.7 Zero Percent (0%) Attendance: The Students, who have earned 0% of attendance, have to repeat the program (by rejoining) without proceeding to succeeding semester and they have to obtain prior permission from the College immediately to rejoin the program.

6.8 Transfer of Students and Credits: The strength of the credit system is that it permits inter Institutional transfer of students. By providing mobility, it enables individual students to develop their capabilities fully by permitting them to move from one Institution to another in accordance with their aptitude and abilities.

6.8.1 Transfer of Students is permitted from one Institution to another Institution for the same program with same nomenclature.

Provided, there is a vacancy in the respective program of Study in the Institution where the transfer is requested.

Provided the Student should have passed all the courses in the Institution from where the transfer is requested.

6.8.2 The marks obtained in the courses will be converted and grades will be assigned as per the College norms.

6.8.3 The transfer students are eligible for classification.

6.8.4 The transfer students are not eligible for Ranking, Prizes and Medals.

6.8.5 Students who want to go to foreign Universities upto two semesters or Project Work with the prior approval of the Departmental/College Committee are allowed to get transfer of credits and marks which will be converted into Grades as per the University norms and are eligible to get CGPA and Classification; they are not eligible for Ranking, Prizes and Medals.

6.9 Students are exempted from attendance requirements for online courses of the College and MOOCs.

7. EXAMINATION AND EVALUATION

7.1 Register for all subjects: Students shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester Examination. For this purpose, Students shall register for all the arrear subjects of earlier semesters along with the current (subsequent) Semester Subjects.

7.2 Marks for Internal and End Semester Examinations for PART I, II, III, and IV

Category	Theory	Practical
Internal Assessment	25	40
End semester (University) Examination	75	60

7.3 Procedure for Awarding Internal Marks

Course	Particulars	Marks
Theory Papers	Tests (2 out of 3)	10
	Attendance	05
	Seminars	05
	Assignments	05
	Total	25
Practical Papers	Attendance	05
	Test best 2 out of 3	30
	Record	05
	Total	40
Project	Internal Marks (best 2 out of 3 presentations)	20
	Viva-Voce	20
	Project Report	60
	Total	100

7.4 (i) Awarding Marks for Attendance (out of 5)

- Below 60% = 0 marks,
- 60 % to 75% = 3 marks,
- 75 % to 90% = 4 marks
- Above 90%= 5 marks

(ii) Conducting Practical and Project Viva-voce Examination:

By Internal and External Examiners

7.4.1 Improvement of Internal Assessment Marks.

- (a) Should have cleared end-semester University examination with more than 40% Marks in UG.
- (b) Should have obtained less than 30% marks in the Internal Assessment
- (c) Should be permitted to improve internal assessment within N+2 years where N is denoted for number of years of the programme.
- (d) Chances for reassessment will be open only for 25% of all core courses in Colleges and only one chance per course will be given.
- (e) The reassessment may be based on a written test / assignment or any other for the entire internal assessment marks.

Question Paper Pattern for End Semester (University) Examination

SECTION – A			
10 questions out of 12 Questions	30 words	10 X 2	20 Marks
SECTION – B			
5 questions out of 7 Questions	200 words	5 X 5	25 Marks
SECTION – C			
3 questions out of 5 Questions	500 words	3 X 10	30 Marks
Total			75 Marks

7.6 PASSING MINIMUM

7.6.1 There shall be no passing minimum for Internal.

7.6.2 For external examination, passing minimum shall be 40% [Forty Percentage] of the maximum marks prescribed for the paper for each Paper/Practical/Project and Viva-Voce.

7.6.3 In the aggregate [External/Internal] the passing minimum shall be of 40%.

7.6.4 He/She shall be declared to have passed the whole examination, if he/she passes in

all the papers and practical wherever prescribed as per the scheme of the examinations by earning **140 CREDITS** in PartI, II, III, IV & V. He/she shall also fulfil the extension activities prescribed earning a minimum of 1 credit to qualify for the Degree.

7.7 INSTANT EXAMINATION: Instant Examinations is conducted for the students who appeared in the final semester examinations. Eligible criteria for appearing in the Instant Examinations are as follows:

7.7.1 Eligibility: A Student who is having arrear of only one theory paper in the current final semester examination of the UG Degree programme alone is eligible to appear for the Instant Examinations.

7.7.2 Non-eligibility for more than one arrear paper: A Student who is having more than one arrear paper at the time of publication of results is not eligible to appear for the Instant Examinations.

7.7.3 Non-eligibility for arrear in other semester: Student having arrear in any other semester is not eligible and a Student who is absent in the current appearance is also not eligible for appearing for the Instant Examinations and those Student who have arrear in Practical/Project are not eligible for the Instant Examinations.

7.7.4 Non-eligibility for those completed the program: Students who have completed their Program duration but having arrears are not eligible to appear for Instant Examinations.

7.8 RETOTALLING, REVALUATION AND PHOTOCOPY OF THE ANSWER SCRIPTS:

7.8.1 Re-totalling: All UG Students who appeared for their Semester Examinations are eligible for applying for re-totalling of their answer scripts.

7.8.2 Revaluation: All current batch Students who have appeared for their Semester Examinations are eligible for Revaluation of their answer scripts. Passed out candidates are not eligible for Revaluation.

7.8.3 Photocopy of the answer scripts: Students who have applied for revaluation can

download their answer scripts from the College Website after fifteen days from the date of publication of the results.

7.9 The examination and evaluation for MOOCs will be as per the requirements of the Courses and will be specified at the beginning of the Semester in which such courses are offered and will be notified by the College

8. CLASSIFICATION OF SUCCESSFUL STUDENTS

8.1 PART I TAMIL / OTHER LANGUAGES; PART II ENGLISH AND PART III CORE SUBJECTS, ALLIED, ELECTIVES COURSES AND PROJECT:

Successful Students passing the Examinations for the Part I, Part II and Part III courses and securing the marks (a) 60 percent and above and (b) 50 percent and above but below 60 percent in the aggregate shall be declared to have passed the examination in the **FIRST and SECOND** class respectively; all other successful candidates shall be declared to have passed the examination in the **THIRD Class**.

9. **MARKS AND GRADES:** The following table shows the marks, grade points, letter grades and classification to indicate the performance of the Student:

RANGE OF MARKS	GRADEPOINTS	LETTERGRADE	DESCRIPTION
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
40-49	4.0-4.9	C	Satisfactory
00-39	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

9.1 Computation of Grade Point Average (GPA) in a Semester, Cumulative Grade Point Average (CGPA) and Classification

GPA for a Semester: = $\sum iC_iG_i \div \sum iC_i$

That is, GPA is the sum of the multiplication of grade points by the credits of the courses divided by the sum of the credits of the courses in a semester.

CGPA for the entire programme: $= \frac{\sum_{n} \sum_{i} C_{ni} G_{ni}}{\sum_{n} \sum_{i} C_{ni}}$ That is, CGPA is the sum of the multiplication of grade points by the credits of the entire programme divided by the sum of the credits of the courses of the entire programme

Where,

C_i = Credits earned for course i in any semester,

G_i = Grade Points obtained for course i in any semester, n = Semester in which such courses were credited.

9.2 Letter Grade and Class

CGPA	GRADE	CLASSIFICATION OF FINAL RESULT
9.5-10.0	O +	First Class - Exemplary *
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D ++	First Class with Distinction *
8.0 and above but below 8.5	D +	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A ++	First Class
6.5 and above but below 7.0	A +	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B +	Second Class
5.0 and above but below 5.5	B	
4.5 and above but below 5.0	C +	Third Class
4.0 and above but below 4.5	C	
0.0 and above but below 4.0	U	Re-appear

*The Students who have passed in the first appearance and within the prescribed semester of the UG Programme (Major, Allied and Elective courses only) are eligible.

10. RANKING

Students who pass all the examinations prescribed for the Program in the **FIRST APPEARANCE ITSELF ALONE** are eligible for Ranking / Distinction, provided in the

case of Students who pass all the examinations prescribed for the Program with a break in the First Appearance due to the reasons as furnished in the Regulations 6 are only eligible for Classification.

11. CONCESSIONS FOR DIFFERENTLY-ABLED STUDENTS

11.1 Dyslexia students: For students, who are mentally disabled, learning disability and mental retardation, who are slow learners, who are mentally impaired having learning disorder and seizure disorder and students who are spastic and cerebral Palsy, the following concessions shall be granted:

- i) Part I Foundation course Tamil or any other Language can be exempted.
- ii) One-third of the time of paper may be given as extra time in the examination.
- iii) Leniency in overlooking spelling mistakes, and
- iv) Amanuensis for all courses provided the request is duly certified by the Medical Board of the Government Hospital/ General Hospital/ District headquarters Hospitals and they shall be declared qualified for the degree if they pass the other examinations prescribed for the degree.

11.2 Hearing, Speaking Impaired & Mentally retarded: For students who are hearing and speaking impaired and who are mentally challenged, the following concessions shall be granted:

- i) One Language paper either Part I Foundation course Tamil or any other Language or Part II English or its equivalent can be exempted
- ii) Part IV Non-Major Elective (NME) or Basic Tamil or Advanced Tamil can be exempted.

11.3 Visually Challenged students:

- i) A scribe shall be arranged by the College and the scribe be paid as per the College decision.

12. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMS TO QUALIFY FOR A DEGREE

12.1 A Student who for whatever reasons is not able to complete the program within the normal period (N) or the Minimum duration prescribed for the programme, may be allowed two years period beyond the normal period to clear the backlog to be qualified for the degree. (Time Span = N + 2 years for the completion of programme.)

12.2 In exceptional cases like major accidents and child birth an extension of one year be considered beyond maximum span of time (Time Span = N + 2 +1 years for the completion of programme).

12.3 Students qualifying during the extended period shall not be eligible for **RANKING**.

Learning Outcomes-based Approach to Curricular Planning

Aims of B.Sc degree programme in Biochemistry:

The overall aims of B.Sc degree programme in Biochemistry are to:

- Develop broad and balanced knowledge and understanding of biomolecules, key biochemical concepts, principles and theories related to Biochemistry
- Provide students with some work experience, for example laboratory training or a science project to further boost the career prospects.
- Develop the ability of the students to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Biochemistry.
- Expose the students to a wide range of careers that combine molecular biology, plants and medicine.
- Provide students with the knowledge and skill base that would enable them to undertake further studies in Biochemistry and related areas.
- Equip students with appropriate tools of analysis and with theoretical, technical and analytical skills to tackle issues and problems in the field of Biochemistry.

Graduate attributes

A graduate student shall be able to develop skill and acquire knowledge in disciplinary theory and practical knowledge in the diversified areas of Biochemistry. The students are given fundamentals and advancements in each course and they are motivated to become unique by allowing them to perform experiments in the areas of their interest. This will enable the students to equip themselves with the basic practical training in different areas of Biochemistry ranging from Metabolism, Plant Biochemistry, Enzymology, Clinical Biochemistry, Molecular Biology, Biotechnology, Proteomics, and Genomics etc. to pursue research or to undertake suitable assignments/jobs in Biochemical industries. The students shall enjoy the academic freedom which will bring to light the talent from each student. These attributes are elaborated as under:

Disciplinary Knowledge:

- a) Ability to understand advancements of biochemistry.
- b) Ability to apply basic principles of chemistry to biological systems and molecular biology.

c) Ability to relate various interrelated physiological and metabolic events.

d) A general awareness of current developments at the leading edge in biochemistry to apply for competitive examinations.

Communication Skills:

a) Ability to communicate well in English

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

C) Ability to present complex information in a clear and concise manner to different groups

Critical Thinking:

a) Ability to observe critical readings of scientific texts.

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

c) Capability to critically evaluate practices, policies and theories by following scientific approach to knowledge development.

Problem Solving:

a) Ability to analyse the situation and apply wise thinking and analytical skills.

b) Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge.

Analytical Reasoning:

a) Ability to assess the strengths and weaknesses in scholarly texts identifying blemishes in their arguments.

b) Ability to use critics and theorists to create a framework and to corroborate one's argument in one's reading of scientific texts.

c) Capability to analyse and synthesise data from a variety of sources and draw valid conclusions and support them with evidence and examples.

Research-Related Skills:

a) Ability to develop hypothesis and research questions and to identify and consult appropriate sources to find answers.

b) Capability to analyse, interpret and draw conclusions from data

c) Ability to plan, execute and report the results of an experiment or investigation.

Teamwork and Time Management:

a) Ability to participate effectively in class room discussions.

b) Ability to contribute to group work and to complete the work within stipulated time.

c) Capability to work effectively and respectfully with diverse teams.

Scientific Reasoning:

a) Capability to analyze texts, evaluating ideas and scientific strategies.

b) Ability to formulate logical and convincing arguments.

c) Ability to analyze, interpret and draw conclusions from quantitative/qualitative data

Reflective Thinking:

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

Self-Directed Learning:

a) Ability to work independently in terms of organizing laboratory and analyzing research literature.

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

c) Capability to manage a project effectively through to completion.

Digital Literacy:

a) Ability to handle digital sources and execute various platforms to convey and explain concepts of biochemistry.

Moral and Ethical Values:

a) Ability to interrogate one's own ethical values and to be aware of ethical and environmental issues and to avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights.

b) Ability to read values inherited in society and treats the environment, religion and spirituality as also structures of power.

Leadership Readiness:

a) Ability to conduct group discussions, to formulate questions related to scientific and social issues.

b) Setting direction, formulating an inspiring vision, building a team to achieve the vision, motivating and inspiring the team members to engage with that vision.

Life-long Learning:

a) Ability to retain and build clear thinking skills and execute them to update scientific knowledge

b) Ability to apply skills in day to day life.

c) Ability to acquire knowledge and skills that are necessary for participating in learning activities throughout life.

Qualification descriptors for B.Sc degree programme in Biochemistry

Each graduate in Biochemistry should be able to

- Demonstrate a coherent and systematic approach to the experimental and theoretical aspects of biochemistry. This would also include the student's ability to understand and engage with critical concepts, theories and dogmas.
- Demonstrate the ability to understand the role of scientific developments, particularly, biological sciences in a changing world from the disciplinary perspective as well as in relation to its professional and everyday use.
- Communicate ideas, opinions and values—both scientific themes and values of life in all shades and shapes—in order to expand the knowledge of the subject as it moves from the classroom/laboratory to industry and society.
- Demonstrate the ability to share the results of academic and disciplinary learning through different forms of communication such as dissertations, reports, findings, notes, seminars etc, on different platforms of communication such as the classroom, the media and the internet.
- Recognize the scope of biochemistry in terms of career opportunities, employment and lifelong engagement in teaching, publishing, communication, media, soft skills and other allied fields.
- The programme will strengthen the student's competence, help identify, analyze and evaluate keys issues of current science around in the world and think of ways to find logical and viable solutions.
- Students will have the ability to understand and articulate with clarity and critical thinking one's position in the world as a biochemistry graduate and as an Indian citizen of the world.
- Acquiring practical training as well as critical knowledge of the Biochemistry subject

Programme Specific Outcomes

- PSO-1.** Comprehending fundamental concepts in Biochemistry to enhance knowledge in theoretical aspects.
- PSO-2.** Understanding and acquiring skills in performing laboratory experiments.
- PSO-3.** Inculcating research motivation among student community and boosting them to pursue higher studies in Biochemistry
- PSO-4.** Contribution to the betterment of the student community by inculcating sound knowledge in the clearance of competitive exams.
- PSO-5.** Facilitate the development of skills based on current trends in versatile fields by offering Job oriented certificate courses and Value-added courses.

B. Sc DEGREE COURSE IN BIOCHEMISTRY

SYLLABUS

(Effective from the academic year 2020 – 2021)

SEMESTER- I

CORE PAPER-I: NUTRITIONAL BIOCHEMISTRY

CREDITS – 5

TOTAL HOURS – 60

On successful completion of the course, students will be able to:

CO-1: Explore the role of food and nutrients in the maintenance of health and to understand about the calorific value of foods and nutrients, BMR and its determination.

CO-2: Know about the sources, daily requirements, biological functions and deficiency symptoms of various vitamins and minerals.

CO-3: Know about causes, biochemical manifestations and treatment of nutritional disorders such as Kwashiorkor and Marasmus (Under nutrition) and Obesity (over nutrition).

CO-4: Know about the physiological role and nutritional significance of carbohydrates, proteins, lipids and nutraceuticals.

CO-5: Understand the concepts of human rights and its applications.

Nutritional Biochemistry	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2			✓	✓	
Unit-3		✓			
Unit-4		✓			
Unit-5					✓

UNIT I

Basics of Food and Nutrition - Concepts of food and nutrition. Composition of food, Basic food groups- energy yielding, body building and functional foods. Units of energy. Calorific value of foods. Measurement of calories by bomb calorimeter. Energy requirement of man, Basal metabolic rate (BMR) - definition, determination of BMR and factors affecting BMR. Respiratory quotient (RQ) of nutrients and factors affecting the RQ. SDA - definition and biological significance.

UNIT II

Biological role of Macronutrients - Physiological role and nutritional significance of carbohydrates, lipids and proteins. Glycemic index of foods, Evaluation of proteins by nitrogen balance method - Biological value of proteins - Digestibility Coefficient, Biological Value, and Net Protein Utilization. Protein energy malnutrition- Kwashiorkor and Marasmus, Clinical manifestations and management. Obesity (elementary details).

UNIT III

Balanced Diet and Vitamins - Balanced diet, example of a low and high cost balanced diet – for children, adults and elderly people. Role of dietary fiber. Nutrient antioxidants and their sources. Role of nutraceuticals in health.

Vitamins - definition and types of vitamins. Sources, requirement, biological functions, deficiency symptoms of Water soluble vitamins - thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folic acid and cyanacobalamine and vitamin- C. Sources, requirement, biological functions, deficiency symptoms of Fat soluble vitamins - A, D, E and K. Hypervitaminosis.

UNIT IV

Minerals - sources, requirement, physiological functions, deficiency and toxicity of calcium, sodium, potassium, iron, magnesium, Chromium, cobalt, copper, manganese, molybdenum, selenium, iodine and Zinc.

UNIT V

Human rights – introduction- definition, scope and need for study of human rights and relations. Categories- civil and political rights, economic relations and social relations. Institutions : International and National- United Nations Human Rights Commission, State Human Rights Commission. International Convention on civil and political rights. International convention on economic and social rights. National Human Rights Act- National Commission for minorities, SC/ST and Women, Students activity- assignment, case study, term paper.

Books Recommended

1. Garrow, JS, James WPT and Ralph A (2000). Human nutrition and dietetics (10th ed) Churchill Livingstone
2. Andreas M. Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1st ed) CRC Press
3. M.Swaminathan (1995). Principles of Nutrition and Dietetics. Bappco
4. Margaret Mc Williams (2012). Food Fundamentals (10th ed), Prentice Hall
5. Tom Brody (1998). Nutritional Biochemistry (2nd ed), Academic Press, USA
6. Aravind Kumar (1999). Human rights and social movements, Anmol publishers.
7. Piarey Lal Mehta, Neena Verma, P I Mehta (1999). Human Rights Under the Indian Constitution. Deep & Deep Publications Pvt. Ltd.

NON – MAJOR ELECTIVE PAPER- I - MEDICINAL CHEMISTRY

CREDITS – 2

TOTAL HOURS – 30

On successful completion of the course, students will be able to:

CO-1: Understand the first aid methods, specimen collection and transportation.

CO-2: Explain about the roles of anti-inflammatory, antihypertensive and antiulcer drugs

CO-3: Explain the Causes, Symptoms and Treatment of Blood pressure, stroke, cirrhosis and AIDS.

CO-4: Explain the mechanism of action of streptomycin, tetracyclines, *Ofloxacin*. Chloroquine, Metronidazole and Lamivudine.

CO-5: Describe Common vernacular name, biological sources and chemical nature of chief constituents and common uses of indigenous medicinal plants.

Medicinal Chemistry	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓	✓		
Unit-3		✓	✓		
Unit-4				✓	
Unit-5					✓

UNIT I

First Aid and Safety - Treatment of Shock, Hemorrhage, Cuts and Wounds. Burns – Classification and first Aid. Specimen collection and processing (Blood, urine, feaces), anti-coagulant and preservatives for blood and urine. Transport of specimens. Blood transfusion.

UNIT II

Basic Drugs: Cardiac glycosides, Antihypertensive drugs, Antihyperlipidemics, Anti-inflammatory agents, Anti-asthmatic drugs and Antiulcer drugs - each two examples, uses and side effects.

UNIT III

Vital ailments and treatment: Vital ailments and treatment - Blood pressure (Hypertension and Hypotension), stroke, cirrhosis. AIDS - Causes, Symptoms and Treatment.

UNIT IV

Antimicrobial drugs: Mode of action and uses of streptomycin, tetracyclines, Ofloxacin. Cholroquine, Metronidazole and Lamivudine.

UNIT V

Phytoedicine: Traditional drugs : Common vernacular name, biological sources, chemical nature of chief constituents and common uses of indigenous medicinal plants: Amla, Brahmi, Tulsi, Turmeric, Aloe Vera and Neem

Reference Books

1. Applied Chemistry, Jayashree Ghosh - S. Chand and Company Ltd., 2006
2. Biochemistry, S. C. Rastogi - Tata McGraw Hill Publishing Co., 1993.
3. Medicinal Plants of India, Rasheeduz Zafar - CBS Publishers and Distributors, 2000.
4. Hawk's Physiological Chemistry, B. L. Oser - Tata-McGraw Hill Publishing Co. Ltd.
5. Practical Pharmaceutical Chemistry, A. H. Beckett and J. B. Stenlake - Vol. I - CBS Publishers and Distributors, 2000.

II SEMESTER

CORE PAPER – II - CELL BIOLOGY

CREDITS – 5

TOTAL HOURS – 60

On successful completion of the course, students will be able to:

CO-1: Explore the structural organization of prokaryotic and eukaryotic cell and to know about the classification of bacteria, virus and fungi.

CO-2: Know about the detailed information about the sub cellular organelles such as nucleus, mitochondria, endoplasmic reticulum, golgi complex, lysosome etc.,

CO-3: Explore the organization of cells in to tissues and role of various molecules in cell-cell adhesion and cell-matrix adhesion.

CO-4: Know about the details of cell division such as mitosis and meiosis and its importance.

CO-5: Know the about the organization of prokaryotic and eukaryotic genome, Cell cycle and Cancer.

Cell Biology	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2			✓		
Unit-3		✓	✓		
Unit-4		✓	✓		
Unit-5				✓	✓

UNIT I

Classification of living organisms - Cell theory, cell as basic unit of life. Classification of Viruses, Bacteria and Fungi. Structure and organization of prokaryotic and eukaryotic cells. Comparison between prokaryotic and eukaryotic cell. Comparison between plant and animal cells. Bacterial cell wall.

General structure of cytoskeleton - structure, composition and functions of microfilaments, microtubules and intermediate filaments.

UNIT II

Sub cellular organelles - The ultra structure of cell wall, nucleus, mitochondria, rough and smooth endoplasmic reticulum, Golgi apparatus, lysosome, ribosomes, peroxisome, chloroplast and glyoxisome and their function.

UNIT III

Membrane Transport - Biomembrane – structure, organization and basic functions, fluid mosaic model, Transport across cell membrane – uniport, symport and antiport. Passive and active transport, Ion channel and water channel. Intercellular junction – Tight junction and Gap junction.

UNIT IV

Types of Tissues - Organization of cells into tissue. Types of tissue. Cell – cell adhesion, cell matrix adhesion. Extracellular matrix– components and their biological role. Cancer- cause, types, symptoms and treatment, Tumor markers.

UNIT V

Cell division and Cellular genome - Organisation of prokaryotic and eukaryotic genome, chromosomes, types, structure and function. Sex determination in Humans. Cell division, mitosis, meiosis, their significance. Cell cycle – phases of cell cycle, Role of cyclins and CDKs in cell cycle. Cell death-Apoptosis.

Books recommended

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed). John Wiley & Sons. Inc.
2. Bruce Alberts and Dennis Bray (2013). Essential Cell Biology, (4th ed), Garland Science.
3. De Robertis, E.D.P. and De Robertis, E.M.F. (2010). Cell and Molecular Biology. (8th ed). Lippincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. (5th ed). Sunderland, Mass. Sinauer Associates, Inc.

5. Wayne M. Baker (2008). The World of the Cell. (7th ed). Pearson Benjamin Cummings Publishing, San Francisco. Cell Biology
6. P.S.Verma and V.K.Agarwal (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology (14th ed), S.Chand and Company Ltd

CORE PAPER – III - CORE PRACTICAL – I

CREDITS – 4

TOTAL HOURS – 60

On successful completion of the course, students will be able to

CO-1: Know about the quantitative determination of vitamin-C, oxalic acid, iron, glycine by titrimetric method.

CO-2: understand the procedure of isolation and estimation of starch from potato, Casein from milk, Hemoglobin from blood and albumin from egg white.

CO-3: Calculate the BMI of a person to assess normal class, underweight and obesity.

CO-4: Identify the structure of cells by microscopic method.

CO-5: Know about the various nutrients present in foods by food analysis.

Core Practical I	PSO-1 (Theory)	PSO-2 (Practical)	PSO-3 (Higher studies)	PSO-4 (Competitive Exams)	PSO-5 (Employment)
CO-1		✓		✓	✓
CO-2		✓	✓		
CO-3	✓	✓		✓	✓
CO-4	✓	✓	✓		✓
CO-5		✓	✓	✓	✓

I. Titrimetric procedures

1. Estimation of Glycine by Sorenson's formal titration.
2. Estimation of calcium from milk.
3. Estimation of iron.
4. Estimation of Vitamin C (Ascorbic acid) from lemon or citrus fruits or amla.

II. Group experiments

1. To make a temporary stained mount of onion peel to see the structure of cells under microscope
2. To make a temporary stained mount of onion root tip to show different stages of mitosis.
3. Determination of BMI
4. Food analysis – Determination of Moisture and ash content of food sample,
Test for carbohydrates, protein, fat & minerals (iron, calcium, phosphorus and chloride)

III. Biochemical Preparation

1. Preparation of starch from potatoes.
2. Preparation of casein from milk.
3. Preparation of albumin from eggs.
4. Extraction and estimation of total lipid content in the food sample/oil seeds.

Books recommended

1. Varley's practical clinical biochemistry, Alan. H. Gowen clock, 6th Edition, 1988, CBS publishers & distributors, India.
2. Practical manual of Biotechnology, Lab Manual, Dr.Ritu Mahajan, Dr.Jitender Sharma & Dr. R.K. Mahajan, 1st Edition, 2010, Vayu education of India, New Delhi.
3. Laboratory manual and Practical biochemistry, T.N.Pattabiraman, 4th Edition, 2010, All India Publisher's & Distributors limited, New Delhi.
4. Practical text book of biochemistry for MBBS students, D.M.Vasudevan, 1st Edition, 2007, Jaypee brothers, New Delhi.
5. An introduction to practical biochemistry, David. T. Plummer, 3rd Edition, 1998, Tata Mc.Grawhill education private limited, New Delhi.

NON –MAJOR ELECTIVE PAPER –II

HUMAN DISEASES AND PREVENTIVE ASPECTS

CREDITS – 2

TOTAL HOURS – 30

On successful completion of the course, students will be able to

CO1: Explain infectious diseases, diseases in young children and prevention.

CO2: Describe causes, types, symptoms and treatment measures of cancer.

CO3: Explain causes, types and treatment for diabetes and Kidney stones.

CO4: Know the nutritional significance of lipids & it's diseases with treatment measures

CO5: Understand the causes, symptoms and management of liver diseases

Human Diseases and Preventive Aspects	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

UNIT I

Pathological diseases - Diseases – definition – Examples for bacterial, viral and fungal diseases. Endemic and epidemic diseases – causes and symptoms. Major diseases of young children with special reference to diarrhea, primary complex, whooping cough, Kwashiorkor and Marasmus and their preventive aspects.

UNIT II

Cancer and prevention - Cancer- differences between benign and malignant tumors. Growth characteristics of cancer cells. Metastasis, Agents causing cancer - physical, chemical, biological. Prevalence of cancer in India. Cancer therapy - surgery, radiation and chemotherapy. Cancer prevention.

UNIT III

Thyroid hormone disorders and prevention - Hypothyroidism and hyperthyroidism – Causes, aetiology, symptoms, diagnosis, treatment and prevention. Kidney stones – Causes, types, aetiology, symptoms, diagnosis, treatment and prevention.

UNIT IV

Cardiovascular diseases and prevention - Cardiovascular diseases- Role of dietary lipids. HDL and LDL as risk factors. Hyperlipidemia, Hypo lipidemia, Atherosclerosis, Myocardial infarction- pathogenesis, diagnosis, treatment and prevention.

UNIT V

Anemia and gall stones - Anemia – classification. Iron deficiency anemia and sickle cell anemia - causes, symptoms, diagnosis, treatment and prevention. Gall stones –types, pathogenesis, diagnosis, treatment and prevention.

Books recommended

1. M.N.Chatterjee and Rana Shinde (2007).Textbook of Medical Biochemistry (7th ed)
2. Ambika Shanmugam (2012). Fundamentals of Biochemistry for Medical Students (7th ed),
3. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (2014) (7th ed),
Saunders
4. A.Catherine Ross (2012) Modern nutrition in health and diseases (11th ed). Lippincott Williams and Wilkins
5. Michael.G.Wohl, Robert.S.Goodhart, Maurice E.Shils (1999). Modern nutrition in health and disease (9th ed), Lippincott Williams and Wilkins
6. R.Ananthanarayan and C.K.Jayarane Paniker (2009). Text book of Microbiology (8th ed), Universities press private (India) Limited.

III SEMESTER

CORE PAPER – IV - CHEMISTRY OF BIOMOLECULES- I

CREDITS – 5

TOTAL HOURS – 60

On successful completion of the course, students will be able to:

CO-1: Understand the basic component or biomolecules of living organisms

CO-2: Have knowledge on the structure/conformational freedom of biomolecules, e.g. Carbohydrates, amino acids and proteins.

CO-3: Understand and demonstrate how the structure of biomolecules determines their chemical properties and reactivity.

CO-4: Learn the classifications of carbohydrates and proteins

CO-5: Recognize the importance of the three dimensional shape of a protein and its function and the role of non-covalent bonds in maintaining the shape of a protein.

Chemistry of Biomolecules I	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2	✓	✓			✓
Unit-3		✓	✓		
Unit-4	✓			✓	
Unit-5					✓

UNIT I

Carbohydrates - Classification and biological significance, physical properties, stereo isomerism, optical isomerism and mutarotation. Configuration of aldo and keto trioses, tetroses, pentoses and hexoses. Reactions of monosaccharides due to the presence of hydroxyl, aldehyde and ketone groups. Structure and properties of reducing disaccharides (lactose & maltose), non-reducing disaccharide (sucrose). Identification of ketose, pentose, reducing and non - reducing sugars.

UNIT II

Polysaccharides - Occurrence, structure and functions of polysaccharides- starch, glycogen and cellulose. (structural elucidation is not needed). Structure and biological significance of mucopolysaccharides - hyaluronic acid, chondroitin sulphate and heparin. Composition and functions of inulin, agar, pectin, chitin, dextran, gum arabic and alginic acid. (structures are not necessary). Structure of bacterial cell wall polysaccharides (peptidoglycan and teichoic acid), blood group polysaccharides and glycoprotein.

UNIT III

Amino acids - Biological role. General structure of amino acids. 3- and 1-letter abbreviations. Classification of amino acids based on nature of R group (polar, non polar, acidic, basic, neutral). Modified amino acids in protein, non protein amino acids. Physical properties of amino acids, isoelectric point, titration curve (alanine, lysine, glutamic acid), optical activity. Chemical reactions due to carboxyl group, amino group and side chains. Colour reactions of amino acids.

UNIT IV

Proteins - Composition and biological importance of peptides. Examples of peptide hormones. Solid state peptide synthesis. Structure of oligopeptides like glutathione, vasopressin and oxytocin, Peptidases – exo and endo peptidases. Classification of proteins based on composition, solubility, and functions. Properties of proteins- salting in and salting out, denaturation and renaturation, UV absorption. Estimation of protein by Biuret, Folin's phenol and UV methods.

UNIT V

Protein Structure - Definition and biological significance of hydrogen bond, hydrophobic interactions and van der waals forces. Levels of organization of protein structure – primary structure – composition, peptide bond. Outline of protein sequencing, Secondary structure – α helix (egg albumin), β -pleated sheath (keratin), triple helix (collagen). Tertiary structure – forces

involved in maintenance of tertiary structure like hydrogen bond, hydrophobic interactions, van der waals force, disulphide linkage and ionic bonds with reference to myoglobin. Quaternary structure with reference to haemoglobin. Ramachandran plot.

Books Recommended:

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
2. Voet.D and Voet. J.G (2010) Biochemistry (4th ed), John Wiley & Sons, Inc.
3. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
4. Zubay G.L (1999) Biochemistry (4th ed), Mc Graw-Hill.
5. Lubert Stryer (2010) Biochemistry (7th ed), W.H.Freeman
6. Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.

IV - SEMESTER
CORE PAPER – V - CHEMISTRY OF BIOMOLECULES II

CREDITS – 5

TOTAL HOURS – 60

On successful completion of the course, students will be able to:

CO-1: Understand the basic component or biomolecules of living organisms

CO-2: Have knowledge of the structure/conformational freedom of biomolecules, e.g. lipids and nucleic acids.

CO-3: Compare and contrast saturated, mono-unsaturated, and poly-unsaturated fatty acids.

CO-4: Understand the types and structure of DNA and RNA

CO-5: Study about heterocyclic compounds and porpyrins.

Chemistry of Biomolecules II	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓	✓	
Unit-4	✓	✓			
Unit-5					✓

UNIT I

Lipids - Chemical nature, biological functions and classification of lipids. Fatty acids – definition, classification – saturated, unsaturated, hydroxy and cyclic fatty acids, nomenclature, structure and properties of fatty acids. Simple and mixed triglycerides – structure and general properties, Isolation of fats (Folch method) and identification. Characterization of fats – iodine value, saponification value, acid number, acetyl number, Polensky number, Reichert-Meissl number.

UNIT II

Sterols - Structure of cyclopentanoperhydro phenanthrene nucleus. Animal sterol: cholesterol - properties and functions. Plant sterol: stigmasterol – Functions, Ergosterol: Functions. Lipoproteins: general structure, classification: chylomicrons, VLDL, LDL, IDL, HDL – composition and biological roles. Classification, structure, properties and biological functions of glycolipids, phospholipids and sphingolipids.

UNIT III

Nucleic acids - Structure of purine and pyrimidine bases, nucleosides and nucleotides and their biological importance. Types of DNA : A, B, C, Z DNA, structure and biological significance, superhelicity. Isolation, purification, identification and estimation of DNA. Properties of DNA – hypochromic and hyperchromic effect, melting temperature, viscosity. Denaturation and annealing.

UNIT IV

Ribonucleic acids - Isolation, purification, identification and estimation of RNA. Salient features of prokaryotic and eukaryotic RNA. RNA as a genetic material. Types of RNA: mRNA, tRNA, rRNA, hnRNA, snRNA- location and role. Secondary and tertiary structure of tRNA. Action of nucleases of pancreas, spleen and venom on RNA.

UNIT V

Heterocyclic Compounds - Heterocyclic rings of biological importance - pyridine, pyrrole, quinoline, pteridine, thiazole, imidazole, indole with examples. Porphyrins: Porphyrin nucleus and classification of prophyrins, important metalloporphyrins occurring in nature, Chemical nature and significance of bile salts and bile pigments.

Books Recommended

1. David L.Nelson and Michael M.Cox (2012). Lehninger Principles of Biochemistry (6th ed), W.H. Freeman.
2. Voet.D and Voet. J.G (2010) Biochemistry (4th ed), John Wiley and Sons, Inc.

3. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
4. Zubay G.L (1999). Biochemistry (4th ed), Mc Graw-Hill.
5. Lubert Stryer (2010). Biochemistry (7th ed), W.H.Freeman
6. Satyanarayan,U (2014). Biochemistry (4th ed), Arunabha Sen Books and Allied (P) Ltd, Kolkata.

CORE PAPER VI - CORE PRACTICAL – II

CREDITS – 4

TOTAL HOURS – 60

On Completion of the course, students are able to understand

CO -1: Safety measures in laboratory, handling and care of instruments.

CO -2: Determination of saponification, Iodine and acid value of oil using titrimetric methods.

CO- 3: Qualitative analysis of carbohydrates, amino acids and proteins.

CO- 4: Quantitative estimation of biomolecules carbohydrates, proteins, amino acids.

CO -5: Quantitative estimation of Nucleic acids DNA and RNA.

PSO- CO MATRIX

Core Practical II	PSO-1 (Theory)	PSO-2 (Practical)	PSO-3 (Higher studies)	PSO-4 (Competitive Exams)	PSO-5 (Employment)
CO-1		✓			✓
CO-2		✓			
CO-3		✓	✓		✓
CO-4		✓	✓		✓
CO-5		✓	✓		✓

I. Titrimetric methods

1. Determination of saponification value of an edible oil.
2. Determination of acid number of an edible oil.
3. Determination of iodine value of an edible oil.

II. Qualitative analysis

1. Analysis of simple sugars- glucose, fructose, galactose, xylose, sucrose, lactose, maltose and starch.
2. Analysis of amino acids - tyrosine, tryptophan, arginine, cysteine and histidine
3. Tests for protein- Solubility, Biurette, Xanthoproteic, Million's tests. Denaturation by heat, pH change. Precipitation by heavy metals and by acidic reagents.

III. Colorimetry

1. Estimation of Protein by Biuret method.
2. Estimation of inorganic phosphorus by Fiske and Subbarow method.
3. Estimation of amino acids by Folins method.
4. Estimation of DNA by Indole method
5. Estimation of RNA by Orcinol method
6. Estimation of carbohydrate by Anthrone method

Books recommended

1. Varley's practical clinical biochemistry, Alan. H. Gowen clock, 6th Edition, 1988, CBS publishers & distributors, India.
2. Practical manual of Biotechnology, Lab Manual, Dr.Ritu Mahajan, Dr.Jitender Sharma & Dr. R.K. Mahajan, 1st Edition, 2010, Vayu education of India, New Delhi.
3. Laboratory manual and Practical biochemistry, T.N.Pattabiraman, 4th Edition, 2010, All India Publisher's & Distributors limited, New Delhi.
4. Practical text book of biochemistry for MBBS students, D.M.Vasudevan, 1st Edition, 2007, Jaypee brothers, New Delhi.
5. An introduction to practical biochemistry, David. T. Plummer, 3rd Edition, 1998, Tata Mc.Grawhill education private limited, New Delhi.

V SEMESTER

CORE PAPER – VII – ENZYMES

CREDITS – 5

TOTAL HOURS – 60

CO-1: To gain knowledge about Enzymes, chemical nature and general properties of enzymes.

CO-2: To learn mechanism of enzymatic reactions and kinetics.

CO-3: To understand about isolation, homogenization and separation procedures of enzymes using various biochemical techniques.

CO -4: To recognize Enzyme, coenzymes and their role in biological processes in the body and industrial applications of Immobilized Enzymes.

CO-5: To understand on Enzyme Inhibition, types and mechanism of Inhibition.

Enzymes	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓	✓			
Unit-2			✓		
Unit-3				✓	
Unit-4		✓			
Unit-5					✓

UNIT I

Introduction - Enzymes - definition and chemical nature of enzymes. General properties; Nomenclature and classification, enzymes as catalysts - Activation energy. Enzyme specificity- Active site. Lock and key hypothesis and Induced fit theory, Allosteric site. Regulatory enzymes- allosteric enzymes with reference to ATcase. Isoenzymes with reference to LDH and CK – types and functions.

UNIT II

Isolation & Purification of Enzymes - Methods of isolation of enzymes: Homogenisation techniques, intracellular localization of enzymes; isolation of intracellular enzymes; separation

procedure based on molecular size - dialysis, ultrafiltration, molecular exclusion chromatography. Methods based on solubility – isoelectric precipitation, Salting in and salting out. Methods based on electric charge – electrophoresis, Ion exchange chromatography.

UNIT III

Coenzymes - action and functions of TPP, PLP, NAD / NADP, FMN, FAD, coenzyme A, lipoic acid and Biotin. Multienzyme complexes. Metallo enzymes and metal activated enzyme. Industrial uses of enzymes – food and pharmaceutical industries. Biosensors – principle, types and applications. Immobilized enzymes - methods of immobilization and applications.

UNIT IV

Enzyme Kinetics - Rate of enzyme catalyzed reaction, Derivation of Michaelis - Menten equation. Lineweaver Burk plot and Eadie Hofstee plot. Factors affecting enzyme activity - pH, temperature, activators, cofactors, concentration of enzyme and substrate.

UNIT V

Enzyme inhibition – reversible and irreversible inhibition – types of reversible inhibitors: competitive, non competitive , uncompetitive inhibitors. (Derivation not required). Mechanism of enzyme activity, covalent catalysis. Mechanism of action of chymotrypsin.

Books recommended

1. David L.Nelson and Michael M.Cox (2012). Lehninger Principles of Biochemistry (6th ed), W.H.Freeman
2. Voet.D and Voet. J.G (2010). Biochemistry, (4th ed), John Wiley & Sons, Inc.
3. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012). Harper's Illustrated Biochemistry (29th ed), McGraw-Hill Medical
4. Trevor Palmer (1995). Understanding Enzymes (4th ed), Ellis Horwood Ltd

CORE PAPER VIII – METABOLISM

CREDITS – 5

TOTAL HOURS – 60

On Successful completion of course, students will be able to

CO-1: Gain knowledge about anabolism and catabolism.

CO-2: Obtain knowledge on carbohydrate, lipid and Protein metabolism help to understand the conversion of simple nutrients after absorption into energy and cell macromolecules.

CO-3: Provide information on conversion of toxic ammonia into Urea through Urea cycle.

CO-4: Understand about Electron Transport Chain and Oxidative Phosphorylation

CO-5: Learn about Purine and Pyrimidine biosynthesis and catabolism.

Metabolism	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓			✓	
Unit-2		✓			
Unit-3		✓			
Unit-4			✓		
Unit-5					✓

UNIT I

Biological Oxidation - Introduction to intermediary metabolism, the basic metabolic pathways, anabolic, catabolic and amphibolic pathways. High energy compounds – definition, structure and free energy of hydrolysis of high energy compounds. Lippman ATP cycle. Biological oxidation – Redox reactions. Electron transport in mitochondria – components of electron transport chain, energetics and inhibitors of electron transport. Oxidative phosphorylation – mechanism of Chemi-Osmotic theory. Inhibitors of oxidative phosphorylation – uncouplers and ionophores. Substrate level phosphorylation.

UNIT II

Metabolism of carbohydrates - Glycolysis, Pyruvate oxidation, Citric acid cycle-reactions, inhibitors, energetics, Glyoxalate cycle, Gluconeogenesis, Cori cycle, anaplerotic reactions and HMP shunt pathway. Glycogenolysis, glycogenesis and regulation of glycogen metabolism.

UNIT III

Metabolism of lipids - Biosynthesis and degradation of saturated fatty acids, triglycerides, phospholipids (lecithin). Biosynthesis of cholesterol and ketone bodies.

UNIT IV

Metabolism of amino acids - Oxidative deamination – role of dehydrogenases and oxidases. Non-oxidative deamination – role of pyridoxal phosphate with reference to serine and cysteine, Decarboxylation, Transamination reaction – mechanism of Schiff's base formation and transpeptidation, Ammonia detoxification – urea cycle – compartmentation and enzymes of urea cycle.

UNIT V

Metabolism of nucleic acid - Introduction, fate of dietary nucleic acids, Biosynthesis of purine nucleotides – *Denovo* synthesis and salvage pathways, catabolism of purines, regulation of purine biosynthesis. Biosynthesis of pyrimidine nucleotides - *Denovo* synthesis and salvage pathways, Catabolism of pyrimidines, regulation of pyrimidine synthesis.

Books Recommended

1. David L.Nelson and Michael M.Cox (2012). Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
2. Voet.D and Voet. J.G (2010). Biochemistry (4th ed), John Wiley & Sons, Inc.
3. Lubert Stryer (2010). Biochemistry (7th ed), W.H.Freeman.
4. Denise R Ferrier (2013). Biochemistry (Lippincott's Illustrated Reviews), (6th ed), Lippincott Williams and Wilkins.
5. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012). Harper's Illustrated Biochemistry (29th ed), McGraw-Hill Medical.

CORE PAPER – IX - ANALYTICAL BIOCHEMISTRY

CREDITS – 5

TOTAL HOURS - 60

On successful completion of the course, students will be able to:

CO-1: Understand about pH, its importance in the body and its determination by glass electrode.

To know about the working principle and applications of oxygen electrode.

CO-2: Explore about the principle, procedure and applications of different chromatographic techniques and electrophoretic techniques for the separation and identification of biomolecules.

CO-3: Know the Separation and purification of proteins and nucleic acids by Centrifugation, Chromatography and Electrophoresis techniques.

CO-4: Understand the principle, instrumentation and applications of colorimetry and UV spectroscopy techniques.

CO-5: Recognize the principle, instrumentation and applications of spectrofluorimetry and flame photometry techniques for the determination of vitamins, enzyme activity and minerals.

Analytical Biochemistry	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2			✓		
Unit-3		✓	✓		
Unit-4		✓	✓		
Unit-5				✓	✓

UNIT I

Biophysical Techniques - Definition of Molality, Molarity, Normality, Osmolarity, Definition of pH, pOH, determination of pH- Glass electrode, Isoelectric pH, Zwitter ion, buffers, Henderson–Hasselbalch equation, Tonicity, Donnon membrane equilibrium and application.

Buffers in body fluids, Red blood cells and tissues. Measurement of oxygen consumption - the Clark oxygen electrode

UNIT II

Centrifugation - Principle of Centrifugation. Centrifugal force, centripetal force, sedimentation rate, Svedberg constant. Types of centrifuges. Types of rotors – fixed angle, vertical, swinging bucket, zonal, elutriator rotors. Preparative centrifugation – differential centrifugation – fractionation of subcellular organelles. Density gradient centrifugation – gradient preparation, separation and recovery of sample. Ratezonal centrifugation and Isopycnic centrifugation. Analytical centrifugation.

UNIT III

Chromatography - General principles of chromatography – partition and adsorption chromatography. Paper chromatography – principle, sample application, development – ascending, descending and radial, detection of amino acids and sugars. Thin layer chromatography – principle, instrumentation and applications (separation of alkaloids). Column chromatography – principle, factors affecting resolution. Basic principles and applications of affinity chromatography. High Performance Liquid Chromatography (HPLC) - principle, instrumentation and applications. Molecular sieve chromatography – principle, instrumentation and applications

UNIT IV

Electrophoresis - General principle of electrophoresis, factors affecting migration rate – electrical potential, nature of the sample, nature of buffer, nature of the supporting medium. Tiselius moving boundary electrophoresis. Principle, procedure and application of paper, cellulose acetate, agarose and starch gel electrophoresis. Principle and applications of SDS-PAGE and Immuno electrophoresis.

UNIT V

Spectroscopy - Basic principles of electromagnetic radiation, energy, wavelength, wave number and frequency. Absorption and emission spectrum. Beer Lambert law – UV and Visible range. Colorimetry and UV Spectrophotometry- principle, instrumentation and applications.

Spectrofluorimetry- principle, instrumentation and applications with reference to riboflavin.
Flame photometry – atomic absorption and emission - principle, instrumentation and applications with reference to sodium and potassium analysis.

Books Recommended

1. Keith Wilson , John Walker (2010). Principles and Techniques of Biochemistry and Molecular Biology (7th ed), Cambridge University Press
2. David Sheehan (2009). Physical Biochemistry: Principles and Applications (2nd ed), Wiley-Blackwell
3. David M. Freifelder (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Biology, W.H.Freeman
4. Rodney F.Boyer (2012). Biochemistry Laboratory: Modern Theory and techniques (2nd ed), Prentice Hall
5. Kaloch Rajan (2011). Analytical techniques in Biochemistry and Molecular Biology, Springer

CORE ELECTIVE PAPER –I - HUMAN PHYSIOLOGY

CREDITS – 5

TOTAL HOURS – 60

CO-1: To understand different physiological systems and their functions

CO-2: To be able to analyze the status of different systems.

CO-3: To categorize different components according to their nature.

CO-4: To describe the mechanism and process of different physiological events.

CO-5: To draw and prepare charts about different human organ systems.

Human Physiology	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓	✓	✓	✓	✓
Unit-2	✓	✓	✓	✓	✓
Unit-3	✓	✓	✓	✓	✓
Unit-4	✓	✓	✓	✓	✓
Unit-5	✓	✓	✓		✓

UNIT I

Digestive and excretory systems - Structure of digestive system, digestion and absorption of carbohydrates, lipids and proteins. Mechanism of HCl formation in stomach, role of various enzymes and hormones involved in digestive process and defecation. Excretory system – structure and function of kidney, structure of a nephron, mechanism of urine formation.

UNIT II

Circulatory system - Composition of blood - cells, plasma, serum and lymph. ABO blood grouping. Blood clotting - Bleeding and clotting time. Mechanism of blood clotting. - basic anatomy of heart. Systemic, pulmonary and portal circulation. Heartbeat, cardiac cycle, electrocardiogram and pacemaker.

UNIT III

Nervous and muscular system - Brain - ventricles, spinal cord, central and autonomous nervous system - sympathetic and parasympathetic nervous system. Structure of a neuron, synaptic transmission. Reflex action and neurotransmitters. Muscular system- types of muscles, structure and composition of skeletal muscle, structure of a myofibril, mechanism of muscle contraction.

UNIT IV

Respiratory system - Composition of air. Partial pressure of oxygen and carbon dioxide. Structure of lungs and alveoli. Gaseous exchange of oxygen and carbon dioxide in the lungs and tissues. Role of kidney and lungs in maintaining the pH of blood.

UNIT V

Endocrine system - Classification of hormones, endocrine glands and their secretions. Insulin, thyroxine and growth hormone -structure and functions. Steroid hormones. Corticosteroids- sex hormones – testosterone and estrogen - menstrual cycle.

Books recommended

1. Stuart Ira Fox (2011). Human Physiology. (12th ed), McGraw Hill Publications.
2. Sembulingam (2016). Essentials of Medical Physiology (7th ed). Jaypee Brothers Medical Publishers
3. John E. Hall (2010). Guyton and Hall Textbook of Medical Physiology (12th ed), Saunders
4. Best and Taylor (1990). Medical Physiology (12th ed), Lippincott Williams and Wilkins
5. Walter F. Boron, Emile L. Boulpaep (2012). Medical Physiology (2nd ed), Saunders
6. Anne Waugh (2010). Ross and Wilson Anatomy and Physiology in Health and Illness. Elsevier

VI - SEMESTER

CORE PAPER-X - CLINICAL BIOCHEMISTRY

CREDITS – 5

TOTAL HOURS – 60

On Successful completion of course, students will be able to

CO-1: Understand the pathology, diagnosis and treatment of metabolic disorder Diabetes Mellitus.

CO-2: Obtain information about Inborn Errors of Carbohydrate metabolism

CO-3: Learn the diagnostic procedures for the assessment of liver diseases through Liver function tests.

CO-4: Explain Renal function Tests that provide information regarding diagnostic procedures of kidney diseases.

CO-5: Gain knowledge about clinical symptoms, diagnosis and treatment of various diseases through Clinical enzymology.

Clinical Biochemistry	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

UNIT I

Disorders of Carbohydrate metabolism - Scope of clinical biochemistry. Blood glucose homeostasis, hormonal regulation of blood glucose, Abnormalities in glucose metabolism: Diabetes mellitus - types, causes, biochemical manifestations, diagnosis and treatment. Inborn errors of carbohydrate metabolism - Galactosemia, fructosuria and Glycogen storage diseases.

UNIT II

Disorders of lipid metabolism - Normal levels of cholesterol, triglycerides, phospholipids, free fatty acids and lipoprotein in blood. Abnormal levels of these lipids in diseases, Atherosclerosis,

hyper and hypo lipoproteinemias. Inborn errors of Lipid metabolism- Niemann-Pick disease, Gaucher's and Tay-Sach's disease.

UNIT III

Liver function tests - Bile pigment metabolism. Tests based on bile pigment metabolism, Carbohydrate metabolism, plasma proteins and lipids, detoxification and excretory functions of liver. Jaundice -classification, biochemical changes and differential diagnosis for jaundice.

UNIT IV

Renal function tests - Normal and abnormal constituents in urine. Kidney function tests - Inulin, urea and creatinine clearance tests. Concentration and dilution tests. Phenol red test. Levels of plasma protein and its significance related to kidney function. Proteinuria. Inborn errors of amino acid metabolism-Phenyl ketonuria, Alkaptonuria, Tyrosinemia, cystinuria

UNIT V

Clinical enzymology - Definition of functional and non-functional plasma enzymes. Isozymes and diagnostic tests. Enzyme patterns in acute pancreatitis, liver damage, bone disorder, malignancy, myocardial infarction and muscle wasting.

Books Recommended

1. Thomas M.Devlin (2014). Textbook of Biochemistry with Clinical Correlations (7th ed), John Wiley and Sons.
2. Montgomery R, Conway TW, Spector AA (1996). Biochemistry: A Case-Oriented Approach (6th ed), Mosby Publishers, USA.
3. Tietz (2014). Fundamentals of Clinical Chemistry and Molecular Diagnostics (7th ed), Saunders.
4. Dinesh Puri, (2002). Text book of Biochemistry: A clinically oriented approach - Churchill Livingstone Inc., India.
5. M.N.Chatterjee and Rana Shinde (2007). Textbook of Medical Biochemistry (7th ed).

CORE PAPER – XI- MOLECULAR BIOLOGY

CREDITS – 5

TOTAL HOURS – 60

After the completion of this course, the student will be able to

CO1: Understand the basic concepts of genetic information and the general principles of gene organization and expression

CO2: Understand the synthesis of DNA and Post replication processing.

CO3: Understand the synthesis of RNA and post transcriptional modifications

CO4: Understand the synthesis of protein and its post translational modifications

CO5: Describe the molecular mechanisms behind DNA damage and repair

Molecular Biology	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

UNIT I

Basic concepts of Genome - DNA as the unit of inheritance. Griffith, Avery, McLeod, McCarthy, Hershey and Chase experiments and their significance. Definition of gene, organization of gene and non-coding sequence in prokaryotes, mitochondrial DNA, plasmid DNA. Viral genome- bacteriophages (M13 and Φ X174), animal virus (influenza virus), plant virus (TMV).

UNIT II

Replication - Prokaryotic replication- model of replication - semiconservative mode of replication- replication forks, semi-discontinuous replication, Okazaki fragments. Bacteriophages M13 and Φ X174 replication, rolling circle model of replication. Enzymology of replication- role

of DNA polymerases I, II, III, gyrase, topoisomerases, helicase, ligases and SSB proteins. Theta replication in *E.Coli* - initiation events at Ori C, elongation events on the replication fork and termination - fidelity of replication - inhibition of replication.

UNIT III

Transcription - Transcription- prokaryotic RNA polymerases - role of sigma factor. TATA box, promoter, closed and open promoter complexes- initiation, elongation and termination of transcription, post transcriptional modifications in prokaryotes (tRNA and rRNA). Inhibitors of transcription.

UNIT IV

Translation - Genetic code - characteristics of genetic code - Wobble hypothesis - protein biosynthesis - activation of amino acids, initiation, elongation and termination of translation in prokaryotes. Inhibitors of protein biosynthesis.

UNIT V

DNA Damage & Repair - DNA damage, Mutation - types of mutation with examples, causes- physical and chemical agents, site - specific mutagenesis and mutational hot spots. DNA repair by direct reversal of damage, photoreactivation, excision repair-base excision, nucleotide excision and mismatch, recombination repair, SOS repair in prokaryotes.

Books recommended

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed), John Wiley and Sons. Inc.
2. Bruce Alberts and Dennis Bray (2013). Essential Cell Biology (4th ed), Garland Science.
3. De Robertis, E.D.P. and De Robertis, E.M.F. (2010). Cell and Molecular Biology (8th ed), Lippincott Williams and Wilkins, Philadelphia.
4. James.D.Watson (2013). Molecular Biology of the Gene (7th ed), Benjamin Cummings.
5. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach (5th ed), Sunderland, Mass. Sinauer Associates, Inc.
6. David Freifelder (1992). Essentials of Molecular Biology (2nd ed), Jones and Bartlett Pub.

CORE PAPER – XII - CORE PRACTICAL III

CREDITS – 4

TOTAL HOURS – 60

CO1: To understand the collection and preservation of biological specimens

CO2: To determine the activity of Salivary amylase.

CO3: Separation and identification of aminoacids and sugars by Radial Paper chromatography & thin Layer chromatography.

CO4: To analyse qualitatively the normal and abnormal constituents of Urine

CO5: To estimate the amount of urea and creatinine in Urine.

Core Practical-III	PSO-1 (Theory)	PSO-2 (Practical)	PSO-3 (Higher studies)	PSO-4 (Competitive Exams)	PSO-5 (Employment)
CO-1		✓			✓
CO-2		✓			✓
CO-3		✓			✓
CO-4		✓		✓	✓
CO-5		✓	✓		✓

1. Collection and preservation of urine sample.
2. Qualitative analysis of normal constituents of urine such as urea, creatinine, phosphorus, calcium and abnormal constituents such as calcium, sugar, protein, amino acid, ketone bodies and bile pigments with clinical significance.
3. Quantitative Analysis of Urine
 - a. Urea
 - b. Uric acid
 - c. Creatinine
4. Paper chromatography: Separation and detection of amino acids and simple sugars
5. Thin layer chromatography: Separation and detection of amino acids
6. Assay of activity of salivary amylase
7. Effect of pH and substrate concentration on activity of salivary amylase

Books recommended

1. Varley's practical clinical biochemistry, Alan. H. Gowen clock, 6th Edition, 1988, CBS publishers & distributors, India.
2. Practical manual of Biotechnology, Lab Manual, Dr.Ritu Mahajan, Dr.Jitender Sharma & Dr. R.K. Mahajan, 1st Edition, 2010, Vayu education of India, New Delhi.
3. Laboratory manual and Practical biochemistry, T.N.Pattabiraman, 4th Edition, 2010, All India Publisher's & Distributors limited, New Delhi.
4. Practical text book of biochemistry for MBBS students, D.M.Vasudevan, 1st Edition, 2007, Jaypee brothers, New Delhi.
5. An introduction to practical biochemistry, David. T. Plummer, 3rd Edition, 1998, Tata Mc.Grawhill education private limited, New Delhi.

CORE PAPER – XIII - CORE PRACTICAL – IV

CREDITS – 4

TOTAL HOURS – 60

After the completion of this course, the student will be able to

CO1: Understand the Basic concepts and principles of Clinical Biochemistry, detail on the various biological specimens including the process of collection, preservation and storage.

CO2: Analyze blood for RBC, WBC, TC/DC, ESR and hemoglobin by performing hematological assays

CO3: Acquire knowledge in the quantitative estimation of biomolecules, and correlating the laboratory test results with common diseases or conditions.

CO4: Determine blood urea and creatinine which acts as renal indices

CO5: Explain the nature and function of various enzymes, normal levels and elevated levels in various diseases.

Core Practical - IV	PSO-1 (Theory)	PSO-2 (Practical)	PSO-3 (Higher studies)	PSO-4 (Competitive Exams)	PSO-5 (Employment)
CO-1		✓	✓		✓
CO-2		✓	✓	✓	
CO-3		✓	✓	✓	✓
CO-4	✓	✓	✓	✓	
CO-5		✓	✓	✓	✓

1. Collection and preservation of blood sample

2. Haematological studies

- a. RBC counting
- b. Total and differential count of white blood cells
- c. Packed cell volume
- d. Erythrocyte sedimentation rate
- e. Blood clotting time
- f. Blood grouping

3. Quantitative estimation in blood

- a. Haemoglobin
- b. Glucose
- c. Cholesterol
- d. Urea
- e. Creatinine
- f. Protein by Lowry's method.

4. Enzyme assay

- a. AST
- b. ALT
- c. Alkaline phosphatase

Books recommended

1. Varley's practical clinical biochemistry, Alan. H. Gowen clock, 6th Edition, 1988, CBS publishers & distributors, India.
2. Practical manual of Biotechnology, Lab Manual, Dr.Ritu Mahajan, Dr.Jitender Sharma & Dr. R.K. Mahajan, 1st Edition, 2010, Vayu education of India, New Delhi.
3. Laboratory manual and Practical biochemistry, T.N.Pattabiraman, 4th Edition, 2010, All India Publisher's & Distributors limited, New Delhi.
4. Practical text book of biochemistry for MBBS students, D.M.Vasudevan, 1st Edition, 2007, Jaypee brothers, New Delhi.
5. An introduction to practical biochemistry, David. T. Plummer, 3rd Edition, 1998, Tata Mc.Grawhill education private limited, New Delhi.

CORE ELECTIVE PAPER – II - IMMUNOLOGY

CREDITS – 5

TOTAL HOURS – 60

After the completion of this course, the student will be able to

CO-1: To understand different immunological components

CO-2: To be able to analyze the role of organs and cells for immunity.

CO-3: To categorize different components according to their nature.

CO-4: To describe the structure and functions of antibodies.

CO-5: To draw and prepare charts about different defense mechanisms.

Immunology	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓	✓			✓
Unit-2	✓		✓		✓
Unit-3	✓		✓		✓
Unit-4	✓			✓	✓
Unit-5	✓	✓			✓

UNIT I

Cells of immune system - Hematopoiesis, Pluripotent stem cells, Lymphoid progenitor lineage – T – Lymphocytes, B – Lymphocytes, NK cells and K- cells, Myeloid progenitor lineage – Neutrophil, Eosinophil, Basophil, Platelets, Erythrocytes, Monocytes, Macrophages, Antigen presenting cell – Dendritic cells.

UNIT II

Organs and tissues of immune system - Primary lymphoid organs – Bone marrow, Thymus; Secondary lymphoid organs – Spleen, Lymph node; Tertiary lymphoid organs – Mucosal associated lymphoid tissue (MALT), Cutaneous associated lymphoid tissue (CALT), Evolutionary comparisons of lymphoid organs.

UNIT III

Antigens - Antigenicity, Factors affecting antigenicity – Foreignness, Molecular size, Chemical composition, heterogeneity, Chemical nature, Susceptible to antigen processing, genotype, dosage and route; Adjuvants, Haptens, and Epitopes. Complement Pathways – Classical, Alternate and Lectin pathways.

UNIT IV

Immunoglobulins - Immunoglobulin genes, Basic structure of immunoglobulins, Different types of immunoglobulins – Isotypes, Allotypes and Idiotypes, Structure and functions of Immunoglobulins – Ig M, Ig G, Ig A, Ig E and Ig D and Characteristics of Immunoglobulins.

UNIT V

Immunity - Types of Immunity; Innate immunity – Components of innate immunity, phagocytic barrier, inflammatory barrier, physiological barrier, Adaptive immunity – Antigenic specificity, Immunologic memory, Immune diversity, self / non-self-recognition, Cell mediated immunity and Humoral immunity. Vaccines – Types of vaccines.

Books recommended

1. Kuby's Immunology - Janis Kuby, Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, 4th Edition, 2000, W.H. Freeman. (Unit I to V)
2. Roitt's Essential Immunology - Ivan Roitt and Peter Delves, 10th Edition, 2001, Wiley (Unit I to V)
3. Basic immunology - Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai, 4th Edition, 2012, Elsevier Health Sciences.
4. Immunobiology - Janeway CA, Travers P, Walport M, and Shlomchik M, 6th edition, 2001, Garland Publishing, New York.
5. Immunology: An Introduction - Tizard, I.R., 4th edition, 1995. Saunders College Publishing, New York.
6. Immunology: Introductory text book – Nandini Shetty, 1st Edition, 2005, New Age International.

CORE ELECTIVE-III – BIOTECHNOLOGY

CREDITS – 5

TOTAL HOURS – 60

On successful completion of the course, students will be able to:

CO-1: Understand the basic concepts of rDNA technology and restriction enzymes.

CO-2: Understand DNA library construction, gene transfer methods, screening of clones and hybridization

CO-3: Understand basics of animal cell culture, transfection methods and microinjection.

CO-4: Explain the basics of plant tissue culture, viral vectors, transgenic plants and applications.

CO-5: Describe types of fermentation, design of fermenter, commercial production of fuels, microbial enzymes, antibiotics and vitamins.

Biotechnology	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				✓
Unit-2	✓	✓			
Unit-3	✓	✓	✓		
Unit-4	✓			✓	
Unit-5					✓

UNIT I

rDNA Technology - Scope and importance of biotechnology. Recombinant DNA technology- Definition, restriction endonucleases - types, role, recognition sequences, cleavage pattern, modification of cuts ends, vectors- plasmid, cosmid, phage and construction maps of PBR322, λ bacteriophage. Enzymes used in rDNA technology - DNA ligases, Alkaline phosphatase, polynucleotide kinase, linkers, homopolymer tailing and end labeling

UNIT II

Gene Transfer Methods - Steps in genetic engineering - Construction of genomic library. Synthesis of cDNA Construction of cDNA library. Gene transfer methods- transformation, conjugation, transduction, microinjection and electroporation. Selection - selectable markers,

selection of recombinants by blue-white selection method (chromogenic substrate) and screening of clones - colony hybridization, screening with antibodies. PCR – Principle and applications.

UNIT III

Animal cell culture - Introduction to basic tissue culture techniques; chemically defined and serum free media, disaggregation of animal tissue, establishment of cell line. Transfection methods- calcium phosphate precipitation, DEAE - dextran mediated transfection. Transgenic mice - retroviral transfer and stem cell mediated transfer, applications. Embryonic stem cell - definition, ES cell culture to produce differentiated cells. Microinjection and applications.

UNIT IV

Plant tissue culture - basic requirements for culture, MS medium, callus culture. protoplast culture – Protoplast Preparation and culture. Vectors – Ti plasmid . Viral vectors- TMV, CaMV and their applications. Transgenic plants – Agrobacterium mediated gene transfer. Applications of transgenic plants -Pesticide resistant Plants and herbicide resistant plants.

UNIT V

Basics of Fermentation – Design of fermenter, Types (Solid state and Sub merged fermentation), concepts of Upstream and Downstream processing, Production and applications of ethanol, Lactic acid, streptomycin, Riboflavin, Biogas.

Books Recommended

1. David Freifelder (1992). Essentials of Molecular Biology (2nd ed), Jones & Bartlett Pub.
2. Click B.R. and Pasternark J.J (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. (4th ed), American Society for Microbiology.
3. James D. Watson, Amy A. Caudy, Richard M. Myers, Jan Witkowski (2006). Recombinant DNA: Genes and Genomes - a Short Course (3rd ed), W.H.Freeman and Co.
4. Satyanarayana U (2008). Biotechnology, Books and Allied (P) Ltd.
5. Casida L (2007). Industrial Microbiology, New Age International.
6. Reed G (2004). Prescott and Dunn's Industrial Microbiology, CBS Publishers and Distributors.

ALLIED PAPERS FOR OTHER BRANCHES

ALLIED BIOCHEMISTRY – PAPER –I

CREDITS – 3

TOTAL HOURS – 60

On successful completion of the course, students will be able to:

CO-1: Understand the basic component or biomolecules of living organisms. Have knowledge of the structure/conformational freedom of biomolecules of carbohydrates. Learn the classifications of carbohydrates

CO-2: Understand and demonstrate how the structure of biomolecules determines their chemical properties and reactivity.

CO-3: Learn the molecular structures of 20 amino acids, differentiating essential and non-essential amino acids, biologically important modified amino acids and their functions.

CO-4: Recognize the structural levels of organization of proteins, 3D structure of proteins, its functions and denaturation.\

CO-5: Study about heterocyclic compounds and porpyrins.

Allied Biochemistry-I	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

UNIT I

Carbohydrates - Monosaccharides and Disaccharides: Definition and classification of carbohydrates, linear and cyclic forms (Haworth projection) for glucose, fructose, mannose and

disaccharides (maltose, lactose, sucrose). Physical properties – Stereoisomerism, Optical isomerism, mutarotation. Chemical properties of sugar.

UNIT II

Carbohydrates – Polysaccharides: Occurrence and Properties - Polysaccharides (Starch, Glycogen, Cellulose, Chitin, Pectin) and Mucopolysaccharides - Hyaluronic acid, heparin, Chondroitin sulphate, Dermatan sulphate.

UNIT III

Amino acids - Amino acids, various classifications, amphoteric nature, isoelectric point. Reactions of carboxyl and amino groups.

UNIT IV

Proteins - Proteins- classification - biological functions, physical properties - ampholytes, isoionic point, salting in and salting out, denaturation, nature of peptide bond. Secondary structure, α -helix and β -pleated sheet, tertiary structure, various forces involved - quaternary structure. Deamination, transamination and urea cycle.

UNIT V

Heterocyclic Compounds - Heterocyclic rings of biological importance - pyridine, pyrrole, pteridine, thiazole, imidazole and indole with examples. Porphyrins: Porphyrin nucleus and classification of porphyrins, important metalloporphyrins occurring in nature, Chemical nature and significance of bile salts and bile pigments.

Books Recommended

1. David L.Nelson and Michael M.Cox (2012). Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
2. Voet.D & Voet. J.G (2010). Biochemistry, (4th ed), John Wiley & Sons, Inc.
3. Lubert Stryer (2010). Biochemistry (7th ed), W.H.Freeman.
4. Satyanarayan,U (2014). Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.
5. Jain J.L (2007). Fundamentals of Biochemistry, S.Chand publishers.

ALLIED BIOCHEMISTRY – PAPER –II

CREDITS – 3

TOTAL HOURS – 60

On successful completion of the course, students will be able to:

CO-1: Understand the basic component or biomolecules of living organisms. Have knowledge of the structure/conformational freedom of biomolecules. Understand and demonstrate how the structure of biomolecules determines their chemical properties and reactivity.

CO-2: To understand the types and structure of DNA and RNA.

CO-3: Learning kinetics of enzyme catalysed reactions and enzyme inhibitions and regulatory process, Enzyme activity, Enzyme Units, Specific activity.

CO-4: To know the sources, biological functions and deficiencies of vitamins.

CO-5: To know the sources, biological functions and deficiencies of Minerals.

Allied Biochemistry-II	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

UNIT I

Lipids - Fats - function, classification, simple lipids, fatty acids (saturated and unsaturated), compound lipids, derived lipids, properties- saponification, rancidity, reduction, oxidation, halogenation. Functions of phospholipids, Cholesterol – biological importance, chemical properties.

UNIT II

Nucleic acids - Purine and pyrimidine bases, nucleosides, nucleotides, polynucleotides, DNA structure, various types, properties- absorbance, effect of temperature. Different types of RNA structure and function, Genetic code.

UNIT III

Enzymes - definition, units of enzyme activity, enzyme nomenclature, specificity, isoenzymes, factors affecting enzyme activity- substrate concentration, pH, temperature. Michaelis and Menten equation. Lineweaver- Burk plot, Enzyme inhibition, competitive, uncompetitive and non competitive inhibition

UNIT IV

Vitamins - definition and types of vitamins. Sources, requirement, biological functions, deficiency symptoms of water soluble vitamins, B1, B2, B3, B6, B12 and Vitamin-C.

Sources, requirement, biological functions, deficiency symptoms of fat soluble vitamins - A, D, E and K- Deficiency diseases.

UNIT V

Minerals - sources, requirement, physiological functions, deficiency and toxicity of calcium, sodium, potassium, iron, magnesium, copper, manganese, selenium, iodine and zinc.

Books Recommended

1. David L.Nelson and Michael M.Cox (2012). Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
2. Voet.D & Voet. J.G (2010). Biochemistry, (4th ed), John Wiley & Sons, Inc.
3. Lubert Stryer (2010). Biochemistry, (7th ed), W.H.Freeman
4. Satyanarayan,U (2014). Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.
5. Jain J.L (2007). Fundamentals of Biochemistry,S.Chand publishers

ALLIED BIOCHEMISTRY PRACTICALS

FOR PAPERS I & II

CREDITS – 4

TOTAL HOURS – 60

On successful completion of the course, students will be able to:

CO-1: Estimate the ascorbic acid and glycine by titration method.

CO-2: acquire knowledge in the Identification of carbohydrate using qualitative tests

CO-3: acquire knowledge in the Identification of amino acids using qualitative tests

CO-4: Colorimetric estimation of protein and phosphorous.

CO-5: Preparation of starch from potatoes and casein from milk.

Allied Biochemistry Practicals	PSO-1 (Theory)	PSO-2 (Practical)	PSO-3 (Research, Higher studies)	PSO-4 (Competitive Exams)	PSO-5 (Employment)
CO-1		✓			
CO-2		✓		✓	✓
CO-3		✓			
CO-4		✓	✓	✓	✓
CO-5		✓	✓	✓	✓

1. Volumetric analysis

- Estimation of ascorbic acid using 2, 6 – dichlorophenol indophenol as link solution.
- Estimation of Glycine by formal titration.

2. Qualitative analysis

- Qualitative analysis of carbohydrates- glucose, fructose, galactose, lactose, maltose and sucrose.
- Qualitative analysis of amino acids – arginine, cysteine, tryptophan and tyrosine.

3. Quantitative analysis: (demonstration)

a. Colorimetric estimation of protein by Biuret method.

b. Colorimetric estimation of phosphorus.

4. Biochemical preparations

a. Preparation of casein from milk.

b. Preparation of starch from potato.

Books recommended

1. Varley's practical clinical biochemistry, Alan. H. Gowen clock, 6th Edition, 1988, CBS publishers & distributors, India.
2. Laboratory manual and Practical biochemistry, T.N.Pattabiraman, 4th Edition, 2010, All India Publisher's & Distributors limited, New Delhi.
3. Practical text book of biochemistry for MBBS students, D.M.Vasudevan, 1st Edition, 2007, Jaypee brothers, New Delhi.
4. An introduction to practical biochemistry, David. T. Plummer, 3rd Edition, 1998, Tata Mc.Grawhill education private limited, New Delhi.
