

**SRI SANKARA ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)
ENATHUR, KANCHIPURAM – 631 561**

DEPARTMENT OF BIOCHEMISTRY



**B.Sc., BIOCHEMISTRY
REGULATIONS AND SYLLABUS
(Effective from the academic year 2023-2024)**

Choice Based Credit System

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SRI SANKARA ARTS AND SCIENCE COLLEGE
(Autonomous)
DEPARTMENT OF BIOCHEMISTRY
BACHELOR DEGREE PROGRAMME IN BIOCHEMISTRY
CHOICE BASED CREDIT SYSTEM (CBCS)
(With effect from the academic year 2023-2024)

PREAMBLE

Biochemistry is the cross over scientific discipline that integrates the living world and chemistry. It involves the study of the structure of biomolecules and explores the biological processes at molecular level in the living organisms. It is the laboratory science that has several domains like cell biology, molecular biology, clinical biology, enzymology, immunology, physiology, pharmacology etc., It has enlightened many aspects of health and diseases and paved the way for many interdisciplinary technological innovations like metabolomics, genomics and proteomics. There is a continuous demand for biochemists in public and private health care sectors, agriculture, medical and forensic departments. Almost all food, pharmaceuticals, health and beauty care etc required quality control and safety checks for which experts in the field of Biochemistry are always in need. The syllabi for the three year B.Sc., degree programme in Biochemistry was framed in such a way that at the end of the course they could apply the knowledge and expertise in industries, diagnostic laboratories and various research fields.

The programme endeavours to provide students a broad based training in biochemistry with a solid background of basic concepts as well as exposing them to the exciting advancements in the field. In addition to theoretical knowledge, significant emphasis has been given to provide hands on experience to the students in the forefront areas of experimental biochemistry. A multidisciplinary approach has been employed to provide the best leverage to students to enable them to move into frontier areas of biological research in the future.

The course defines clearly the objectives and the learning outcomes, enabling students to choose the elective subjects for broadening their skills. The course also offers skills to pursue research in the field of Biological Chemistry and thus would produce best minds to meet the demands of society.

Biochemistry, today is considered as an application oriented integrated basic science. It's an interdisciplinary science that has emerged by the confluence of principles of Chemistry, Physics and Mathematics to Biology. Advances in Biochemistry have immense positive implications on the understanding of biochemical interactions, cellular communications, hormonal mechanisms and the cross talks between them. The research in Biochemistry has been translational and there is a shift

from hypothesis driven research to data dependent research that promises translational, product oriented research. Much of the advancement in Biochemistry is in the advancement of Biotechnology, as a basic science discipline Biochemistry lead to Biotechnological advancement. Considering its pivotal role in biological sciences, it is imperative to strengthen the fundamental concepts of Biochemistry.

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 REQUIRMENTS 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)

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	13	20	19	91
Part IV	4	4	4	6	4	2	24
Part V	-	-	-	-	-	1	1
Total	23	23	23	25	24	22	140

***Part I, II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

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) as 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:

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).

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.

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

v. Skill Enhancement Courses

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) Rotaract/ 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

Part	Course	Over all Credits	Marks		
			CIA	ESE	Total
Part -1	Language –Tamil – I	3	25	75	100
Part -2	English –I	3	25	75	100
Part -3	Core Course I Nutritional Biochemistry	4	25	75	100
	Elective Paper I- Chemistry I	3	25	75	100
	Core Course II Core Practical I -Nutritional Biochemistry	4	40	60	100
	Elective Practical- I- Chemistry Practical –I	2	40	60	100
Part -4	Skill Enhancement Course SEC-1 NME I - Health and Nutrition	2	25	75	100
	Foundation Course- Bridge course -Basics of Biochemistry for Beginners - Scope and applications	2	25	75	100
	Total	23			

SEMESTER II

Part	Course	Overall Credits	Marks		
			CIA	ESE	Total
Part -1	Language –Tamil – II	3	25	75	100
Part -2	English –II	3	25	75	100
Part -3	Core Course III- Cell Biology	4	25	75	100
	Elective Paper II- Chemistry- II	3	25	75	100
	Core Course IV- Core Practical II - Cell Biology	4	40	60	100
	Elective Practical II- Chemistry Practical II	2	40	60	100
Part -4	Skill Enhancement Course SEC-2- NME-II - Life Style Diseases	2	25	75	100
	Skill Enhancement Course -SEC-3 Discipline/Subject specific) - First Aid	2	25	75	100
	Total	23			

SEMESTER III

Part	Course	Overall Credits	Marks		
			CIA	ESE	Total
Part -1	Language –Tamil –III	3	25	75	100
Part -2	English –III	3	25	75	100
Part -3	Core Course V- Biomolecules	4	25	75	100
	Elective Paper III Elective Microbiology-I	3	25	75	100
	Core Course VI- Core Practical III- Biomolecules	4	40	60	100
	Elective Practical - III Elective Microbiology Practical –III	2	40	60	100
Part-4	Skill Enhancement Course SEC-4 Entrepreneurial Based Medical Laboratory Technology	2	25	75	100
	Skill Enhancement Course -SEC-5 Discipline/subject specific) Biomedical Instrumentation	2	25	75	100
	Total	23			

SEMESTER-IV

Part	Course	Overall Credits	Marks		
			CIA	ESE	Total
Part –1	Language –Tamil –IV	3	25	75	100
Part –2	English –IV	3	25	75	100
Part 3	Core Course VII- Biochemical techniques	4	25	75	100
	Elective Paper IV- Elective Microbiology-II	3	25	75	100
	Core Course VIII- Core Practical IV- Biochemical Techniques	4	40	60	100
	Elective Practical IV Elective Microbiology Practical-II	2	40	60	100
Part -4	Skill Enhancement Course SEC-6 Discipline/subject specific) Basics of Forensic Science	2	25	75	100
	Skill Enhancement Course -SEC-7 Discipline/subject specific Tissue Culture	2	25	75	100
	EVS	2	25	75	100
	Total	25			

SEMESTER V

Part	Course	Overall Credits	Marks		
			CIA	ESE	Total
Part 3	Core Paper 9- Enzymes	4	25	75	100
	Core Paper 10- Intermediary Metabolism	4	25	75	100
	Core Paper 11- Clinical Biochemistry	4	25	75	100
	Elective Paper 1 1A- Immunology 1B- Biochemical pharmacology 1C- Research methodology	4	25	75	100
	Core paper 12- Core Practical V - Clinical Biochemistry	4	40	60	100
Part 4	Value Education	2	25	75	100
	Internship/ Industrial visit/ Field visit	2	20	80	100
	Total	24			

SEMESTER VI

Part	Course Category	Course	Overall Credits	Marks		
				CIA	ESE	Total
Part 3		Core Paper 13- Molecular Biology	4	25	75	100
		Core Paper 14- Human Physiology	4	25	75	100
		Core Paper 15- Plant Biochemistry & Plant therapeutics	4	25	75	100
		Elective-paper 2 2A-Biotechnology 2B- Bioinformatics 2C- Bioentrepreneurship	3	25	75	100
		Core paper-16- Core Project	4	40	60	100
Part 4		Professional Competency Skill	2			
Part 5		Extension activity	1			
		Total	22			

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, Second, Third and Fourth semesters:

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

* 2 hours for Part IV Basic Tamil/ Advanced Tamil

@ 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 up to 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.

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

7.5 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 Part-I, II, III, IV & V. He/she shall also fulfill 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, 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

$$\text{GPA for a Semester:} = \frac{\sum_i C_i G_i}{\sum_i C_i}$$

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, 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 behaviour 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

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

REGULATIONS ON LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK

Programme	B. Sc Biochemistry
Programme Code	
Duration	3 years [UG]
Programme Outcomes	<p>PO1 - Acquire knowledge in Biochemistry and apply the knowledge in their day to day life for betterment of self and society</p> <p>PO2 - Develop critical, analytical thinking and problem solving skills</p> <p>PO3 - Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret and draw conclusion from data</p> <p>PO4 - Address and develop solutions for societal and environmental needs of local, regional and national development</p> <p>PO5 - Work independently and engage in lifelong learning and enduring proficient progress</p> <p>PO6 - Provoke employability and entrepreneurship among students along with ethics and communication skills</p>
Programme Specific Outcomes	<p>PSO1 - Comprehend the knowledge in the biochemical, analytical, bio statistical and computational areas</p> <p>PSO2 - Ability to understand the technical aspects of existing technologies that help in addressing the biological and medical challenges faced by human kind</p> <p>PSO3 - Acquiring analytical and hands on skills to perform research in multidisciplinary environments</p> <p>PSO4 - Use library search tools and online databases and sources to locate and retrieve scientific information about a topic and techniques related to biochemistry.</p>

HIGHLIGHTS OF THE REVAMPED CURRICULUM

- The curriculum is created to improve the relationship between business and academia
- Every semester, practicals are based on the course taken that semester will aid students in applying what they have learned
- Students will benefit from the introduction of skill based elective courses including Bioinformatics, Nano-biotechnology, Therapeutic nutrition, and Medical Laboratory technology as they keep up with technological advancements in their fields of study
- The fourth semester internship will give students a chance to apply what they have learned in class to a real world working experiment
- Skill enhancement courses help students venture new platforms in career.
- Equip students with employability skills; generate self employment and small scale entrepreneurs.

VALUE ADDITIONS IN THE REVAMPED CURRICULUM:

Semester	Newly introduced Components	Outcome / Benefits
I	Foundation Course It depicts the overview of entry education and makes the students assimilate with the biochemistry course. This course will inculcate knowledge of the academic skills, laboratory skills and research	It gives a strong determination to undergo the course. Be committed and interested in learning the subject
I, II, III, IV	Skill Enhancement papers (Discipline centric / Generic / Entrepreneurial)	<p>Improve employability Develop the skill as Laboratory Analyst To make students compete with industrial expectations.</p> <p>Incorporating the interest on health, diet, lifestyle diseases will enable the students gain knowledge to get exposed themselves in medical field</p> <p>Biomedical Instrumentation skills will aid the students gain knowledge on the various instruments used in the field of medical laboratory and research.</p> <p>Entrepreneurial skill training will increase the chance to build their career independently. Learning this skills will encourage the students to enhance creativity, innovation and collaboration</p> <p>Discipline /subject specific skill will serve as a route for employability.</p>

V & VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	It reinforces additional knowledge inputs along with core course. Students are familiarized with multi-disciplinary, cross disciplinary and inter disciplinary subjects. It broadens the knowledge on immunological aspects, pharmacology and research. Additional Employability skills are facilitated through computational biology and Bio entrepreneurship.
V semester Vacation activity	Internship/ Industrial visit/Field visit	Hand on training in Medical Labs/ Industry/ Research centres enable the students to explore the practical aspects in career path. They gain confident to fix their career.
VI Semester	Project with Viva – voce	Self-learning is enhanced. It serves as a platform to express their innovative ideas in a practical way, which serves as a pathway to enter in the field of research.
VI Semester	Introduction of Professional Competency skill	The revamped curriculum caters the education to all category of learners; Learning multidisciplinary papers, updated in the curriculum will help the students to fix their career in the fields of Medical, pharmaceutical, forensic, nutritional, diagnostic coding ,etc Students are trained in the field of research to bring out the progress in the field of Medical, Agriculture, Nutrition, etc which will be a back bone for health and wealth creation and improve the quality of life
Extra Credits: For Advanced Learners / Honours degree		To cater to the needs of peer learners / research aspirants
Skills acquired from the Courses		Analytical, Laboratory operating, Predicting, Experimenting, Critical thinking, Problem solving, Communication, Interpersonal, Time management and Multi-tasking Skills

CREDIT AND HOURS DISTRIBUTION SYSTEM

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil-I	3	6
Part-2	English-I	3	6
Part-3	Core Courses & Elective Courses [in Total]	13	14
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course-	2	2
		23	30

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil-II	3	6
Part-2	English-II	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-2	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
		23	30

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil-III	3	6
Part-2	English - III	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	13
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	2	2
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	-	1
		23	30

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil-IV	3	6
Part-2	English - IV	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	13
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
	E.V.S	2	1
		25	30

Third Year- Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based	20	28
Part-4	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	--
		24	30

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based & LAB	19	28
Part-4	Professional Competency Skill	2	2
Part-5	Extension Activity	1	-
		22	30

Total credits - 140

Credit distribution for UG programme in Biochemistry

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil - I	3	6	Part..1. Language – Tamil-II	3	6	Part..1. Language – Tamil-III	3	6	Part..1. Language – Tamil-IV	3	6	5.1 Core Course – CC IX Enzymes	4	6	6.1 Core Course – CC XIII Molecular Biology	4	6
Part.2 English- I	3	6	Part..2 English-II	3	6	Part..2 English-III	3	6	Part..2 English-IV	3	6	5.2 Core Course – CC X Intermediary Metabolism	4	6	6.2 core Course – CC XIV Human Physiology	4	6
1.3 Core Course – CC I Nutritional Biochemistry	4	4	2..3 Core Course – CC III Cell Biology	4	4	3.3 Core Course – CC V Biomolecules	4	4	4.3 Core Course – CC VII Biochemical Techniques	4	4	5. 3.Core Course CC –XI Clinical Biochemistry	4	6	6.3 Core Course – CC XV Plant Biochemistry and Plant Therapeutics	4	6
1.4 Core Course – CC II Core Practical-I Nutritional Biochemistry Practical	4	3	2.4 Core Course – CC IV Core Practical-II Cell Biology	4	3	3.4 Core Course – CC VI Core Practical-III Biomolecules	4	3	4.4 Core Course – CC VIII Core Practical-IV Biochemical Techniques	4	3	5. 4. CC –XII Core Practical-V Clinical Biochemistry	4	5	6.4 Elective -VI Biotechnology	3	5
1.5 Elective I Chemistry-I Theory Practical	3	4	2.5 Elective II Chemistry-II Theory Practical	3	4	3.5 Elective III Microbiology-I Theory Practical	3	3	4.5 Elective IV Microbiology-II Theory Practical	3	3	5.5 Elective V Immunology	4	5	6.5 Core Course/ Project with Viva voce	4	5
1.6 Skill Enhancement Course SEC-1 NME-1 Health & Nutrition	2	2	2.6 Skill Enhancement Course SEC-2 –NME-2 Life Style Diseases	2	2	3.6 Skill Enhancement Course SEC-4, Medical Laboratory Technology	2	2	4.6 Skill Enhancement Course SEC-6 Basics of forensic science	2	2	5.6 Value Education	2	2	6.6 Extension Activity	1	-
1.7 Skill Enhancement - (Foundation Course) Basics of Biochemistry for Beginners - Scope and applications	2	2	2.7 Skill Enhancement Course –SEC-3 First Aid	2	2	3.7 Skill Enhancement Course SEC-5 Biomedical Instrumentation	2	2	4.7 Skill Enhancement Course SEC-7 Tissue culture	2	2	5.7 Summer Internship /Industrial Training	2	-	6.7 Professional Competency Skill	2	2
						E.V.S	--	1	4.8 E.V.S	2	1						
	23	30		23	30		23	30		25	30		24	30		22	30
Total – 140 Credits																	

CONSOLIDATED SEMESTER WISE AND COMPONENT WISE CREDIT DISTRIBUTION

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	13	20	19	91
Part IV	4	4	4	6	4	2	24
Part V	-	-	-	-	-	1	1
Total	23	23	23	25	24	22	140

***Part I, II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall(K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or off beat situation, Discussion, Debating or Presentations	

ILLUSTRATION FOR B.SC BIOCHEMISTRY CURRICULUM DESIGN

First Year- Semester-I

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language –Tamil	3	6
Part-II	English	3	6
Part-III	Nutritional Biochemistry	4	4
	Core Practical I - Nutritional Biochemistry	4	3
	Elective Paper I- Chemistry I	3	4
	Elective Practical –I Chemistry Practical –I	2	3
Part-IV	Skill Enhancement Course (Non Major Elective) Health and Nutrition	2	2
	Foundation Course (FC)- Bridge course Basics of Biochemistry for Beginners - Scope and applications	2	2
		23	30

Semester-II

Part	List of Courses	Credit	Hours per week(L/T/P)
Part-I	Language - Tamil	3	6
Part-II	English	3	6
Part-III	Cell Biology	4	4
	Core Practical II - Cell Biology	4	3
	Elective Paper II- Chemistry- II	3	4
	Elective Practical II Chemistry Practicals-II	2	3
Part-IV	Skill Enhancement Course- 2 (Non Major Elective) Life Style Diseases	2	2
	Skill Enhancement Course (Discipline / Subject Specific) – First Aid	2	2
		23	30

Second Year - Semester-III

Part	List of Courses	Credit	Hours per week(L/T/P)
Part-I	Language -Tamil	3	6
Part-II	English	3	6
Part-III	Biomolecules	4	4
	Elective Paper III - Microbiology-I	3	3
	Core Practical III Biomolecules	4	4
	Elective Practical III - Microbiology Practical –III	2	3
Part-IV	Skill Enhancement Course-4 (Entrepreneurial Based) Medical Laboratory Technology	2	1
	Skill Enhancement Course -SEC-5 Biomedical Instrumentation	2	2
	Environmental Studies	-	1
		23	30

Semester-IV

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language - Tamil-III	3	6
Part-II	English	3	6
Part-III	Biochemical techniques	4	4
	Elective Paper IV - Microbiology-II	3	3
	Core Practical IV -Biochemical Techniques	4	3
	Elective Practical IV Microbiology Practical-II	2	3
Part-IV	Skill Enhancement Course -6 Basics of Forensic Science	2	2
	Skill Enhancement Course – 7 - Tissue Culture	2	2
	Environmental Studies	2	1
		25	30

Third Year: Semester-V

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	Enzymes	4	6
	Intermediary Metabolism	4	6
	Clinical Biochemistry	4	6
	Elective Paper 1 - Immunology	4	5
	Core Practical V -Clinical Biochemistry	4	5
Part-IV	Value Education	2	2
	Internship / Industrial Training (At the end of IV semester- Summer vacation)	2	--
		24	30

Semester-VI

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	Molecular Biology	4	6
	Human Physiology	4	6
	Plant Biochemistry & Plant therapeutics	4	6
	*Elective paper 2 - Biotechnology	3	5
	Core Project	4	5
Part-IV	Professional Competency Skill	2	2
Part -V	Extension Activity	1	-
		22	30

Total Credits : 140

SUGGESTIVE TOPICS IN CORE COMPONENT

- Nutritional Biochemistry
- Practical 1- Nutritional Biochemistry
- Cell Biology
- Practical II: Cell Biology
- Biomolecules
- Practical III - Biomolecules
- Biochemical techniques
- Practical IV- Biochemical techniques
- Enzymes
- Intermediary metabolism
- Clinical Biochemistry
- Practical V- Clinical Biochemistry
- Molecular Biology
- Human Physiology
- Plant Biochemistry and Plant therapeutics
- Core Project

SUGGESTIVE TOPICS IN SKILL ENHANCEMENT COURSES (NME)

Group I

- Medicinal Diet
- Lifestyle Diseases
- Health and Nutrition
- Basics of Biochemistry for Beginners – Scope & Applications

SUGGESTIVE ELECTIVE COURSES (DISCIPLINE-CENTRIC)

Group II

- Immunology
- Biochemical pharmacology
- Research methodology
- Bio-entrepreneurship
- Bioinformatics
- Biotechnology

SUGGESTIVE TOPICS IN SKILL ENHANCEMENT COURSES (SEC)

Group III

- Biomedical Instrumentation
- First Aid
- Basics of forensic science
- Medical Laboratory technology
- Tissue culture
- Medical coding
- Microbial techniques

SYLLABUS FOR B.SC BIOCHEMISTRY

SEMESTER I

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Nutritional Biochemistry	Core	3	1	0	0	4	4	25	75	100

Course	CORE PAPER -I
Title of the Course:	NUTRITIONAL BIOCHEMISTRY
Credits:	4
Pre-requisites, if any:	Basic Knowledge on Food, Nutrition & Dietetics
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Create awareness about the role of nutrients in maintaining proper health • Understand the nutritional significance of carbohydrates, lipids and proteins. • Understand the importance of a balanced diet. • Study the effect of additives, emulsifiers, and flavour enhancing substances in food. • Study the significance of Nutraceuticals.
Course Outcomes	<p>On successful completion of this course, students should be able to:</p> <p>CO1 Cognizance of basic food groups viz. Carbohydrates, proteins and lipids and their nutritional aspects as well as calorific value (K1, K2 & K4)</p> <p>CO2 Identify and explain nutrients in foods and the specific functions in maintaining health (K1, K2 & k5)</p> <p>CO3 Classify the food groups and its significance (K1, K3 & k6)</p> <p>CO4 Describe the importance of nutraceuticals and pigments (K1,K2)</p> <p>CO5 Study the importance of probiotics and prebiotics (K1 & K4)</p>
Units	
I 12 Hours	<p>Basics of Food and Nutrition: - Concepts of food and nutrition. Basic food groups-energy yielding, body building and functional foods. Modules of energy. Calorific and nutritive value of foods. Measurement of Calories by bomb calorimeter. 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 determination- Anthropometric measurement and indices –Height, Weight, chest and waist circumference BMI.</p>

<p style="text-align: center;">II</p> <p style="text-align: center;">12 Hours</p>	<p>Biological role of Macronutrients: Physiological role and nutritional significance of carbohydrates, lipids and protein. Evaluation of proteins by nitrogen balance method- Biological value of proteins- Digestibility coefficient, Protein Energy Ratio and Net Protein Utilization. Protein energy malnutrition – Kwashiorkor and Marasmus, Obesity-Types and preventive measures.</p>
<p style="text-align: center;">III</p> <p style="text-align: center;">12 Hours</p>	<p>Balanced Diet and Junk foods: Balanced diet, example of low and high cost balanced diet- for infants, children, adolescents, adults and elderly people. ICMR classification of five food groups and its significance food pyramid. Junk foods- definition and its adverse effects.</p>
<p style="text-align: center;">IV</p> <p style="text-align: center;">12 Hours</p>	<p>Food additives: Introduction, Structure, chemistry, function and application of preservatives, emulsifying agents, buffering agents, stabilizing agents, natural and artificial sweeteners, bleaching, starch modifiers, antimicrobials, food emulsions, fat replacers, viscosity agents, gelling agents and maturing agents. Food colors, flavors, anti-caking agent, antioxidants. Safety assessment of food additives.</p>
<p style="text-align: center;">V</p> <p style="text-align: center;">12 Hours</p>	<p>Nutraceuticals and Functional Foods: Definition, properties and function of Nutraceuticals, food Supplements, dietary supplements prebiotics and probiotics, and functional Foods. Food as medicine. Natural pigments from plants– carotenoids, anthocyanins and its benefits.</p>
<p style="text-align: center;">Reading List (Print and online)</p>	<p>http://old.noise.ac.in/SecHmscicour/english/LESSON O3.pdf https://study.com/academy/lesson/energy-yielding-nutrients-carbohydratesfat-protein.html. https://www.nhsinform.scot/healthy-living/food-and-nutrition/eatingwell/vitamins-and-minerals</p>
<p style="text-align: center;">Self-Study</p>	<ul style="list-style-type: none"> ➤ Biological Value of Proteins. ➤ Adverse effects of junk foods.
<p style="text-align: center;">Recommended Texts</p>	<ol style="list-style-type: none"> 1. Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bredbenner. 2013. Wardlaw's Perspectives in Nutrition: A Functional Approach. McGraw-Hill, Inc., NY, USA. 2. M.Swaminathan (1995) Principles of Nutrition and Dietetics. Bappco. 3. Tom Brody (1998). Nutritional Biochemistry (2nded), Academic press, USA 4. Garrow, JS, James WPT and Ralph A (2000). Human nutrition and dietetics (10thed) Churchill Livingstone. 5. Andreas M.Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1sted) CRC. 6. Branen, A.L., Davidson PM & Salminen S. 2001. Food Additives. 2nd Ed. Marcel Dekker. 7. George, A.B. 1996. Encyclopedia of Food and Color Additives. Vol. III CRC Press. 8. Advances in food biochemistry, Fatih Yildiz (Editor), CRC Press, Boca Raton, USA, 2010 9. Food biochemistry & food processing, Y.H. Hui (Editor), Blackwell Publishing, Oxford, UK, 2006.

	10. Geoffrey Campbell-Platt. 2009. Food Science and Technology. Wiley-Blackwell ,UK.
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Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation.

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	S	S	S
CO 2	S	M	M	M	L	M	S	S	M	S
CO 3	S	M	M	M	M	L	S	L	L	S
CO 4	S	M	M	M	M	M	S	S	M	S
CO5	S	L	M	M	M	M	S	S	M	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Practical 1- Nutritional Biochemistry	Core	1	0	2	0	4	3	25	75	100

Course	CORE PAPER II
Title of the Course:	Practical 1- Nutritional Biochemistry
Credits:	4
Pre-requisites	Knowledge on basic principles, Instrumentation of Biochemical techniques and biomolecules
Course Objectives	The objectives of this course are to <ul style="list-style-type: none"> • Impart hands-on training in the estimation of various constituents by titrimetric method • Prepare Biochemical preparations • Determine the ash content and extraction of lipid
Course Outcomes	On successful completion of this course, students should be able to: After completion of the course, the students should be able to: CO1 Estimate the important biochemical constituents in the food samples (K1, K3, K4 & K6) CO2 Prepare the macronutrients from the rich sources (K2, K3, K4 & K6) CO3 Determine the ash and moisture content of the food samples (K1, K2, & K4) CO4 Extract oil from its sources (K2, K3, K4 & K6) CO5 Prepare the micronutrients from the rich sources (K2, K3, K4 & K6)
Units	
I 18 Hours	TITRIMETRY 1. Estimation of ascorbic acid in a citrus fruit. 2. Estimation of calcium in milk. 3. Estimation of glucose by Benedict's method in honey. 4. Estimation of phosphorous by Fiske-Subbaraow method (Plant source)
II 15 Hours	BIOCHEMICAL PREPARATIONS Preparation of the following substances and its qualitative tests 5. Lecithin from egg yolk. 6. Starch from potato. 7. Casein and Lactalbumin from milk.
III 12 Hours	GROUP EXPERIMENT 8. Determination of ash content and moisture content in food sample 9. Extraction of lipid by Soxhlet's method.
Reading List (Print and Online)	1. https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors

	<p>2.http://rajswashthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/ Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf</p> <p>3.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y</p> <p>4.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y</p>
Self-Study	<ul style="list-style-type: none"> ➤ Role of nutrients in Health and disease ➤ Sources and biological role of micronutrients
Books Recommended	<p>Text books</p> <p>1.Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, New Age International Publishers, 2011,</p> <p>2. An Introduction to Practical Biochemistry, David T. Plummer, 3 rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.</p> <p>Reference books</p> <p>1. Biochemical Methods, Sadasivam S and Manickam A, 4h edition, NewAge International Publishers, 2016</p> <p>2. Essentials of Food and Nutrition, Vol. I & II, M.S. Swaminathan.</p> <p>3. Bowman and Robert M. 2006. Present Knowledge in Nutrition.9th edition, International Life Sciences Publishers.</p> <p>4. Indrani TK. 2003. Nursing Manual of Nutrition and Therapeutic Diet, 1st edition Jaypee Brothers medical publishers.</p> <p>5. Martha H. and Marie A. 2012. Biochemical, Physiological, and Molecular Aspects of Human Nutrition.3rd edition. Chand Publishers</p>

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	S	M	M	L	S	S	L	M
CO 2	S	M	S	M	M	M	L	S	S	S
CO 3	S	M	S	L	M	M	S	S	L	S
CO 4	S	M	S	M	M	S	S	L	M	S
CO 5	S	M	S	S	L	M	L	S	S	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Basics Of Biochemistry For Beginners – Scope & Applications	Foundation Course	1	1	0	0	2	2	25	75	100

Course	FOUNDATION COURSE - BRIDGE COURSE
Title of the Course:	Basics of Biochemistry for Beginners – Scope & Applications
Credits:	2
Pre-requisites, if any:	Basic Knowledge on Biomolecules and safe laboratory practices
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Understand Biochemistry as a discipline and milestone discoveries in life sciences • Learn about micronutrients essential for life. • Learn the interdisciplinary nature of Biochemistry. • Create awareness on the scope and applications of Biochemistry. • Understand good and safe laboratory practices.
Course Outcomes	<p>On successful completion of this course, students should be able to:</p> <p>CO1 Establishing a stronger foundation in historical background and basic biomolecules of living system (K1, K2, & K6)</p> <p>CO2 Learning about micronutrients required for life (K1, K2, K3 & K4)</p> <p>CO3 Awareness on the scope & interdisciplinary nature of Biochemistry (K1, K2, K3 & K6)</p> <p>CO4 Knowing Career prospects in Biochemistry (K1, K2, K3 & K6).</p> <p>CO5 Learning about Safety measures in laboratories</p>
Units	
I 12 Hours	Introduction and Historical Background of Biochemistry – Chemical composition of living matter – Basic knowledge of – Aminoacids – Purines – Pyrimidines – Simple & Complex Carbohydrates, Proteins, Fat and Nucleic acids.
II 12 Hours	Basic knowledge of Vitamins – water and fat soluble vitamins - Minerals.- micro and macro minerals.
III 12 Hours	Interdisciplinary Nature of Biochemistry- Opportunity for higher education & research in Biochemistry.

IV 12 Hours	Applications of Biochemistry in various fields - Industrial applications of Biochemistry – Career prospects – Bio-entrepreneurship.
V 12 Hours	Safety measures in laboratories – Preparation of Buffers -Preparation of normal, percentage and molar solutions - and measurement of pH. Good laboratory practices.
Reading List (Print and online)	Websites: 1. Biochemistry Definition, History, Examples, Importance, & Facts Britannica 2. Vitamins and Minerals - HelpGuide.org 3. Scope and Application of Biochemistry (biomadam.com) 4. https://www.oecd.org/chemicalsafety/testing/good-laboratory-practiceglp.htm 5. 12 Great Careers in Biochemistry Indeed.com
Self-Study	<ul style="list-style-type: none"> ➤ Basic knowledge on biochemistry. ➤ Safety aspects of Laboratory.
Recommended Texts	References 1. Biochemical Calculations, 1976, Irwin H. Siegel 2 nd Ed. John Wiley and Sons. 2. A biologist’s Physical Chemistry, 1976, 2nd Edition, J Gareth Morris, Edward Arnold Ltd. 3. Devlin, T.M. (2011). Textbook of Biochemistry with Clinical Correlations (7th ed.). New York, John Wiley & Sons, Inc. ISBN: 978-0-470-28173-4. 4. Nelson, D.L., Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7th Ed.). New York, WH: Freeman and Company. ISBN: 13: 978-1-4641-2611-6 / ISBN:10: 1- 46412611-9. 5. Fundamentals of Biochemistry – J.L.Jain

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or off beat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	S	S	S
CO 2	S	L	M	M	L	M	S	S	M	L
CO 3	S	M	M	M	M	L	S	L	L	S
CO 4	S	M	M	M	M	M	S	S	M	S
CO5	S	L	M	M	M	M	S	L	M	S

S-Strong

M-Medium

L-Low

SEMESTER II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Cell Biology	Core	3	1	-	-	4	4	25	75	100

Course	CORE PAPER -III
Title of the Course:	CELL BIOLOGY
Credits:	4
Pre-requisites, if any:	Basic Knowledge on prokaryotic and eukaryotic cells, cellular organelles and cell division
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Provide basic understanding of architecture of cells and its organelles. • Understand the organization of prokaryotic and eukaryotic genome. • Educate on the structural organization of bio membrane and transport mechanism • Impart knowledge on cell cycle, cell division and basics of cells • Familiarize the concept of mechanism of cell-cell interactions.
Course Outcomes	<p>On successful completion of this course, students should be able to:</p> <p>CO1 Explain the structure and functions of basic components of prokaryotic and eukaryotic cells, especially the organelles (K1, K2, & K4)</p> <p>CO2 Familiarize the cytoskeleton and chromatin (K1, K3 & K5)</p> <p>CO3 Illustrate the structure, composition and functions of cell membrane related to membrane transport (K2, K4 & K6)</p> <p>CO4 Elaborate the phases of cell cycle and cell division-mitosis and meiosis and characteristics of cancer cells (K1, K3 & K5)</p> <p>CO5 Relate the structure and biological role of extracellular matrix in cellular interactions (K1, K2, & K4)</p>
Units	
I 12 Hours	Classification of Living Organisms: - Architecture of cells- Structural organization of prokaryotic and eukaryotic cells microbial, plant and animal cells. The ultra structure of nucleus, mitochondria, RER, SER, golgi apparatus, lysosome, peroxisome and their functions.
II 12 Hours	Cytoskeleton - microfilament, microtubules and intermediary filament-structure, composition and functions. Organization of Genome - prokaryotic, and eukaryotic genome. Organization of chromatin – histones, nucleosome concept, formation of chromatin structure. Special types of

	chromosomes – lamp brush chromosomes, polytene chromosomes.
III 12 Hours	Biomembranes -Structural organization of bilipid layer model and basic functions- transport across cell membranes- uniport, symport and antiport. Passive and active transport.
IV 12 Hours	Cell Division - Cell cycle-Definition and Phases of Cell cycle-Cell division-Mitosis and Meiosis and its significance, Cancer cells- definition, types and characteristics of cancer cells.
V 12 Hours	Extracellular matrix – Collagen, laminin, fibronectin and proteoglycans-structure and biological role. Structure and role of cadherin, selectins, integrins, Cell -cell interactions- Types-gap junctions, tight junctions and Desmosomes.
Reading List (Print and online)	Web resources https://nicholls.edu/biol-ds/bio1155/Lectures/Cell%20Biology.pdf https://www.medicalnewstoday.com/article/320878.php https://biologydictionary.net/cell
Self-Study	<ul style="list-style-type: none"> ➤ Structure and functions of prokaryotic and eukaryotic cells ➤ Characteristics of Cancer cells.
Recommended Texts	<ol style="list-style-type: none"> 1. Arumugam. N, Cell biology. Saras publication (10ed, paperback), 2019 2. Devasena. T. Cell Biology.Oxford University Press India-ISBN 9780198075516, 0198075510, 2012 3. Bruce Alberts and Dennis Bray. 2013, Essential Cell Biology. (4thed) Garland Science. 4. S.C,R. Cell Biology. New age Publishers -ISBN-10: 8122416888/ISBN-13: 978- 8122416886, 2008 5. Cooper, G.A. TheCell : A Molecular Approach.Sinauer Associates, Inc -ISBN10: 0878931066 / ISBN 13: 9780878931064, 2013 6. E.M.F.,D.R, Cell and Molecular Biology. Lippincott Williams &Wilkin Philadelphia - ISBN: 0781734932 9780781734936, 2006 7. Lodish H.A, Berk C.A, Kaiser M, Krieger M.P, Scott A, Bretscher H Ploegh and Matsudaira. 2007. Molecular Cell Biology, 6th Edition, WH Freeman Publishers, New York, USA.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation.

Mapping with Program Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	L	M	M	M	M	S	M	M	S
CO 2	S	S	M	M	M	M	S	M	L	S
CO 3	S	S	M	L	M	M	S	L	M	S
CO 4	S	S	M	M	M	M	S	S	M	S
CO5	S	S	M	M	M	M	S	M	M	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Practical II- Cell Biology	Core practical	1	-	2	-	4	3	40	60	100

Course	CORE PAPER -IV
Title of the Course	PRACTICAL II - CELL BIOLOGY
Credits:	4
Pre-requisites, if any:	Basic Knowledge on microscope and staining procedure
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Learn the parts of microscope • Investigate the cells under microscope. • Image the cells using different stains • Identify the cells, organelles and various stages of cell division • Identify the spotters
Course Outcomes	<p>On successful completion of this course, students should be able to:</p> <p>CO1 Identify the parts of microscope (K1, K2 & K3) CO2 Preparation of Slides (K1, K2, & K4) CO3 Identify the stages of mitosis & meiosis (K1, K3 & K5) CO4 Visualize nucleus and mitochondria by staining methods (K2, K3 & K5) CO5 Identify the spotters of cells, organelles and stages of cell division (K1, K2, & K5)</p>
Units	
I 18 Hours	<p>MICROSCOPY AND STAINING TECHNIQUES</p> <ol style="list-style-type: none"> 1. Study the parts of light and compound microscope 2. Preparation of Slides and Micrometry 3. Examination of prokaryotic and eukaryotic cell 4. Visualization of animal and plant cell by methylene blue 5. Visualization of nuclear fraction by acetocarmine stain 6. Staining and visualization of mitochondria by Janus green stain
II 15 Hours	<p>SPOTTERS</p> <ol style="list-style-type: none"> 7. a) Cells: Nerve, plant and Animal cell b) Organelles: Mitochondria, Chloroplast, Endoplasmic reticulum, c) Mitosis stages–Prophase, Anaphase, Metaphase, Telophase
III 12 Hours	<p>GROUP EXPERIMENT</p> <ol style="list-style-type: none"> 8. Identification of different stages of mitosis in onion root tip 9. Identification of different stages of meiosis in onion bulb

Reading List (Print and online)	Web resources 1. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1 2. https://www.microscopemaster.com/organelles.html
	3. https://www.pdfdrive.com/biochemistry-books.htm 4. http://medcell.med.yale.edu/histology/cell_lab.php#:~:text=The%20electron%20microscope%20is%20necessary,and%20small%20granules%20and%20vesicles. 5. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1 6. https://www.khanacademy.org/science/ap-biology/heredity/meiosis-and-geneticdiversity/a/phases-of-meiosis 7. https://www.microscopemaster.com/organelles.html 8. https://www.pdfdrive.com/biochemistry-books.html
Self-Study	➤ Types of microscope with functions. ➤ Staining procedures to identify cells and organelles.
Recommended Texts	Text books 1. Rickwood, D and J.R. Harris cell Biology: Essential Techniques, John Wiley 1996. 2. Davis, J.M. Basic Cell culture: A practical approach, IRL 1994. 3. Ganesh M.K. and Shivashankara A.R. 2012. Laboratory Manual for Practical Biochemistry Jaypee publications, 2 nd Edn. Reference books 1) Essential practical handbook of Cell biology, Genetics and Microbiology -A Practical manual- Debarati Das Academic publishers, ISBN, 9789383420599, 1st Edition 2017 2) Cell biology Practical, Dr. Venugupta ISBN 8193651219, Prestige publisher, 1 st Jan 2018. 3) Cell and Molecular biology, De Robertis, 8th edition, 1st June, 1987.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge.

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	S	M	M	M	M	S	S	S	S
CO 2	M	S	L	M	M	L	S	S	S	S
CO 3	M	S	M	L	M	M	S	S	L	M
CO 4	M	S	M	M	M	M	S	L	M	S
CO 5	M	S	M	L	M	M	S	S	L	M

S-Strong

M-Medium

L-Low

SEMESTER III

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Biomolecules	Core	3	1	-	-	4	4	25	75	100

Course	CORE PAPER -V
Title of the Course:	BIOMOLECULES
Credits:	4
Pre-requisites, if any:	Basic Knowledge of Biochemistry and Biomolecules
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Introduce the structure, properties and biological significance of carbohydrates • Comprehend the classification, functions and acid base properties of amino acids • Elucidate the various levels of organization of Proteins. • Impart knowledge on the classification, properties and characterization of lipids. • Acquaint with the classification, structure, properties and functions of nucleic acids
Course Outcomes	<p>On successful completion of this course, students should be able to:</p> <p>CO1 Classify, illustrate the structure and explain the physical and chemical properties of carbohydrates (K1, K2, & K4)</p> <p>CO2 Indicate the classification, structure, properties and biological functions of amino acids (K1, K2, & K4)</p> <p>CO3 Explain the classification and elucidate the different levels of structural organization of proteins (K1, K3 & K6)</p> <p>CO4 Elaborate on classification, structure, properties, functions and characterization of lipids (K2, K3 & K6)</p> <p>CO5 Describe the structure, properties and functions of different types of nucleic acids (K1, K3 & K4)</p>
Units	
I 12 Hours	<p>Carbohydrates-Classification and biological significance, physical properties - stereo isomerism, optical isomerism, anomers, epimers and mutarotation. Monosaccharides: Occurrence, linear and cyclic structure, Reactions of monosaccharides due to the presence of hydroxyl, aldehyde and keto groups. Disaccharides: Structure and properties of reducing</p>

	disaccharides (lactose and maltose), non-reducing disaccharide (sucrose). Polysaccharides: Homopolysaccharides - Occurrence, structure and biological significance of starch, glycogen and cellulose. Heteropolysaccharides - Structure and biological significance of mucopolysaccharides - hyaluronic acid, chondroitin sulphate and heparin. (structural elucidation not needed).
II 12 Hours	Amino acids -Classification based on composition of side chain and nutritional significance. General structure of amino acids. 3 - and 1- letter abbreviations. 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.
III 12 Hours	Proteins -Classification based on shape, composition, solubility and functions. Properties of proteins - Ampholytes, isoelectric point, salting in and salting out, denaturation and renaturation, UV absorption. Levels of Organization of protein structure- Primary structure, Formation and characteristics of peptide bond, phi and psi angle, Secondary structure- α helix (egg albumin), β - pleated sheath (keratin), triple helix (collagen). Tertiary structure – with reference to myoglobin. Quaternary structure with reference to haemoglobin.
IV 12 Hours	Lipids - Lipids: Bloor's classification, chemical nature and biological functions. Fatty acids: classification, nomenclature, structure and properties of fatty acids. Simple and mixed triglycerides: structure and general properties, Characterization of fats- iodine value, saponification value, acid number, acetyl number, polensky number, Reichert –Meissel number along with their significance. Compound lipids- Structure and functions of phospholipids and glycolipids. Derived lipids-Structure and functions of cholesterol, bile acids and bile salts.
V 12 Hours	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, super helicity. Types of RNA: mRNA, tRNA, rRNA, hnRNA, snRNA, Secondary and tertiary structure of tRNA. Properties of DNA- Hypochromic and hyperchromic effect, melting temperature, viscosity. Denaturation and annealing.
(Print and online)	Web resources https://www.britannica.com/science/biomolecule https://en.wikipedia.org/wiki/Biomolecule https://www.khanacademy.org/science/biology/macromolecules
Self-Study	➤ Classification of Proteins ➤ Functions of Biomolecules
Recommended Texts	Textbooks 1. Biochemistry, U. Sathyanarayana & U. Chakrapani, 2013, 5 th edition Elsevier India Pvt. Ltd., Books & Allied Pvt. Ltd. 2. Fundamentals of Biochemistry, J.L. Jain, Sunjay Jain, Nitin Jain, 2013, 7 th edition S. Chand & Company Ltd.

	<p>3. Text book of Medical Biochemistry, MN Chatterjea, Rana Shinde, 2002, 8thedition, Jaypee Brothers.</p> <p>Reference books</p> <p>1. DavidL. Nelson, MichaelM. Cox, 2005, Principles of Biochemistry, 4thedition W.H. Freeman and Company.</p> <p>2. Voet. D, Voet. J.G. and Pratt,C.W,2004, Principles of Biochemistry, 4th edition John Wiley & Sons, Inc.</p> <p>3. Zubay G.L, <i>et.al.</i>, 1995, Principles of Biochemistry, 1st edition, WmC. Brown Publishers.</p>
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Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	M	M	S
CO 2	S	M	M	M	M	M	S	M	L	S
CO 3	S	M	L	M	M	M	S	L	M	S
CO 4	S	M	M	M	M	M	S	M	M	S
CO5	S	M	M	M	M	M	S	M	M	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Practical III - Biomolecules	Core Practical	1	-	2	-	4	3	40	60	100

Course	CORE PAPER -VI
Title of the Course:	PRACTICAL III BIOMOLECULES
Credits:	4
Pre-requisites, if any:	Basic practical Knowledge of Biochemistry and Biomolecules
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> Identify the biomolecules carbohydrates and amino acids by qualitative test Determine the quality of Lipids by titrimetric methods Isolate nucleic acids from plant and animal source
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Qualitatively analyzes the carbohydrates and report the type of carbohydrate based on specific tests (K1, K3 & K4)</p> <p>CO2 Qualitatively analyzes amino acids and report the type of amino acids based on specific tests (K1, K2, & K4)</p> <p>CO3 Determine the Saponification, Iodine and acid number of edible oil.</p> <p>CO4 Isolate the nucleic acid from biological sources (K1, K2, & K4)</p> <p>CO5 Check the quality of an edible oil using various tests (K1, K4 & K5)</p>
Units	
I 18 Hours	<p>I) Qualitative test for</p> <p>1) Carbohydrates</p> <p>a) Glucose b) Fructose c) Maltose d) Sucrose e) Lactose f) Starch</p> <p>2) Amino acids</p> <p>a) Arginine b) Cysteine c) Histidine d) Tryptophan e) Tyrosine f) Methionine</p>
II 15 Hours	<p>II Titrimetric methods</p> <p>1) Determination of Saponification value of an edible oil 2) Determination of Iodine number of an edible oil 3) Determination of Acid number of an edible oil</p>
III 12 Hours	<p>III. Group Experiments</p> <p>1) Isolation of DNA from plant/animal source. 2) Isolation of RNA from rich source.</p>
Reading List (Print and online)	<p>Web resources</p> <p>1. https://www.pdfdrive.com/instant-notes-analytical-chemistry-e912659.html 14</p> <p>2. https://www.pdfdrive.com/analytical-biochemistry-e46164604.html</p>

	3. https://www.pdfdrive.com/biochemistry-books.html
Self-Study	<ul style="list-style-type: none"> ➤ Preparation of standard solution and reagents. ➤ Preparation of reagents and test samples for qualitative analysis.
Recommended Texts	<p>Text books</p> <ol style="list-style-type: none"> 1. David T Plummer, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw-Hill Edition 2. J. Jayaraman Laboratory Manual in Biochemistry New Age International (P) Limited Fifth edition 2015 3.S.Sadasivam A. Manickam Biochemical Methods New age International Pvt Ltd publisher's third edition 2018 <p>Reference books</p> <ol style="list-style-type: none"> 1. Rageeb, Kiran Patil, M. Bakshi Rahman, Sufiyan Ahmad Raees - A Practical book on Biochemistry Everest publishing house 1st Edition, 2019 2. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005. 3. Biochemical Tests – Principles and Protocols. Anil Kumar, Sarika Garg and Neha Garg. Vinod Vasishtha Viva Books Pvt Ltd, 2012. 4. Harold Varley, Practical Clinical Biochemistry, CBS. 6 edition, 2006. 5. Keith Wilson and John Walker. Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University press, Britain.1995.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	S	S	M	M	M	S	S	S	S
CO 2	M	S	S	L	M	M	S	L	M	S
CO 3	M	M	S	M	M	L	S	S	S	S
CO 4	M	L	S	M	M	M	S	S	L	M
CO 5	M	S	S	M	M	M	S	L	S	S
	S-Strong			M-Medium			L-Low			

SEMESTER IV

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Biochemical techniques	Core	3	1	-	-	4	4	25	75	100

Course	CORE PAPER -VII
Title of the Course:	BIOCHEMICAL TECHNIQUES
Credits:	4
Pre-requisites, if any:	Comprehensive Knowledge of Tools and Techniques of Biochemistry
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Introduce the basic principles, types and applications of various sedimentation techniques. • Provide an understanding of the underlying principles of chromatographic techniques • Demonstrate experimental skills in various electrophoretic techniques. • Appraise the use of colorimetric and spectroscopic techniques in biology • Impart knowledge about the expression of concentration in solution and role of buffers .
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Describe types of rotors and identify the centrifugation technique for the separation of biomolecules (K1, K3 & K4)</p> <p>CO2 Demonstrate the principles, operational procedure and applications of planar and column chromatography (K1, K2, & K6)</p> <p>CO3 Specify the factors and explain the separation of DNA and protein using electrophoretic technique (K1, K3 & K5)</p> <p>CO4 State Beer's Law and illustrate the instrumentation and uses of colorimeter and spectrophotometer (K1, K2, & K5)</p> <p>CO5 Enumerate various methods of measurement of pH and oxygen in biological samples (K1, K2, & K6)</p>
Units	
I 12 Hours	Centrifugation - Basic principles, RCF, Sedimentation coefficient, Svedberg constant. Types of rotors. Types of centrifuges, Preparative centrifugation- differential and density gradient centrifugation, Rate zonal and Isopycnic techniques, Construction, working and applications of analytical ultracentrifuge-Determination of molecular weight.
II 12 Hours	Chromatography - adsorption, partition. Principle, instrumentation and applications of paper chromatography, thin layer chromatography, ion-exchange chromatography, gel permeation chromatography and affinity chromatography.
III 12 Hours	Electrophoresis - General principles, factors affecting electrophoretic mobility. Tiselius moving boundary electrophoresis. Electrophoresis with

	paper and starch. Principle, instrumentation and applications of agarose gel electrophoresis, PAGE and SDS-PAGE.
IV 12 Hours	Spectroscopy -Basics of Electromagnetic radiations- Energy, wavelength, wave number, absorbance and frequency. Absorption and emission spectra, Laws of spectroscopy, Absorbance and transmittance. Colorimetry - Principle, instrumentation and applications. Visible and UV spectrophotometry – Principle, instrumentation and applications -enzyme assay, structural studies of proteins and nucleic acids. Spectrofluorimetry - Principle, instrumentation and applications. Flame photometry – atomic absorption and emission - principle, instrumentation and applications with reference to sodium and potassium analysis.
V 12 Hours	Biophysical Techniques - Definition of Molarity, Molality, Normality, Osmolarity, Definition of pH, pOH, determination of pH- Glass electrode, Isoelectric pH, Zwitter ion, Buffers, Buffers in body fluids, Red blood cells and tissues. Henderson–Hasselbalch equation, Tonicity, Donnan membrane equilibrium and application. Measurement of oxygen consumption - the Clark oxygen electrode-Principle, Construction and applications.
Reading List (Print and online)	Web Resources 1. https://www.britannica.com/science/chromatography 2. https://www.youtube.com/watch?v=xgxFBQZYXIE 3. https://www.youtube.com/watch?v=7onjVBsQwQ8
Self-Study	➤ Applications of SDS- PAGE. ➤ Applications of spectrofluorimetry.
Recommended Texts	Textbooks 1. Avinash Upadhyay, Kakoli Upadhyay & Nirmal endu Nath, 2002, Biophysical Chemistry, Principles and Techniques, 3 rd edition, Himalaya Publishing House. 2. Rangarajan. N & Sampath. V, 2023, Fundamentals of Analytical Biochemistry, 1 st edition, MJP publishers. 3. Keith Wilson & John Walker, 2000, Practical Biochemistry-Principles and techniques, Cambridge University Press, 4 th edition. 4. L. Veerakumari, 2009, Bioinstrumentation, 1 st edition, MJP Publishers. Reference books 1. Terrance G. Cooper The tools of Biochemistry,. 1977, John Wiley & Sons, Singapore. 2. Gurumani, Research Methodology for Biological Sciences, 2011,1 st edition, MJP Publishers. 3. Saroj Dua, Neera Garg, Biochemical Methods of Analysis, 2010, 1 st edition, Narosa Publishing house.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	S	M	M	M	M	S	M	S	S
CO 2	M	S	M	M	L	M	S	S	S	M
CO 3	M	S	M	M	M	M	M	L	S	S
CO 4	M	S	L	M	M	M	S	S	S	L
CO 5	M	S	M	M	M	M	L	S	S	S

S-Strong M-Medium L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst.	Marks		
									CIA	Exter	Total
	Practical IV- Biochemical techniques	Core Practical	1	-	2	-	4	3	40	60	100

Course	CORE PAPER -VIII
Title of the Course:	PRACTICAL IV - BIOCHEMICAL TECHNIQUES
Credits:	4
Pre-requisites, if any:	Knowledge on basic principles, Instrumentation of Biochemical techniques and metabolic reactions
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Acquaint the students with colorimetric estimations of biomolecules. • Equip skills on various separation techniques. • Impart knowledge about the estimation of minerals and vitamins.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Estimate the amount of biomolecules by Colorimetric method (K1, K2, &K4)</p> <p>CO2 Quantify the amount of minerals by Colorimetric method (K1, K3 & K4)</p> <p>CO3 Separate and identify sugars, lipids and amino acids by chromatography.(K1, K2, & K4)</p> <p>CO4 Operate centrifuge for the separation of serum and plasma (K1, K2 & K4)</p> <p>CO5 Demonstrate the separation of proteins electrophoretically (K1, K3 & K6)</p>
Units	
I 18 Hours	<p>Colorimetry</p> <ol style="list-style-type: none"> 1. Estimation of amino acid by Ninhydrin method. 2. Estimation of protein by Biuret method. 3. Estimation of DNA by Diphenylamine method. 4. Estimation of RNA by Orcinol method. 5. Estimation of Starch by Anthrone method.
II 15 Hours	<p>Chromatography</p> <ol style="list-style-type: none"> 1. Separation and identification of sugars and amino acids by paper chromatography. 2. Separation and identification of amino acids and lipids by thin layer chromatography.
III 12 Hours	<p>Demonstration</p> <ol style="list-style-type: none"> 1. Separation of serum and plasma from blood by centrifugation. 2. Separation of serum proteins by SDS-PAGE.
Reading List (Print and online)	<p>Web resources</p> <p>https://www.pdfdrive.com/biochemistry-books.html</p>

Self-Study	<ul style="list-style-type: none"> ➤ Handling of colorimeter. ➤ Separation of amino acids by paper chromatography.
Recommended Texts	<p>Text books</p> <ol style="list-style-type: none"> 1. J. Jayaraman, Laboratory Manual in Biochemistry New Age International (P) Limited Fifth edition 2015. 2. S. Sadasivam A. Manickam Biochemical Methods New age International Pvt Ltd publishers- third edition 2018. 3. Keith Wilson and John Walker Principles and techniques of Practical Biochemistry Cambridge University Press 2010, Seventh edition.. <p>Reference books</p> <ol style="list-style-type: none"> 1. S. K. Sawhney and Randhir Singh, Introductory Practical Biochemistry. Alpha Science International, Ltd 2nd edition, 2005. 2. David T. Plummer, 2001, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw- Hill publishing company limited. 3. Varley's Practical Clinical Biochemistry by Alan H Gowenlock, published by CBS Publishers and distributors, India Sixth Edition, 1988..

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	M	S	M	M	M	M	S	S	S
CO 2	M	M	S	M	M	M	S	S	S	M
CO 3	M	L	S	M	M	L	L	M	S	S
CO 4	M	M	S	L	M	M	S	S	S	L
CO 5	M	M	S	M	M	M	S	L	S	S

S-Strong

M-Medium

L-Low

SEMESTER V

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Enzymes	Core	5	1	-	-	4	6	25	75	100

Course	CORE PAPER -IX
Title of the Course:	ENZYMES
Credits:	4
Pre-requisites, if any:	Basic knowledge about catalysis, enzyme inhibition and chemical reaction mechanisms.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> ➤ Provide fundamental knowledge on enzymes and their properties. ➤ Understand the mechanism of action of enzymes and the role of coenzymes in catalysis. ➤ Introduce the kinetics of enzymes and determine the K_m and V_{max}. ➤ Explain the effect of inhibitors on enzyme activity ➤ Understand the role of enzymes in clinical diagnosis and industries
Course Outcomes	<p>On successful completion of this course, students should be able to:</p> <p>CO1 Identify the major classes of enzymes, differentiate between a chemical catalyst and a biocatalyst and define the units of enzymes (K1, K2, & K4)</p> <p>CO2 Explain the mechanism of enzyme catalysis and the role of coenzymes in enzyme action (K1, K3 & K5)</p> <p>CO3 Illustrate the steady state kinetics, interpret MM plot and LB-plot based on kinetics data, and determine K_m and V_{max} (K1, K2, & K5)</p> <p>CO4 Distinguish the types of inhibition along with its importance in biochemical reactions (K1, K3 & K5)</p> <p>CO5 Comprehend the various methods for production of immobilized enzymes and discuss the application of enzymes in clinical diagnosis and various industries (K1, K3 & K6)</p>
Units	
I 15 Hours	Introduction to enzymes: Nomenclature and Classification based on IUB with examples, enzyme as catalyst-Activation energy, Enzyme specificity-absolute, Group, linkage and stereo specificities. Concept of Active site, Lock and key hypothesis and induced fit theory, Enzyme expression Units-IU, turnover number, katal and specific activity.
II 15 Hours	Mechanism of enzyme catalysis -Acid Base catalysis, covalent catalysis, electrostatic catalysis, metal ion catalysis, proximity and orientation effect. Coenzymes -Definition, types, co-enzymatic forms of vitamins- NAD/NADP, FAD, FMN, Coenzyme A TPP, PLP, lipoic acid and biotin. Multienzyme

	complexes - Pyruvate dehydrogenase complex. Isoenzyme with reference to LDH and CK.
III 15 Hours	Enzyme kinetics -Definition of kinetics, Factors affecting enzyme activity - temperature, pH, substrate and enzyme concentration, activators-cofactors, Derivation of Michaelis-Menton equation for uni-substrate reactions, Lineweaver-Burk plot, Eadie-Hofstee plot Significance of Km and Vmax and their determination using the plots.
IV 15 Hours	Enzyme inhibition - Reversible and irreversible inhibition-types of reversible inhibitors, competitive, non-competitive, un-competitive inhibitors. Graphical representation by L-B plot, (Kinetic derivations not required), Determination of Km and Vmax in the presence and absence of inhibitors. Allosteric enzymes - Sigmoidal curve, positive and negative modulators.
V 15 Hours	Applications of enzymes - Immobilized enzymes - methods of immobilization-adsorption, covalent bonding, cross linking, encapsulation, entrapment and applications of immobilized enzymes. Biosensors – e.g. Glucose sensors. Industrial applications of enzymes –Food, textile and pharmaceutical industries.
Reading List (Print and online)	Web resources www.biologydiscussion.com/notes/enzymes- noteshttps://www.britannica.com/science/protein/The-mechanism-of-enzymatic-actionhttps://www.youtube.com/watch?v=oVJ2LJxO6tU
Self-Study	<ul style="list-style-type: none"> ➤ Isoenzymes in clinical diagnosis. ➤ Industrial and therapeutic applications of enzymes.
Recommended Texts	<p>Textbooks</p> <ol style="list-style-type: none"> 1. U. Sathyanarayana & U. Chakrapani, 2013, Biochemistry, 4th edition, Elsevier India Pvt. Ltd., Books & Allied Pvt. Ltd. 2. Dr. G.R Agarwal, Dr. Kiran Agarwal & O.P. Agarwal, 2015, Textbook of Biochemistry (Physiological chemistry), 18th edition,Goel Publishing House, 3. T. Devasena, 2010, Enzymology, 1stedition, Oxford university Press. <p>Reference books</p> <ol style="list-style-type: none"> 1. Trevor Palmer, 2008, Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2ndedition, East West Press Pvt. Ltd. 2. David L. Nelson, Michael M. Cox, 2005, Principles of Biochemistry, 4thedition W.H. Freeman and Company, 3. Voet. D, Voet.J.G. and Pratt,C.W, 2004, Principles of Biochemistry, 4th edition John Wiley & Sons, Inc. 4. Zubay G.L, <i>et. al.</i>, 1995, Principles of Biochemistry, 1st edition, WmC. Brown Publishers.

Methods of assessment:**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.**Application (K3)** - Suggest idea/concept with examples, Observe, Explain.**Analyse (K4)**- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons.**Create (K6)**- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation**Mapping with Program Outcomes**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	M	M	S
CO 2	S	L	M	M	M	M	S	M	M	M
CO 3	S	M	L	M	M	M	M	M	M	S
CO 4	S	M	M	L	M	M	S	M	M	L
CO 5	S	M	M	M	M	M	L	S	S	S

S-Strong**M-Medium****L-Low**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst.	Marks		
									CIA	Exte	Total
	Intermediary metabolism	Core	5	1	-	-	4	6	25	75	100
Course	CORE PAPER -X										
Title of the Course:	INTERMEDIARY METABOLISM										
Credits:	4										
Pre-requisites, if any:	Basic knowledge on biochemical reactions such as anabolic and catabolic reactions of cells										
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> Review the basic concepts of free energy transformation and describe biological oxidation. Illustrate the pathways of carbohydrate metabolism. Explain the pathways of oxidation and biosynthesis of lipids. Detail the catabolism of amino acids and synthesis of specialized products from amino acids. Acquaint the metabolism of nucleic acids and its regulation. 										
Course Outcomes	<p>On successful completion of this course, students should be able to:</p> <p>CO1 State the concepts of bioenergetics and illustrate the mechanism of flow of electrons and the production of ATP (K1, K3 & K5)</p> <p>CO2 Elaborate the biochemical reactions and integration of pathways of carbohydrate metabolism (K2, K3 & K6)</p> <p>CO3 Sketch the oxidation and biosynthesis of fatty acids, phospholipids, triglycerides and cholesterol with suitable examples (K2, K4 & K5)</p> <p>CO4 Explain catabolism of amino acids, synthesis of non essential amino acids and specialized products from amino acids (K2, K4 & K5)</p> <p>CO5 Describe the metabolism of nucleic acids with necessary illustrations and its regulation (K1, K3 & K5)</p>										
Units											
I 15 Hours	<p>Bioenergetics-High energy compounds: Role of high energy compounds, free energy hydrolysis of ATP and other organophosphates, ATP-ADP cycle.</p> <p>Biological Oxidation: Electron transport chain -its organization and function. Inhibitors of ETC. Oxidative phosphorylation, P/O ratio, Peter Mitchell's chemiosmotic hypothesis. Mechanism of ATP synthesis, uncouplers of oxidative phosphorylation, substrate level phosphorylation with examples.</p>										
II 15 Hours	<p>Metabolism of carbohydrates - Glycolysis, TCA Cycle, Amphibolic role of TCA cycle. Anaplerosis, Pentose Phosphate Pathway (HMP shunt), Gluconeogenesis, Glycogenesis, Glycogenolysis and its regulation, glyoxylate cycle and Cori cycle.</p>										
III	<p>Metabolism of lipids -Oxidation of fatty acids - α, β and ω -oxidation of saturated</p>										

15 Hours	fatty acids, Oxidation of fatty acids with odd number of carbon atoms and unsaturated fatty acids, Ketogenesis, Biosynthesis of saturated fatty acids and unsaturated fatty acids, Biosynthesis and degradation of triglycerides, phospholipids and cholesterol.
IV 15 Hours	Metabolism of amino acid - Metabolic nitrogen pool, Catabolism of amino acid: Oxidative deamination, non – oxidative deamination, transamination and decarboxylation- Biogenic amines, Urea cycle and its regulation.
V 15 Hours	Metabolism of nucleotides -Biosynthesis of purines and pyrimidines, - denovo synthesis and salvage pathways, Degradation of purines and pyrimidines, Conversion of ribonucleotide to deoxyribonucleotide.
Reading List (Print and online)	Web resources 1. https://nptel.ac.in/courses/104/105/104105102/ 2. http://www.nptelvideos.in/2012/11/biochemistry-i.html 3. https://www.saddleback.edu/faculty/jzoval/mypptlectures/ch15_metabolism/lecture_notes_ch15_metabolism_current-v2.0.pdf
Self-Study	<ul style="list-style-type: none"> ➤ Understanding metabolic pathways of biomolecules. ➤ Production of ATP through oxidative phosphorylation.
Recommended Texts	<p>Textbooks</p> <ol style="list-style-type: none"> 1. U. Sathyanarayana & U. Chakrapani, 2015, Biochemistry, 4th Elsevier India Pvt. Ltd., 2. M.N. Chatterjea and Rana Shinde, 2002, Textbook of Medical Biochemistry, 5th edition Jaypee Brothers Medical Publishers Pvt. Ltd. <p>Reference books</p> <ol style="list-style-type: none"> 1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox, 2008, 5th edition, W.H. Freeman and Company. 2. Robert K. Murray, Dary I.K. Granner, Victor W. Rodwell, 2006, Harper's Illustrated Biochemistry, 27th edition, McGraw Hill Publishers. 3. Principles of Biochemistry Voet. D, Voet.J.G, and Pratt C.W., 2010,, Fourth edition, John Wiley & Sons, Inc., 4. Principles of Biochemistry, Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, 2nd Edition, Wm. C. Brown Publishers. 5. Biochemistry, Garret, R.H. and Grisham, C.M. 2005, 3rd Edition. Thomson Learning INC.

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Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	M	M	S
CO 2	S	M	M	M	M	M	S	M	M	S
CO 3	S	L	M	M	M	M	S	M	S	S
CO 4	S	M	L	M	M	M	S	L	L	S
CO 5	S	M	M	M	M	M	S	M	M	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Clinical Biochemistry	Core	5	1	-	-	4	6	25	75	100

Course	CORE PAPER -XI
Title of the Course:	CLINICAL BIOCHEMISTRY
Credits:	4
Pre-requisites, if any:	Basic knowledge on sample collection, organ functions and Enzymology.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Comprehend the basic concepts and disorders of carbohydrate metabolism • Explain the disorders of lipid metabolism. • Elucidate the liver function test and kidney function test. • Designate the gastric function test. • Familiarize the clinical Enzymology.
Course Outcomes	<p>On successful completion of this course, students should be able to:</p> <p>CO1 Explain the concepts of hormones and their importance to maintain glucose and types of Diabetes, diagnosis and treatment (K2, K4 & K5)</p> <p>CO2 Analyze the lipid profile and different deficiency state (K1, K3 & K5)</p> <p>CO3 Describe the liver and kidney functions and specific diagnostic methods used for biological sample (K1, K3 & K5)</p> <p>CO4 Detail about the composition of gastric juice and special test for diagnosis (K1, K2, & K5)</p> <p>CO5 Elaborate the enzyme markers used for diagnostic studies (K1, K3 & K5)</p>
Units	
I 15 Hours	Disorders of carbohydrate metabolism: Maintenance of blood glucose by hormone with special reference to insulin and glucagon. Abnormalities in glucose metabolism: Diabetes mellitus; types, causes, biochemical manifestations, diagnosis and treatment. HbA1C- Glycated hemoglobin. Inborn errors of carbohydrate metabolism, Glycosuria, Fructosuria, Galactosemia and Glycogen storage diseases.
II 15 Hours	Liver function test: Bile pigment metabolism. Tests based on bile pigments, Carbohydrate metabolism, plasma proteins and lipids, detoxification and excretory functions of liver. Jaundice -classification, biochemical changes and differential diagnosis for jaundice.
III 15 Hours	Kidney Function Tests: Measurement of urine pH, volume, specific gravity, sediments in urine. Test for glomerular function: Inulin clearance, urea clearance and creatinine clearance tests. Test for tubular function: Concentration and dilution tests, Phenol red test. Proteinuria.
IV 15 Hours	Gastric Function test: Composition of gastric juice, collection of gastric contents, examination of gastric residuum, fractional test meal (FTM), stimulation test-alcohol and histamine stimulation, Tubeless gastric analysis. Inborn errors of amino acid metabolism: Phenylketonuria, Alkaptonuria and Cystinuria.

V 15 Hours	Clinical Enzymology: Definition of functional and non-functional plasma enzymes. Isoenzymes. Enzymes of diagnostic importance- Marker enzymes of heart diseases - LDH, creatine kinase, Aspartate transaminases, Marker enzymes of liver diseases – Alanine Transaminase, LDH and Alkaline phosphatases, Marker enzymes for acute pancreatitis-Amylase and Lipase, Marker enzymes for bone disorders – ALP and ACP, Marker enzymes for muscle wasting disorders – LDH, Aldolases, AST.
Reading List (Print and online)	Web Resources 1. https://www.britannica.com/science/metabolic-disease/Disorders-of-carbohydrate-metabolism 2. https://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests 3. https://onlinecourses.nptel.ac.in/noc20_ge13/preview
Self-Study	➤ Diagnosis and treatment of diabetes mellitus. ➤ Marker enzymes for organ disorders.
Recommended Texts	Reference books 1. Philip.D.Mayne,Clinical Chemistry in diagnosis and treatment. ELBS Publication, 6th edition, 1994. 2. Thomas M. Devlin (2014) Text book of Biochemistry with clinical correlations (7 th ed). John Wiley and sons. 3. Tietz Fundamentals of clinical chemistry and molecular Diagnostics (2014) (7 th ed) Saunders. Reference books 1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox, 2008, 5 th edition, W.H. Freeman and Company. 2. Robert K.Murray, Dary IK. Granner, Victor W. Rodwell, 2006, Harper’s Illustrated Biochemistry, 27 th edition, McGraw Hill Publishers. 3. Principles of Biochemistry Voet. D, Voet.J.G, and Pratt C.W., 2010,, Fourth edition, John Wiley & Sons,Inc.,. 4. Principles of Biochemistry, Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, 2 nd Edition, Wm. C. Brown Publishers. 5. Biochemistry, Garret, R.H. and Grisham, C.M. 2005, 3 rd Edition. Thomson Learning INC.

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Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	S	M	M	M	S	M	M	S
CO 2	S	M	S	L	M	M	S	M	L	S
CO 3	S	M	S	M	M	M	S	S	M	S
CO 4	S	M	S	M	M	L	S	S	S	S
CO 5	S	L	S	M	M	M	S	S	L	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Immunology	Elective	4	1	-	-	4	5	25	75	100

Course	Elective Course IA
Title of the Course:	IMMUNOLOGY
Credits:	4
Pre-requisites, if any:	Basic knowledge on antigens, antibodies, cells and organs of immune system
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Introduce the structure and functions of lymphoid organs and cells of the immune system • Illustrate the structure and classification of antibodies and adaptive immune response • Impart knowledge on the types of immunity and uses of vaccines • Provide an understanding of immune related diseases and transplantation • Study the Ag-Ab interaction and immunological techniques to identify antigens and antibodies.
Course Outcomes	<p>On successful completion of this course, students should be able to:</p> <p>CO1 Associate structure and function of the organs involved in our body's natural Defence (K1, K3 & K4)</p> <p>CO2 Classify antigens and antibodies and the role of lymphocytes in defending the host (K1, K2, & K4)</p> <p>CO3 Describe the types of immunity and the uses of vaccines (K1, K3 & K5)</p> <p>CO4 Understand the immune related diseases and mechanism of transplantation (K1, K3 & K5)</p> <p>CO5 Examine the immunological tests and relate it to the immune status of an individual (K2, K3 & K4)</p>
Units	
I 15 Hours	Cells and Organs of Immune system - Structure and function of primary lymphoid organs (thymus, bone marrow), secondary lymphoid organs (spleen and lymph node), Cells involved in immune system- Functions-Phagocytosis –Inflammation.
II 15 Hours	Antigens - Nature, Immunogens, haptens, cross reactions - Immunoglobulin- types-structure and function, Clonal selection theory, Co-operation of T-cell with B-cell. Humoral and cell mediated immunity. Monoclonal antibody – Production and application in biology.
III 15 Hours	Immunity and its types -Innate, Acquired, active and passive.- Natural and Artificial immunity - Commonly used toxoid vaccines, killed vaccines, live attenuated vaccines, rDNA Vaccines, DNA and subunit vaccines.
IV 15 Hours	Hypersensitivity – Immediate and Delayed type hypersensitivities, Autoimmunediseases with examples - Organ specific and systemic autoimmunity. (SLE and RA).

	Transplantation – Types of Grafts, structure & functions of MHC, graft Vs host reaction, immunosuppressive Agents.
V 15 Hours	Antigen-antibody reactions- General features of Antigen Antibody reactions. Precipitation, Immuno diffusion, SID and DID - Oudin Procedure, Oakley Fulthrope Procedure, Radio immuno diffusion, Ouchterlony double diffusion, CIE, Rocket electrophoresis, Agglutination-Coomb's test. Complement Fixation test, Wasserman's reaction, RIA and ELISA.
Reading List (Print and online)	Web resources 1. https://onlinecourses.nptel.ac.in/noc22_bt40/preview 2. https://onlinecourses.swayam2.ac.in/cec20_bt05/preview 3. https://youtu.be/8uahFPI6ny8
Self-Study	<ul style="list-style-type: none"> ➤ Know about evolutionary development of immune organs. ➤ Understand about immunodeficiency diseases.
Recommended Texts	<p>Text Books</p> <ol style="list-style-type: none"> 1. Kuby, J. (2018). Immunology (5th ed). W.H. Freeman - ISBN-10 : 1319114709 / ISBN-13 : 978-1319114701 2. Rao, C. V. (2017). Immunology (3rd ed.). Chennai: Alpha Science Int. Ltd - ISBN-10 : 1842652559/ ISBN 13:978-1842652558 3. Tizard (1995). An Introduction to Immunology. Harcourt Brace College Publications. <p>References Books</p> <ol style="list-style-type: none"> 1. Kenneth M. Murphy, Paul Travers, Mark Walport - (2007), Janeway's Immunobiology, 7th edition, Garland Science. 2. Abul K. Abbas, Andrew H. Lichtman, Jordan S. Pober - (1994), Cellular and molecular immunology, 2nd edition, B. Saunders Company. 3. Basic Immunology Functions and Disorders of the Immune System, 6th Edition - January 25, 2019 Authors: Abul Abbas, Andrew Lichtman, Shiv Pillai, ISBN: 9780323549431 eBook ISBN: 9780323639095 4. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt - (2006), Roitt's Essential Immunology, 11th edition, Wiley-Blackwell.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	M	M	S
CO 2	S	M	M	M	M	M	S	L	M	S
CO 3	S	M	S	M	M	M	S	S	S	S
CO 4	S	M	L	M	M	M	S	L	L	S
CO 5	S	L	S	M	L	M	S	S	S	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Biochemical Pharmacology	Elective	4	1	-	-	4	5	25	75	100

Course	Elective Course IB
Title of the Course:	BIOCHEMICAL PHARMACOLOGY
Credits:	4
Pre-requisites, if any:	Basic knowledge on drugs, drug metabolism and drug allergy.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Introduce the basic concepts of pharmacology. • Explain the metabolism of drugs and factors responsible for metabolism. • Acquaint the adverse response and side effects of drug. • Familiarize important drugs used for common metabolic disorders. • Provide an understanding about the action of antibiotics.
Course Outcomes	<p>On successful completion of this course, students should be able to:</p> <p>CO1 Classify the different routes of drug administration; describe the absorption, distribution, metabolism and excretion of drugs (K1, K2, & K4)</p> <p>CO2 Illustrate the metabolism of drugs, classify the microsomal and non-microsomal reactions and explain the role of cytochromes (K1, K3 & K4)</p> <p>CO3 List out the various adverse response and side effects of drugs (K1, K3 & K5)</p> <p>CO4 Justify the use of synthetic drugs and elucidate its pharmacological actions and its adverse effects for different disease (K2, K4 & K6)</p> <p>CO5 Highlight the importance and explain the mode of action of important antibiotics (K2, K4 & K5)</p>
Units	
I 15 Hours	Drugs – classification based on sources, routes of drug administration - Oral/ Enteral, Parenteral and Local application. Absorption of drugs, factors influencing drug absorption, distribution and excretion of drugs.
II 15 Hours	Drug metabolism - Phase I and Phase II reactions, role of cytochrome P ₄₅₀ , non-microsomal reactions of drug metabolism. Factors influencing drug metabolism. Therapeutic index.
III 15 Hours	Drug allergy - Drug tolerance - IC 50, LD50 of a drug, Drug intolerance, Drug addiction, Drug abuses and their biological effects. Drug resistance - biochemical mechanism.
IV 15 Hours	Therapeutic Drugs - Analgesics and Non-steroidal anti-inflammatory drugs (NSAIDs) – Aspirin and Acetaminophen. Insulin, Oral antidiabetic drugs - Sulfonylureas,

	Biguanides. Antihypertensive drugs - ACE inhibitors, Calcium channel blockers. Anti-cancer agents – Antimetabolites.
V 15 Hours	Antibiotics - Definition, Examples and Biochemical mode of action of penicillin, streptomycin, tetracyclines and chloramphenicol.
Reading List (Print and online)	Web Resources https://slideplayer.com/slide/3728296/64/video/What+is+bioremediation%3F.mp4
Self-Study	<ul style="list-style-type: none"> ➤ Various routes of administration of drugs. ➤ Pharmacological action of some drugs with example.
Recommended Texts	<p>Text Books</p> <ol style="list-style-type: none"> 1. N. Muruges, A concise text book of Pharmacology –Sathya Publishers. 2. Jayashree Ghosh, A Textbook of Pharmaceutical chemistry –S. Chand & Company Ltd. 3. SC Metha, Ashutosh Kar, Pharmaceutical Pharmacology – New Age International (P) Limited, Publishers. <p>References Books</p> <ol style="list-style-type: none"> 1. Lippincott’s illustrated Reviews- Pharmacology by Mary J.Mycek, Richard A.Harvey, Pamela C. Champe, Lippincott – Raven publishers, New Delhi. 2. David . E. Golan, Principles of Pharmacology, Wolters Kluwer (India) Pvt.Ltd. 3. R.S. Satoskar, S. B. Elsevier Pharmacology and pharmacotherapy. - ISBN-10: 9788131248867 / ISBN-13 : 978-8131248867 ,2017. <p>Tripathi, K. Essentials of Medical Pharmacology. Jaypee Publishers- ISBN-10: 9350259370 / ISBN-13 : 978-9350259375.2018.</p>

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	M	M	S
CO 2	S	M	M	M	M	M	S	M	M	S
CO 3	S	M	L	M	M	M	S	M	M	S
CO 4	S	L	M	M	S	M	S	L	S	S
CO 5	S	M	M	M	L	M	S	M	L	S

S-Strong**M-Medium****L-Low**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Research Methodology	Elective	4	1	-	-	4	5	25	75	100

Course	Elective Course IC
Title of the Course:	RESEARCH METHODOLOGY
Credits:	4
Pre-requisites, if any:	Basic knowledge on research, experimental design and statistical analysis.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Introduce the components of research. • Acquaint on the experimental design and literature survey • Analyse the data and find out the significance statistically • Highlight the importance of computation in research. • Provide mechanics of writing a research report hands-on experience in designing and working on small projects.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Explain the types of research and formulate and plan the research (K1, K2, &K4)</p> <p>CO2 Design experimental setup, review the literature, compile and document the data (K2, K3 & K5)</p> <p>CO3 Analyze and validate the experimental data using statistical tools (K2, K3 &K4)</p> <p>CO4 Interpret the data using computational tools (K2, K4 & K5)</p> <p>CO5 Compile and draft a research report, present results findings and publish ethically (K2, K4 & K5)</p>
Units	
I 15 Hours	Research: Characteristics and types of Research, Research Methods versus Methodology, Research designs in Biochemistry: experimental, <i>in vitro</i> , <i>in vivo</i> , <i>in situ</i> , clinical trials. Identification and criteria of selecting a research problem (Hypothesis); Formulation of objectives; Research plan and its components.
II 15 Hours	Experimental design - Objective, Design of work, Guidelines for design of experiments, Literature Search - Databases for literature search, Material and methods, Designing biological experiments, Compilation and documentation of data.
III 15 Hours	Statistical Analysis: Measures of variation - standard deviation, Non-linear regression, Standard error. Analysis of variance for one-way and two-way classified data and multiple comparison procedures. Significance - students "t" test, chi-square test. Dunnet's test
IV 15 Hours	Computer and its role in research: Basics of MS word, MS Excel: tabulation, calculation and data analysis, preparation of graphs, histograms and charts. Use of

	statistical software SPSS. Power Point: preparation of presentations and scientific poster designing.
V 15 Hours	Scientific writing for journals - Preparation of Abstract, Impact factor, h-index, i-10 index, citation index, Dissertation/Thesis writing: format, content and chapterization, writing style, drafting titles & sub-titles, captions and legends. Writing results, discussion and conclusions. Bibliography and references, referencing style - Harvard and Vancouver systems, Appendices and acknowledgement; Ethical issues in research; Intellectual property right and plagiarism.
Reading List (Print and online)	Web Resources 1. https://explorable.com/research-methodology 2. http://www.scribbr.com 3. http://www.open.edu 4. http://www.macmillan .ihe.com .
Self-Study	➤ A brief review on types of research. ➤ Guidelines for dissertation and paper writing.
Recommended Texts	Text Books 1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers. 2. Kothari, C.R., Research Methodology: Methods and Techniques. 2004, New Age International. 3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications.2 volumes. 4. Gurumani.N, Research Methodology for biological Sciences, 2014, MJP Publishers. Reference Books 1) Dr. Prabhat Pandey, Dr.Meenu Mishra Pandey, Research Methodology: Tools and Techniques 2015 2) 2.Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications. 3) Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press. 4) Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications 5) Scientific Thesis Writing and Paper Presentation . MJP Publishers.2010 Research Methodology (2 Vols-Set) ,Suresh C. Sinha and Anil K. Dhiman, Vedams Books (P) Ltd.2002.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	S	M	M	M	S	L	M	S
CO 2	S	M	S	M	M	M	M	S	S	M
CO 3	S	M	S	M	M	L	S	S	M	S
CO 4	S	M	S	L	M	M	L	S	S	L
CO 5	S	M	S	M	M	M	S	S	L	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Practical V- Clinical Biochemistry	Core Practical V	1	0	4	0	4	5	40	60	100

Course	Core paper XII
Title of the Course:	Practical V- CLINICAL BIOCHEMISTRY
Credits:	4
Pre-requisites, if any:	Basic knowledge on sample collection, biomolecular analysis and haematological studies.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Introduce the methods of sample collection (blood & urine) for analytical purpose. • Impart practical knowledge on the assay of activity of various diagnostically important enzymes • Understand the estimation procedure for various important biomolecules. • Help students learn the routine qualitative analysis of urine sample for diagnostic purpose. • Train students on various hematological tests and its significance.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Acquaint knowledge on collection of biological samples (urine, blood) and their preparation for diagnostic purpose (K1, K4 & K5)</p> <p>CO2 Assay the activity of various clinically important enzymes and relate their clinical importance (K1, K4 & K5)</p> <p>CO3 Estimate the important biomolecules in biological samples and relate their clinical significance (K2, K3 & K4)</p> <p>CO4 Qualitatively analyze urine sample for normal and abnormal constituents in urine and interpret the results (K2, K4 & K5)</p> <p>CO5 Perform the routine haematological tests (K2, K4 & K5)</p>
Units	

I (45 Hrs)	<p>Colorimetric Experiments</p> <ol style="list-style-type: none"> 1. Collection and preservation of blood and urine samples. 2. Estimation of creatinine by Jaffe's method (serum & urine) 3. Estimation of urea by diacetyl- monoxime method (serum & urine) 4. Estimation of cholesterol by Zak's method 5. Estimation of Glucose by Ortho Toluidine method 6. Estimation of Protein by Lowry's method 7. Estimation of Hemoglobin by Sahli's method
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<p style="text-align: center;">II (15 Hrs)</p>	<p>8. Estimation of Hemoglobin by Drabkins method 9. Assay of activity of ALT (Alanine Transaminase) 10. Assay of activity of AST (Aspartate Transaminase)</p> <p>Qualitative Urine analysis Qualitative analysis of normal constituents of urine: Normal constituents</p> <ol style="list-style-type: none"> a. Urea, b. Creatinine, c. Phosphorus, d. Calcium <p>Abnormal constituents</p> <ol style="list-style-type: none"> a. Calcium b. Sugar (Glucose, fructose) c. Protein d. Aminoacids (Tyrosine, Cysteine, Tryptophan) e. Ketone bodies f. Bile pigments with clinical significance.
<p style="text-align: center;">II (15 Hrs)</p>	<p>Demonstration Experiments HEMATOLOGY</p> <ol style="list-style-type: none"> 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
<p style="text-align: center;">Reading List (Print and online)</p>	<p>Web resources</p> <ol style="list-style-type: none"> 1. https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors 2. http://rajswashya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/ Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf 3. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrytrypdf.pdf?sequence=1&isAllowed=y 4. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrytrypdf.pdf?sequence=1&isAllowed=y *
<p style="text-align: center;">Self-Study</p>	<ul style="list-style-type: none"> ➤ Sample collection for clinical diagnosis. ➤ Hematological tests with significance.
<p style="text-align: center;">Recommended Texts</p>	<p>Text Books</p> <ol style="list-style-type: none"> 1. Manickam, S.S.(2018).Biochemical Methods(3rded.).New age International Pvt Ltd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408 2. Plummer, D.T. (n.d.).An Introduction to Practical Biochemistry. Tata McGraw Hill -ISBN: 97800708416 3. Alan H Gowenlock. 1998. Varley’s Practical Clinical Biochemistry, 6th edition, CBS Publishers, India. 4. B. Godkar. 2020. Textbook of Medical Laboratory Technology Vol 1 & 2 Paperback, 3rd edition, Bhalani Publishers.

	<p>5. Kanai L Mukerjee. 1996. Medical Lab Technology, Vol I& II, 1st edition, Tata Mcgraw Hill, Pennsylvania.</p> <p>6. Ranjna Chawla. 2014. Practical Clinical Biochemistry Methods and interpretations 58 (Paperback). 4th edition, Jaypee Brothers Medical Publishers, New York.</p> <p>Reference books</p> <p>1. Singh, S.K. (2005). Introductory Practical Biochemistry (2nd ed.). Alpha Science International, Ltd- ISBN 10: 8173193029 / ISBN 13: 9788173193026</p> <p>2. Ashwood, B. a. (2001). Tietz Fundamentals of Clinical chemistry. WB Saunders Company, Oxford Science Publications USA - ISBN 10: 0721686346 / ISBN 13: 978072168634.</p>
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Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation.

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	S	M	M	M	M	M	S	S	S
CO 2	S	S	M	M	M	M	S	S	S	M
CO 3	S	S	S	M	L	S	L	M	S	S
CO 4	S	S	M	M	M	L	S	S	S	L
CO 5	S	S	S	M	M	S	S	L	S	S

S-Strong

M-Medium

L-Low

SEMESTER VI

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Molecular Biology	Core	5	1	-	-	4	6	25	75	100

Course	CORE PAPER XIII
Title of the Course:	MOLECULAR BIOLOGY
Credits:	4
Pre-requisites, if any:	Basic knowledge on DNA replication, Transcription, Translation and mutation.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Provide insights in to the central dogma of molecular biology and explain the mechanism of DNA replication. • Elaborate the mechanism of transcription and reverse transcription. • Highlight the characteristics of genetic code and describe the process of protein synthesis. • Introduce the concept of regulation of gene expression in prokaryotes • Familiarize the different types of mutations and explain the mechanism of DNA repair.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Illustrate the Central Dogma of molecular biology, explain the multiplication of DNA in the cell and describe the types and modes of replication (K1, K2, & K4)</p> <p>CO2 Elaborate the mechanism of transcribing DNA into RNA, discuss the formation of different types of RNA (K1, K2, & K4)</p> <p>CO3 Decipher the genetic code and summarize the process of translation (K1, K4 & K5)</p> <p>CO4 Comprehend the principles of gene expression and explain the concept of operon in prokaryotes (K1, K4, & K5)</p> <p>CO5 Distinguish the types of mutations and explain the various mechanisms of DNA repair (K2, K4, & K5)</p>
Units	
I 15 Hours	<p>Central Dogma of molecular Biology: DNA as the unit of inheritance. Experimental evidences by Griffith are transforming principle, Avery, McLeod and McCarthy's experiment, and Hershey and Chase Experiment.</p> <p>Replication in prokaryotes: Modes of replication, Meselson and Stahl's experimental proof for semiconservative replication. Mechanism of Replication – Initiation, events at OriC, Elongation - replication fork, semi discontinuous replication, Okazaki</p>

	fragments, and termination. Bidirectional replication, Inhibitors of replication. Models of replication-theta, rolling circle and D-loop model.
II 15 Hours	Transcription - Mechanism of transcription: DNA dependent RNA polymerase(s), recognition, binding and initiation sites, TATA/ Pribnow box, elongation and termination. Post-transcriptional modifications; inhibitors of transcription. RNA splicing and processing of mRNA, tRNA and rRNA. Reverse transcription.
III 15 Hours	Translation: Genetic Code and its characteristics, Wobble hypothesis. Adaptor role of tRNA, Activation of amino acids, Initiation, elongation and termination of protein synthesis, post-translational modifications and inhibitors of protein synthesis.
IV 15 Hours	Regulation Of Gene Expression- Regulation Of Gene Expression in Prokaryotes - Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, regulation of lac operon and trp operon.
V 15 Hours	Mutation: Types - Nutritional, Lethal, Conditional mutants. Missense mutation and other point mutations. Spontaneous mutations; chemical and radiation – induced mutations. DNA repair: Direct repair, Photo-reactivation, Excision repair, Mismatch repair, Recombination repair and SOS repair.
Reading List (Print and online)	Web resources 1. www.mednotes.net/notes/biology 2. https://www.onlinebiologynotes.com/repair-mechanism-of-mutation/ 3. https://teachmephysiology.com/biochemistry/protein-synthesis/dna-translation/
Self-Study	➤ Experimental evidence for DNA as genetic material. ➤ Different types of mutations.
Recommended Texts	Textbooks 1. Veer Bala Rastogi, 2008, Fundamentals of Molecular Biology, 1 st edition, Ane books India. 2. David Friefelder, 1987, Molecular Biology, 2 nd edition, Narosa Publishing House. 3. Dr.P.S.Verma and Dr. V.K. Agarwal, 2013, Cell biology, Genetics, Molecular Biology, Evolution and Ecology, 1 st edition, S. Chand & Company Pvt. Ltd. Reference books 1. Karp, G., 2010, Cell and Molecular Biology: Concepts and Experiments, 6 th edition, John Wiley & Sons. Inc. 2. DeRobertis, E.D.P. and DeRobertis, E.M.F., 2010, Cell and Molecular Biology, 8 th edition, Lippincott Williams and Wilkins, Philadelphia. 3. James.D. Watson, 2013, Molecular Biology of the Gene 7 th edition, Benjamin Cummings. 4. George M. Malacinski, 1992, Friefelder's Essentials of Molecular Biology, 4 th edition, Narosa publishing House

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	M	M	S
CO 2	S	M	M	M	M	M	M	M	M	S
CO 3	S	M	L	M	M	M	S	L	M	M
CO 4	S	M	M	L	M	M	L	M	M	S
CO 5	S	M	M	M	M	M	S	L	M	L

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Human Physiology	Core	5	1	-	-	4	6	25	75	100

Course	Core Paper XIV
Title of the Course:	HUMAN PHYSIOLOGY
Credits:	4
Pre-requisites, if any:	Basic knowledge on organ structure and functions and glands with their secretions.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Aid in understanding the physiology of respiratory and circulatory systems • Explain the structure and physiology of the nervous and muscular system • Explicate the functions of digestive and excretory system of the body. • Impart knowledge about the process of reproduction. • Emphasize the importance of various endocrine factors that regulate metabolism, growth, homeostasis and reproduction.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Explain the exchange of gases, design of blood vessels and cardiac cycle (K2, K4, & K5)</p> <p>CO2 Design experimental model of different systems (K2, K3 & K4)</p> <p>CO3 Elaborate the structure and functions of digestive system, structure of nephron and mechanism of urine formation and role of kidney in maintenance of pH (K1, K4, & K5)</p> <p>CO4 Describe the process of Oogenesis, Spermatogenesis, Fertilization, and Parturition (K1, K2, & K5)</p> <p>CO5 Understand the role of different hormones that regulate metabolism, growth, glucose homeostasis and reproductive function (K1, K3, & K4).</p>
Units	
I 15 Hours	<p>Respiratory System-Overview of respiratory system, Types of respiration, Transport of respiratory gases, Exchange of respiratory gases in lungs and tissues - Chloride Shift & Bohr's effect, Lung surfactant.</p> <p>Circulatory System-Structure and functions of the Heart. Arterial and venous system, Cardiac cycle, Pace maker, Blood pressure and Factors affecting blood pressure.</p>
II 15 Hours	<p>Nervous system- Structure of neuron, synaptic transmission, reflex action, neurotransmission- Resting membrane and Action potential. neurotransmitters-</p>

	acetyl choline, Nor-adrenaline, Dopamine, Serotonin, Histamine, GABA, Substance-P. Muscular system -structure and types of muscles - skeletal, smooth and cardiac muscles, muscle proteins- types and functions, mechanism of muscle contraction.
III 15 Hours	Digestive system - composition, functions of saliva, gastric pancreatic intestine and bile secretions, structure of digestive system, Digestion, absorption of carbohydrates, lipids, proteins. Excretory system- Structure of nephron, mechanism of urine formation, Concentration and acidification of Urine. Role of kidneys in the maintenance of pH.
IV 15 Hours	Reproductive system: Oogenesis, spermatogenesis, capacitation and transport of sperm- blood-testis barrier. Fertilization, early development, Implantation, Placentation and Parturition.
V 15 Hours	Endocrine system - Classification of hormones, endocrine glands and their secretions, structure and functions of Insulin and thyroxine. Steroid hormones - Corticosteroids, Sex hormones – testosterone and estrogen, menstrual cycle.
Reading List (Print and online)	Web resources https://www.youtube.com/watch?v=6qnSsV2syUE https://www.youtube.com/watch?v=9_h0ZXx1IFw https://slideplayer.com/slide/9431799/
Self-Study	<ul style="list-style-type: none"> ➤ Acquire the knowledge about various biological systems. ➤ Understand about male and female reproductive organs.
Recommended Texts	<p>Textbooks</p> <ol style="list-style-type: none"> 1. K. Sembulingam & Prema Sembulingam, 2016, Essentials of Medical Physiology, 7th edition, Jaypee Brothers Medical Publishers (P)Ltd. 2. Chatterjee. C.C., 1988, Human Physiology-Vol I & II, 1stedition, Medical Allied Agency. 3. Animal Physiology- Mariakuttikan and Arumugam, Saras publication, 2017 <p>Reference books</p> <ol style="list-style-type: none"> 1. Text book of medical biochemistry physiology- MN. Chatterjee and Rana shinde, 7th edition, Jaypee brothers - medical publishers, 2007. 2. Guyton and Hall, 2011, Textbook of Medical Physiology, 12th edition, W.B. Saunders Company. 3. Textbook of Medical Physiology –Guyton & Hall, 12th edition, Saunders Publishers, 2010 4. Human anatomy and physiology–Elaine N. Marieb, 3rd edition, Benjamin/Cummings (a Pearson education company), 1995.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

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Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	M	M	S
CO 2	S	L	M	M	M	M	M	M	M	S
CO 3	S	M	M	M	L	M	S	M	M	M
CO 4	S	S	M	L	M	M	L	L	M	S
CO5	S	S	M	M	M	M	S	M	M	L

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Plant Biochemistry and Plant Therapeutics	Core	5	1	-	-	4	6	25	75	100

Course	Core Paper XV
Title of the Course:	PLANT BIOCHEMISTRY AND PLANT THERAPEUTICS
Credits:	4
Pre-requisites, if any:	Basic knowledge on photosynthesis, plant metabolism and phytohormones.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Convey the knowledge on photosynthesis. • Detail the structure and types of secondary metabolites. • Impart the idea on various plant hormones. • Emphasize the effects of free radicals and the importance of antioxidants • Understand the role of medicinal plants in treating diseases.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Gain knowledge on photosynthetic apparatus, pigments present, pathways, and significance of photosynthesis (K1, K3, & K4)</p> <p>CO2 Understand the plant metabolic processes (K1, K2, & K3)</p> <p>CO3 Understand the structure and functions of plant hormones (K1, K2, & K5)</p> <p>CO4 Discuss about free radicals, types and its harmful effects. Role of enzymatic and non-enzymatic antioxidant in defence mechanism, prevention in disease (K1, K4, & K5)</p> <p>CO5 Learn in detail about the structure, types, sources, biosynthesis and functions of secondary metabolites (K2, K3, & K5)</p>
Units	
I 15 Hours	Photosynthesis- Photosynthesis apparatus, pigments of photosynthesis, photo chemical reaction, photosynthetic electron transport chain, path of carbon in photosynthesis- Calvin cycle, Hatch – slack pathway(C4 pathway), CAM pathway, significance of photosynthesis.
II 15 Hours	Plant metabolism - Plant Metabolic Processes, Uptake and metabolism of mineral nutrients in plants, Nitrogen cycle, nitrate and nitrite reduction, denitrification, symbiotic and non-symbiotic nitrogen fixation. Phytoremediation and its applications
III 15 Hours	Plant hormones: Structure and function of plant hormones such as auxins, Gibberlins, cytokinins, Abscic acid, Florigin and Ethylene.
IV 15 Hours	Free radicals and antioxidants – Free radicals - types, production, free radical induced damages, lipid peroxidation, reactive oxygen species, antioxidant defense system,

	enzymatic and non-enzymatic antioxidants, role of antioxidants in prevention of disease, phytochemicals as antioxidants.
V 15 Hours	Secondary metabolites: Structure, Types, Sources and function of phenolics, tannins, lignins, terpenes and alkaloids. Therapeutic potential of secondary metabolites
Reading List (Print and online)	Web resources 1 https://www.intechopen.com/books/secondary-metabolites-sources-and-applications/anintroductory-chapter-secondary-metabolites 2 https://www.toppr.com/guides/biology/plant-growth-and-development/plant-growth
Self-Study	➤ Role of various medicinal plants for treatment of diseases. ➤ Role of phytochemicals as antioxidants.
Recommended Texts	Text books 1. Singh M.P and Panda.H2005. Medicinal Herbs with their formulations, Daya publishing house, Delhi 2. Plant Physiology-Devlin N. Robert and Francis H. Witham, CBS Publications 3. Molecular activities of plant cell – An Introduction to Plant Biochemistry. John. W. 4. Anderson and John Brardall, Black well Scientific Publications, 1994. Reference books 1. Khan, I.A and Khanum. A 2004. Role of biotechnology in medicinal and aromatic plants, Vol.1 and Vol.10, Ukka2 publications, Hyderabad. 2. Plant Biochemistry and Molecular Biology – Hans Walter Heldt, Oxford University, 4th Edition, 2010 3. Plant biochemistry (2008), Caroline bowsher, Martin steer, Alyson Tobin, garland science. 4. Plant physiology and development (sixth edition) by Lincoln Taiz, Eduardo Zeiger, Ian Max Moller and Angus Murphy publisher ; Oxford university press

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or off beat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	L	M	M	M	S	L	M	S
CO 2	S	M	M	M	M	M	M	S	M	S
CO 3	S	M	L	M	M	M	S	L	M	M
CO 4	S	S	S	M	M	M	L	S	L	S
CO5	S	S	S	M	M	M	S	S	M	L

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Biotechnology	Elective	4	1	0	0	3	5	25	75	100

Course	Elective Course 2 A
Title of the Course:	BIOTECHNOLOGY
Credits:	3
Pre-requisites, if any:	Basic knowledge on tools of recombinant DNA technology, tissue culture and fermentation technology.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Impart knowledge on gene manipulation and gene transfer technologies • Make the students understand the procedures involved in plant tissue culture. • Acquire knowledge on animal cell culture and stem cell technology. • Improve the employability skills of students by providing knowledge in recent techniques such as PCR, blotting, ELISA etc. • Understand the application of fermentation technology.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Acquire knowledge on rDNA technology, DNA manipulation, and use of restriction endonucleases. (K1, K2, & K4)</p> <p>CO2 Get acquainted with the use of cloning and vectors in plant tissue culture (K1, K2, & K5)</p> <p>CO3 Understand the methods for production of proteins using recombinant DNA technology and their applications, basics of tissue culture, transgenesis, stem cell technology, risks, and safety aspects and patenting in biotechnology (K1, K3 & K4)</p> <p>CO4 Gain knowledge about the importance of gene and gene manipulation technologies (K1, K2, & K4)</p> <p>CO5 Know the concept fermentation technology and its applications (K1, K4 & K6)</p>
Units	
I 15 Hours	<p>Cloning strategy</p> <p>Scope and importance of biotechnology. Cloning Vectors - PBR322, λ-bacteriophage. Restriction endonucleases and other enzymes used in manipulating DNA molecules. Ligation of DNA molecules- DNA ligase, linkers, adapters and homopolymer tailing. Selection and screening of recombinants – insertional inactivation method and colony hybridization method. Production of insulin by rDNA technology.</p>
II 15 Hours	<p>Plant Tissue culture</p> <p>Plant tissue culture- basic requirements for culture, MS medium, callus culture, protoplast culture. Vectors – Ti plasmid. Viral vectors- TMV, CaMV and their applications. Transgenic plants – Agrobacterium mediated gene transfer.</p>

	Applications of transgenic plants - Pest resistant plants and herbicide resistant plants.
III 15 Hours	Animal Tissue culture Animal cell lines and organ culture - Introduction to basic tissue culture techniques, media, disaggregation of animal tissue, establishment of cell line. Transfection methods- calcium phosphate precipitation, electroporation, DEAE - dextran mediated transfection methods. Reporter genes. Transferring genes into animal cells or embryos - Microinjection, Nuclear transfer and Embryonic stem cell methods. Applications of transgenic animals.
IV 15 Hours	Molecular Techniques PCR –Principle, types and its application in clinical diagnosis and forensic science. Southern blotting, Northern blotting and DNA finger printing Technique-principle, procedure and their applications. DNA Sequencing techniques – Sanger’s method, pyrosequencing and Next generation sequencing (NGS)- principle, procedure and applications.
V 15 Hours	Fermentation technology Fermentation technology – Fermentors - design, fermentation processes - Media used, downstream processing. Production and applications of ethanol, streptomycin and riboflavin. Biogas – production and applications.
Reading List (Print and online)	Web Sources NPTEL Certification course - Gene Therapy by Sachin Kumar https://nptel.ac.in/courses/102/103/102103041/ Coursera Certification course – Vaccines https://futureoflife.org/background/benefits-risks-biotechnology/ https://www.sciencedirect.com/topics/neuroscience/genetic-engineering http://www.biologydiscussion.com/biotechnology/techniques-biotechnology/important-techniques-of-biotechnology-3-techniques/15683 https://iopscience.iop.org/book/978-0-7503-1347-6/chapter/bk978-0-7503-1347-6ch1 https://www.slideshare.net/zeal_eagle/fermentation-technology https://www.slideshare.net/zeal_eagle/fermentation-technology https://www.slideshare.net/Chepkitwai/blotting-techniques-6129300
Self-Study	➤ Applications of rDNA technology. ➤ Basics of stem cell technology
Recommended Texts	Text Books 1. 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 & Co 2. Satyanarayana U (2008), Biotechnology, Books & Allied (P) Ltd. 3. Cassida L (2007) Industrial Microbiology, New Age International. Reference books 1. Reed G (2004) Prescott and Dunn’s Industrial Microbiology, CBS Publishers & Distributors 2. Biotechnology: applying the genetic revolution- David P. Clark , Pazdernik N. J, Elsevier (2009).

3. Click B.R. and Pasternark J.J (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. (4th ed) American Society for Microbiology.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	L	S	M	S	S	S	S	S	M
CO 2	S	S	S	M	S	S	S	M	S	S
CO 3	S	M	S	M	S	M	S	S	S	L
CO 4	S	M	S	M	S	S	S	L	S	S
CO5	S	M	S	M	S	L	S	S	S	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Bioinformatics	EP2	4	1	0	0	3	5	25	75	100

Course	Elective Course 2 B
Title of the Course:	BIOINFORMATICS
Credits:	3
Pre-requisites, if any:	Basic knowledge on biological database and tools for genome comparison
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Impart knowledge on bioinformatics and applications • Learn about biological databases • Understand the local and global sequence alignment • Provide insights on BLAST and Microarray • Familiarize about structural genomics and visualization tools.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Introduce the fundamentals of Bioinformatics and its applications Genome, metabolome & Transcriptome (K2, K3 & K4)</p> <p>CO2 Classify biological database and to correlate the different file formats used by nucleic acid, protein database, structural and metabolic database (K1, K3 & K5)</p> <p>CO3 Develop algorithms for interpreting biological data (K1, K3 & K4)</p> <p>CO4 Discuss the concepts of sequence alignment and its types. Understand the tool used to detect the expression of genes (K1, K3 & K5)</p> <p>CO5 Apply the various tools employed in genomic study and protein visualization. Analyse the entire genome by shot gun method (K1, K2 & K5)</p>
Units	
I 15 Hours	Introduction to Bioinformatics – Bioinformatics and its applications. –Genome, Metabolome- Definition and its applications. Metabolome- Metabolome database- E.coli metabolome database, Human Metabolome database. Transcriptome- Definition and applications.
II 15 Hours	Biological Databases - definition, types and examples –, Nucleotide sequence database (NCBI, EMBL, Gene bank, DDBJ) Protein sequence database- SwissProt, TrEMBL, Structural Database-PDB, Metabolic database-KEGG.
III 15 Hours	Sequence Alignment -Local and Global alignment-Dot matrix analysis, PAM, BLOSUM. Dynamic Programming, Needleman- Wunch algorithm, Smith waterman algorithm. Heuristic methods of sequence alignment.
IV 15 Hours	BLAST -features, types (BLASTP, BLASTN, BLASTX), PSI BLAST, result format. DNA Microarray-Procedure and applications.
V 15 Hours	Structural genomics -Whole genome sequencing (Shotgun approach), Comparative genomics-tools for genome comparison, VISTA servers and pre computed tools.

	Molecular visualization tools. RASMOL, Swiss PDB viewer. Nutrigenomics-Definition and applications.
Reading List (Print and online)	Web resources 1. https://nptel.ac.in/courses/102/106/102106065/ 2 http://www.digimat.in/nptel/courses/video/102106065/L65.html 3 https://www.slideshare.net/sardar1109/bioinformatics-lecture-notes
Self-Study	➤ Short review on biological databases. ➤ Tools used to study gene expression
Recommended Texts	Text books 1. Basic of Bioinformatics by Rui Jiang Xuegong Zhang and Michael Q. Zhang Editors 2. Bioinformatics for Beginners Genes, Genomes, Molecular Evolution, Databases and Analytical Tools By: Supratim Choudhuri (Author) 3. Bioinformatics by Saras publication 4. Introduction to Bioinformatics by Arthur Lesk. Reference books 1. Computation in Bioinformatics Multidisciplinary Applications S Balamurugan, Anand T. Krishnan, Dinesh Goyal, Balakumar Chandrasekaran 2. Chemoinformatics and Bioinformatics in the Pharmaceutical Sciences Navneet Sharma PhD Pharmaceutics, Himanshu Ojha, Pawan Raghav, Ramesh K. Goyal

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	M	M	S
CO 2	M	S	S	M	M	M	M	M	S	M
CO 3	S	S	L	M	M	M	S	M	M	M
CO 4	L	S	S	M	M	M	L	M	S	M
CO5	S	S	L	M	M	M	S	M	L	M

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Bioentrepreneurship	Elective	4	1	-	-	3	5	25	75	100

Course	Elective Course 2 C
Title of the Course:	BIOENTREPRENEURSHIP
Credits:	3
Pre-requisites, if any:	Basic knowledge on entrepreneurship, venture creation and business plan.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Impart knowledge on bio entrepreneurship and the types of industries • Learn about business plan, proposal and funding agencies • Understand the market strategy and the role of information technology in expansion of business • Provide insights on legal requirement and accounting to establish as Bio entrepreneurship • Familiarize about business bio incubators centres.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Understand the concept and scope for entrepreneurship (K1, K2, & K4)</p> <p>CO2 Identify various operations involved in a venture creation (K1, K3 & K4)</p> <p>CO3 Gather funding and launching a winning business (K1, K3 & K4)</p> <p>CO4 Nurture the organization and harvest the rewards (K1, K2 & K4)</p> <p>CO5 Illustrate about the Business incubator centres and Bio entrepreneurship (K1, K3 & K4)</p>
Units	
I 15 Hours	Introduction to Bio entrepreneurship; Types of industries – Biopharma, Bio agriculture and CRO; Introduction to Trademarks, Copyrights and patents.
II 15 Hours	Business Plan, Budgeting and Funding Idea or opportunity; Business proposal preparation; funds/support from Government agencies like MSME/banks, DBT, BIRAC, Start-up and make in India Initiative; dispute resolution skills; external environment changes; avoiding/managing crisis; Decision making ability.
III 15 Hours	Market Strategy- Basics of market forecast for the industry; distribution channels – franchising, policies, promotion, advertising, branding and market; Introduction to information technology for business administration and Expansion.
IV 15 Hours	Legal Requirements, Finance and Accounting; Registration of company in India; Ministry of Corporate Affairs (MCA); basics in accounting: introduction to concepts of balance sheet, profit and loss statement, double entry, bookkeeping; finance and break-even analysis; difficulties of entrepreneurship in India.
V 15 Hours	Entrepreneurship development: Role of knowledge centres such as universities, innovation centres, research institutions (public & private) and business incubators

	in Entrepreneurship development; quality control and quality assurance; Definition, role and importance of CDSCO, NBA, GLP, GCP, GMP.
Reading List (Print and online)	Web sources 1. http://www.simplynotes.in/e-notes/mbabba/entrepreneurship-development/ 2. https://openpress.usask.ca/entrepreneurshipandinnovationtoolkit/chapter/chapter-1-introductionto-entrepreneurship/
Self-Study	➤ Outline on patent, copy right and trademark. ➤ Scope and applications of entrepreneurship.
Recommended Texts	Text books 1. Adams, D. J. (2008). Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion - ISBN 10: 1904842364 / ISBN 13: 9781904842361 2. Shimasaki, C. (2014). Biotechnology Entrepreneurship: Starting, managing, and Leading Biotech Companies. Academic London Press - ISBN 10: 0124047300 / ISBN 13: 9780124047303 3. Onetti, A. &. (2015). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge - ISBN 10: 1138616907 / ISBN 13: 9781138616905 4. Kapeleris, D. H. (2006). Innovation and entrepreneurship in biotechnology: Concepts, theories & cases - ISBN-13: 978-1482210125, ISBN-10: 1482210126. Reference books 1. Desai, V. (2009). The Dynamics of Entrepreneurial Development and Management New Himalaya. New Himalaya House Delhi:pub - ISBN : 9789350440810 9350440814 2. Ono, R. D. (1991). The Business of Biotechnology, From the Bench of the Street. Butterworth-Heinemann - ISBN 10: 1138616907 / ISBN 13: 9781138616905 3. Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press - ISBN-10 : 812243049X ,ISBN-13 : 978-8122430493

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	M	M	M	L	M	S	M	M	S
CO 2	M	M	M	M	M	S	S	M	M	S
CO 3	M	M	M	M	M	S	S	M	M	M
CO 4	M	M	M	M	M	S	S	M	S	S
CO 5	M	M	M	M	M	S	S	M	L	L

S-Strong

M-Medium

L-Lo

SEMESTER VI- PROJECT

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Project	Core	1		4	-	4	5	40	60	100

SKILL ENHANCEMENT COURSE -SEC (NME)

**Choose any of the skill enhancement course (NME) for Semester I & II
FIRST YEAR - SEMESTER I/II**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	NME: Health and Nutrition	SEC	1	1	-	-	2	2	25	75	100

Course	NON MAJOR ELECTIVE
Title of the Course:	NME: Health and Nutrition
Credits:	2
Pre-requisites, if any:	Basic knowledge on health, role of nutrients in health and disease and malnutrition.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Gain basic knowledge about health. • Understand about vitamins. • Learn about functions of fat on health. • Understand the types of minerals and its functions. • Know about the importance of carbohydrates and proteins on health.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Understand about the importance of health and diet (K2, K3 & K4)</p> <p>CO2 Discuss about the classification properties and deficiencies of vitamins (K1, K3& K4)</p> <p>CO3 Understand about sources and functions of fats and lipids on health (K1, K4 &K5)</p> <p>CO4 Detail about the different typed of minerals and its role in health (K1, K2 & K4)</p> <p>CO5 Relate the role of proteins and carbohydrates on health (K1, K2 & K4)</p>
Units	
I 6 Hours	Health – Definition, Dimensions and Concepts of health, Factors affecting human health. Components of Health Care - Primary health care, Health care programmes, Occupational health care and Mental health care. Balanced diet and calorific value.
II 6 Hours	Vitamins - Definition and classification. Fat soluble vitamins - sources, RDA, functions and deficiency disorders of Vitamin A, D and K. Water soluble vitamins- sources, RDA, functions and deficiency disorders of vitamin C, thiamine, riboflavin, niacin and folic acid.
III 6 Hours	Lipids -Plant and animal sources of lipids, biological functions of fats, Essential and non essential fatty acids – definition. Role of cholesterol in health and diseases- Atherosclerosis – Pathogenesis, etiology, symptoms and treatment.

IV 6 Hours	Minerals- Sources, RDA, biological functions and deficiency disorders of Calcium, Phosphorus, Iron, Zinc and Selenium.
V 6 Hours	Carbohydrates and Proteins -Dietary sources, calorific value and biological functions of carbohydrates. Dietary sources, calorific value and biological functions of proteins. Protein-Calorie Malnutrition – Kwashiorkor and Marasmus.
Reading List (Print and online)	Web Resources 1. https://www.universalclass.com/articles/health/nutrition/nutritional-needs-for-differentages . 2. nhp.gov.in/healthyliving/healthydiet 3. www.anme.com.mx/libros/PrinciplesofNutrition.pdf
Self-Study	➤ Role of lipids in health and disease. ➤ Disorders of mineral metabolism.
Recommended Texts	Text books 1. S. Davidson and J.R.Passmore (1986) Human Nutrition and Dietetics, (8th ed), Churchill Livingstone 2. J. S. Garrow, W. Philip T. James, A. Ralph (2000), Human Nutrition and Dietetics (10th ed), Churchill Livingstone 3. M. Swaminathan (1995) Principles of Nutrition and Dietetics, Bappco Reference Books 1. Margaret Mc Williams (2012). Food Fundamentals (10th ed), Prentice Hall

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation
Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	S	M	S
CO 2	S	M	M	L	M	M	S	S	M	S
CO 3	S	M	M	M	M	M	M	S	M	M
CO 4	S	M	M	M	M	M	S	S	M	S
CO5	S	M	M	M	M	M	L	S	M	L

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Lifestyle Diseases	Non – Major Elective	1	1	-	-	2	2	25	75	100

Course	NON MAJOR ELECTIVE
Title of the Course:	LIFE STYLE DISEASES
Credits:	2
Pre-requisites, if any:	Basic knowledge on food habits, metabolic diseases and its prevention.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Create awareness on lifestyle diseases among adolescents. • List out the lifestyle diseases. • Explain the common lifestyle diseases and their prevention. • Acquaint the disorders associated with women's health. • Impart life skills so as to prevent life style diseases.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Define Life style diseases and describe the contributing factors (K2, K3 & K4)</p> <p>CO2 Enumerate the top life style diseases and its impact on life (K1, K4 & K5)</p> <p>CO3 Elaborate the treatment and prevention measures of common lifestyle diseases (K1, K4 & K5)</p> <p>CO4 Highlight the life style disease that affects the women's health (K1, K3 & K4)</p> <p>CO5 Illustrate the various measures for prevention of life style diseases (K1, K4 & K5)</p>
Units	
I 6 Hours	Lifestyle diseases: Definition, Factors contributing to lifestyle diseases - Physical inactivity, Poor food habits, disturbed biological clock, sleep deprivation.
II 6 Hours	Top lifestyle diseases- Impact of Lifestyle diseases on family, society and economy of country. Causes. Symptoms, types, preventive measures and treatment of Obesity and cancer.
III 6 Hours	Metabolic Syndrome- Causes, symptoms, types, preventive measures and treatment of cardio vascular disease and diabetes mellitus.
IV 6 Hours	Women's lifestyle diseases: Causes, symptoms, types, preventive measures and treatment of Polycystic Ovarian Disease, Breast cancer and Osteoporosis.
V 6 Hours	Prevention of lifestyle diseases: Balanced diet, sufficient intake of water, physical activity, sleep-wake cycle, stress management and meditation.
Reading List (Print and online)	<p>Web resources</p> <ol style="list-style-type: none"> 1. https://youtu.be/jDdL2bMQXfE 2. https://youtu.be/7WnpSB14nDM 3. https://youtu.be/ollz9MqtW-U

Self-Study	<ul style="list-style-type: none"> ➤ Causes, prevention and treatment of obesity. ➤ Causes, prevention and treatment of cancer.
Recommended Texts	<p>Textbooks</p> <ol style="list-style-type: none"> 1. James M R, Lifestyle Medicine, 2nd Edition, CRC Press, 2013 2. Akira Miyazaki, New Frontiers in Lifestyle-Related Disease, Springer, 2008. <p>Reference books</p> <ol style="list-style-type: none"> 1. Steyn K, Lifestyle and related risk factors for chronic diseases 2. Willett WC, Prevention of chronic disease by means of diet and lifestyle. 3. Kumar M & R. Kumar, . Guide to prevention of life style diseases. Deep & Deep publications

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	M	M	L	L	M	S	S	M	S
CO 2	M	M	M	M	S	M	S	M	M	S
CO 3	M	M	M	M	S	M	S	S	M	S
CO 4	M	M	M	M	S	M	S	L	M	S
CO 5	M	M	M	M	S	M	S	S	M	S
	S-Strong			M-Medium			L-Low			

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	NME: Medicinal Diet	SEC	1	1	-	-	2	2	25	75	100

Course	NON MAJOR ELECTIVE
Title of the Course:	MEDICINAL DIET
Credits:	2
Pre-requisites, if any:	Basic knowledge on role of diet and diet therapy for various diseases
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Provide basic knowledge about diet • Understand of diet modification for GI diseases • Plan a diet for liver diseases • Prepare diet chart for Infectious diseases • Plan a diet for Diabetes, Renal and Cardio-vascular diseases.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Possess basic knowledge about diet (K1, K3 & K4)</p> <p>CO2 Sketch diet plan for GI diseases (K1, K3 & K4)</p> <p>CO3 Sketch diet plan for liver diseases (K1, K5 & K6)</p> <p>CO4 Sketch a diet plan for Infectious diseases (K1, K5 & K6)</p> <p>CO5 Prepare diet chart for Diabetes Renal and Cardio-vascular diseases (K1, K4 & K5)</p>
Units	
I 6 Hours	Principles of Therapeutic Diet: Definitions of Normal diet, Therapeutic diet, soft Diet and Liquid diet. Objectives of Diet Therapy. Advantages of using normal diet as the basis for Therapeutic diet. Normal Diet-therapeutic modification of normal diet.
II 6 Hours	Diet modification in Gastrointestinal diseases: Peptic ulcer, Diarrhea, Lactose intolerance, Constipation and Malabsorption syndrome.
III 6 Hours	Diet Modification in liver and gall bladder in diseases: Etiology, symptoms and dietary treatment in jaundice, hepatitis, cirrhosis of liver and hepatic coma.
IV 6 Hours	Diet Modification in Infectious Diseases: Fevers, Typhoid, Tuberculosis and Viral Hepatitis. Dietary modifications in Tuberculosis.
V 6 Hours	Diet Modification in Diabetes, Renal and Cardio-vascular diseases- Diabetes, acute & chronic glomerulonephritis, nephrosis, renal failure, kidney stone and Hypertension.
Reading List (Print and online)	<p>Web resources</p> <p>1. https://youtu.be/jDdL2bMQXfE</p> <p>2. https://youtu.be/7WnpSB14nDM</p>

	3. https://youtu.be/ollz9MqtW-U
Self-Study	<ul style="list-style-type: none"> ➤ Basic knowledge on therapeutic diet. ➤ Dietary treatment of Gastrointestinal disease.
Recommended Texts	<p>Text Books</p> <ol style="list-style-type: none"> 1.M. Raheena Begum , A Text Book of Foods, Nutrition and Dietetics, Sterling Publishers. Ltd. 2. M.V. RajaGopal, Sumati.R., Mudambi, Fundamentals of foods and Nutrition, Wiley Eastern Limited, Year-1990. 3. William S.R Nutrition and Diet Therapy, 1985, 5thedition, Mosly Co. St. Louis. <p>Reference books</p> <ol style="list-style-type: none"> 1.Rodwell Williams Nutrition and Diet Therapy, 1985,the C.V Mosly St.Louis. 2.M.V.Krause&M.A.Mohan ,Food Nutrition and Diet Therapy, 1992 by W.B Saunders Company, Philadelphia, London. 3.Davidson and Passmore, Human Methods and Diabetics, 1976 the English Language Book Society and Churchill

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or off beat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	M	M	M	M	M	S	S	M	S
CO 2	M	M	M	M	S	M	S	S	M	S
CO 3	M	M	M	L	S	M	S	S	L	S
CO 4	M	M	M	M	S	M	S	S	M	S
CO 5	M	M	M	M	S	M	S	S	M	S

S-Strong

M-Medium

L-Low

SKILL ENHANCEMENT COURSE -SEC
Semester - II, III & IV/ Year - I/II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Biomedical Instrumentation	SEC (Discipline)	1	1	-	-	2	2	25	75	100

Course	Skill Enhancement Course
Title of the Course:	BIOMEDICAL INSTRUMENTATION
Credits:	2
Pre-requisites, if any:	Basic knowledge on medical assisting devices and imaging techniques.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Provide insights about the blood pressure and its measurement. • Elaborate the mechanism of instruments related to respiration. • Highlight the importance of imaging techniques. • Acquaint students about the basics of medical assisting devices. • Familiarize about the life saving therapeutic equipments.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Illustrate the functions of instruments used for measuring blood pressure (K1, K4 & K5)</p> <p>CO2 Elaborate the devices required for monitoring of respiratory gases (K1, K4 & K5)</p> <p>CO3 Understand the operation of the imaging and sonographic instruments (K1, K4 & K5)</p> <p>CO4 Understand the mechanism of ECG and EEG (K1, K4 & K5)</p> <p>CO5 Demonstrate the function of therapeutic equipments (K1, K4 & K5)</p>
Units	
I 6 Hours	Cardiovascular measurements: Measurement of blood pressure – sphygmomanometer – working principle and applications. Cardiac output, Cardiac rate, Heart sound – Stethoscope. Valvular defects assisting equipments- pacemakers, and defibrillators.
II 6 Hours	Respiratory system measurements: Working mechanism of Spirometer. Measurement of Carbon dioxide and oxygen in inhaled air - CO ₂ analyzer and O ₂ analyzer, inhalators, nebulizers, aspirators
III 6 Hours	Imaging Modalities and Analysis Working principle and applications of Medical imaging: X-ray machine - Radio graphic technique. Working principle and applications of Computed tomography, MRI and PET scan.

IV 6 Hours	Electrical Parameters Acquisition and Analysis. Cardio vascular measurements: Electrocardiogram – Working principle and applications. Measurement of neuronal activity: EEG – Working principle and significance
V 6 Hours	Therapeutic equipments: working principle and applications of diathermy, Heart-Lung machine and Dialyzers.
Reading List (Print and online)	Web Resources https://youtu.be/GkUCmb0cKwo?list=PLCZ9KmODEcu138IIVeHClJ4nskArYr1Dg
Self-Study	<ul style="list-style-type: none"> ➤ Principle and applications of imaging techniques. ➤ Short review on life saving therapeutic instruments.
Recommended Texts	<p>Text books</p> <ol style="list-style-type: none"> 1. M. Arumugam, ‘Bio-Medical Instrumentation’, Anuradha Agencies. 2. L.A. Geddes and L.E.Baker, ‘Principles of Applied Bio-Medical Instrumentation’, John Wiley & Sons. 3. J.Webster, ‘Medical Instrumentation’, John Wiley & Sons. 4. C.Rajaroo and S.K.Guha, ‘Principles of Medical Electronics and Bio-medical Instrumentation’, Universities (India) Ltd, Orient Longman Ltd.. <p>Reference books</p> <ol style="list-style-type: none"> 1. Leslie Cromwell, Fred J.Weibell, Erich A. Pfeiffer, ‘Bio-Medical Instrumentation and Measurements’, II Edition, Pearson Education, 2002. 2. R.S.Khandpur, ‘Handbook of Bio-Medical instrumentation’, Tata McGraw Hill Publishing Co Ltd.,

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	S	M	M	S	M	S	S	S	S
CO 2	M	S	M	M	S	M	M	S	S	M
CO 3	M	S	M	M	S	L	S	S	M	S
CO 4	M	S	L	M	S	M	L	S	S	L
CO 5	M	S	M	M	S	M	S	S	L	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	First Aid	SEC (Discipline)	1	1	-	-	2	2	25	75	100

Course	Skill Enhancement Course
Title of the Course:	FIRST AID
Credits:	2
Pre-requisites, if any:	Basic knowledge on various first aid techniques to treat injuries.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Provide knowledge on the basics of first aid. • Perform first aid during various respiratory issues. • Demonstrate the first aid to treat injuries. • Learn the first aid techniques to be given during emergency. • Familiarize the first aid during poisoning.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Discuss on the rules of first aid, dealing during emergency and first aid techniques(K1, K3 & K4)</p> <p>CO2 Understand the first aid techniques to be given during different types of respiratory problems (K1, K4 & K5)</p> <p>CO3 Provide first aid for injuries, shocks and bone injury (K1, K4 & K5)</p> <p>CO4 Detail on the first aid to be given for unconsciousness, stroke, fits and convulsions(K1, K4 & K6)</p> <p>CO5 Gain expertise in giving first aid for insect bites and chemical poisoning (K1, K4& K5)</p>
Units	
I 6 Hours	First Aid Techniques - Aims and important rules of first aid, dealing with emergency, content of a first aid kit. First aid technique – fast evacuation technique, transport techniques. General safety rules in the laboratory.
II 6 Hours	Basics of Respiration – CPR, first aid during difficult breathing, drowning, choking, strangulation and hanging, swelling within the throat, suffocation by smoke or gases and asthma.
III 6 Hours	Common medical aid - first aid for wounds, cuts, head, chest and abdominal injuries, shocks, burns, fractures of bones.
IV 6 Hours	First aid related to unconsciousness - first aid for stroke, convulsions – seizures and epilepsy
V 6 Hours	First aid in poisonous bites - Insects and snakes, honey bee stings, animal bites, disinfectant, acid and alkali poisoning.

Reading List (Print and online)	Web Resources 1) https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online • 2) https://www.firstaidforfree.com/
Self-Study	➤ Safety precautions to be followed in a laboratory. ➤ Overview on first aid techniques.
Recommended Texts	Text books 1) First aid and health Dr. Gauri Goel, Dr. Kumkum Rajput, Dr. Manjul Mungali 1ISBN-978-93-92208-19-5 2) Indian First Aid Manual- https://www.indianredcross.org/publications/FA-manual.pdf Reference books 1) Red Cross First Aid/CPR/AED Instructor Manual

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	M	M	S	S	M	S	S	S	S
CO 2	M	M	L	S	S	M	S	S	M	S
CO 3	M	M	M	M	S	M	S	S	S	M
CO 4	M	M	M	S	S	L	S	S	L	S
CO5	M	M	M	L	S	M	S	S	S	L

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Basics of Forensic Science	SEC (Discipline)	1	1	-	-	2	2	25	75	100

Course	Skill Enhancement Course
Title of the Course:	BASICS OF FORENSIC SCIENCE
Credits:	2
Pre-requisites, if any:	Basic knowledge on collection of samples for forensic analysis.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Gain knowledge on the basic practices of forensic analysis. • Perform investigation using fresh blood. • Carry out the analysis using body fluids • Investigate the presence of forms of drugs and poisons in body fluids. • Execute the identification test on multiple samples
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Gain knowledge on basics of forensic science and method for collection and preservation of samples (K1, K3 & K4)</p> <p>CO2 Assess the paternity, maternity problems and DNA profiling (K1, K4 & K5)</p> <p>CO3 Identify the presence of alcohol, insecticides and pesticides in body fluids (K1, K4 & K5)</p> <p>CO4 Detail on the test performed to identify the presence of drugs and poisons in body fluids (K1, K4 & K5)</p> <p>CO5 Identify species and sex from the available body fluids (K1, K3 & K4)</p>
Units	
I 6 Hours	Forensic Science: Definition, History and Development. Crime scene management and investigation; collection, preservation, packing and transportation of physical and trace evidences for analysis.
II 6 Hours	Investigation of fresh blood: Blood grouping– grouping and typing of fresh blood samples including enzyme. Cases of disputed paternity and maternity problems, DNA profiling-RFLP.
III 6 Hours	Analysis of body fluids- Analysis of illicit liquor including methyl and ethyl alcohol in body fluids and breathe. Chemical examination, physiology and pharmacology of insecticides and pesticides.
IV 6 Hours	Psychotropic drugs– Sedatives-mechanism of action of barbiturate, benzodiazepines and opioids. Stimulants- mechanism of action of Caffeine and nicotine, opiates and drugs of abuse.

V 6 Hours	Identification tests on clinical samples- Identification of hair, sex, and individual identification from hair. Examination and identification of saliva and urine.
Reading List (Print and online)	Web Resources <ul style="list-style-type: none"> ➤ https://www.nist.gov/forensic-science ➤ https://www.sjsu.edu/people/mary.juno/courses/1066/s8/Intro.pdf ➤ https://www.youtube.com/watch?v=4dATz4M7U8c
Self-Study	<ul style="list-style-type: none"> ➤ Basic practices followed in forensic analysis. ➤ Analysis of body fluids for alcohol and drugs.
Recommended Texts	Text books 1. Forensics by Embar-Seddon, Ayn and Pass. Allan D. 2. Forensic Medicine by Adelman, Howard C &Kobilinsky, Lawrence Page 24 of 63 Reference books 1. An Introduction to Forensic DNA Analysis by Norah Rudin & Keith Inman USA, Second edition. 2. Forensic Science Handbook, Volume 2 & 3 by Saferstein, Richard E.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	S	M	M	M	S	S	M	S	S
CO 2	M	S	M	M	M	M	S	M	S	S
CO 3	M	S	M	L	M	M	S	M	S	M
CO 4	M	S	M	M	M	L	S	M	S	S
CO5	M	S	M	M	M	M	S	M	S	L

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Medical Laboratory Technology	SEC (Discipline)	1	1	-	-	2	2	25	75	100

Course	Skill Enhancement Course
Title of the Course:	MEDICAL LABORATORY TECHNOLOGY
Credits:	2
Pre-requisites, if any:	Basic knowledge on sample collection for analysis, blood transfusion and interpretation of various diseases.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Impart knowledge on specimen collection and disposal of waste. • Acquaint knowledge on collection, preservation and transfusion of blood. • Quantify the biomolecules in biological sample • Understand the significance of various tests and their interpretation in diseased conditions • Acquaint knowledge on enzymes, hormones and Immunoglobulins as markers for diagnosis.
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Collect & preserve of biological samples (K1, K3 & K4) CO2 Estimate the various constituents in biological sample (K1, K4 & K5) CO3 Perform the routine procedures adopted in blood bank (K1, K3 & K4) CO4 Analyze and interpret the values for both normal and disease conditions (K1, K4 & K5) CO5 Assay the enzymes and hormones & interpret clinical implications (K1, K4 & K5).</p>
Units	
I 6 Hours	Specimen Collection: Collection, transport, analysis of specimen – blood, routine urine, feces, sputum, semen, CSF Documentation of samples & results. Disposal of laboratory/hospital wastes
II 6 Hours	Blood banking and Transfusion: Determination of Blood group and Rh factor -Basic blood banking procedures- cross matching, screening test. Blood transfusion and hazards.
III 6 Hours	Analysis of biomolecules- Estimation of blood sugar – Enzymatic method, HbA1C, Qualitative and quantitative analysis of urine sample- NPN-urea, uric acid, creatinine. CSF analysis.
IV 6 Hours	Immuno diagnostics -Widal test, VDRL test, ASO, RA, CRP and Complement fixation Test. RIA, ELISA, Skin test – Montaux test.

V 6 Hours	Assay of clinically important enzymes -LDH and Transaminases. Estimation of clinically important hormones – Insulin, Thyroid and Reproductive hormones and its clinical significance.
Reading List (Print and online)	Web Resources 1 https://www.youtube.com/watch?v=QNY1X5Ne9IQ 2 https://www.slideshare.net/doctorrao/agglutination-tests-and-immunoassays 3 https://microbenotes.com/introduction-to-precipitation-reaction/
Self-Study	➤ Selection criteria for a eligible blood donor. ➤ Immunodiagnostics in disease identification.
Recommended Texts	Text Books 1 Kanai L Mukherjee and Anuradha Chakravarthy Medical Laboratory Technology IV edition, Vol I,2022 2. Ramnik Sood, Text Book of Medical Laboratory Technology, Jaypee Publishers, 2006. Reference books 1.Tietz, N. (2018) Fundamentals of Clinical Chemistry and Molecular Diagnostics 8th edition, W.B. Saunders Company

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	S	M	M	M	L	S	S	S	S
CO 2	M	S	M	M	M	M	S	S	S	M
CO 3	M	M	M	M	L	M	S	M	S	S
CO 4	M	S	L	M	M	M	S	S	S	L
CO5	M	L	M	M	M	M	S	L	S	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Tissue Culture	SEC (Discipline)	1	1	-	-	2	2	25	75	100

Course	Skill Enhancement Course
Title of the Course:	TISSUE CULTURE
Credits:	2
Pre-requisites, if any:	Basic knowledge on tools and techniques used in tissue culture with applications.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Introduce the tools and techniques used in tissue culture technique. • Acquire knowledge on preparation of growth medium for culture techniques. • Impart knowledge on procedures involved gene transfer. • Acquaint with the process of tissue culture technique. • Understand the importance of plant and animal tissue culture for the production and evaluation of bioactive compounds
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Collect & preserve of biological samples (K1, K4 & K5) CO2 Estimate the various constituents in biological sample (K1, K2 & K4) CO3 Perform the routine procedures adopted in blood bank (K1, K3 & K5) CO4 Analyze and interpret the values for both normal and disease conditions (K1, K3 & K4) CO5 Assay the enzymes and hormones & interpret clinical implications (K1, K3 & K4)</p>
Units	
I 6 Hours	Introduction to Tissue culture: Types- seed, embryo, Callus, Organ, Advantages and importance of tissue culture, Tools and techniques
II 6 Hours	Media and Culture Preparation - pH, temperature, solidifying agents. Role of Micro and macro nutrients. Maintenance of cultures.
III 6 Hours	Methods of gene transfer – Transfer of gene in to plants – Agrobacterium mediated, microprojectile and electroporation. Transfer of gene in to animals – microinjection, stem cell transfer and nuclear transfer.
IV 6 Hours	Cell culture technique - Explants selection, sterilization, callus development and organogenesis. Protoplast culture, protoplast isolation, protoplast fusion and applications.
V 6 Hours	Transgenic plants and animals. Transgenic plants for molecular farming. Animal Cloning - an overview- Applications of animal cell culture.
Reading List (Print and online)	<p>Web Resources</p> <p>https://www.britannica.com/science/tissue-culture https://en.wikipedia.org/wiki/Plant_tissue_culture</p>

	https://microbeonline.com/animal-cell-culture-introduction-types-methods-applications/
Self-Study	<ul style="list-style-type: none"> ➤ Applications of tissue culture. ➤ Overview of animal cloning.
Recommended Texts	<p>Text books</p> <ol style="list-style-type: none"> 1. Trivedi, P.C.2000. Applied Biotechnology: Recent Advances. PANIMA Publishing corporation. 2. Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw – Hill. 3. Lycett, G.W. and Grierson, D. (ed). 1990. Genetic Engineering of crop plants. 4. Grierson and Covey, S.N.1988. Plant Molecular biology. Blackie. 5. Chawla, H.S., "Introduction to Plant Biotechnology", 3rd Edition, Science Publishers, 2009. <p>Reference books</p> <ol style="list-style-type: none"> 1. Gamburg OL, Philips GC, Plant Tissue & Organ Culture fundamental Methods, arias Publications. 1995. 2. Stewart Jr., C.N., "Plant Biotechnology and Genetics: Principles, Techniques and Applications" Wiley-Interscience, 2008. 3. Freshney, R. I. (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell, 2010.6th Edition. 4. Davis, J. M. (2008). Basic Cell Culture. Oxford University Press. New Delhi. 5. Davis, J. M. (2011). Animal Cell Culture. John Willy and Sons Ltd. USA.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	S	S	M	M	M	S	S	S	S
CO 2	M	M	L	M	M	M	S	S	S	M
CO 3	M	S	S	M	M	M	S	S	M	S
CO 4	M	L	S	M	M	M	S	S	S	L
CO5	M	S	S	M	M	M	S	S	L	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Medical Coding	SEC(Discipline)	1	1	-	-	2	2	25	75	100

Course	Skill Enhancement Course
Title of the Course:	MEDICAL CODING
Credits:	2
Pre-requisites, if any:	Basic knowledge on basic concepts of medical coding and medical terminologies.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Understand the basic concept of Medical coding • Familiarize the student about medical terminology • Understand about the classification of diseases based on WHO/AHA • Understand about the CPT code used for diseases as per American Medical Association (AMA)
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Explaining the basic concept of coding and its application. Possess the knowledge about the First aid and CPR (K2, K4 & K5)</p> <p>CO2 Possess the knowledge about medical terminology used in Medical coding industry (K1, K3 & K4)</p> <p>CO3 Possess the knowledge about the ICD-10 CM international classification of diseases based on WHO (K1, K3 & K4)</p> <p>CO4 Possess the knowledge about the CPT codes used for diseases as per American Medical Association (AMA) (K1, K4 & K5)</p> <p>CO5 Understand CPT coding and its types (K1, K4 & K5)</p>
Units	
I 6 Hours	Introduction to Medical coding, coding theory, Healthcare Common Procedure Coding, First Aid and CPR
II 6 Hours	Introduction to Medical Terminology, specialization I & II, Diagnostic coding, factors affecting diagnostic coding.
III 6 Hours	Documenting medical records- Importance of Documentation, Types of dictation formats.
IV 6 Hours	Introduction to Human Anatomy and Coding, ICD-10- CM classification system.
V 6 Hours	Introduction to CPT coding, types of CPT coding Medical Law and Ethics.
Reading List (Print and online)	<p>Web Resources</p> <ul style="list-style-type: none"> ➤ https://yes-himconsulting.com/introduction-to-medical-coding-basic-terminology/ ➤ https://www.youtube.com/watch?v=iBkLbXhFOJE

Self-Study	<ul style="list-style-type: none"> ➤ Basic concepts and terminologies of medical coding. ➤ Overview of documentation of medical records.
Recommended Texts	<p>Text books</p> <p>1.Understanding Medical Coding, A comprehensive guide Sandra L Johnson Robin Linker</p> <p>2.Buck’s Step – by – step Medical Coding Elsevier reference</p> <p>Reference books</p> <p>1. Terry Tropin M Shai, RHIA, CCS-P, AHIMAICD-10-CMcoding guidelines made easy2017.</p> <p>2.Besty J Shiland- Medical terminology and anatomy for ICD-10</p>

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	S	M	M	M	S	S	M	M	S
CO 2	M	M	M	M	M	S	S	M	M	M
CO 3	M	S	M	M	M	S	S	M	M	S
CO 4	M	L	M	M	M	S	S	M	M	L
CO5	M	M	M	M	M	M	S	M	M	S

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	SEC- Microbial techniques	SEC (Discipline)	1	1	-	-	2	2	25	75	100

Course	Skill Enhancement Course
Title of the Course:	MICROBIAL TECHNIQUES
Credits:	2
Pre-requisites, if any:	Basic knowledge on growth of bacteria, uses of microscope and culture techniques.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Study the growth of bacteria • Know the parts & uses of microscope • Learn staining methods to identify microbes • Learn different types of culture methods • Study food preservation methods
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Understand the growth of bacteria and to perform cell count (K1, K3 & K4)</p> <p>CO2 Acquire knowledge of microscope and its uses (K1, K3 & K5)</p> <p>CO3 Identify the microbes by staining methods (K2, K3 & K5)</p> <p>CO4 Culture microbes by various methods (K1, K3 & K4)</p> <p>CO5 Preserve foods at high and low temperature (K1, K3 & K4)</p>
Units	
I 6 Hours	Growth of bacteria- Definition, growth phases, factors affecting growth (pH, temperature, and oxygen), cell count (hemocytometer, Bacterial cell- Bacillus subtilis), fungal cell (Saccharomyces) and human blood cell.
II 6 Hours	Microscopy- Principle, types - Compound microscope, electron microscope- TEM, SEM, use of oil immersion objective.
III 6 Hours	Stains and staining- Principles of staining, simple staining, negative staining, Differential staining, Gram and acid-fast staining, flagella staining, capsule and endospore Staining. Staining of yeast (methylene blue), lactophenol cotton blue, staining of mold (Penicillium, Aspergillus), Agaricus.
IV 6 Hours	Cultivation of bacteria– Types of growth media (natural, synthetic, complex, enriched, selective- definition with example), culture methods (streak plate, spread plate, pour plate, stab culture, slant culture, liquid shake culture, anaerobiosis) - aerobic and Anaerobic bacteria.
V 6 Hours	Food microbiology- Microbiological examination of food: microscopic examination and culture, phosphatase test of Pasteurized milk. Preservation of food- High temperature (boiling, pasteurization, appreciation), low temperature (freezing), dehydration, osmotic pressure, chemical preservations, radiation. Microorganisms as food SCP.

Reading List (Print and online)	Web Resources ➤ https://www.pharmaguideline.com/2007/02/identification-of-bacteria-using-staining-techniques.html ➤ https://bitesizebio.com/36644/methods-microbial-identification/ ➤ https://microbiologynote.com/methods-of-food-preservation/
Self-Study	➤ Staining procedures for microbial identification. ➤ Overview on food preservation.
Recommended Texts	Text books 1. Sherris Medical Microbiology, 7th Edition by Authors: Kenneth Ryan, C. George Ray, Nafees Ahmad, W. Lawrence Drew, Michael Lagunoff, Paul Pottinger, L. Barth Reller and Charles R. Sterling 2. Food Microbiology: Fundamentals And Frontiers, 5th Edition by Editor(s):Michael P. Doyle, Francisco Diez-Gonzalez, Colin Hill 3. Text book of microbiology by Ananthanarayan and Panicker's 4. Textbook of microbiology by P.C. Trivedi Sonali Pandey Seema Bhadauria5. 5. Prescott's Microbiology, 10th Edition by Authors: Joanne Willey, Linda Sherwood and Christopher J. Woolverton Reference books 1. Bailey & Scott's Diagnostic Microbiology, 14th Edition by Author: Patricia Title 2. Medical Microbiology, 7th Edition Authors: Patrick R. Murray, Ken S. Rosenthal and Michael A. Pfaller 3. Microbiology: Laboratory Theory and Application, 3rd Edition Authors: Michael J. Leboffe and Burton E. Pierce

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	S	M	M	M	M	S	S	S	S
CO 2	M	S	M	M	M	M	S	S	S	M
CO 3	M	S	M	M	M	M	S	S	M	S
CO 4	M	S	M	M	M	M	S	S	S	L
CO5	M	S	M	M	M	M	S	S	L	S

S-Strong

M-Medium

L-Low

ALLIED COURSE OFFERED BY BIOCHEMISTRY
FIRST YEAR: FIRST SEMESTER
ALLIED BIOCHEMISTRY I

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Allied Biochemistry-I	(Theory) Allied I	3	1	-	-	3	4	25	75	100

Course	ALLIED COURSE
Title of the Course:	ALLIED BIOCHEMISTRY I
Credits:	3
Pre-requisites, if any:	Basic knowledge on structure and classification of biomolecules.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Introduce the structure and classification of carbohydrates • Comprehend the metabolism of carbohydrates • Study the classification and properties of amino acids • Elucidate the various levels of organization of Proteins • Study functions and deficiency diseases of vitamins
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Classify the structure of carbohydrates and its properties (K1, K2 & K5) CO2 Explain the metabolism of carbohydrates and its significance (K1, K3 & K5) CO3 Classify amino acids and its properties (K1, K4 & K5) CO4 Explain the classification and elucidate the different levels of structural organization of proteins (K2, K3 & K4). CO5 Identify the disease caused by the deficiency of vitamins (K1, K3 & K4)</p>
Units	
I 12 Hours	Carbohydrates -Definition and classification of carbohydrates, linear and cyclic forms (Haworth projection) for glucose, fructose and mannose and disaccharides (maltose, lactose, sucrose).General properties of monosaccharides and disaccharides. Occurrence and significance of polysaccharides.
II 12 Hours	Metabolism- Catabolism and Anabolism. Carbohydrate metabolism- Glycolysis, TCA cycle, HMP shunt and glycogen metabolism and energetics
III 12 Hours	Amino acids -Classifications, physical properties -amphoteric nature, isoelectric point and chemical reactions of carboxyl, amino and both groups. Amino acid metabolism- transamination, deamination and decarboxylation.
IV 12 Hours	Proteins- classification - biological functions, physical properties- ampholytes, isoelectric 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.

V 12 Hours	Vitamins- Fat (A, D, E and K) and water soluble vitamins (B complex and C) - Sources, RDA, biological functions and deficiency diseases.
Reading List (Print and online)	Web sources 1.onlinecourses.swayam2.ac.in/cec20_bt12 2 onlinecourses.swayam2.ac.in/cec20_bt19
Self-Study	➤ Structural organization of proteins. ➤ Note on vitamin deficiency diseases.
Recommended Texts	Text Books 1 Satyanarayan, U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata. 2.Jain J.L.(2007) Fundamentals of Biochemistry, S.Chand publishers. Reference books 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.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	M	M	S
CO 2	S	M	M	M	M	M	S	M	M	S
CO 3	M	M	L	M	M	M	S	M	L	M
CO 4	S	M	M	L	M	M	S	L	M	S
CO5	L	M	M	M	M	M	S	M	M	L

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Allied Biochemistry Practical I	Allied Practical I	-	1	2	-	3	3	25	75	100

Course	ALLIED PRACTICAL
Title of the Course:	ALLIED BIOCHEMISTRY PRACTICAL-I
Credits:	3
Pre-requisites, if any:	Basic knowledge on carbohydrates and amino acids.
Course Objectives	The objectives of this course are to <ul style="list-style-type: none"> Identify carbohydrates by qualitative test Estimate biomolecules volumetrically Estimate protein quantitatively
Course Outcomes	On completion of this course, students will be able to CO1 Qualitatively analyze and report the type of carbohydrate based on specific tests (K2, K4 & K5) CO2 Quantitatively estimate the carbohydrates, amino acids and ascorbic acid (K3, K4 & K5) CO3 Estimate protein by colorimetric method (K2, K4 & K5)
Units	
I 25 Hours	Qualitative analysis of carbohydrates <ol style="list-style-type: none"> Monosaccharides-Glucose, Fructose Disaccharides- Lactose, Maltose, Sucrose Polysaccharides-Starch
II 15 Hours	Volumetric analysis <ol style="list-style-type: none"> Estimation of ascorbic acid using 2,6dichlorophenolindophenol as link solution Estimation of Glucose by Benedict's method Estimation of Glycine by Sorenson Formal titration
III 5 Hours	Quantitative analysis (Demonstration Experiment) <ol style="list-style-type: none"> Colorimetric estimation of protein by Biuret method
Reading List (Print and online)	Web sources <ul style="list-style-type: none"> ➤ https://www.egyankosh.ac.in/bitstream/123456789/68527/1/Experiment-5.pdf ➤ https://www.vedantu.com/chemistry/uses-of-colorimeter
Self-Study	<ul style="list-style-type: none"> ➤ Principle of color reactions for qualitative analysis of carbohydrates. ➤ Working principle and applications of colorimetry.
Recommended Texts	Text books <ol style="list-style-type: none"> Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, New Age International Publishers, 2011, An Introduction to Practical Biochemistry, David T. Plummer, 3rd edition, Tata McGraw-Hill Publishing Company Limited, 2001..

	Reference books 1. Biochemical Methods, Sadasivam S and Manickam A, 4h edition, New Age International Publishers, 2016
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Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	S	S	M	M	M	M	S	M	S
CO 2	M	S	S	M	M	L	S	S	S	S
CO 3	M	S	S	M	M	M	L	S	L	S
	S-Strong			M-Medium			L-Low			

SEMESTER II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Allied Biochemistry II	Allied II	3	1	-	-	3	4	25	75	100

Course	ALLIED COURSE
Title of the Course:	ALLIED BIOCHEMISTRY II
Credits:	3
Pre-requisites, if any:	Basic knowledge on lipids, nucleic acids and enzyme action.
Course Objectives	<p>The objectives of this course are to</p> <ul style="list-style-type: none"> • Impart knowledge on the classification, properties and characterization of lipids. • Comprehend the metabolism of Lipids • Acquaint with the structure, properties and functions of nucleic acids • Learn about the enzyme kinetics and inhibition • Study the importance of Hormones
Course Outcomes	<p>On completion of this course, students will be able to</p> <p>CO1 Elaborate on classification, structure, properties, functions and characterization of lipids (K1, K3 & K5)</p> <p>CO2 Discuss the metabolism of lipids and its importance (K1, K3 & K4)</p> <p>CO3 Explain about structure, properties and functions of nucleic acids (K2, K4 & K5)</p> <p>CO4 Derive Michaelis- Menten equation and concepts of enzyme inhibition (K3, K4 & K5)</p> <p>CO5 Classify the Hormones and its biological functions (K1, K3 & K5)</p>
Units	
I 12 Hours	Lipids – Classification of lipids- simple lipids, fatty acids (saturated and unsaturated), compound lipids, derived lipids. Properties of lipids- reduction, oxidation, halogenation, saponification and rancidity .Classification and functions of phospholipids, Cholesterol – structure and biological importance.
II 12 Hours	Lipid metabolism - Oxidation of fatty acids (Palmitic acid) – Beta oxidation-Role of carnitine, energetics, alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids.
III 12 Hours	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.

IV 12 Hours	Enzymes - Nomenclature, IUB system of enzyme classification, active site, specificity, isoenzymes, units of enzyme activity factors affecting enzyme activity- substrate concentration, pH, temperature. Enzyme Kinetics- Michaelis and Menten equation. Line weaver- Burk plot. Enzyme inhibition, competitive, uncompetitive and non competitive inhibition.
V 12 Hours	Hormones - Endocrine glands. Classification of hormones. Biological functions of Insulin, Thyroid and Reproductive hormones.
Reading List (Print and online)	Web sources 1.onlinecourses.swayam2.ac.in/cec20_bt12 2 onlinecourses.swayam2.ac.in/cec20_bt19
Self-Study	➤ Biological role of DNA and RNA. ➤ Short review of biological actions of various hormones.
Recommended Texts	Text books 1. Satyanarayan, U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata. 2.Jain J.L.(2007) Fundamentals of Biochemistry, S.Chand publishers. Reference books 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

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	S	M	M	M	M	M	S	M	M	S
CO 2	M	M	M	L	M	M	S	M	M	S
CO 3	S	M	S	M	M	M	S	L	M	M
CO 4	L	M	M	S	M	M	S	M	M	S
CO5	S	M	M	M	M	M	S	S	M	L

S-Strong

M-Medium

L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Allied Biochemistry Practical II	Allied Practical II	-	1	2	-	3	3	25	75	100

Course	ALLIED PRACTICAL
Title of the Course:	ALLIED BIOCHEMISTRY PRACTICAL-II
Credits:	3
Pre-requisites, if any:	Basic knowledge on amino acids and storage nutrients in various food stuff.
Course Objectives	The objectives of this course are to <ul style="list-style-type: none"> Identify amino acids by qualitative test Prepare biomolecules from its sources Estimate phosphorus quantitatively
Course Outcomes	On completion of this course, students will be able to CO1 Qualitatively analyze the amino acids and report the type of amino acids based on specific tests (K2, K4 & K5) CO2 Prepare the macronutrients from the rich sources (K1, K3 & K5) CO3 Check the quality of edible oil (K1, K3 & K5)
Units	
I	Qualitative analysis of amino acids a) Arginine b) Cysteine c) Tryptophan d) Tyrosine
II	Biochemical preparations a) Preparation of casein from milk. b) Preparation of starch from potato. c) Preparation of albumin from egg.
III	Group Experiment a. Determination of Iodine/ Saponification number of an edible oil (Demonstration) .
Reading List (Print and online)	Web sources ➤ https://www.egyankosh.ac.in/bitstream/123456789/68528/1/Experiment-6.pdf ➤ https://www.egyankosh.ac.in/bitstream/123456789/68529/1/Experiment-7.pdf
Self-Study	➤ Principle of color reactions for qualitative analysis of amino acids. ➤ Tests to check the quality of an edible oil.
Recommended Texts	Text books 1. Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, New Age International Publishers, 2011, 2. An Introduction to Practical Biochemistry, David T. Plummer, 3 rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.. Reference books

1. Biochemical Methods, Sadasivam S and Manickam A, 4th edition, New Age International Publishers, 2016
2. Essentials of Food and Nutrition, Vol. I & II, M.S. Swaminathan.

Methods of assessment:

Recall (K1) - Simple definitions, MCQ, Recall steps, Concept definitions.

Understand/ Comprehend (K2) - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

Application (K3) - Suggest idea/concept with examples, Observe, Explain.

Analyse (K4)- Problem-solving questions, Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

Evaluate (K5) - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

Create (K6)- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	M	S	S	M	M	M	S	M	S	M
CO 2	M	S	S	M	M	L	S	S	S	S
CO 3	M	S	S	M	M	M	S	L	S	L

S-Strong

M-Medium

L-Low



The board of studies approved the syllabus with effect from the academic year 2023-24 and the distinguished members suggested incorporation of following changes:

First Semester:

- ✚ Nutritional Biochemistry is offered as Core paper with practical.
- ✚ Chemistry - I is offered as allied paper with practical.
- ✚ Skill Enhancement Course SEC-1 - Health and Nutrition is offered as Non major elective Paper-I. Dimensions and concepts of health, components of Health Care topics are included in Unit-I. In Unit II, Vitamins topic is elaborated into fat soluble and Water soluble vitamins. Atherosclerosis topic is included in Unit III.
- ✚ Basics of Biochemistry for Beginners - Scope and applications is provided as foundation or bridge course.

Second semester:

- ✚ Cell biology is offered as Core paper with practical.
- ✚ Allied chemistry - II is presented as allied paper with practical.
- ✚ Skill Enhancement Course SEC-2 - Lifestyle diseases is offered as Non major elective Paper-I. Obesity and cancer topics are included in Unit II.
- ✚ First Aid is provided as Skill Enhancement Course SEC-3. General safety rules in the laboratory topic is included in Unit I.

Third semester:

- ✚ Biomolecules is offered as Core paper with practical.
- ✚ Allied Microbiology - I is presented as allied paper with practical.
- ✚ Biomedical Instrumentation is offered as Skill Enhancement Course SEC-4. EMG and ERG topics are removed from Unit I. ECG and EEG topics are replaced from Unit I to Unit IV. Working mechanism of Spirometer, CO₂ analyzer, O₂ analyzer topics are included in Unit II.
- ✚ Medical Laboratory Technology is provided as Skill Enhancement Course SEC-5. LDH and Transaminases are included in Unit V as clinically important enzymes.

Fourth semester:

- ✚ Biochemical Techniques is presented as core paper. Polyacrylamide Gel electrophoresis topic is included in Unit III. Spectrofluorimetry and Flame Photometry topics are included in Unit IV. Radioisotopes unit is excluded as it is included in M.Sc syllabus and Electrochemical techniques unit containing topics such as Buffers, Glass electrode, Clark oxygen electrode are added in Unit V.
- ✚ Practical IV- Biochemical Techniques is offered as Core practical.
- ✚ Allied Microbiology - II is presented as allied paper with practical.
- ✚ Basics of Forensic Science is offered as Skill Enhancement Course SEC-6. RFLP analysis is

added in Unit II. Sedatives and stimulant drug topics are elaborated in Unit IV.

- ✚ Tissue culture is provided as Skill Enhancement Course SEC-7. Methods of gene transfer title is elaborated into topics relating to transfer of gene in to plants and animals.

Fifth Semester:

- ✚ Enzymes and Intermediary metabolism are offered as core papers.
- ✚ Clinical biochemistry is offered as core paper. Liver function tests are given in Unit II instead of disorders of lipid metabolism. Inborn errors of amino acid metabolism topics are included in Unit IV. Clinical marker enzymes of diagnostic importance for Heart, Liver, bone and muscle wasting disorders are included in Unit V.
- ✚ In Core Practical V- Clinical biochemistry, estimation of Uric acid in serum and urine experiment is excluded.
- ✚ Immunology is offered as elective paper.

Sixth Semester:

- ✚ Molecular Biology and Human Physiology are offered as core papers.
- ✚ Plant biochemistry and Plant therapeutics are presented as core paper. Unit II topics are changed as Unit V. Plant metabolism topics such as nitrogen cycle, nitrate and nitrite reduction, denitrification, symbiotic and non-symbiotic nitrogen fixation, phytoremediation are included as Unit II. Plant therapeutics topics are excluded from Unit V.
- ✚ Biotechnology is offered as elective paper. Scope and importance of Biotechnology, selection and screening of recombinant methods, production of insulin by rDNA technology topics are included under Unit I. Basics of Animal Cell culture techniques, Transfection methods, methods for transferring genes into animal cells or embryos are included under the title Animal tissue culture in Unit III. DNA Sequencing techniques by Sanger's method, Pyrosequencing method and Next generation sequencing (NGS) are included in Unit IV. Production and applications of Biogas is included in Unit V.

Allied Biochemistry:

- ✚ Allied Biochemistry - I and Allied Biochemistry - II are offered as allied papers.
- ✚ In Allied Biochemistry –II, Endocrine glands topic is included in Unit V.
- ✚ Allied Biochemistry practical I and II are offered as Allied Practicals.